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Canadian

Organic Research Priorities

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Organic sector leaders participating in the consultations and Priority Setting Committee

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1 Preface

Canada is a geographically large country with a diversity of growing environments while organic encompasses the full breadth of agricultural production systems. As such research needs are plentiful and diverse. Priority setting must consider the economic importance of production challenges and opportunities across commodities. However, environmental challenges have become increasingly important, and producers have needed to become increasingly resilient to the many pressures from climate change, global markets, consumer expectations, and government policy

The Organic Agriculture Centre of Canada (OACC) has led national organic research needs assessment and priority setting processes since 2003. This document summarizes the research priority setting consultations held in December 2021 to guide research programs nationally as well as to support preparation of the fourth Organic Science Cluster program (OSC4).

The Organic Science Cluster (OSC) program is jointly led by the Organic Federation of Canada and the OACC at Dalhousie University. The OSC is the national science program for organic agriculture in Canada supporting scientists at over 35 research institutes including Agriculture and Agri-Food Canada (AAFC) research centres, universities and other research centres since 2009. The Organic Science Cluster program is supported by the AgriScience Program under Agriculture and Agri-Food Canada's Canadian Agricultural Partnership (an investment by federal, provincial, and territorial governments) and matching contributions from the agricultural community. AAFC has already identified priority areas for the next AgriScience Program beginning in April 2023 (Table 1).

A total of 15 open consultation meetings were held on the topics of grains, field vegetables, greenhouse vegetables, fruits, livestock and general (open) thematic areas. These consultations were attended by over 190 individuals primarily consisting of producers, extension specialists, researchers and sector leaders or consultants. Additional consultations were held with the Canadian Organic Growers who are evaluating the opportunities and barriers associated with the value chains of key commodities. Priority-setting discussions were also led by CRAAQ for QC. Some suggestions also arose from discussions with individual researchers, industry partners, or at conference events. There were also submissions from provincial organizations which had undergone their own research needs assessment process.

In total, approximately 300 suggestions were made through the course of the meetings and other submissions. These submissions have been condensed into priority statements which consisting of three components:

- one or more **outcomes** related to Table 1,
- **a priority crop, livestock, or production system**, and
- the **approach** to achieving the outcome.

Table 1. Federal thematic priority areas and examples of related outcomes.

Climate & Environment	Economic Growth	Resilience
•C sequestration, GHG emissions	•Productivity	•Climate adaptation
•Recycling organic waste	•Profitability, reduced costs	•Soil and plant health
•Biodiversity	•Technologies	•Animal welfare
•Clean air & water	•Value-adding, new attributes	•Public trust
•Plastic waste	•Market opportunities	•Adaptation to labour & markets

Upon completion of consultations, a meeting of a national priority setting committee was held including 29 sector leaders representing different commodities, disciplines, and organizations across Canada. The committee was presented with 27 statements which were compiled from the submissions from consultations. Each statement was presented for open discussion and modification.

Section 2 of the document provides a summary of key concepts discussed throughout the meetings. **Section 3** introduces broad sector priorities followed by more specific priorities by theme in **Section 4**.

