The Power of Soil

An Agenda for Change to Benefit Farmers and Climate Resilience

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This research was supported with
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An Agenda for Change to Benefit Farmers and Climate Resilience

NB: This report is a summary of "Power of Soil: Assessment of Best Approaches to Improving Agricultural Soil Health in Canada". Please refer to the full report for further details on all topics, and for references.

COVER PHOTO CREDIT: MYRIAM BARIL-TESSIER

Executive summary

Farmers know their soil is their future, their capital, and their legacy. Innovative sustainable agricultural practices have been developed by every kind of farmer, in all areas of the country, and around the world - grounded in the knowledge that farm profit and climate action all happily coexist within healthy soil systems. This is why many who work the land are at the frontlines of a movement for change - championing the benefits of healthy soils.

Through healthy soils, it is possible to build prosperous and resilient farms that can sustain us all into the future, while providing important contributions to climate action. Thriving soil ecosystems build productivity, fertility and biodiversity, resulting in less dependency on purchased synthetic inputs, and greater margins. Through shifts in farm practices, we can sustain farm incomes, strengthen food security, stabilize water cycles, contribute to human health, and conserve biodiversity. Healthy soil practices also capture carbon to build soil organic matter, and reduce crop agricultural greenhouse gas (GHG) emissions. It is a real win-win-win for people, profit and the planet.

The multiple and interconnected benefits of sustainable farming practices are all the more important as Canadian agriculture is facing significant challenges - including extreme weather, herbicide and pesticide resistance, and record-high farm debt. Farming challenges are also echoed globally where, due to the inter-connected impacts of soil degradation and global warming, the United Nations Food and Agriculture Organization has predicted the world has fewer than sixty harvests remaining. It is clear that change is needed.

Through widespread adoption of healthy soil practices by many more farmers, system change can occur - creating the conditions for long-term, agricultural productivity and climate resilience. To do so, we will need to attract many tens of thousands more farmers to adopt soil health systems for their farm businesses. Federal and provincial policies and programs must change significantly to enable the scale of action required by farmers to meet the challenge, and the opportunity. Removing bureaucratic barriers, increasing funding, making participation easier, offering multiple paths to entry, building business cases, and understanding farmers' needs - all are part of the interconnected puzzle. This will require extensive financial investments, as well as a broader strategic framework which enables innovation in policy, programming and on the farm.

PHOTO CREDIT: MYRIAM BARIL-TESSIER

To fully leverage this opportunity, this report takes a close look at how and why farmers adopt soil health practices, offers a comprehensive overview of Canada's current agri-environmental policy and programming landscape, innovative policies from other jurisdictions, and provides a foundation for rethinking Canada's agricultural and climate change policies and programs in support of greater soil health. The resulting recommendations are intended to support program-level interventions in the development of the upcoming new federal climate plan, and the new Federal Provincial Territorial (FPT) agricultural policy framework, expected in 2023. The recommendations are grouped under these themes:

- **Prioritize Soil Health**
- **Enhance Soil Health Knowledge and Learning**
- **Incentivize Soil Health**
- **Conserve Agricultural Land and Protected Areas**

The recommendations form an integrated package of significant changes to public policy and partnerships that would signal a fundamental shift in direction in agri-environmental policy and programs. Through this roadmap for change, farmers can help Canada meet its global climate change commitments and its economic goals for the agricultural sector, while helping to ensure long term viability and resilience through adaptation to climate change.

It is time to think big. Canadian, provincial and territorial governments have an unprecedented opportunity to demonstrate forward-looking leadership by placing a real priority on soil health. People, planet and profit will all benefit as a result.

1

Introduction

Farmers know their soil is their future, their capital, and their legacy. They also know that farm profit and climate action all happily coexist within healthy soil health systems. Many who work the land across Canada and around the world are at the frontlines of a movement for change - championing the benefits of healthy soils. Through sustainable agriculture, it is possible to build prosperous and resilient farms that can sustain us all into the future, while providing important contributions to climate action. Thriving soil ecosystems build productivity, fertility and biodiversity, resulting in less dependency on purchased synthetic inputs, and greater margins. **Through shifts in farm practices, it becomes possible to sustain farm incomes, strengthen food security, stabilize water cycles, contribute to human health, and conserve biodiversity. Healthy soil practices also capture carbon to build soil organic matter, and reduce crop agricultural greenhouse gas emissions,** which have been growing in recent years.

This is very important, **as Canadian agriculture is facing significant challenges.** Climate change has led to unpredictable and extreme weather. Herbicide and pesticide resistance is growing. Production and productivity have improved dramatically over recent decades, but maintaining long term productivity depends on reversing declines in soil health. Meanwhile, farm debt is at a record high. This is taking place in a broader global context where agriculture is under pressure to feed the growing population while facing the impacts of soil degradation and climate change**.** It is clear that change is needed.

The benefits of soil health practices are inter-connected, and best understood within a systems-lens. Each aspect of soil health is related to every other aspect. When farmers build soil organic matter, more water is captured and stored. When farmers increase diversity in soil bacteria, fungi and other beneficial organisms, ecological nutrient cycles function properly - often meaning less pesticides and fertilizers are required. When farmers use cover crops and no-till, erosion is significantly reduced. This can result in more productive soil, at less cost, increased soil carbon, resistance to droughts and floods, and reduced emissions. It is a real win-win-win for people, the planet, and profit.

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Innovative agricultural practices that build healthy soil have been developed by every kind of farmer, in all areas of the country, and around the world. Some may call these practices sustainable agriculture, or regenerative agriculture - others may consider that they are incorporating healthy soil practices into modern farming. Organic farmers follow many soil health practices as part of their regulated standards. Others refer to multi-functionality or agroecology. No matter what it is called, all efforts towards soil health are vital to long-term, viable crop production in Canada. **Through widespread adoption of healthy soil practices by many farmers, system change can occur - creating the conditions for long-term, agricultural productivity and climate resilience.**

Yet farmers are under pressure from all sides: running their businesses, watching markets, financing equipment and inputs, servicing debt, balancing debt and investments. Those many stresses reduce farmers' capacity to take new risks or try new practices. Effective public policy promoting soil health systems must take into account all these pressures on farmers and ensure all the policies and programs are sending the right signals.

To fully leverage this opportunity, **this report provides a foundation for rethinking Canada's agricultural and climate change policies and programs in support of greater soil health.** Recommendations are offered to support program-level interventions in the development of the upcoming new federal climate plan, and the new Federal Provincial Territorial (FPT) agricultural policy framework, expected in 2023.

Soil health strategies and related program instruments can help Canada meet its global climate change commitments and its economic goals for the agricultural sector, while helping to ensure long term viability for farmers through adaptation to climate change.

2

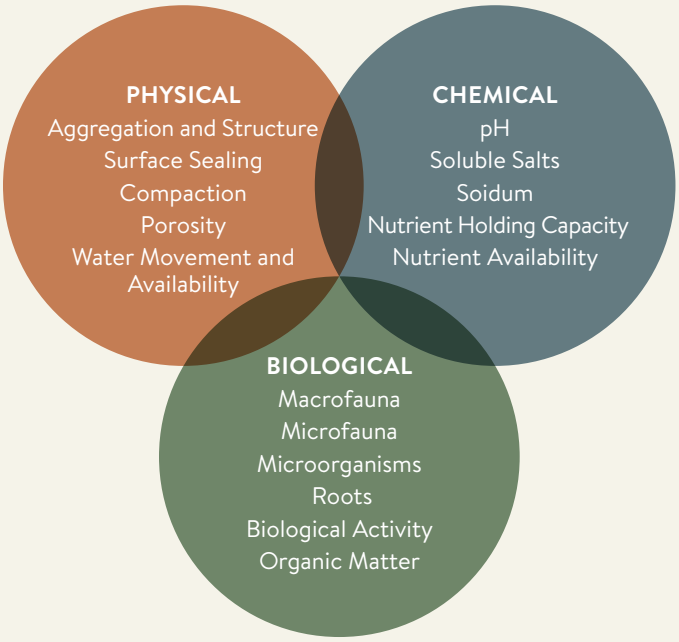
Soil health: building resilience from the ground up

'Soil health' is an evolving, dynamic concept. A common definition is "the continued capacity of soil to function as a vital living ecosystem that sustains plants, animals, and humans". This is used by the United States Department of Agriculture, some provincial jurisdictions, corporations, as well as national and international organizations. An older definition from Agriculture and Agri-Food Canada, defines soil health as the soil's capacity to support crop growth without resulting in soil degradation or otherwise harming the environment. **Soil health is a complex state involving numerous physical, biological and chemical characteristics and processes.** In the last few decades, the growth and remarkable findings of soil biology have transformed how we think about soils, and how biological processes are crucial to soil health.

Physical, Chemical & Biological Aspects of Soil Health

What defines a healthy soil is also highly localized. It depends on regional factors (e.g., soil types, climate, etc.) as well as on the soil's intended use (e.g., growing trees, grain, grass, etc.) and function (e.g., control water flow, retain and cycle nutrients, support biodiverse soil communities). On every farm, different crops and commodities are produced requiring differing inputs, and business and farm practices. For each farm, a customized, holistic approach is needed, integrating a suite of soil health practices that take into account the crops produced, regional climate, soil characteristics, applied technology, and many other parameters that influence the potential impacts of beneficial practices.

Soil health is also the result of a dynamic interplay of various broader factors – geographic, economic, agronomic, social, political, ecological, demographic, and psychological. Due to these complex interactions, **improving soil health requires a comprehensive, systems approach that considers all aspects of crop production and the agroecosystem.**



Source: North Dakota State University.

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2.1 Four perspectives on soil health

Based on the literature, we have identified four perspectives to describe and assess soil health: soil health principles, soil degradations, soil functions, and soil characteristics. Any management practice (or set of practices) consistent with these perspectives can be considered beneficial to soil health.

The **first perspective** is based on the five **principles of soil health** (see the table below for details). These principles are designed to guide action towards stopping soil degradation, and restoring and maintaining soil health so that soils can fulfill their functions.

The **second perspective**, **soil degradation**, focuses on the problems and issues related to soil functions and characteristics. Healthy soil is defined as not degraded, or as soil that does not contribute to degrading the surrounding environment. This particular dimension is critical as soil degradations are usually issues associated with specific causes that can be observed and managed at the farm level through practices consistent with the five principles of soil health. These problems can also be the most directly associated with yields and revenues, experienced by producers firsthand.

The **third and fourth perspectives**, based on **soil functions and soil characteristics** offer a more technical approach to soil health. Soil characteristics are usually measurable and manageable by farmers. Soil functions, on the other hand, refer to soil-based ecosystem services that contribute to the generation of nature-based goods and services and are therefore more challenging to measure and manage at the farm level.

Distinguishing these four perspectives is helpful in defining:

- **specific farm-level objectives (e.g. reduce erosion);**
- **ways of achieving them (e.g. by minimizing soil disturbance);**
- **how to measure improvements (e.g. level of soil organic matter);**
- **how to measure environmental benefits induced by the above improvements (e.g. better retention and cycling of nutrients).**

The four approaches are complementary and interrelated. For instance, for soils to have he continued capacity to function as a vital living ecosystem that sustains plants, animals, and humans, degradations must be managed, and soil characteristics improved, through a soil health management system that is consistent with the five soil health principles.

Incorporating the four perspectives allows for developing narratives that can speak to different audiences, from farmers to scientists and policy makers. It also helps in the identification of policy approaches to support farmers in protecting soil health.

Four perspectives on soil health

Soil Health Principles	Soil Degradation	Soil Functions	Soil Characteristics
Build soil organic matter	Erosion (water, tillage and wind erosion)	Water flow and retention	Soil Composition (texture)
Minimize soil disturbance and compaction	Salinity	Solute transport and retention	Soil structure (aggregates)
Keep the soil covered as much as possible	Loss of SOM	Physical stability and support	Soil organic matter (SOM)
Diversify crops to increase diversity in the soil	Decline in soil fertility or Saturation/contamination with nutrients	Retention and cycling of nutrients (incl. carbon sequestration)	Soil chemical composition and fertility (Nitrogen, Phosphorus, Potassium, macro and micronutrients)
Keep living roots throughout the year as much as possible	Soil acidity and/or alkalinity	Buffering and filtering of toxic materials	Soil water holding capacity
	Decline of soil structure (compaction, bulk density and surface sealing)	Maintenance of soil biodiversity and habitat	Color
	Soil and water pollution	Mineral Cation exchange capacity	Texture
		Crop productivity	Microbial activity and diversity

Source: Groupe AGÉCO.
Definitions and the supporting literature are available in "Power of Soil: Assessment of Best Approaches to Improving Agricultural Soil Health in Canada".

