



**Regional
Extension
Program**

Environment and Climate REGIONAL GUIDEBOOK Lower Mainland and Sea-to-Sky

Fraser Valley, Greater Vancouver, Delta, and Squamish-Pemberton



Prepared for the
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Photo: Stan Slade/Unsplash

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Introduction to the guide

Agricultural producers are grappling with the impacts of climate change and are on the front lines of developing strategies that maintain economic viability alongside environmental sustainability. Top issues, response strategies, and feasibility of practices differ across British Columbia's diverse ecoregions, highlighting the need for targeted extension and applied research projects. To meet these needs, the B.C. Ministry of Agriculture and Food's new Regional Extension Program aims to increase on-farm adoption of management practices that support producers in making their operations more climate resilient, sustainable, and economically viable.

This regional guide aims to serve as a resource for producers, on-the ground researchers, and consultants to reflect on the climate issues challenging environmental sustainability and local farm businesses and food production.

In this guide, three overarching strategies address the agricultural climate and environment priorities identified by producers across the province:



Adaptation: Prepare for and respond to a changing climate. Practices in this guide are largely adaptation focused, reflecting the immediate impacts producers are experiencing.



Mitigation: Reduce greenhouse gas emissions and increase carbon sequestration.



Environment: Protect and regenerate soil, water, and air quality. Improve biodiversity and protect sensitive habitats.

The priority issues highlighted in this guide were identified by a regional extension committee that represents the climates, soils, and commodity groups in each region, facilitated by the B.C. Ministry of Agriculture and Food. For more information, contact your Regional Agrologist or [AgriServiceBC](#). The content of this document may change with the results of engagement with producers in the region.

Each priority issue described in this guide includes:

- ▶ **An overview of the priority** and why it is important to producers in the region.
- ▶ An **inventory** of past and current applied research and extension projects relevant to the issue. Many of these projects were implemented under the BC Ministry of Agriculture & Food's Climate Change Adaptation Program (2008-2023) with support from government, industry, and research partners.
- ▶ **Beneficial management practices and work that can be built on** to address priority areas.
- ▶ Current **funding programs** associated with each priority area.
- ▶ Current **provincial tools** relevant to each priority area.

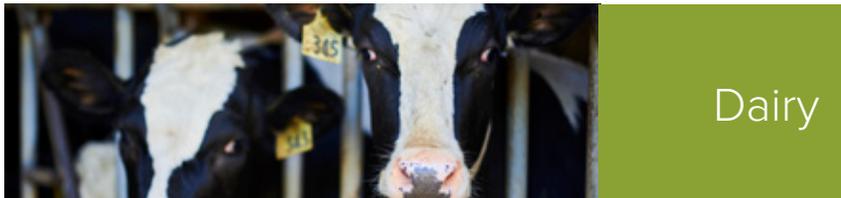
Introduction to the region

Regional boundaries

For the purpose of this program, the Lower Mainland and Sea-to-Sky agricultural region comprises the Fraser Valley, Greater Vancouver, and Squamish-Pemberton. Statistics in this document represent combined 2021 agricultural census data from the Fraser Valley Regional District, Greater Vancouver, and Squamish-Lillooet Area C.



Agricultural Sector Demographics



Dairy

Photo: Emrys Miller



Berries

Photo: Sneha Cecil/Unsplash



Field and greenhouse vegetables

Photo: Dieter Geesing



Poultry

Photo: Emrys Miller



Nursery Crops

Photo: Emrys Miller



Mushrooms

Photo: Ashleigh Shea/Unsplash



Floriculture

Photo: Thom O'Dell

TRENDS IN FARM NUMBERS, FARM TYPE, AND FARMLAND AREA

(Census of Agriculture, 2021)