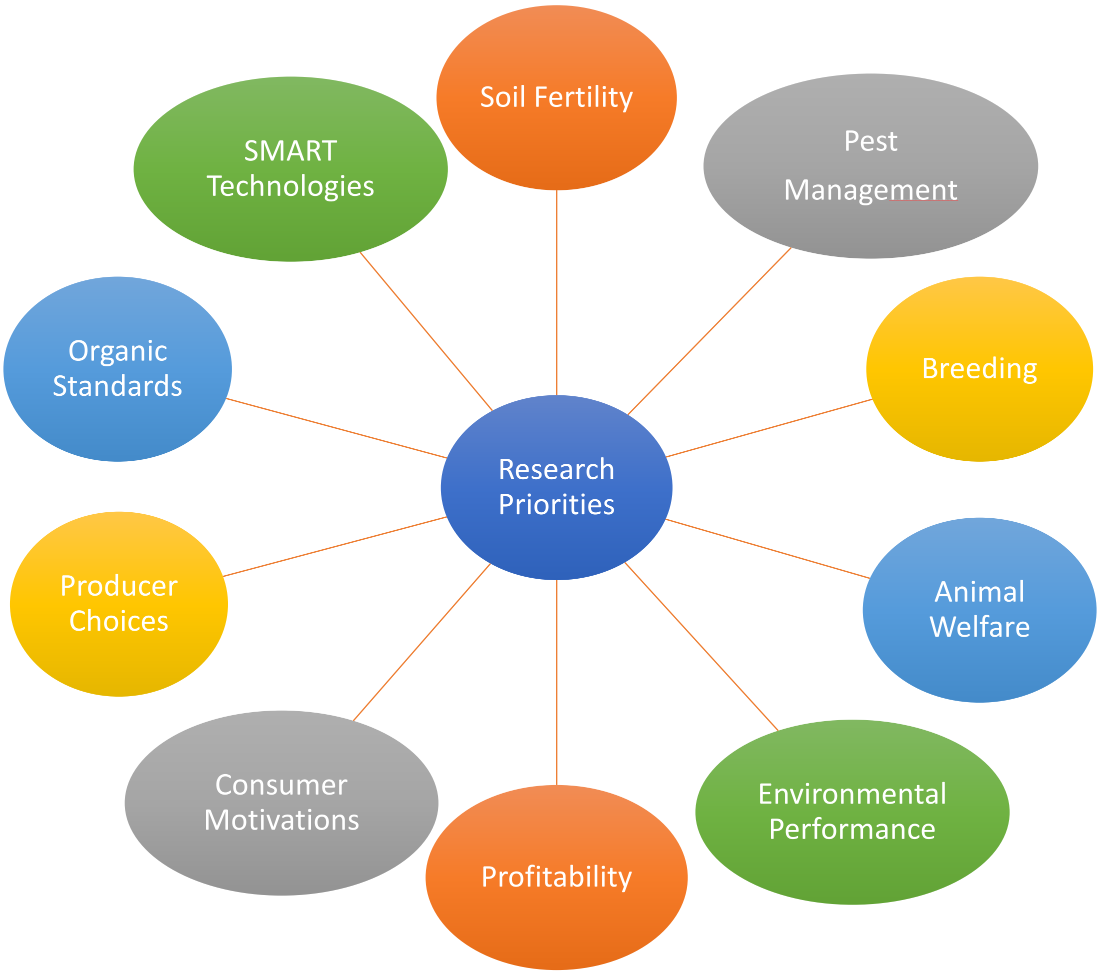

Figure 1. Organic research prioritization must consider many different issues along the value chains of many commodity areas.

2 What Was Heard

In this section, we summarize the discussions and submissions of the priority setting process. The list of individual priorities is included in Section 4.

2.1 Inclusivity

The Priority Setting Committee discussed whether specific crops, livestock, or their challenges should be targeted. Attempts to narrow the focus of research led to recognition of important omissions whether in crop or livestock systems. Ultimately, the committee recommended that the priorities should not restrict research to certain crops or livestock species, individual pests, or crop production aids. Instead, they preferred to leave space for excellent science with the potential for significant impact, taking into account the holistic and integrated nature of organic production.

2.2 Systems Approach

While many specific issues were identified for individual crops and livestock, the discussions almost always came back to needing a systems approach in research and perhaps multifunctional solutions for the whole farm. Pest and nutrient cycles are often inter-related; they should be studied and managed together. Applying integrated, multidisciplinary approaches is a continuing priority in all types of organic production. Integrating crops and livestock, as a means of providing manure for soil fertility, as well as a weed control tool, came up frequently. Strategies for increasing integration were suggested, such as intercropping greenhouse vegetables, testing novel mixtures for field crops, and incorporating biodiversity with diverse seeds and genetics, flowering strips and hedgerows.