2.2 How farmers build soil health

Healthy agricultural soils are built by farmers using specific on-farm practices. These are often called 'beneficial management practices' (BMPs), which refers to any proven, practical management practice that reduces or eliminates an environmental risk. Based on this definition, **management practices consistent with the four perspectives outlined above can be considered beneficial to soil health.** For the purposes of this report, we also use the terms healthy soil practices, sustainable agricultural practices and regenerative practices, interchangeably.

To identify the key overall BMPs, we performed a thorough literature review of publications on soil health. These reports include policy documents, government publications, academic and scientific papers. For each document reviewed, we identified the most promising soil health practices. Based on this review, **we found a strong level of concurrence around best practices.** Each has many variants for specific conditions, such as strip till, no-till, vertical tillage. Regardless of the publication type, the same set of BMPs were identified. By selecting only those BMPs relevant to Canadian farmers, we developed a list of 11 categories of beneficial practices. These are:

Conservation tillage
Pasture and grazing management
Prevention of soil compaction
Nutrient management
Cover crops
Land retirement
Integrated pest management
Diverse crop rotation
Organic amendments
Soil information collection
Conservation buffers

Key groups of farm practices beneficial for soil health

Practice category	Description	Some Details
 Conservation tillage	Any tillage sequence designed to minimize or reduce the loss of soil and water; a tillage and planting system that leaves 30% or more crop residue cover on the soil surface.	Includes: • No-till (or zero-till) • Strip-till • Direct seeding • Strip-cropping
 Cover crops	Secondary crop grown after a primary crop or between rows of the primary crop to provide a protective soil cover that can minimize soil erosion and leaching of nutrients, increase organic matter and diversify the soil biota. Cover crop seed mixes can consist of one or more species, and different mixes are used to achieve different goals.	May include: • Planting after harvest • Frost-seeding • Termination before or after crop planting • Inter-seeding
 Organic amendments	Periodic application or retention of organic materials to cropland to build soil organic matter.	Organic amendments include manure, compost, composted sludge, food waste, digestate, sewage biosolids, crop residue.
 Nutrient management	Applying nutrient sources based on an anticipated yield target, crop nutrient requirements and soil nutrient availability, in order to optimize nutrient performance, reduce inputs and to minimize environmental impacts.	• Principles: Right source, Right amount, Right time, Right place (4R) • Example of source BMP: Slow and controlled release (SCR) fertilizers, Nitrogen stabilizers • Example of rate BMP: Variable rate technology
 Diverse crop rotation	Crop rotation consists of growing different types of crops (e.g alternating forage or cereal crops with row crops; legumes, cereals, brassicas, maize) in the same field in sequenced growing seasons.	Rotation involves: • Duration (number of years, crops) • Crop Type (crop family) • Inclusion of a perennial crop is beneficial
 Conservation buffers	Conservation buffers are small areas or strips of land in permanent vegetation, designed to intercept pollutants and manage other environmental concerns.	Includes: • Buffer strips • Windbreaks/Shelterbelts • Riparian areas • Agroforestry • Grassed waterways
 Prevention of soil compaction	Any measures that limit the bulk density and the reduction in the soil pore space available for air and water due to the impact of heavy equipment, rainfall or animals.	• Minimizing axle or wheel load • Tire / track technology to reduce load pressure • The automatic air inflation deflation (AAID) system • Controlled traffic farming (CTF) • Agronomic measure (e.g. cover crops, no till)

Integrated pest management	Strategy that includes cultural, mechanical, biological and chemical pest control measures and regular pest identification and monitoring to prevent, measure, anticipate and avoid or reduce agrochemical use.	Tools and approaches: • Integrated Pest Management (IPM) strategy • Economic threshold calculators • Climate-smart pest management (CSPM)
Pasture / grazing management	The management of grazing involves the control of livestock access to areas of native or tame pasture land. Often referred to as intensive rotational grazing or regenerative grazing.	Includes: • Creation of paddocks (small subdivisions of pasture) • Permanent and temporary fencing options • Remote watering systems • Movement of animals between paddocks • Periodic rejuvenation of pasture vegetation
Land retirement	Retirement plantings cover the soil with perennial vegetation such as trees, grass or shrubs, providing a permanent cover to protect soil from erosion, rehabilitate degraded soils and provide other environmental, social or economic benefits.	• Cropland retirement, habitat creation (e.g. grassland, prairie, wetland,woodland)
Soil information collection	Soil information plays an important role in crop production and nutrient management and requires ongoing monitoring so that progress can be assessed and adjustments can be made.	Includes: • Soil test data (fertility, organic matter) • Soil health tests (physical, chemical, biological parameters) • Precision Agriculture Data • Soil profile • Record keeping

NB: For a more detailed assessment, please refer to "Power of Soil: Assessment of Best Approaches to Improving Agricultural Soil Health in Canada".

The assessment of what will be the most promising soil health practices for a given farm is highly context specific. It is therefore essential to have an in-depth understanding of the context (e.g. climate, soil types, crops) in which regenerative practices are implemented prior to setting expectations around specific soil health outcomes. **It is also important to note that all farm management practices are inter-connected within a farming production system.** For instance, cover crops can be an organic amendment if incorporated to soil. At the same time, it is possible that one practice may undermine a different soil health goal. For instance, a practice beneficial to building soil organic matter may negatively impact water quality through increased soil erosion within a given context.

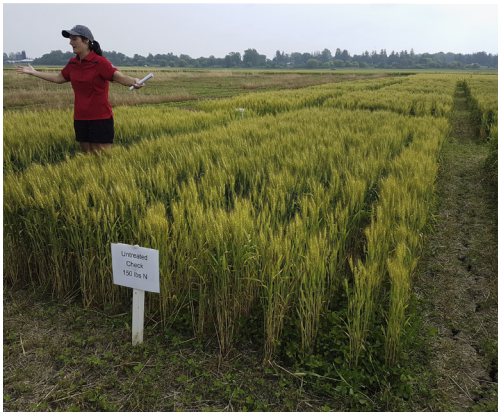

PHOTO CREDIT: P. SMITH

In other words, while it is useful to identify and evaluate the benefits of individual BMPs, improvements to soil health require a systems approach to consider all aspects of the production and agroecosystem.

Another way to further understand the contributions of the 11 key sustainable agriculture practices to soil health, is in relation to the five primary soil health principles. Please see the table below.

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Connections between the main BMPs and the soil health principles

Selected BMPS	Soil health principles				
	Build soil organic matter	Minimize soil disturbance and soil compaction	Keep the soil covered as much as possible	Diversify crops to increase diversity in the soil	Keep living roots throughout the year as much as possible
Conservation Tillage	•	•	•		
Cover crops	•		•	•	•
Organic amendments	•				
Nutrient management	•	•			
Diverse crop rotation	•			•	•
Conservation buffers	•	•	•	•	•
Prevention of soil compaction		•	•		
Integrated pest management		•		•	
Pasture management	•	•	•	•	•
Land retirement	•	•	•	•	•
Soil information collection	•*	•*	•*	•*	•*

*This practice indirectly impacts soil health principles
Source: Groupe AGÉCO.

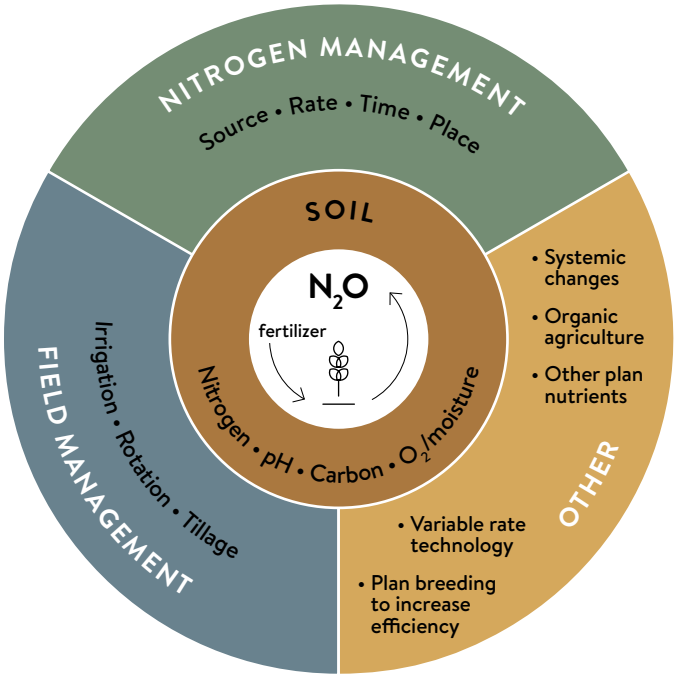
Through these diverse and inter-connected practices, farmers are able to make significant and practical contributions to soil health, building farm-level resilience and financial prosperity, as well as reducing GHG emissions and increasing soil organic carbon.

PHOTO CREDIT: SHARON ROSSEELS/UNSPLASH

Spotlight on nitrogen: the 'elephant in the room'

Despite much attention on the role of carbon dioxide in climate change, when it comes to crop agriculture, nitrous oxide is the elephant in the room. 70% of agricultural GHG emissions are associated with the manufacture and use of nitrogen fertilizers, in large part through nitrous oxide (N_2O) emissions. Nitrous oxide is a GHG with a global warming potential estimated to be 298 times greaterworse than carbon dioxide (CO_2), on a 100 years horizon in terms of global warming potential with additional damaging effects on the ozone layer. Nitrous oxide emissions, caused largely by nitrogen fertilizer additions to croplands above crop requirements, have risen 30% over the last four decades. Many farmers apply nitrogen fertilizer judiciously according to crop needs but the challenge is to ensure that more farmers do so. Differences due to region, soil types crops and other factors also affect emissions (see figure).

Soil and Management Factors Affecting Soil N_2O Emissions



Source: University of Nebraska–Lincoln.

Nitrogen and carbon dynamics in agricultural soils is complex. Many practices affect the production of nitrous oxide. The addition of nitrogen in agriculture enhances nitrogen availability and carbon sequestration in the soil, yet at the same time increases emissions of nitrogen oxides and nitrous oxides from soils. Studies have shown that increased N_2O emissions resulting from soil carbon sequestration over 20 years can in fact be significantly counter productive, undoing 75 to 310% of the reduction in climate warming potential. A 2019 study based on a dataset of 275 sites from multiple ecosystems around the world, showed that an increase of 3.7% in soil carbon sequestration increases GHG emissions by 0.3% for CO_2, 24.5% for CH_4 and 91.3% for N_2O.

Efforts to increase the efficiency of nitrogen use through improved management of fertilizers, manures and legumes are at least as important as increasing soil carbon sequestration. A systems approach that considers all GHG emissions and soil carbon sequestration together is critical for maximizing the contribution of sustainable agriculture for climate resilience.

3

Farmers at the Forefront: How and why farmers adopt soil health practices

As the principles, most promising practices and critical importance of soil health become more and more clear, it is necessary to better understand how and why farmers decide to adopt soil health practices. This insight is essential to successfully bringing many more farmers onboard, as it enables the development of effective communication strategies and tools, as well as informs the design of policies and programs that will best resonate with farmers.