- Farmland area in the Lower Mainland and Sea-to-Sky region decreased by nearly 10% and farm numbers decreased by 20% between 2011 and 2021. Loss in farm numbers was the same as the provincial decrease of 20%, and loss in farmland area was below the provincial average of 12.5%.
- By provincial hectares under production, in 2021 the Lower Mainland and Sea-to-Sky region produced 98% of the blueberries, 74% of the potatoes, 70% of the field vegetables, 90% of the greenhouse vegetables, 98% of the mushrooms, 92% of greenhouse floriculture, and 62% of nursery crop production.
- By number of animals, in 2021, the Lower Mainland and Sea-to-Sky region had 72% of dairy cows and 88% of the poultry raised in BC.
- Farm receipts across the Lower Mainland and Sea-to-Sky region increased by 70% between 2011 and 2021, which was greater than the provincial increase of 63%.
- In 2021, 28% of farms earned revenues below \$10,000 and 8% of farms earned revenues above \$2,000,000. Since 2011, the number of farms operating under \$10,000 has decreased by 47% and the number of farms operating above \$2,000,000 has increased by 108%.

Regional Climate Change Impacts

The Lower Mainland and Sea-to-Sky region covers an area of the province that has different climate zones, but all are already experiencing the impacts of climate change. Increases in the average number of days over 30°C, drier summer conditions, and more frequent extreme rainfall events have become the norm over the past several years.

The changes being observed in this region are consistent with the 2015 Pacific Climate Impacts Consortium (PCIC) 2050 projections. More recent climate models continue to show the same trends. Because the majority of agricultural production occurs in the Fraser Valley and Greater Vancouver regions, agricultural climate projections and data were modelled here.

PCIC Climate Projections: Fraser Valley/Greater Vancouver, 2050

TEMPERATURE 

2.2°C – 4.3°C
increase
in annual
average temperatures

43 – 72
more
frost free days
annually

PRECIPITATION 

12%
decrease
in average
summer precipitation
(-38% to -1%)

50%
decrease
in precipitation
falling as snow
(-55% to -43%)

EXTREMES 

Increase in frequency
and magnitude
of extreme rainfall events

Average of
26 days
over 30°C annually,
up from 7 (Abbotsford)

Average of
29 days
over 30°C annually,
up from 8 (Chilliwack)

Projections provided by the [Pacific Climate Impacts Consortium](#) in 2015. 2050 averages are compared to the baseline historical period of 1961-1990.

Photo: Shutterstock





Water Management

Photo: Emrys Miller



Adaptation

Changing climatic, regulatory, and farm management conditions are impacting water availability, water quality, and storage capacity needs in the Lower Mainland and Sea-to-Sky region. Water needs for crops and livestock are increasing as the region experiences lower than normal precipitation in the summer months. Sustainable water management is a priority for producers to maintain productivity *and* allow water sources to recharge for future use. Drought conditions have reached levels 3-5 (mid to maximum in [Provincial Drought Level](#)) across the region in four of the last five years during summer and/or fall periods.

The 2021 agricultural census indicated that 38% of cropped land in the Lower Mainland and Sea-to-Sky region is irrigated. As summer precipitation becomes less frequent and temperatures increase, irrigation demand is projected to increase across the region. Irrigated operations will require more water and unirrigated operations may need to install irrigation systems or face productivity declines.

Concerns around agricultural water have emerged with processing delays and communication challenges that have occurred with the rollout of the new groundwater licensing requirement in the [2016 Water Sustainability Act](#). New groundwater sources in the Fraser Valley have been identified to increase supply, but licencing timelines may pose challenges.

1.1 Why is water management a priority?

- ▶ **DECREASED WATER SUPPLY from changing temperature, precipitation, and salinity:** Coastal agricultural areas that rely on irrigation water from the lower Fraser River may experience reduced water supply due to increased water salinity. Reduced river flow rates cause ocean water to move upriver during certain annual periods, which are expected to increase with climate change. Water with salinity levels that exceed crop thresholds is unusable for irrigation because it causes irreversible crop damage. Agricultural demand on surface water from small watersheds in the Fraser Valley may also exceed supply as warmer temperatures cause earlier peak stream flows and less summer rainfall reduces supply.
- ▶ **IRRIGATION EFFICIENCY increases water conservation through targeted application that ensures optimal amount and timing, reducing overapplication, evaporation, cost and greenhouse gas emissions:** Increasing irrigation efficiency can require improved irrigation infrastructure such as subsurface drip irrigation or targeted sprinkler systems.