2.3 Climate Change: Is Organic the Canary in the Coal Mine?

Through the course of these meetings a sense was beginning to develop that organic was the "canary in the coal mine" in terms of early impacts of climate change on disease and insect pressure, particularly in horticulture. For example, insect pests are coming earlier, staying longer, and cycling more quickly resulting in overall more pressure. Concerns were expressed over the ability of biological controls to keep up with pest cycles.

Climate change has already resulted in extended periods of hot weather. Some commonly used organic pest control products require 12 hours of <25°C weather to avoid crop stress. Producers are reporting that in some areas they may not use these products for 2 or 3 weeks due to continuously high temperatures; they are missing the optimum timing for application of products.

Organic systems may be more vulnerable to insect pest and disease pressures as producers have fewer control options. Organic may be an early indicator of climate change- driven trends in pest cycles and management. Organic research should target greater resilience through adoption of ecological practices.

2.4 Resilience

Yield and quality stability is becoming a higher priority than yield increase. Long-term systems approaches are needed to build resilience to stressors. Organic systems must begin with resilient genetics and healthy soil; these are the foundation for resilient agroecosystems. Diversity becomes even more important whether discussing crop/livestock resilience to climate stress, solutions to pest problems, or ensuring economic sustainability of an operation.

Drought is a major concern not only for cash crop productivity but also green manure crops. Low-yielding green manures in a given year means less nitrogen fixation and biomass production which in turn means lower soil fertility and health for subsequent crops. Farmers dedicating a growing season to building soil fertility and health have not only lost a year of cash crop production, they have also had a poor return on their investment into future crop productivity. Drought resilience of leguminous cover crops needs to be enhanced.

2.5 Environmental Performance

Organic agriculture is already recognized to have improved environmental performance over non-organic production systems, particularly in terms of higher biodiversity, lower pesticide risk, and reduced losses of nutrients in the environment. However a number of challenges remain:

- further research is needed to understand greenhouse gas emissions from organic production practices in Canada, and to support improvement in practices,
- alternatives to reduce use of copper-based fungicides are needed,
- organic nutrient management tools are needed especially in systems with higher input use,
- greenhouse systems use peat in growing mediums while producing large amounts of waste biomass that is not recycled,
- cost-effective alternatives are needed to single-use plastic for weed control and packaging, and
- research supporting whole farm strategies for reduction in net carbon emissions are needed.

Production systems research should include assessments of environmental performance.

2.6 Genetics

Genetics are a key factor influencing performance in terms of productivity, quality, and disease resistance in all of agriculture. Previous research has indicated that, at least for some crops, development of cultivars under organic management conditions can result in genetics that perform better than cultivars produced under conventional management. However, crop breeding requires a large investment of time and resources to develop new cultivars, particularly in field crops where registration is required.

Breeding programs must not only select for good productivity and quality under organic management, but must also consider resistance to pests and resilience in storage. Thus breeding programs should focus on crops of high economic importance where breeding can make significant strategic improvements for organic farming systems. A key example of strategic improvement is developing regionally adapted seed while involving farmers in the breeding and selection process. Participatory breeding techniques successfully produce superior genetic populations, are resource-efficient and improve producer skills. Cultivar evaluation programs can be helpful, but should be part of production systems research.

2.7 Production Inputs

Organic producers are expected to build sustainability within their production systems by using systems approaches that first and foremost maintain health of the soil, crops, and livestock. Health may come in the forum of high vigour, efficiency in using resources, and resilience to stressors. This is achieved through use of cultural practices such as strong genetics, diversity, rotation, and management of population density. In greenhouses, the recommended use of inputs needs to be fine tuned and new options developed to provide fertility at the right time, as well as effective pest management options for season extension and winter growing. Inputs to support organic production have become increasingly available, however, producers are dealing with a number of input challenges where scientific data is lacking:

- efficacy of pest control products,
- cost effectiveness and environmental footprint of soil amendments (ex. the use of peat in greenhouses), and
- affordability and efficacy of production aids including biological treatments.