3.1 Key factors and challenges influencing adoption of soil health practices

Whether or not a farmer decides to adopt soil health practices is an individual decision. Given this, understanding the factors that underpin decision-making processes is key to advancing efforts. Through a literature review and interviews with experts, **we have identified five primary factors that influence farmer decision-making regarding soil health practices.** These are: farmer profile, farmer attitude and behavior, farm characteristics, awareness and access to information, and economic consideration. Land rental is also a factor, and the characteristics of non-farm landowners are important. Once again, **this can be best understood within an interrelated system-lens, where all factors are connected.**

Work has also been done to identify barriers associated with specific soil health practices, which can vary regionally. For many healthy soil practices, **the lack of information about the benefits, and how to measure them, have a negative impact on adoption. The lack of understanding regarding how to optimize the practice, the lack of regionally specific information on the practice, the costs associated with implementation, and the lack of time and labour are also obstacles to adoption.**

As we have seen, farmers' individual characteristics such as environmental concern and knowledge, risk tolerance, willingness to seek information related to BMPs, and awareness of sustainable practices are positively correlated with the adoption of soil health practices. This key finding from the literature review illustrates the importance of understanding the individual behind the decision-making process, especially in the context of a systems approach.

Summary of barriers associated with soil health BMPs

BMP	Barriers
 Conservation tillage	• Already owning conventional tillage equipment, and cost of acquiring new equipment • Adaptability of the technology to certain types of soils and crop environments • Risk aversion and risk of yield reduction • Long transition period • Limitations on no-till in humid climates and with high biomass crops
 Cover crops	• Understanding of how to optimize cover cropping with cash cropping • Lack of regionally specific information on selecting cover crop variety • Expenditures required for new equipment • Added costs of seeds, planting and killing pests • Short term start up costs versus long term financial and environmental benefits • Increased complexity of the management system and associated time and labour required for planting and managing cover crops
 Organic amendments	• Composting may require new equipment and new management practices • Increased purchase and shipping costs • Variable availability and transport of compost, and variable compost quality and composition
 Nutrient management	• Startup and operating costs (planning, record keeping, professional fees and operating expenses) • Additional complexity in management
 Diverse crop rotation	• Lack of markets and profitability for alternative and new crops • May require new or more equipment and skills • May offer lower financial returns during the transition period • Increased complexity of the management system
 Conservation buffers	• Perceived as impediment to agricultural activities • Costs of planting, establishing, and maintaining the buffers and cost of land being taken out of production • The short-term cost of implementing and maintaining does not necessarily equal the short-term economic returns • Working around natural waterways with farm equipment can be difficult
 Prevention of soil compaction	• The cost associated with the adoption of new equipment or novel technologies • Lower capacity equipment (less compaction) are less efficient (seeding and harvesting) compared to high-capacity machinery (heavier) • Poor spreading of straw and lime beyond 9m • Poor understanding of controlled traffic farming • Difficulty moving burned windrows • Concerns about managing erosion and weeds in permanent wheel tracks
 Integrated pest management	• Increased complexity of IPM system versus conventional pest management • Lack of IPM tools, information and training • Time and labour required to adopt an IPM system • Cost and expenses associated with IPM system implementation

Pasture and grazing management	• Labour required to set up paddocks and to move livestock frequently • Costs (temporary fencing materials and infrastructure to provide water in all paddocks) • Return on investment
Land retirement	• Costs (establishment and maintenance) • Opportunity cost of removing land from production
Soil information collection	• Knowledge, accessible tools, or reliable assistance to analyze soil data and make decisions • Multiple industry players and platforms, creating compatibility challenges for software and data

Source: Groupe AGÉCO.

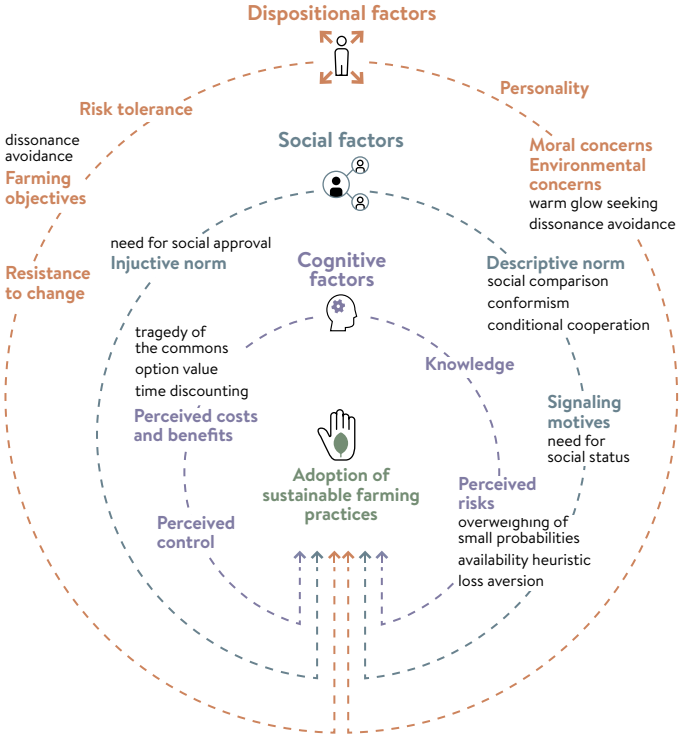
3.2 Framework of behavioral factors affecting adoption of soil health practices

Better understanding farmers, and how and why they make decisions, is an important step in designing policies that will foster the adoption of soil health practices. There is a vast body of literature looking at the links between behavioural characteristics and the adoption of sustainable farming practices. One leading framework classifies behavioural (or psychological) factors under three categories: dispositional factors, social factors, and cognitive factors.

Cognitive factors, such as farmers' knowledge and awareness of sustainable farming practices as well as their perceptions of the benefits, costs and risks are directly related to the decision-making process behind the adoption of sustainable farming practices. Compared with dispositional and social factors, **cognitive factors such as being aware of sustainable practices, or expecting a positive return on investment by implementing them, are much more likely to result in farmers making the decision to adopt sustainable farming practices.**

However, as with any interrelated system, cognitive factors can be strongly influenced by dispositional and social factors. For example, a farmer with an aversion to risk (dispositional factor) is much less likely to recognize the potential benefits associated with a given beneficial practice, and thus less likely to seek relevant information to support adoption.

Framework of behavioural factors affecting farmer's adoption of BMP



Source: Dessart et al., 2019.

3.3 Promising entry points for increased adoption of soil health practices

There are three promising entry points for the adoption of soil health practices: a strong business case, access to information, and the ability to track progress over time.

A) Strong business case: "If it pays, it stays"

The number one consideration behind farmers' decision to adopt sustainable farming practices relates to the perception of economic benefits, costs, and risks. To increase adoption potential, it is important to align regenerative practices with the farm's business objectives, including yields, productivity, and profitability. Adoption levels show that beneficial practices primarily resulting in private benefits to the producer are the most popular BMPs. In contrast, BMPs primarily resulting in public benefits were the least commonly adopted.

> It is essential to demonstrate that transitioning to regenerative practices makes sound business sense - while benefiting the health of people and the planet.

Financial incentives (government subsidies, credits or loans) can help alleviate any perceived cost barriers. Several studies have found that financial incentives generally encourage farmers to move to sustainable practices. According to a 2018 study of 285 Québec agricultural producers, 75% of farmers would be motivated to adopt more sustainable farming practices if they had access to financial compensation during adoption, and/or to financial support on a yearly basis.

Despite a strong business case, behavioral factors can still act as barriers to the adoption of regenerative practices. For example, as we have seen, farmers who are resistant to change and/or risk averse, are less likely to adopt soil health practices. Farmers with these traits could still decide not to move forward with beneficial new ways of farming, even with a sound business case in support. This example highlights the importance of better understanding and engagement with farmers' underlying motivation for changes in farming practices.

Some examples of successful ways to increase motivation for change include: improved communication focused on benefits; increased awareness of environmental issues, soil health practices and programs; extension/advisor outreach; peer to peer experimentation; field demonstrations, workshops and short seminars; providing social recognition of farmers' efforts; and increasing positive attitudes towards regenerative practices and programs.

> The lack of expertise in soil health among both farmers and farm advisors is considered by most interviewed experts as one of the biggest barriers to the adoption of sustainable farming practices.

PHOTO CREDIT: P. SMITH

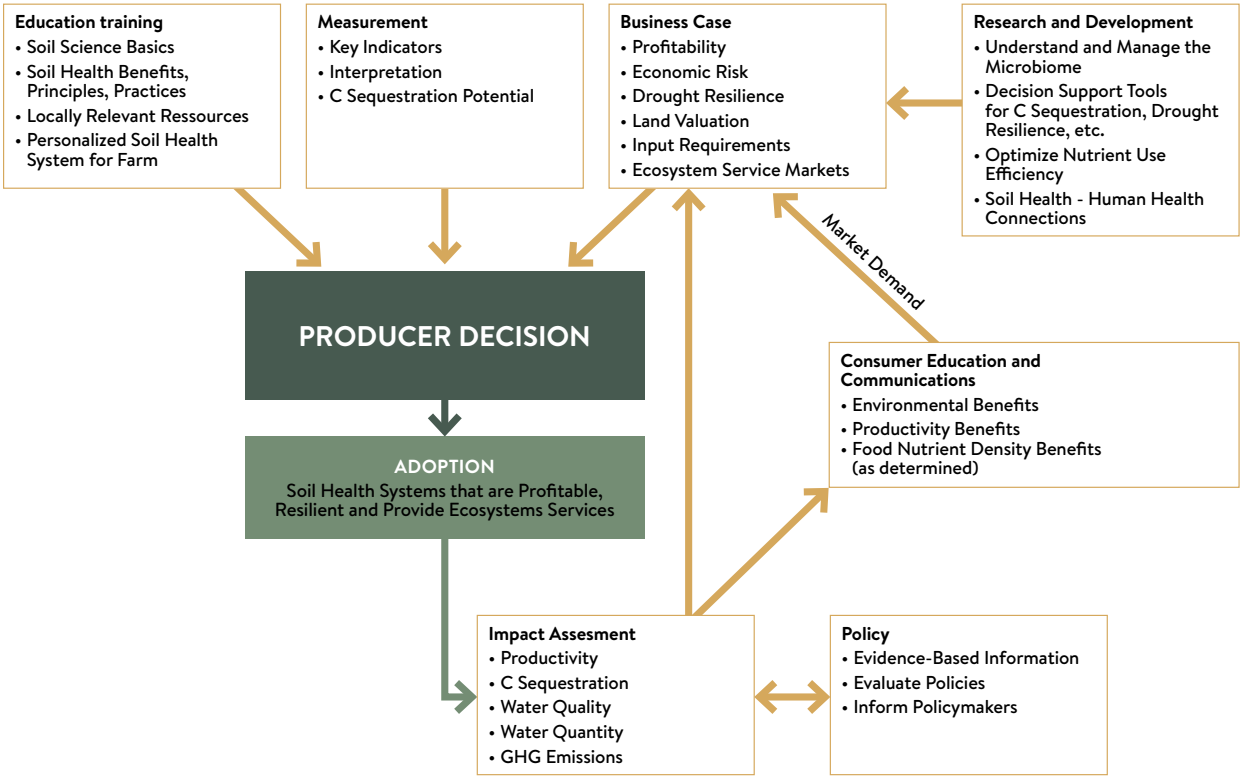
B) Access to information and expertise (education, training)

Having access to quality information is critical for the adoption of regenerative practices. Education and training in its many forms, including farmer-to-farmer learning, demonstrations and technical advice, provides farmers and advisors with the expertise they need to assess, plan and implement solutions. They also help farmers develop and enact an individual, farm-specific, soil health management plan.

C) Ability to track progress

The third important aspect for successful adoption and implementation of sustainable farming practices relates to farmers' ability to track progress, and evaluate impact, over time. Farmers need to know how to measure the health of their soil, so they can determine baseline and current status and monitor progress. Once a regenerative practice is adopted, farmers need to be able to assess its impact on productivity, soil organic matter, etc. Similarly, interviews with key informants highlighted the importance for farmers to have better access to data beyond their own farm, to help them more readily understand what other farmers are doing, monitor the adoption of beneficial practices over time and, critically, to identify successful interventions.