- ▶ **MORE INTENSE RAINFALL causing flooding, runoff, and erosion:** This can result in high economic and ecological costs for producers. Agricultural operations in the Fraser Valley experienced the brunt of the 2021 atmospheric river, and sustained extensive damage to crops, livestock, and infrastructure.
- ▶ **DRAINAGE in coastal and floodplain agricultural areas is limited by high water tables and high seasonal precipitation:** Producers in the Fraser Valley and Delta implement a range of drainage systems that make agriculture possible, but more intense rainfall is creating new drainage challenges.
- ▶ **INSUFFICIENT FEED for livestock due to drought forage crop yields:** in dryland operations, reduced precipitation has led to significant declines in pasture, hay and forage yields (particularly in summer 2023), forcing some operators to buy feed they would normally grow themselves at demand-surge costs. Livestock producers across the province have faced difficult decisions (e.g., reduction of herd size, feeding winter stock early, having pasture not available late in the grazing season) and have needed to rely on additional support programs.

1.2 What water management work has been done?

* Links in green are producer-oriented resources and tools

CROSS-COMMODITY			
Project	Project Resources*	Location	Year
WATER SUPPLY			
Delta farmers institute water and salinity monitoring program	Factsheet: soil moisture sensors Factsheet: soil water Full project report	Delta	2023
Fraser Valley agricultural water supply assessment and action plan	Full project report	Fraser Valley	2021
Modelling future salinity in the lower Fraser River: effects of climate change on agricultural water	Salinity monitoring program Webinar Project summary Full project report	Delta	2021
Delta’s future agricultural water supply and demand	Full project report	Delta	2020
Regional agricultural water demand models	Pemberton Valley project report Fraser Valley project report Metro Vancouver project report	Squamish-Lillooet, Fraser Valley, Metro Vancouver	2013-2020
IRRIGATION EFFICIENCY			
Managing the water systems with decision support tools for sustainable agricultural irrigation in Delta	<i>In progress, Ministry of Agriculture and Food</i>	Delta	2023

CROSS-COMMODITY			
Project	Project Resources*	Location	Year
Farm water fix: climate resilient irrigation systems and management	Video series	Provincial, Kootenay-Boundary	2021
Improving irrigation efficiency for managing during dry conditions	Factsheet series Webinar	Okanagan	2023
Irrigate better: anatomy, pipe design, emission design, scheduling, and monitoring	Webinar series	Kootenay/ Boundary	2018
Guidance on farm water storage	Factsheet	Provincial	2021
B.C. Farm water dugouts	Guide	Provincial	2016
Water management resources and knowledge transfer of water best management practices for agriculture in B.C.	Resource summary Webinar series Full project report	Bulkley-Nechako. Fraser-Fort George	2021
MORE INTENSE RAINFALL			
Farm flood readiness toolkit	Toolkit Factsheet: Landscape-level mitigation Factsheet: Delta Factsheet: Fraser Valley	Fraser Valley, Delta	2021
Riparian management field workbook for streams and small rivers	Field workbook	Provincial	2019
Livestock sector emergency preparedness for flooding	Factsheet	Provincial	2019
Horticulture sector emergency preparedness for flooding	Factsheet	Provincial	2019
Freshet flooding in the Fraser Valley	Project summary Full project report Study area maps	Fraser Valley	2017
Assessing flood risk in the Fraser Delta	Full project report	Fraser Valley	2016
Stormwater management planning for agricultural facilities	Factsheet	Provincial	2016
Supporting riparian health on farmland for flood protection	Full project report	Kootenay-Boundary	2023
DRAINAGE			
Agricultural drainage and ditch management in the Fraser Valley	Project report: drainage and ditches Project report: runoff and drainage	Fraser Valley	2018

CROSS-COMMODITY			
Project	Project Resources*	Location	Year
Evaluating on-farm drainage management practices in Delta	Research summaries Full project report	Delta	2018
Agricultural waterways: drainage maintenance and stewardship	Guide	Provincial	2018
Knowledge and practices about on-farm drainage management in Delta	Project summary Full project report	Delta	2015-2016