Development of new solutions must focus on crops and pests or nutrients of high economic importance. Testing of existing inputs should be incorporated within a systems approach.

2.8 Responsible Tillage

Many organic producers and researchers have been exploring strategies for reducing tillage in organic systems to prevent soil degradation, improve soil health and reduce carbon emissions. Significant challenges are apparent in no-till organic systems, specifically the proliferation of perennial weeds and lower crop yield due to timing of nutrient availability. While tillage cannot be entirely removed from most organic cropping systems, further research is needed relating to "Responsible Tillage" described as:

Responsible tillage: The use of tillage strategically and purposefully to enhance management and productivity in cropping systems while minimizing soil degradation. Practices may include reducing the frequency, intensity, aerial extent, and depth of tillage, as well as minimizing topsoil inversion and maintaining surface residue. Responsible tillage systems will also incorporate practices to mitigate risks of soil degradation from erosion, compaction/plow pan formation, salinization, and soil organic matter loss.

2.9 Livestock and Outdoor Access

One of the unique value propositions of organic livestock production is the requirement that livestock have opportunity to express their natural behaviour through outdoor access and enhanced indoor spaces. Challenges associated with outdoor access include:

- strategies that encourage livestock to actually use outdoor spaces,
- protection from predators,
- prevention of disease introduction,
- management of parasites,
- breed suitability for outdoor systems,
- maintenance of pasture productivity, and
- greenhouse gas emissions from ruminants and manure.

More specific issues were also identified such as managing mastitis in dairy cows, and ensuring bees have a suitable overwinter food source in honey production. Climate change discussions again came forward with concerns about ensuring that animals have access to shade and the need for enhancing resilience of forage systems to drought. Overall, it was clear that systems- based solutions were needed for keeping livestock comfortable in high temperatures.

2.10 Likelihood of Success and Adoption

Organic production systems are knowledge intensive, requiring understanding of ecosystem components and how they interact in order to be sustainable. While improving understanding of the agroecosystem is important, the priority now is to ensure that research is resulting in practices or products that achieve measurable outcomes of improved environmental performance, economic growth and resilience. Results oriented research is essential, however, impact on targeted outcomes depends also on producer adoption. Research programs must consider producer perceptions and barriers to adoption, which should be addressed through well-designed knowledge transfer programs. Knowledge transfer should extend beyond the results of an individual project; it should integrate results of other research to form comprehensive production recommendations.

2.11 Summary

Organic production systems have long been challenged with balancing productivity, cost of production, and ecological performance. Organic research must work within the context of organic farming <u>systems</u>; stand alone practices, inputs and breeding programs must be developed within the context of whole production systems. Resilience to climate change and environmental performance are key priority areas that should be incorporated within all production practice research. Emerging tools and technologies should be coupled with cultural practices to achieve outcomes of improved resilience as well as environmental and economic performance.

3 Overarching Research Priorities

Overarching priorities apply widely in the sector, crossing commodity areas and value chains. Each priority consists of three elements: one or more outcomes; a priority crop, livestock, or production system; and the approach to achieving the outcome. In bold is the key concept of each priority and whether it relates to **outcome**, **area**, or **approach**. The numerical ratings for environment, economic growth and resilience identify the primary, secondary, and tertiary area of focus.