Strategy to increase adoption of "soil heath systems"

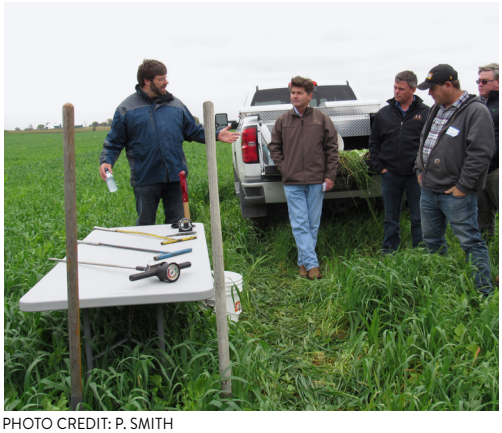


Source: Soil Health Institute, 2020.

It is also useful to note that some researchers have identified a process comprised of four different stages by which farmers usually adopt sustainable farming practices:

1. **Farmers become aware of available BMPs and the potential relevance to their farm.**
2. **Farmers collect information about BMPs and assess suitability and feasibility of adoption for their farm.**
3. **Farmers test and evaluate BMPs to reduce risk and develop skills, often on small plots or areas.**
4. **Based on trial results, farmers adopt and adapt selected practices.**

Generally, a lag is observed between each step. As a result, **the adoption and implementation of sustainable farming practices is a continuous process.**



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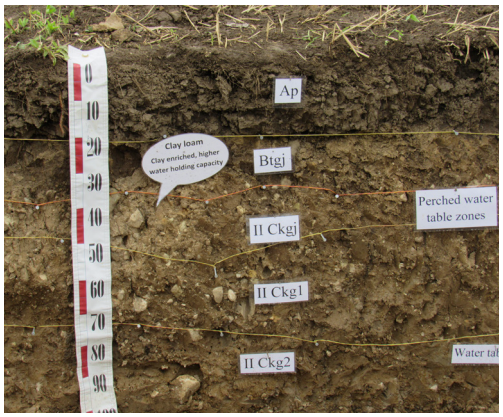

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3.4 Policy implications

As we have seen above, **policy-making for the adoption of sustainable farming practices can be strengthened by integrating what we currently know about what motivates farmers, and what is most likely to successfully encourage transitions to soil health practices.** In addition to considering the five key factors that influence farmer decision-making, **we know that a strong business case, access to information and expertise, and ability to track progress over time are all key to success.**

It is clear that farmers make decisions based on individual and farm specific considerations. As such, **policies and programs should not be one-size-fits-all.** Studies underline the importance of addressing this heterogeneity between farmers, and the benefit of segmenting them into groups or 'farm types' according to their sociodemographic and geographic characteristics. Designing region-specific environmental policies can also be a way to take into account potential cultural barriers, as well as localized environmental issues.

A diversity of policy tools is usually more effective than a single approach. For instance, mixing voluntary and mandatory adoption of sustainable practices can be a solution to addressing the diversity which exists within farmers and farming contexts. The current range of education, planning and grants approaches has merit, but **a wider range of tools would meet more farmers needs.** Offering alternative options within programs can help address differences in farmers' styles of learning, interests, values and other attributes. For example, farmer-to-farmer learning, technical advisors, agronomic smartphone apps and how-to-videos can serve similar purposes but appeal to different people.

To increase participation, policies should also emphasize practices that have real and tangible environmental benefits for farmers. As benefits may interact with one another, bundling support for different soil health practices may make adoption more cost-effective, and thus increase the extent of adoption. **New programs should frame farms as multifunctional enterprises, to stimulate agronomic and market innovations in support of sustainable agriculture.**

Finally, **it is important that policies support farmers through the adoption, maintenance and retention of soil health practices, as they learn more about beneficial practices, their soil, and their farms over time.** With BMP adoption understood as a continuous process, long term support - rather than one-off interventions - is highly recommended.

4

Canada's soil health policy and program landscape: a comprehensive review

Canada's federal, provincial and territorial agricultural policies and programs are designed to achieve many objectives related to agriculture and food, one of which is environmental sustainability. Jurisdiction for agriculture in Canada is a shared responsibility between the federal and provincial-territorial governments, and policies and programs vary significantly across the country. In theory, policies reflect the strategic directions for government, and programs are tools for implementation. In reality however, policies and programs are often inter-connected, each influencing the other. Climate policies and programs, federal and provincial, neglect the role of agriculture in both mitigation and adaptation.

At the core of the policies surrounding agricultural production in Canada is a set of federal-provincial programs whereby federal and provincial/territorial governments fund initiatives relating to agriculture and the environment. These are contained within a five-year Federal/Provincial/Territorial (FPT) plan, the Canadian Agricultural Partnership (CAP), running from 2018 to 2023. CAP covers a $3 billion investment over the duration of the program, from federal, provincial, and territorial governments.

Overall, recent agriculture policy and programming in Canada tends to emphasize economic growth over rural, social and environmental sustainability. While resourcing of farm programming aimed at environmental issues have increased over the last couple of decades, **the overall resources devoted to agri-environmental incentives in Canada remain low.** In fact, **research suggests that the United States and Europe spend many times more than Canada on agri-environmental programs as a percentage of farm income.** Agri-environmental programs are routinely oversubscribed with demand significantly outstripping available funding, demonstrating that farmers are eager to bring regenerative practices to their farms. Funding could increase in coming years through the development and implementation of national and provincial climate policies, as well as the next iteration of the CAP, set for 2023-2028 - but only if public pressure is brought on governments to make soil health and environment a higher priority.

PHOTO CREDIT: JAMES BALTZ/UNSPLASH

QUÉBEC SUSTAINABLE AGRICULTURE PLAN

The Government of Québec has adopted a new ambitious plan for sustainable agriculture, the "Agir, pour une agriculture durable", with a strong focus on healthy soils. Released by the Department of Agriculture, Fisheries and Food in the fall of 2020, the ten-year plan follows many years of debate and advocacy by agricultural and civil society organizations. It adopts five key goals:

1. **Reduce use of pesticides and their risk for health and the environment**
2. **Conserve and improve soil health**
3. **Improve fertilizer management**
4. **Optimize water management**
5. **Improve biodiversity**

Each of these goals has targets and indicators of success. In terms of soil health specifically, the aim is for 75% of cultivated surfaces to be covered by crops or crop residue during the winter months (up from 50% now), as well as to ensure that 85% of all cultivated soils contain at least 4% organic matter (organic matter is in decline, and only 75% of fields currently meet this target). The plan also incorporates principles of soil health and best management practices under other key goals. For example, the plan intends to double the number of fields with conservation buffers, for biodiversity protection. Goals to reduce the use of synthetic pesticides (aiming to reduce sales by 500,000 kilos) and nitrogen fertilizers (by 15%) will also improve pest and nutrient management.

The plan has a $125 million budget for the first five years, which will be used to reward producers who have adopted sustainable practices; for knowledge development and research; as well as regionally specific knowledge transfer, extension services and training (notably by the addition of 75 agronomists to advise producers). In addition, the government has stated its intention to improve the independence and impartiality of commissioned research by updating laws governing agronomists, as well as other measures.

4.1 Programs under the Canadian Agricultural Partnership

The CAP provides the foundation for government agricultural programs and services in Canada. Relative to its predecessors, the CAP focuses on streamlined programming, and programs that help farmers manage risks. Similar to its predecessors, the CAP comprises key agri-environmental programs, as well as programs to address markets, diversification and innovation. The CAP includes federal activities and programs, as well as cost-shared programs between the federal, provincial and territorial governments. In addition, producers continue to have access to a suite of Business Risk Management (BRM) programs designed to help them manage specific risks on the farm and stabilize income. Each of these categories of programs is briefly outlined below.

A) Federal activities and programs

Agriculture and Agri-Food Canada (AAFC) delivers federal programs under the CAP aimed at generating economic growth in the agricultural sector. These are open to National Industry Associations, small and medium-sized enterprises, clusters, and projects with programs in the following areas.

- Growing trade and expanding markets ($297 million)
- Innovative and sustainable growth in the sector ($690 million) (includes AgriScience and AgriInnovate Programs)
- Supporting diversity and a dynamic, evolving sector ($166.5 million)

B) Programs cost-shared by federal, provincial/territorial governments

Federal, provincial and territorial governments work under 5-year bilateral agreements. Investments are cost-shared on a 60:40 basis between the federal and provincial/territorial governments, and are delivered by the provinces and territories to ensure that the programs are tailored to meet regional needs. **In Canada, cost-shared programs are the primary means by which federal and provincial governments address environmental issues in the agricultural sector.** Environmental stewardship programming largely relies on supporting the adoption of on farm BMPs through cost-shared programs, providing educational and financial support to producers implementing sustainable agriculture practices. These programs comprise a major and increasing element of agri-environmental policy programming in Canada.

C) Business Risk Management programs

The largest expense under the CAP is Business Risk Management (BRM) programs, averaging about $1.5 billion per year, cost-shared by provinces/territories and the federal government. Producers have access to a suite of BRM programs to help manage significant income risks that threaten the viability of their farm, and are beyond their capacity to manage. At the time of writing, these programs are under review by a Parliamentary committee and by the government and many agricultural stakeholders are involved in their reformulation. There are four different insurance schemes under BRM.

- AgriStability is an income stabilization program. It provides support when producers experience a large decline in overall farm income (payouts are determined by a historical reference margin that was lowered from 85% to 70% in 2013).
- AgriInvest is basically a subsidized saving account, where the government will match a deposit up to 1% of net farm sales. This income stabilization program helps farmers with cash flow and short-term income declines.
- AgriInsurance is crop insurance designed to compensate farmers in instances of production or asset losses due to natural hazards.
- AgriRecovery is disaster relief insurance that helps producers to recover following natural disasters.

PHOTO CREDIT: VIKTOR TALASHUK/UNSPLASH

SPOTLIGHT ON CANADA'S CLIMATE POLICIES

Canada, and all provincial and territorial governments, have policies and programs related to climate change mitigation and adaptation. Canada currently coordinates policies through the Pan Canadian Framework on Clean Growth and Climate Change, which falls under the portfolio of Environment and Climate Change Canada. More recently, the government has promised a new and more ambitious climate plan to go beyond the Pan Canadian Framework, expected in late 2020 or early 2021. The recent Throne Speech also committed to a role for farmers and ranchers. The Pan Canadian Framework contains relatively little information related to agriculture. However, it does acknowledge the potential role of agricultural soils for climate mitigation through "***increasing adoption of land management practices like increasing perennial and permanent cover crops and zero-till farming***". It also stresses innovation and new technology including "***precision farming and 'smart' fertilizers***". Alberta, British Columbia, Ontario, Québec and other provinces have recognized agriculture in their climate policies from both mitigation and adaptation perspectives.

The November 2020 federal Fall Economic Statement promised "to establish a new Natural Climate Solutions for Agriculture Fund" beginning in 2021-2022. $100 million was promised over the ten years, and this would leverage an additional $85 million from existing programming. A new "Canadian Agri-Environmental Strategy" would guide the fund and "be developed in collaboration with partners to support the sector's actions on climate change and other environmental priorities towards 2030 and 2050." This is a significant infusion of funding, but it is not yet clear what that funding would support.

Action on climate change in agriculture specifically, was deferred to the Federal-Provincial-Territorial (FPT) agricultural agreements, namely the current CAP. While there was some emphasis on climate in the CAP, it is not sufficient to support significant change. The OECD recently reviewed member states' climate mitigation policies for agriculture and found relatively limited action, Canada being no exception. They suggest "***policy efforts will need to intensify for the (...) sector to contribute effectively to limiting global temperature increases***".

The new national climate plan should include robust and well-funded new measures to help farmers across the country both adapt to the very real impacts of climate change, and to support their leadership in advancing climate solutions through soil health.