DAIRY & GRAZING LIVESTOCK			
Project	Project Resources*	Location	Year
INSUFFICIENT FEED			
Strategies for rejuvenating forage and pasture lands impacted by drought	Resource guide	Provincial	2023
Maximizing forage yield with an integrated cropping system	Research summary Full project report	Fraser Valley	2021
Forage and water resiliency overview: managing water and forage resources in a changing climate	<i>In progress, B.C. Cattlemen's Association, Ministry of Agriculture and Food, Ministry of Forests</i> Factsheet <i>Forthcoming tool: Landscape and range resiliency planning tool</i>	Provincial	2022-2023
Drought resources for livestock producers	Resource guide	Provincial	2023
IRRIGATION EFFICIENCY			
Maximizing forage yield by optimizing irrigation	Full project report	Fraser Valley	2018
MORE INTENSE RAINFALL			
Livestock sector emergency preparedness for flooding	Factsheet	Provincial	2019

BERRIES & VEGETABLES			
Project	Project Resources*	Location	Year
IRRIGATION EFFICIENCY			
Drought resources for B.C. berry producers	Resource guide	Provincial	2023
Optimizing water and fertilization management practices with B.C. potato varieties in a changing climate	<i>In progress Ministry of Agriculture and Food</i>	Lower Mainland	2023

BERRIES & VEGETABLES			
Project	Project Resources*	Location	Year
Using mulches to reduce water use	Grab and go template for on-farm research	Provincial, Kootenay-Boundary	2021
WATER SUPPLY			
Delta greenhouse water supply: risks and options	Technical briefing Full project report	Delta	2023
MORE INTENSE RAINFALL			
Too much water or too little: climate resilient vegetable farming	Research summary Factsheet: Soil water dynamics Factsheet: Soil N dynamics Project Webpage	Southern Vancouver Island	2023

1.3 What’s next: Looking ahead

Sustainable agricultural water management is shaped by regulatory requirements, regional conditions, and farm level practices. Field-level water conservation is a primary adaptation strategy for producers as they respond to reduced water supply associated with climate impacts.

Excess precipitation events can be unpredictable in timing and severity, but producers can take steps to implement management strategies that mitigate risk to crops, soil, and infrastructure. Flood planning resources as well as containment and diversion infrastructure can support farm resilience during flood and storm events.

On-Farm Management Practices

In the Lower Mainland and Sea-to-Sky region, drought management includes both water and soil-based strategies:

Field-level water conservation is concerned with balancing increased water demands for crops and livestock with reduced water supply. Increasing water use efficiency is primarily achieved through targeted irrigation or watering systems that reduce overapplication, evaporation, and greenhouse gas emissions. Practices to increase water conservation include:

- ▶ Water-efficient irrigation systems
- ▶ Irrigation scheduling
- ▶ Water quality protection measures
- ▶ Soil moisture meters and other technologies
- ▶ Rainwater collection and storage

Drainage and containment systems are critical for channeling water away from crops and livestock and preventing waterlogging. Drainage systems can be natural (e.g. watercourses) or engineered (e.g. dikes, ditches, subsurface systems). Observation of farm level and watershed level topography

**Funding Programs:
WATER MANAGEMENT**

- ▶ [Environmental Farm Plan Program](#) (EFP)
- ▶ [EFP Beneficial Management Practices Program](#) – *water infrastructure projects*
- ▶ [Agricultural Water Infrastructure Program](#)
- ▶ [Extreme Weather Preparedness for Agriculture](#) - *flooding preparedness stream*
- ▶ [AgriStability](#) – agriculture income protection



**Provincial
Toolbox:
WATER
MANAGEMENT**

Irrigation

- [BC Agriculture Water Calculator](#)
- [BC Irrigation Water Use Calculator](#)
- [Agricultural Irrigation Scheduling Tool](#)
- [B.C. Irrigation Management Guide](#)
- [B.C. Irrigation Assessment Guide](#)
- [Delta Farmer’s Institute Salinity Monitoring System](#)