#	Overarching Organic Priority	Notes	Environment	Economic	Resilience
1	**Priority crops, pests and inputs** are those expected to have significant economic or strategic importance in more than one region of the country regardless of scale of farming systems.	Example: Wheat may be important due to its very large area of production and export market, while leafy greens may have lower acreage but are a critical part of smaller scale market garden systems providing local produce.	-	-	-
2	Increase productivity, profitability, and economic resilience of cropping systems by **optimizing soil/growing medium fertility and health.**	Soil fertility and health management must consider reducing environmental impacts and be integrated with pest and water management strategies. Approaches should optimize timing of nutrient supply to support crop requirements, maintain good soil health for crop resilience and vigour, and support nutrient dense food. Practices should take an integrated approach using combinations of crop rotation, responsible tillage, organic amendments, precision crop management, and application of appropriate smart technologies. Organic inputs should emphasize recycling of nutrients and minimize use of carbon sinks such as peat.	3	1	2
3	Increase productivity and profitability and reduce pesticide risk of **field cropping systems** by **optimizing weed management.**	Weed management should be achieved through combinations of cultural practices, responsible tillage, other physical controls that reduce use of plastic or fossil fuels, and new chemical controls supported by precision technologies. Priority should be placed on weeds of significant economic importance in more than one region of the country, including but not limited to perennial weeds such as couch grass/quackgrass and Canada thistle. Weed management systems should be designed with consideration for soil fertility and soil health management.	3	1	2

#	Overarching Organic Priority	Notes	Environment	Economic	Resilience
4	**Improve resilience to disease and drought stress** in priority crops with diverse, integrated and systems approaches.	Resilience should be achieved through combinations of improved genetics (conventional breeding and participatory plant breeding), cultural practices, clean seed, appropriate (virus free) root stocks, canopy and groundcover management, effective biological treatments, and alternatives that reduce use of copper fungicides.	3	2	1
5	Reduce pesticide risk and improve resilience in **horticultural crops** in both outdoor seasonal as well as protected growing systems by finding cost-effective **alternatives for managing insect pests** of economic importance in more than one region of the country.	Priority is given where a pest solution does not exist, or where single solutions are at risk of losing efficacy. Approaches may include modelling to optimize timing of input application, non-chemical control of insect pests including physical controls (ex. netting, vibration within protected structures), biological controls, botanical repellents, push-pull-immobilize systems, and re-evaluating efficacy of solutions and diversifying options.	1	-	2
6	**Enhance carbon sequestration** while **supporting above- and belowground biodiversity** through farmscape planning/design.	Approaches may include but are not limited to agroforestry, shelterbelts, habitat for pollinators/wildlife, silvopastoral systems and intentional management of alleyways and field edges.	1	3	2
7	**Reduce greenhouse gas emissions** in organic crop production using whole farm or systems approaches.	Approaches should identify improvements in practices that address one or more of the following: - optimizing use of alternatives to fossil fuel intensive N sources, - N management that reduces N_2O emissions (including precision agriculture), - finding alternatives to peat or ways of safely reducing or reusing, - CO_2 enhancement techniques in greenhouses without using fossil fuels, - reduced net C emissions in weed management (without single use plastic), and - reduce methane emissions.	1	-	-

#	Overarching Organic Priority	Notes	Environment	Economic	Resilience
8	Enhance resilience, and environmental performance of **forage systems,** especially for grazing.	Research should result in maintaining forage productivity over time with resilience to drought while reducing net greenhouse gas emissions and supporting biodiversity. Practices should relate to diversifying forage species mixtures and addressing soil fertility gaps.	2		1
9	Improve welfare and public trust in dairy, poultry, sheep and swine production systems by **optimizing outdoor spaces** and the management of those spaces for livestock safety, health, and well-being.	Research should identify management practices that extend beyond current codes of practice: - enhance utilization of outdoor areas with the unique needs of the species in mind (ex. shade and shelter), - address risk of disease introduction, parasites, and predation, - apply smart technologies to allow proactive management of livestock health and well-being, - reduce mortality in outdoor systems, and - address and better define livestock tolerance thresholds for 'when weather permits'.	-	-	1
10	Improve **livestock's resilience to disease** by enhancing management practices and livestock immune systems, while identifying products for controlling diseases of significant importance.	Organic livestock production is intended to improve animal health and welfare through improved living environment and feed. Research that identifies options for enhancing livestock immune systems should be prioritized.	-	2	1
11	Enhance resilience and create economic opportunities by developing **organic production systems suitable for indigenous and northern communities**.	Northern communities experience shortages of healthy, affordable food. Organic production options should be explored that are suitable for northern regions and take into consideration climatic warming trends.	-	2	1
12	Improve research impact by better **understanding farmer perceptions and response** to multiple stresses of climate change adaptation, new practices and technologies, public trust (environment, animal welfare, food quality/safety, fair price), and market pressures.	This work could be integrated within natural sciences projects to improve impact of research outcomes.	-	-	1
13	Improve public trust by **quantifying the multifunctional benefits of organic production**.	In the spirit of 'continuous improvement', identify both opportunities as well as weaknesses in the production and post-harvest handling systems including environmental, economic, producer health/wellbeing, nutritional, food safety, and product integrity issues.	-	-	1