PHOTO CREDIT: FLORIAN SCHMETZ/UNSPLASH

NEW FEDERAL CLIMATE PLAN

A new federal climate plan, "A Healthy Environment and A Healthy Economy" was released in December 2020 with new elements related to agriculture including the following:

- "Invest $165.7 million over seven years to support the agriculture industry in developing transformative clean technologies and help farmers adopt commercially available clean technology". Details are not yet available on how this funding would be used.
- "Set a national emission reduction target of 30% below 2020 levels from fertilizers and work with fertilizer manufacturers, farmers, provinces and territories, to develop an approach to meet it."
- "Invest up to $631 million over 10 years to ... to restore and enhance wetlands, peatlands, grasslands and agricultural lands to boost carbon sequestration. This initiative will support improved land and resource management practices in sectors that have some of the greatest potential for increased carbon storage, and will conserve carbon-rich ecosystems."
- "Provide $98.4 million over 10 years to establish a new Natural Climate Solutions for Agriculture Fund. This fund will leverage $85 million in existing programming and will be guided by a new Canadian Agri-Environmental Strategy, to be developed in collaboration with partners, to support the sector's actions on climate change and other environmental priorities towards 2030 and 2050." More detail is needed on what exactly the fund would be directed to.
- "Invest up to $3.16 billion over 10 years, to partner with provinces, territories, non-government organizations, Indigenous communities, municipalities, private landowners, and others to plant two billion trees."

These proposals in the new federal climate plan are promising, but until more details are available evaluation cannot be undertaken. Nevertheless, the climate plan is focused only on mitigation and not on adaptation. Soil health has strong benefits on both fronts and these may not be recognized. The focus on soil carbon is also a potential limitation, whereas a comprehensive approach on all greenhouse gases and both mitigation and adaptation would be more beneficial. In addition, if each of these proposals results in a separate program from each department with its own application forms and delivery agents, this could increase complexity to deter farmer and landowner participation.

4.2 Six primary policy and program tools in support of soil health

A variety of policy and programming tools are used across Canada and in other jurisdictions to promote and incentivize the adoption of various practices by farmers, including those for soil health. Taken as a whole, these tools are the foundation of a system that can help make sustainable agriculture more attractive and accessible to farmers.

In Canada and a number of other jurisdictions, the main categories of policy and program tools used to promote soil health are:

- **Environmental Farm Plans and public assessment and planning tools**
- **Private sector assessment, planning and certification schemes**
- **Grants to farmers**
- **Education and extension services**
- **Business risk management tools**
- **Emerging market-based mechanisms**

Through a review of the literature and discussion with key informants, this section outlines the primary attributes of each tool, as well as a summary of strengths and gaps/limitations for each.

A) Environmental Farm Plans and public assessment and planning tools

The main agri-environmental assessment and planning tool used in Canada under the CAP is the Environmental Farm Plan (EFP) or Plan d'accompagnement agroenvironnemental in Québec. Canada's EFP program is a voluntary environmental education, awareness and action program. It comprises a whole-farm self assessment tool that helps producers identify environmental risks on their farms and develop plans to mitigate those risks. This program is largely self-directed by the producer, with support from the provincial agency administering the program. As of 2017, **40% of Canadian farms have a completed EFP, making this the most widely used environmental program in Canadian agriculture.**

Throughout Canada, **eligibility for producer funding under a range of federal-provincial cost-share programs are contingent on completion of an EFP.** The funding basis for these programs is to offer grants to producers and local conservation associations to implement a wide variety of soil health practices.

Strengths of Environmental Farm Plan tool

- EFPs are available in all Canadian jurisdictions and the level of participation is significant (although far from universal at 40% of farmers in 2016). It is the most widely used environmental program in Canadian agriculture.
- EFPs have a good track record producers and are perceived by the farm community as being credible and meaningful.
- EFPs enable farmers to identify and prioritize risks and develop customized action plans.
- Environmental farm planning is one of the most comprehensive farm planning efforts in the world from an environmental perspective.
- EFPs address most soil health issues and include numerous BMPs beneficial to soil health.
- Except for Saskatchewan, producers can access cost-share programs based on completion of an EFP thus creating a financial incentive for developing one.
- The EFP program has improved environmental awareness in the farm community.

Gaps and limitations of Environmental Farm Plan tool

- EFPs are not consistently focusing on soil health or conservation in detail but refer to additional resources for detail. However, Alberta is working on the development of 'soil health reports' based on the current EFP.
- While workbooks provide a wealth of information on BMPs, many EFPs are delivered without much extension service provided to farmers.
- Barriers related to the financial cost of implementation and limited availability of cost share funding limit further participation in the EFP program.

Innovative options in other jurisdictions

- Ontario's Farmland Health Checkup provides a detailed assessment of soil health and prescription for improvements on selected farm fields with the assistance of a Certified Crop Advisor.
- Resilient Fields is another web-based application being developed to help farmers make choices about agronomic Best Management Practices for soil health and water management in Ontario.
- USDA's Soil Health Conservation planning system offers detailed planning to identify and document soil health resource concerns, problems, and opportunities for improvement with the assistance of extension staff and private accredited conservation planners.

B) Private sector assessment, planning and certification schemes

Beyond government-supported EFPs, there are also private sector assessment, planning and certification tools. A leading initiative is Fertilizer Canada's 4R Nutrient Stewardship program, emphasizing principles of right source, right rate, right timing, right place to optimize nutrient performance, reduce inputs and to minimize environmental impacts. The potential for 4R nutrient stewardship to reduce nitrous oxide emissions, the most powerful GHG from crop agriculture, means that 4Rs can play an important role in future policy scenarios.

Other private sector tools available to and used by farmers in Canada include certification schemes, sustainability standards and self-assessment tools. There are also a number of related initiatives including Responsible Grain, the Certified Sustainable Beef Framework, and the Canadian Agricultural Sustainability Initiative, which is trying to create linkages between the EFP and certification systems to reduce duplication and allow farmers to more easily navigate the range of systems.

Strengths of private sector assessment, planning and certification tools

- Most of the industry-based assessment tools provide clear information as to what practices are required or recommended and how to implement them.
- These initiatives send strong market signals to producers about the importance of adopting BMPs to meet market demand for sustainability or maintain public trust.
- Some tools, such as the 4R Stewardship and certifications, provide recognition to producers.
- 4R Stewardship can help reduce nitrous oxide emissions, an efficient solution in crop agriculture. It is thus important as part of the suite of crop agriculture climate BMPs.
- While some tools are sector-specific or address specific concerns or production systems, they can promote a whole-farm approach, addressing overall management practices.

PHOTO CREDIT: MYRIAM BARIL-TESSIER

PHOTO CREDIT: MYRIAM BARIL-TESSIER

Gaps and limitations of private sector assessment, planning and certification tools

- The industry-driven tools are not focused on soil health in a detailed way. Furthermore, each tool is addressing soil health issues or BMPs differently. This limits the ability of farmers and advisors using these tools to assess soil health in a systematic way.
- These tools are usually not delivered together with education and training to support farmers in the implementation of BMPs and there is a risk that their adoption is bundled with the sale of products, resulting in a lack of safeguard regarding products.
- Most industry-driven tools are designed as checklists to assess performance or compliance. They lack the flexibility needed for each farm's specific situation. They often depend on technical information provided to farmers.
- Incentives for using these tools are not universal and depend on each farm's particular situation.
- The growing number of overlapping initiatives is a source of confusion for farmers and agri-food businesses alike. The Canadian Agricultural Sustainability Initiative seeks to connect the many approaches.
- Market-driven initiatives may be volatile and depend on market demand in regard to certain concerns.
- The industry tools are associated with relatively limited incentives (financial or others).

Overall, most assessment and planning tools deal with soil health in general terms but not in enough detail to guide farmers to comprehensive soil health plans for their farms.

NB: For a more complete summary of strengths, gaps and limitations of assessment and planning tools, please consult "Power of Soil: Assessment of Best Approaches to Improving Agricultural Soil Health in Canada".

C) Grants to farmers

Grants to farmers, also known as cost-share programs, are the primary means by which Canada's federal and provincial governments incentivize addressing environmental issues in agriculture. Overall, many of the current cost-share programs funded under the CAP are relevant to soil health, addressing a significant number of the main soil issues or types of degradation. The structure of these programs is relatively similar across the country, although provinces vary in the emphasis they place on each environmental objective. In each province, a set of BMPs is defined, and producers with completed, valid EFPs can apply to implement a BMP. Successful applicants receive a fixed percentage of the implementation costs to be covered by the government, up to a predefined limit.

NB: A detailed comparison of strengths and weaknesses for each stewardship program structure was undertaken as part of this study. Due to space limitations, it could not be reproduced here. Please refer to "Power of Soil: Assessment of Best Approaches to Improving Agricultural Soil Health in Canada" for details.

Strengths of current grants to farmers

- Help address a key barrier to BMP adoption: the capital cost of adopting healthy soil practices.
- Allow producers to make real changes and have been successful in advancing soil health amongst other objectives.
- Designed at the provincial level, enabling regional intervention to address specific agri-environmental issues.

Gaps and limitations of current grants to farmers

- Grant program structure can create barriers and impediments for the uptake of the programs. Producers need to pay upfront and be reimbursed later, a challenge depending on credit availability. Applications are often quite complex and become a major deterrent.
- Changes in farm practices usually occur in small steps and by trial and error, often on small acreages with low costs and sometimes with borrowed equipment or hiring a custom operator. A small project may not be worth completing the paperwork to get a small grant.
- Proposed grants may offer an insufficient return on investment for application by farmers.
- Most grants provide one-off payments to access materials, equipment or services. They do not provide incentive over time to support system change.
- Cost-share programs do not necessarily support innovation as they target a list of specific BMPs to be considered by farmers.
- Adoption levels show that BMPs primarily resulting in private benefits to the producer are the most popular BMPs adopted. In contrast, BMPs primarily resulting in public benefits were the least commonly adopted BMPs.
- Due to EFP requirement to access most grants, 60% of farmers in 2016 were not eligible for agri-environmental grant programs.

Innovative options used in other jurisdictions

- Small grants for small projects with less paperwork and fewer requirements are available in some jurisdictions, such as through Ontario's Conservation Authorities.
- Several US programs support on-farm BMPs innovation by individual farmers such as Conservation Innovation Grants, Conservation Stewardship Program and Sustainable Agriculture Research and Education.
- Per-acre grants for practices such as cover crops have resulted in high adoption rates in many jurisdictions (e.g. Maryland, Iowa) at rates as high as US$45 per acre.

D) Education and extension services

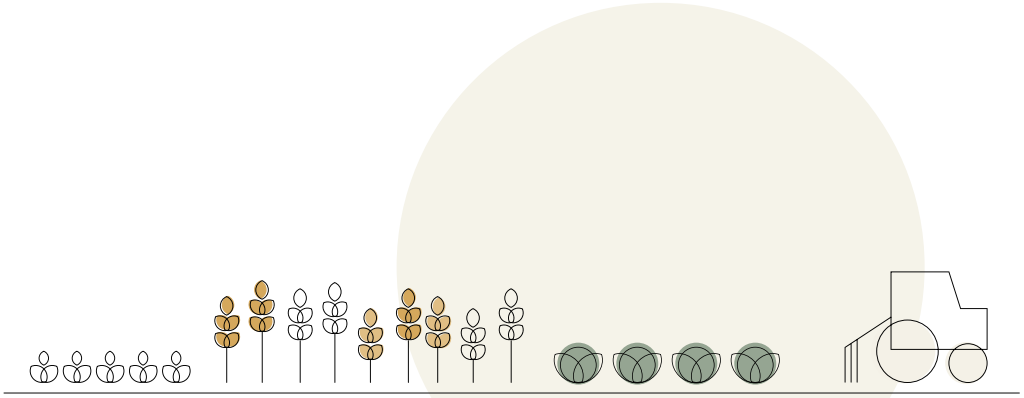
As we have seen above, **experience, advice, mentoring, demonstration, and ongoing technical advice are essential to increasing adoption of soil health practices, and to their success.** Agricultural training and extension services are also critical to facilitating farmers' ongoing access to improved technology and knowledge, in turn enabling them to adapt to changing circumstances.

Research shows that between 1985 and 2016 government expenditures in Canada decreased in real terms and as a share of agricultural GDP for all innovation-related activities such as agricultural research and development, education, and extension (not just agri-environmental) even if the share of GDP allocated was higher than the average in OECD countries. In Canada, in the past, knowledge transfer has been provided through provincial extension agents, working closely with producers. This extension was complemented by formal and informal training offered by post-secondary agricultural institutions. Individual university and government researchers would provide research results and related outreach directly to producers.