4 Supplemental Priorities by Thematic Area

The following sections focus the research priorities into specific commodity areas. This does not preclude the overarching priorities described above.

These submissions have been condensed into priority statements which consisting of three components:

- one or more **outcomes** related to the AAFC overarching priorities,
- **a priority crop, livestock, or production system**, and
- the **approach** to achieving the outcome.

4.1 Grains, Oilseeds, and Pulse Cropping Systems

Item #	Priority	Environment	Economic Growth	Resilience
	In supplement to the priorities described in Section 4: #s 1, 2, 3, 4, 6, 7; 13, 14, 15			
G1	**Increase yield and competitiveness of priority crops** through early season optimization of crop vigour and competitiveness potentially including seed-placed amendments, biological seed treatments, cultural and physical weed management. - Priority weeds include: Canada thistle, quack/couch grass, wild oats, wild mustard, wild radish	-	1	-
G2	Improve sustainability of field crops by finding multi-pronged solutions to **low soil phosphorus**.	-	2	1
G3	Improve public trust in organic foods by developing practices and approaches throughout the value chain that **detect and reduce risk of contamination by genetically engineered crops.**	-	-	1

4.2 Fruits

Item #	Priority	Environment	Economic Growth	Resilience
	In supplement to priorities #s 1 - 7; 13 – 15 described in Section 4:			
F1	**Reduce drought susceptibility** of orchard/vineyard fruit production with consideration of **organic weed management** practices**.**	-	-	1
F2	Enhance environmental performance and resilience in orchards and vineyards through **ecological and multifunctional management of in-row spaces, alleyways, and field edges** (example cover crops, shelterbelts, insectaries, etc.).	1	-	2
F3	Reduce pesticide risk in fruit production by finding cost-effective **alternatives to controlling pests and diseases** of economic importance in more than one region of the country. Approaches may include modelling to optimize timing of input application, supporting biological controls and botanical repellents, improving combinations of virus-free root stocks and variety selection, canopy and groundcover management, and re-evaluating efficacy of solutions and diversifying options. Issues of concern include but are not limited to: - Apples - coddling moth, apple maggot, apple clear-wing moth, oblique banded leaf roller, bud moth; plum curculio, green apple aphid, scab, replant disease, fire blight, bitter rot, flyspeck sooty blotch - Grapes - leaf hopper, foliar phylloxera, ladybird beetles (harvest taint), red blotch virus, powdery and downey mildew options that reduce use of copper - Cherry – spotted wing drosophila, Western cherry fruit fly, black cherry aphid, mildew, bacterial canker, Cytospora - Blueberry - Septoria leaf spot, blueberry maggot, blueberry flea beetle	2	-	1
F4	Increasing productivity and profitability in perennial fruit systems through **optimization of integrated nutrient management** from establishment through production stages.	-	1	-