Government extension services have been substantially reduced over the past few decades with the general downsizing of government services. The use of provincial extension agents and researcher publications has ceased to be the main extension mechanism, with increasing participation of industry-led groups and private companies. Indeed, a review of the agri-environmental programs and tools funded under CAP found that there are now relatively few programs provided by provincial governments supporting extension services and peer-to-peer learning available to producers. **Instead, private companies now train professionals to provide customer services related to input and equipment sales** (e.g. agronomists advising on timing of herbicide application). Private companies also host field days, on-site demonstrations, research trials, trade shows, etc. **The result is a risk that advice is often bundled with the product being sold, while public health and sustainability management are about ecological knowledge, typically resulting in lower input purchases.**

In addition to agricultural training and extension services, other strategies are used by farmers to learn about soil health practices. Examples include accessing technical information online (worksheets, digital resources, apps, videos, podcasts etc), in person demonstrations and workshops, and peer to peer learning.

However, key informants interviewed for this project all agree that **the above does not add up to adequate support for farmers to learn about soil health.** Education and extension services pertaining to soil health in particular are considered a real gap in Canada, with too few professionals with expertise needed to support producers. Additionally, with advice mostly delivered by the private sector, BMPs unassociated with direct or short-term economic awards are not adequately supported.



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Strengths of current education and extension services

- Contracted agronomists and crop advisors can provide well-informed standards and are good at answering the questions of their clients.
- Nutrient management training through 4Rs nutrient stewardship shows promise in offering economical training to farm advisors on a critical issue related to GHG emissions.
- There is a wealth of information available online about soil health both in Canada and abroad.

Gaps and limitations of current education and services

- General lack of education and extension services pertaining to soil health.
- Online information about soil health is not always 'actionable', or user friendly, for farmers and advisors.
- Resources about soil health are spread out across jurisdictions, platforms and websites, with overlap and lack of coordination.
- Based on easily accessible information, it is not possible to determine 'who does what' with respect to soil health in Canada, nor to make that information available for farmers and advisors in an efficient way.
- Soil health information is not always available for all production systems, commodities, and soil types.
- In-service soil health training for farm advisors (e.g. agronomists, agrologists, certified crop advisors) can be difficult to access.
- With significant reduction in public sector extension services, there is a risk that private sector advice is bundled with the product being sold, a potential conflict of interest that the Québec government has committed to addressing.

Innovative options used in other jurisdictions

- Enhanced extension services are offered through Québec's Soil Health Caravan
- Support for farmer-to-farmer learning is offered through efforts like Ontario's Soil Health Network, the Saskatchewan Soil Conservation Association and the Soil Health Partnership of the US.
- Improved on-farm research and demonstration is promised by the new Ontario On-farm Applied Research and Monitoring (ONFARM) program and the new federal Living Laboratories.
- Improved on-farm research and demonstration is promised by the new Ontario On-farm Applied Research and Monitoring (ONFARM) program and the new federal Living Laboratories and reflected in Saskatchewan's existing Agriculture-Applied Research Management (AgriARM) sites.
- Smartphone and web-based apps have been developed for cover crop choice (US Midwest Cover Crop Council), interpreting soil test results and soil health checkup (Ontario).

E) Business risk management (BRM) tools

BRM programs are designed for the important purpose of farm income stabilization and are the subject of discussion and review, especially AgriStability. They are an important element of the policy environment in which Canada's agri-environmental policies operate yet there is no systematic review to assess whether a given insurance premium or payout has a positive or negative effect on environmental sustainability. Some research **suggests that the net impact of BRM programs on sustainable agriculture practices could be negative.** Nor are existing BRM programs designed to deal with the major long-term risks posed by climate change and biodiversity loss as explained in Équiterre's Agr-résilience brief.

The increased risks associated with climate change suggest there is a need to examine existing programs to identify any disincentives to adoption of soil health BMPs. Continuing on the current path without changes may require these programs to cover ever increasing, recurrent losses among agricultural producers due to soil degradation, unpredictable weather events and other climate-related disruptions. Without careful consideration of climate effects, it is possible these programs would be challenged to provide assistance, with serious long-term effects on farm income stabilization.

Strengths of current business risk management tools

- Widely seen as successful in improving farm financial performance and supported by producer organizations.
- Opportunities exist to design and pilot new BRM programs in support of soil health and environment.

Gaps and limitations of current risk management tools

- Some evidence suggests that the net impact of some BRM programs on environmental quality may be negative. Other research suggests some BRM programs may negatively influence the uptake of environmental stewardship practices.
- BRM programs have not evolved significantly to address new risks such as those of climate change, biodiversity loss and soil degradation.
- BRM budgets are notably lower than those of other jurisdictions, namely the USA.

Innovative options used in some jurisdictions or proposed

- Production insurance discounts are used in Iowa, Illinois and formerly in PEI to encourage BMP adoption and their efficacy is supported by research.
- Insurance on potential loss of production due to BMP adoption has been tried in the US and PEI.
- Adding an additional incentive or bonus for BMP adoption within AgriInvest has been proposed to add an incentive to continue practices in the longer term.

F) Emerging market-based mechanisms

F.1 Payments for ecological goods and services

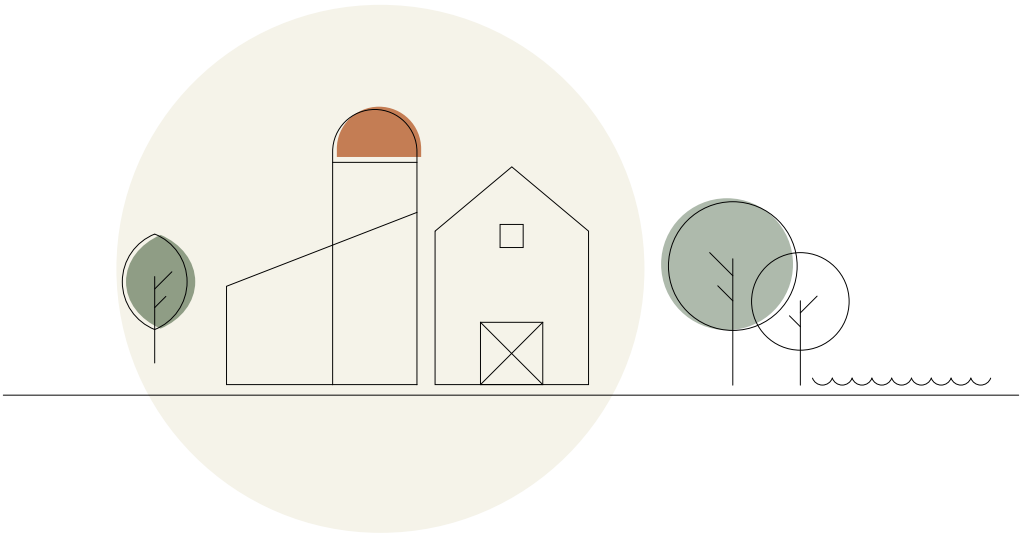
Some practices like retiring cropland to permanent cover as grassland, wetland or woodland, require removal of land from agricultural production for environmental benefits. Based on the concept of natural capital, **the Ecological Goods and Services (EGS) approach attempts to value 'services' performed by ecosystems**. This phrase is also applied to programs incentivizing farmers who produce or enhance EGS, through various market-based instruments. Buyers are usually governments, conservation agencies, NGOs or private organizations, with public programs usually targeting externalities.

US programs like Conservation Reserve, Wetland Reserve and Conservation Stewardship programs offer annual payments equivalent to land rental to farmers for using land for conservation purposes under contract. The Ecological Gifts Program provides tax credits or deductions for market values when landowners donate ecologically sensitive land to registered charities, with the goal of protecting environmental heritage.

There are also non-government EGS programs in Canada and elsewhere. Alternative Land Use Services (ALUS) is a non-governmental program available in Canada. Specifically, ALUS is a program to provide annual incentives to farmers to establish and maintain activities that may lead to production of EGS. These activities target local environmental opportunities, and include restoration, enhancement and protection of various wetland, riparian and upland ecosystems, typically with the goal of protecting sensitive land.

Strengths of current ecological goods services programs

- Programs such as ALUS support producers in going above and beyond minimum environmental standards established through regulation.
- In some areas, EGS programs also demonstrate shared responsibility for environmental stewardship.



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Gaps and limitations of current ecological goods and services programs

- Difficulties remain in identifying appropriate values for EGS.
- The value of a given ecological good in one location may be different in a different location.
- Measurement of specific environmental outcomes has been achieved for certain projects, but is not consistently achieved.
- The difficulties of identifying appropriate values for EGS may be magnified through the process of establishing costs and benefits of public expenditure for environmental benefits.
- Some Canadian governments have expressed reservations about funding ongoing annual payment-based programs except in unusual circumstances.
- Including annual payments as well as establishment costs can increase the net cost of BMP projects depending on the term of contract. This reduces the cost-benefit ratio significantly.
- Financing EGS programs such as ALUS remains a barrier.
- Monetizing behaviours seen as good stewardship raise ethical concerns amongst farmers with BMPs already in place.
- Costs of ecological disservices are not included in most analyses.
- Potential distortions in land markets have been observed in the US.

Innovative options used in some jurisdictions or proposed

- US experience with Conservation Reserve, Wetland and Conservation Stewardship programs and others offer ample lessons for design of EGS programing.
- Extensive use of annual payments in European agri-environmental schemes provides extensive experience to draw upon.

F.2 Greenhouse Gas Offset Programs

Climate policy often involves creation of offset programs in which agriculture can receive funding for emission reductions that can be sold in an offset trading system. Environment and Climate Change Canada has identified the potential for use of offset programs as part of the federal legislative action on climate under the Pan Canadian Framework. Typically, in order to obtain offset 'credits', emission reduction projects or practices must be adopted and put in place for a period of time, specified in a protocol, and sold to a second party looking to offset their emissions either voluntarily or as required by mandatory GHG emission limits.

Farmers may want to use these protocols to participate in compliance or voluntary carbon markets. These two markets create market incentives insofar that the price for carbon is high enough to cover the cost of implementing the protocols. Note that according to key informants, protocols focusing on nitrogen fertilizer use may offer the most potential for both compliance and voluntary offsets. Other types of offsets may have potential applications on farms, such as afforestation/reforestation offsets through planting trees and other woody species for shelterbelts, buffer strips and other applications. Grassland conservation offsets such as the Canada Grassland Protocol of the Climate Action Reserve also offer opportunities for agriculture in the voluntary market and possibly the compliance market.

However, **it is important to note that there are significant practical challenges faced by farmers who want to implement these protocols (e.g. measurement, record-keeping, permanency, high transaction costs and small amounts per acre). The complexity and rigid standards of offset programs currently limit how useful they can be in agricultural contexts.**

Strengths of offset programs

- Provides financial incentives to drive the adoption of BMPs and the delivery of ecological goods and services
- A market-driven system with no direct costs for government
- Potentially cost-effective tool for greenhouse gas mitigation
- Some protocols already developed and used in Alberta.

Gaps and limitations of offset programs

- Research is still needed to reduce the uncertainty around the quantification of GHG reductions
- Protocols are not yet available for all markets, sectors and activities
- The market demand for offsets is still precarious
- Protocols are complex, rigid, and costly to implement at the farm level with extensive record-keeping and monitoring requirements

Innovative options used or proposed in other jurisdictions

- Fertilizer Canada has developed a protocol specific to 4R nutrient management.
- Grassland conservation offsets are already available using the Canada Grassland Protocol of the US Climate Action Reserve.
- Ontario and Québec funded some soil health and climate agriculture programs from climate funds not directly tied to quantification of GHG reductions, which are very challenging to measure when it comes to soil health practices.

NB: A thorough review of innovative approaches for each of the six policy tools was performed as part of our study. Due to space limitations, they could not be reproduced here. Please refer to "Power of Soil: Assessment of Best Approaches to Improving Agricultural Soil Health in Canada" for details.