4.3 Vegetables – General and Field

Item #	Priority	Environment	Economic Growth	Resilience
VF1	**In supplement to priorities #s 1 - 7; 13 - 15 described in Section 4:**			
VF2	Reduce pesticide risk in vegetable production by finding cost-effective **control options** (including breeding for resistance) **for pests and diseases** of economic importance in more than one region of the country. Issues of concern include but are not limited to: - potatoes and tomatoes – reduction in use of copper fungicides, particularly for blight control - tomatoes - brown rugose fruit virus and root knot nematode - lettuce/greens - manage algae as a precursor to Pythium - peppers and cucumbers - lygus bugs, earwigs, cucumber virus (CGMMV) - carrots - carrot rust fly, bacterial rots in storage - Brassicas - flea beetle, swede midge, cabbage butterfly, cutworm - field vegetables - wireworm management	1	-	2
VF3	Improve crop health, market value and public trust in vegetables by identifying production, storage and handling practices (and inputs) that **maintain high nutrient density and quality, and increase resilience to losses in storage and handling**.	-	1	2
VF4	Enhance resilience in local supply of vegetables by developing affordable technologies, tools and production practices specifically **supporting small scale producers**.	-	2	1
VF5	**Reduce single-use plastic** in field vegetable systems by developing cover crop systems, organic mulches, smart technologies, or allowable biodegradable mulches or other weed management practices that would be an effective alternative.	1	-	-

4.4 Vegetables - Greenhouse

Item #	Priority	Environment	Economic Growth	Resilience
	In supplement to priorities 1, 2, 4, 5, 7; 13 – 15 described in Section 4.			
VG1	Increased resilience of soil-based crops in **season extension structures and greenhouses** through managing soil health and pest pressures. Practices may include non-chemical control of insect pests (physical as well as biological) adapted to year-round soil-based systems, or LED lighting in greenhouse structures Priority pests and crops: - lettuce & winter greens - aphids and flea beetles - soil-borne disease through organic amendments and biological treatments - additional pests of existing and emerging importance include: striped leaf beetle, squash bug, tarnished plant bug, fleahopper, Noctuid pests	-	-	1
VG1	Optimizing crop production and profitability of greenhouse vegetables by **developing crop-specific growing media plans** (for container or in-soil production) that, - meet whole crop requirements for short duration leafy crops, - allow effective supplementation according to growth requirements for long duration crops, - maintain high nutrient density, - are disease suppressive, - reduce the use of peat, - address excess soil phosphorus, N_2O emissions, leaching and soil salinity	3	1	2
VG3	**Enhance productivity and resource use efficiency in greenhouse crops** through life cycle assessment of energy and input options, exploration of intercropping or living cover crops in greenhouses, waste biomass recycling	2	1	-

4.5 Livestock

Item #	Priority	Environment	Economic Growth	Resilience
	In supplement to priorities 6 - 15 described in Section 4.			
L1	Improve welfare and productivity of dairy cows while reducing environmental impact by **optimizing their longevity, and identification of improved practices for managing mastitis, lameness and parasites.** Lameness and illness in dairy herds can result in lost productivity and higher replacement cost of cattle. Aside from important animal welfare concerns, enhancing health and longevity can also reduce environmental impact.	2	3	1
L2	**Reduce net greenhouse gas emissions from livestock systems** using a whole farm approach. Practices may include reductions of GHG from forage production or the livestock themselves and mitigation of emissions by improving C sequestration.	1	-	-
L3	Improve resource use efficiency and economics of livestock farming systems by **identifying cost-effective feedstock not suitable for human consumption.**	3	1	2

4.6 Maple and Honey

Item #	Priority	Environment	Economic Growth	Resilience
M1	Maintain public trust and profitability in **maple production** by identifying practices that optimize product quality, utilize waste by-products, and enhance environmental performance.	-	1	2
H1	Enhance hive resilience and public trust in organic honey production through **improved practices to support overwintering of bees.** Research is needed to support organic alternatives for maintaining hive food supply and health.	-	2	1