5

Conclusion

Healthy soils represent an opportunity to build prosperous and resilient farms and agroecosystems that can sustain us into the future. To do so, we will need many tens of thousands of farmers to join the movement for sustainable agriculture. Federal and provincial policies and programs must change significantly to enable the scale of action required by farmers to meet the challenge, and the opportunity. Newly-designed policies and programs that reach out across the country and invite a rapidly growing number of farmers to give regenerative practices a try are essential to transitioning Canada to a lower GHG and more sustainable agricultural sector. This will require extensive financial investments, as well as a broader strategic framework which enables innovation in policy, programming and on the farm.

Through widespread adoption of soil health systems, Canadian farmers can provide positive solutions to climate change mitigation while helping themselves adapt to weather extremes and building long-term financial resilience. Canadian, provincial and territorial governments have an unprecedented opportunity to demonstrate forward-looking leadership by placing a real priority on soil health. People, planet and profit will all benefit as a result.

6

Recommendations

In order to meet the challenge and the opportunity before us, major policy change is needed in the key federal policies, and related FPT implementation: specifically, the promised new federal climate plan, and the upcoming 2023 Federal-Provincial-Territorial successor to the Canadian Agricultural Partnership. Climate and agricultural policy must help many more farmers to make soil health their own priority, through a systems approach that supports the inter-connection of necessary policies and programs. No single action will bring the change needed. Awareness, easily accessible information, advice, farmer-to-farmer learning, technology, and better financial incentives are all part of the puzzle. So is strategic direction by government, and partnerships with industry and other stakeholders.

The recommendations below are interrelated, reflecting this systems approach to policy change. They are grounded in state of the art knowledge regarding how and why farmers adopt sustainable agriculture practices. With a clear vision, strategy and financial investment equal to the goals - these recommendations can form a roadmap for soil health in Canada.

NB: When not specified, the term «governments» includes federal, provincial and territorial governments.

PRIORITIZE SOIL HEALTH

Make soil health a priority in the next Federal-Provincial-Territorial agricultural framework

What

The 2023 federal, provincial/territorial (FPT) framework should identify soil health systems as an important mechanism with climate, economic and environmental benefits, ensuring innovative strategies for promotion in each jurisdiction. The federal and provincial/territorial ministers should commit to making soil health a high priority in the intergovernmental agreements that will set the direction for 2023-2028 Canadian Agricultural Partnership.

How

Each bilateral agreement between the federal and provincial/territorial governments should spell out how soil health will be advanced on many more farms. Future FPT frameworks should prioritize recruiting farmers that have not previously participated in soil health programs. Importantly, increased funding for soil health practice adoption should begin now, under existing CAP programs.

Who

Federal, provincial/territorial governments

PHOTO CREDIT: MEL LUYMES

PHOTO CREDIT: MEL LUYMES

Collaborate on a pan-Canadian soil health strategy

What

A pan-Canadian Soil Health Strategy with regional emphases would help develop consensus for action on soil health and prevention of soil degradation.

How

A strategy could take a number of forms, and should be undertaken in collaboration with agriculture groups, conservation groups, agri-business and different levels of government and other stakeholders. It could be led by a pan-Canadian "voice" for soil health. Ideally, it would be mandated by the FPT agriculture ministers, addressing the specific practices pertinent to their own regions. A pan-Canadian assessment of the state of our agricultural soils could be undertaken as part of the strategy, building on AAFC's agri-environmental indicators analysis and used to track improvements over time. The new Canadian Agri-environmental Strategy proposed in the new federal climate plan could include a major focus on soil health. The Senate could also undertake a study,as it did in 1984 with the influential "Soils At Risk", to raise awareness and explore issues as Senator Rob Black has proposed. Soil issues are different in each region, so regional sub-groups could be organized to guide analysis for each region.

Who

An independent and credible organization mandated by the FPT agriculture ministers in collaboration with all stakeholders.

Strengthen and broaden collaboration on standards among government, farm organizations, industry, and other partners

What

There are many actors across the food system who are working on soil health from various perspectives often but not always including a soil health focus. There are existing standards (eg Canadian Organic Standard and the 4Rs Nutrient Stewardship framework), as well as emerging initiatives (eg. Responsible Grain, Certified Sustainable Beef Framework, Farm Sustainability Assessment, Field To Market Canada) not to mention international sustainability standards. There are efforts to coordinate work on emerging standards, as well as to communicate sustainability progress to the public and to export markets through initiatives like the Canadian Agri-food Sustainability Initiative and the Benchmarking Canada's Agri-Food Sustainability Leadership process. For the most part, these initiatives have low representation from the research and non-governmental environmental community, compared to the high level of engagement between industry and government. A concerted effort needs to be made to prioritize soil health within these initiatives and to broaden their inclusivity beyond industry and government.

How

Working together, governments, industry, farmers and other non-governmental partners should strive to harmonize their work on soil health where the roadmap to greater impact, as laid out in this report, is quite clear and non-controversial. Recommendations on a pan-Canadian soil health strategy, soil health knowledge and learning, and the soil health business case in particular need broad collaboration. Collaboration can best be fostered by building trust on areas where there is agreement on the actions to undertake, so more difficult issues can be subsequently tackled. Transparency and openness is key to success for multi-stakeholder action.

Who

Governments, industry, academic/independent, non-governmental and consumer organizations

Integrate soil health initiatives in federal and provincial climate change policies and funding programs

What

The new federal climate policy should identify the importance of soil health as a means of both mitigating and adapting to climate change, as well as committing significant funding to support adoption of soil health systems. The proposals in the new climate plan are promising but lack the details on whether soil health will be supported or not. Adaptation is not yet part of the plan. Provincial climate strategies should also reflect the importance of soil health.

How

Initiatives that help farmers gain soil health knowledge and that financially assist in practice change are key to success. It is not yet clear the new federal climate plan will do that. There are promising proposals like the new Natural Climate Solutions for Agriculture Fund to be guided by a new Canadian Agri-Environmental Strategy and the other nature-based solutions funding sources in the climate plan could also assist, including the funds for habitat, resource management and tree planting. Funding could also be aligned though The Low Carbon Economy Leadership Fund.

These commitments from several departments should be channeled into a single program for farmers to avoid creating multiple applications and bureaucratic complexity that deters participation.

Who

Governments

ENHANCE SOIL HEALTH KNOWLEDGE AND LEARNING

Create a 'Soil Health Network' to promote and share soil health knowledge across Canada

What

Soil health knowledge and technical information is produced by governments, producers, academia, businesses and non-government organizations across Canada. However this information and knowledge is often not made available in formats and through channels that farmers use. A network of existing organizations could create a more consistent and comprehensive range of information in easy-to-use formats.

How

The network should be composed of private and public actors, including producer associations, industry actors, and academics, governments, non-governmental organizations and educators. Potential roles include: facilitating a pan-Canadian system of information to support extension and education about soil health; mapping/connecting on-going initiatives;identifying gaps; setting national priorities (research areas; funding allocation). Different structural and governance models could be considered to address the great diversity within Canada. Through the network, existing and new soil health knowledge and information resources can be identified in a pan-Canadian knowledge database and gaps identified. Sources include provincial ministries, universities, private sector and other organizations developing all kinds of content including written materials, videos, digital resources, workshops and training. The network could be the vehicle to coordinate production of content to fill gaps in user-friendly and practical resources to help farmers and advisors.

Who

Governments, industry, producers, researchers, stakeholders

Make the business case for soil health

What

Farming is a business and any new venture must make financial sense. Many groups are gathering and analyzing data to prove the business case for soil health. Yet farmers commonly ask the question "Where's the business case?" and there are often few answers.

In order to achieve the widespread adoption of soil health practices needed to make a difference in climate change and long-term productivity, many more farmers will need to join the movement. According to Statistics Canada, 60% of Canadian farmers are not eligible in most jurisdictions for existing agri-environmental programs because they do not have a current Environmental Farm Plan. A much larger percentage of farmers needs to be supported to move towards sustainable agriculture practices through creative program design. Attracting tens of thousands of new farmers requires making participation easier and providing multiple entry pathways with fewer administrative barriers.

How

In order to accomplish this goal, the business case for improving soil health systems needs to be made for different production systems in different regions. The Soil Health Institute and the American Farmland Trust provide good examples of working with farmers and interdisciplinary teams to lay out practical, real-life business cases for soil health in different regions and under different production systems. This kind of work needs to be done across Canada.

As well, context-specific, multi-year, step by step supports offering different types of resources at different stages are key to success. Social science research capacity is also a priority for universities, as understanding how demographic and socio-economic characteristics of farmers affect uptake of soil health practices is crucial to adapting program design to meet needs.

Who

Governments, researchers, industry, producers

PHOTO CREDIT: MEL LUYMES

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Provide support for key soil health practices

What

A menu of options covering the full suite of soil health practices is needed across the country, so farmers can choose practices for their specific production systems, regions, climate and soil characteristics. The key categories are: conservation tillage, cover crops, organic amendments, nutrient management, diverse crop rotations, conservation buffers, prevention of soil compaction, integrated pest management, grazing and pasture management, land retirement, and soil information collection. Each of these categories has many variations and need to be matched to each farmer's needs.

How

Provincial governments should ensure they provide support and share educational resources on the broad range of soil health practices.

Who

Provincial governments

Ensure soil health training for advisors and farmers

What

Advisors specializing in soil health work with farmers to identify soil issues and develop customized solutions. Building the capacity of both advisors and farmers, and fostering the exchange of knowledge they each bring in processes such as adaptive management, is key to success. Advisors trained in soil health, sometimes farmers themselves, can be powerful agents for change. Whether as agronomists, crop advisors, or custom farmwork businesses, they have an influential position. Bankers, financial advisors and non-farm farmland owners also need increased awareness of the business case for soil health.

How

It will be important to strengthen training opportunities by offering access to education, training and extension services on soil health, and specifically to qualified advisors to work with farmers.

Who

Governments, farm organizations, agri-business associations, professional agronomy/ agrology organizations and educational institutions.

Develop a national soil health check-up tool adapted to Canadian regions

What

A soil health planning tool is needed to help farmers identify and prescribe the practical changes needed for their cropping systems and fields. Existing planning tools like the EFP are useful, but more detail is needed for on-the-ground soil health analysis and planning.

How

This new tool could be a standalone resource available electronically, compatible with existing tools like EFP, as an 'add-on' module. A soil health check-up tool, like Ontario's Farmland Health Checkup and the USDA's Soil Health Conservation Activity Plans, should be developed. The soil health check-up would require funding for the assistance of a qualified advisor (e.g. agronomist, crop advisor) as it does for the Ontario and USDA approaches. The modest $500 incentive for advice from a Certified Crop Advisor or agrologist provides the necessary technical advice (Ontario example). Participation in the soil health check up should have few requirements and a very simple application process. The check-up can be a new and easy pathway to participation, whereas complex applications and bureaucratic requirements would eliminate any advantage in attracting new participants.

Who

Governments, farm organizations, researchers, stakeholders

Build capacity for on-farm demonstration

What

Demonstration of soil health practices takes many forms, including agricultural fairs, demonstrations, farm days, twilight tours and tailgate talks. These techniques are used in every province, have been around for decades and have been proven effective. Yet despite some promising new initiatives (AAFC Living Laboratories, Ontario's ONFARM) and strength in some existing institutions (e.g. Saskatchewan's Agri-ARM), the capacity to undertake demonstrations has diminished through decades of cutbacks to extension field staff and facilities.

How

A national soil health strategy could assess the existing capacity for on-farm demonstrations.

Who

Governments, industry and farm organizations.

PHOTO CREDIT: MEL LUYMES

Enhance farmer-to-farmer learning opportunities

What

Farmers learn about new practices and technologies in many ways, yet learning from other farmers often has the most powerful impact. Many farmer-to-farmer learning systems exist throughout Canada but they often rely on the volunteer work of champions of sustainable practices. Such programs need to be supported and expanded.

How

Farmer-to-farmer learning on soil health should be identified as a priority in the next FPT agricultural policy framework and bi-lateral agreements and incentives should be designed for farmers who are sharing their skills with others. Farmers who are skilled in soil stewardship should be supported to share knowledge with other farmers and the broader agricultural community.

Who

Governments, farm organizations

Enhance public sector capacity for research and extension

What

Advisors and specialists in provincial agriculture ministries and university, college and federal researchers and educators play a pivotal and irreplaceable role in promoting soil health knowledge. Any further public sectors cuts will lead to consequences for farmers and our soil resources.

How

Strategic re-investment in public sector extension advisors is needed as Québec is proposing to do. Public sector staff can also be used strategically to facilitate better knowledge transfer to farmers and their advisors. The extension and advisory services offered by the public sector, should be managed as part of a system that also includes private businesses and conservation organizations, but safeguards need to be in place to make sure there's no real or perceived conflict of interest.

Who

Provincial governments

PHOTO CREDIT: JAN KOPRIVA/UNSPLASH

Pan-Canadian reporting on the state of soil health

What

To improve the state of soil health we must know the current state of soil health and track progress. That knowledge is not yet documented. Much of the data needed for this analysis exists in Statistics Canada and AAFC. Provinces also possess important information and some have critical data, such as Québec's extensive database of soil samples. Canada lacks a soil monitoring system like Europe and the US has, leading to gaps in knowledge. An initial state of soil health report could assemble and analyze existing data and identify knowledge and data gaps.

How

The pan-Canadian assessment of the state of our agricultural soils could be undertaken building on AAFC's agri-environmental indicators analysis, census and other statistical data and used to track improvements over time. However, an independent body would be best to oversee this kind of analysis, rather than a government department—perhaps the Commissioner of the Environment and Sustainable Development as part of the existing reporting system. Environment and Climate Change Canada will continue to track all greenhouse gas emissions, including soil related emissions, that could be included in the 5-year reporting introduced in the new Canadian Net-Zero Emissions Accountability Act.

Who

An independent body like the Commissioner of the Environment and Sustainable Development

INCENTIVIZE SOIL HEALTH

Increase overall funding for on-farm soil health projects

What

Existing agri-environmental grant programs for BMP adoption under CAP are often over-subscribed, with needs far exceeding available funds. Research shows that the United States and Europe spend many times as much as Canada on agri-environmental programs as a percentage of farm income. Farmers are clearly eager to undertake soil health and other environmental projects, but are often unable to access cost-sharing grants. Little can change without additional funding. Funding allocations for on-farm grant programs for soil health projects should be increased significantly beginning in 2021-22, targeting especially young farmers.

How

Funding proposed in the new federal climate plan suggests significant new funding may be available, but without more detail it cannot be evaluated. The new Natural Climate Solutions for Agriculture Fund, suggests a positive new approach with an additional almost $100 million over 10 years, presumably ~$10 million per year. The other nature-based solutions funding sources in the climate plan could also assist, including the $631 million for habitat and resource management and the $3.16 billion for tree planting. The farm-related commitments from several departments should be channeled into a single program for farmers to avoid creating multiple applications and bureaucratic complexity that deters participation.

Additional funds can come from a variety of sources such as the Low Carbon Economy Leadership Fund, other AAFC programs, provincial funds and private sources. Provincial commitments to soil health are also needed. Increased private funding from agri-business and foundations can play a role in expanding on-farm projects. Governments could seek or offer matching funds from private sources as they do in many other policy areas. Federal-only incentive programs could be a powerful tool to jumpstart activity through farm organization delivery. Agri-environment incentives surged in 2003-2008 primarily through federal-only funding programs.

Who

Federal and provincial governments, other funders

Fund simple, low risk projects

What

Change usually starts small. Soil health is no different. As outlined in this report, farmers that have adopted one BMP are more likely to adopt others, and can also influence neighbours. It should be made easy for farmers to apply for simple, low-risk soil health projects (e.g. soil tests; cover crops), in order to more readily demonstrate benefits.

How

A small grant program could assist farmers with the common approach of starting small in changing practices, with small acreage, custom equipment and trusted advisors. Such a program would need fewer pre-conditions (e.g. no requirement for an EFP), a small grant size, and simplified application processes. This can help get farmers started on soil health in a small way, especially those who have not yet participated in the EFP or other programs.

Who

Governments, Farm organizations

Reduce the risk of innovation

What

Farming is a risky business with weather, markets, and many other constantly changing forces. Changing practices to improve soil health can be a risk - or a perceived risk - that many farmers will naturally avoid. The government should explore the potential of Business Risk Management programs to reduce the risk of adopting sustainable agriculture practices. This could include new incentives within existing programs, or creating a new program to complement existing ones.

How

Many farmers are concerned about risk of yield or margin loss due to BMP adoption. A new program could take the form of insurance for BMP adoption to cover the production risks of adopting new beneficial practices. Pilots have shown the promise of this tool in the US and PEI.

This is in line with what Canada's ministers of agriculture have agreed upon during the last Federal - Provincial - Territorial meeting in November 2020 and with what Équiterre proposed in its brief to the House of Commons Standing Committee on Agriculture during its study on BRM programs. Research supports this option and there is interest among farmers.

Within the existing BRM system, the government should create additional incentives for the adoption of sustainable agriculture practices such as a discount on production insurance premiums, contingent on the adoption of specific beneficial practices. Production insurance discounts have already shown success in the US and PEI and are supported by research.

Another option could be to offer access to additional funding within Agri-Invest, if BMPs are in place (e.g. cover crops). Producers that adopt soil health practices could be eligible for an additional incentive, for example 2% matching funds up to a $20K cap instead of 1% and $10,000 cap. This would help with cash flow when adopting new practices requires a capital outlay.

Pilot projects could explore program design options for this kind of incentive. This should be undertaken within a systems approach to policy design. The pilot projects should be initiated by federal and provincial governments, engaging both farm organizations and universities in this evaluation research.

Who

Governments, production insurance agencies, universities, farm organizations.

Use development of GHG offset protocols to increase funding for soil health action

What

The Federal climate policy system should include potential for farmers to benefit through offsets. If designed to do so, GHG offset systems can be a source of funding for on-farm soil health practices such as nutrient management systems, grassland conservation and re/afforestation.

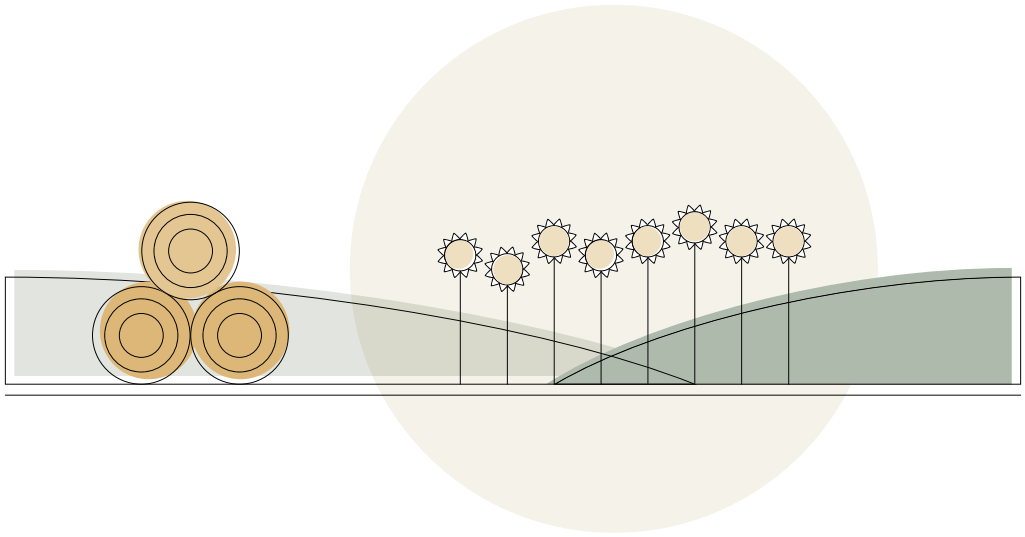
How

In January 2021, the ECCC announced that an offset protocol for “Enhanced Soil Organic Carbon” would be developed in the first phase of the federal GHG offset system development. Previously, the ECCC has already identified a potential protocol for afforestation / reforestation. A protocol for nitrous oxide reductions related to nitrogen fertilizer use should also be included. Similarly, an avoidance of conversion of grassland to cropland protocol should be included and informed by the protocol already developed for the Climate Action Reserve.

Participation in complex offset systems is not possible for most individual farmers and systems are needed to simplify participation. For example, farm organizations could coordinate participation of their members in offset systems. Federal policy on offsets should accommodate the needs of farmers and ranchers to allow participation. Such protocols must be developed for practical real-life farming and not create unachievable record-keeping and monitoring requirements.

Who

Federal government, farm organizations



CONSERVE AGRICULTURAL LAND AND NATURAL AREAS

Develop a program to conserve vulnerable / degraded lands over time

What

Some farmland is unprofitable; the soil may be highly erodible, or susceptible to salinization, and not suitable for annual crops. Other lands contain woodlands, wetlands, native grasslands or streams in need of buffer strips. These lands should be conserved and restored.

How

A national effort is needed to conserve these lands, like previous efforts such as the federal-only Greencover and Permanent Cover programs. Some croplands can be converted to perennial forage land for livestock, other soils can be rehabilitated over time, while still others are best converted to permanent natural cover. This could recognize some of the Ecological Goods and Services for practices that adress these challenges, e.g. limited area-based payments for land retirement. The program should link to nature conservation organizations and allow for voluntary conservation easements and income tax incentives such as the Ecological Gifts Program.

Who

Governments, conservation organizations

Reduce the conversion of perennial forage agricultural lands to annual cropland

What

Over the last two decades, more and more of Canada's rangeland, grassland, hayland and pasture have been removed from perennial cover and converted to annual cropping. This conversion has negative consequences for the livestock industry, for soil health and for climate change. Market forces are behind this conversion, but both government and industry can help.

How

Initiatives are needed to support rangeland and pasture management practices to conserve and improve soil health and carbon stocks. The development of, and growth of participation in the certification system for sustainable beef can play an important role. The new nature-based programs in the new climate plan may help as well.

Who

Governments, industry

BIG CHANGE: NAVIGATING THE ROAD FORWARD

Building soil health on Canadian farms could benefit long-term farm profits, resilience in the face of extreme weather, climate mitigation and adaptation, protection of water quality and biodiversity. But farmers cannot simply take this on alone; they need governments to support them protecting soil health through improved policies and programs.

Mere tweaking of existing programs will not be enough to attract tens of thousands of new farmers to adopt soil health systems. We need to remove bureaucratic barriers, increase funding, raise awareness, make participation easier, and build the business case, for better soil management.

The recommendations made here are based on research and together they make up a package of significant changes to public policy on agriculture and climate change. We need to think big to take full advantage of the huge opportunity soil health offers famers and society for profit, people and planet. It will take all stakeholders working together to bring this vision into reality.

Your views on this report and our recommendations are welcome. Please get in touch with Alice Feuillet, Project Manager at Equiterre at afeuillet@equiterre.org, or with Thomas Bowers, Senior Manager, Research and Policy at Greenbelt, at tbowers@greenbelt.ca.

This report contains a summary of a research paper produced by Groupe Ageco in collaboration with Équiterre and Greenbelt, entitled "Power of Soil: Assessment of Best Approaches to Improving Agricultural Soil Health in Canada."

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With special thanks to (in alphabetical order):
Denis Angers, Suzanne Armstrong, Jean-Marc Bertrand, David Burton, Jean-Michel Couture, Ken Currah, Adrienne Deschutter, Katherine Fox, Marc-Olivier Gasser, Michael Keegan, Bruce Kelly, Alan Kruszel, Derek Lynch, Cedric MacLeod, Rod MacRae, Brian McConkey, Odette Ménard, Susie Miller, Brent Preston, Darrin Qualman, Louis Robert, Karen Ross, Marie-Élise Samson, Sean Smukler, Drew Spoelstra, Gordon Stock, Angela Straathof, Peter Sykanda, Claudia Wagner Riddle, for their expert feedback and input along the production of this report. We would also like to thank all the participants of the Quebec and Ontario virtual workshops of January 21st and 22nd, 2021. Remaining omissions or errors are our own.

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