Drought

- [B.C. Drought Information Portal](#)

Drainage

- [B.C. Agricultural Drainage Manual](#)

Flooding

- [B.C. Flood Study Explorer](#)
- [B.C. River Forecast Center](#)
- [AgSafe Emergency Planning Resources - Flooding](#)

can indicate areas susceptible to waterlogging and/or flooding. Specific practices for drainage include:

- ▶ Dikes
- ▶ Surface drainage (ditches, culverts, waterways)
- ▶ Subsurface drainage (subsurface pipes, tile drains, French drains etc.)
- ▶ Riparian fencing
- ▶ Riparian restoration
- ▶ Bank stabilization and restoration
- ▶ Implementation and restoration of wetlands

Farm emergency preparedness is particularly important for producers with operations in flood risk zones.

As shoulder season precipitation increases and the frequency and severity of unexpected events increase, specific planning may include:

- ▶ Emergency flood planning
- ▶ Livestock evacuation planning
- ▶ Monitoring and weather forecasting

Building on Recent Projects

Drought response:

- ▶ Evaluate and implement strategic water resource assessment actions
- ▶ Identify water management knowledge transfer priorities
- ▶ Demonstration of field-based water management strategies
- ▶ Applied research and knowledge transfer for field-based water management

More intense rainfall:

- ▶ Update dike infrastructure in vulnerable areas
- ▶ Incorporate projections for precipitation changes and extremes into guidance and technical resources for drainage management
- ▶ Expand/enhance supports for farm flood preparedness
- ▶ Undertake a sector flood risk assessment process for B.C. agriculture
- ▶ Pilot (Ministry-led) coordination of extreme events communication for agriculture

Drainage:

- ▶ Pilot coordinated sub-regional agriculture drainage management planning
- ▶ Conduct trials, demonstration and applied research for field and land management practices to address runoff and drainage concerns
- ▶ Increase access to qualified individuals to assist producers with drainage management

Salinity:

- ▶ Support continuation and expansion of salinity monitoring and analysis for infrastructure and irrigation management
- ▶ Undertake applied research, demonstration and knowledge transfer related to irrigation, salinity and soils management

Photo: Emrys Miller





Photo: Lesley Edwards

2 Extreme Heat Management



Adaptation

Extreme heat events have occurred with increasing frequency in recent years, with temperatures in the Lower Mainland and Sea-to-Sky region significantly exceeding seasonal average highs. Because summer heat waves, such as those in 2021-2023, are not historical norms in the region, production systems, workers, and infrastructure may be less equipped to deal with heat related risks. Damage to crops, stress on livestock health, and stress on farmworker health are cited challenges.

Producers are identifying the need for support for cooling infrastructure such as shade, hydration stations, misting systems, augmented refrigeration, and increased ventilation. Additionally, producers have indicated the need for support for electricity consumption related to cooling across livestock barns, greenhouse production systems, and post-harvest storage infrastructure.

Because the impacts of extreme heat on farmworkers and infrastructure have only become apparent in the last three years, there is limited local research and agricultural extension projects addressing this priority area.

2.1 Why is extreme heat management a priority?

- ▶ **CROP PROTECTION measures are becoming crucial to avoid severe impacts of extreme heat:** In the 2021 heat dome, berry, fruit, nursery, floriculture and vegetable crops experienced major losses due to scorching. Earlier extreme heat events also put seedlings and transplants at risk, forcing farmers to alter planting times and irrigation scheduling. Long term impacts of extreme heat exposure on perennial crops are emerging and include increased susceptibility to pests and diseases or reduced productivity.
- ▶ **LIVESTOCK HEALTH during and after extreme heat events can be severely compromised:** In the 2021 heat dome, more than 650,000 farm animals perished. Lack of shade in outdoor areas or lack of ventilation and/or cooling in indoor systems creates immediate and longer-term health risks.
- ▶ **HEALTH AND SAFETY of farmworkers can be compromised in extreme heat events:** Exposure to extreme heat can create serious health concerns such as dehydration, heat stress, and heatstroke, while significantly lowering productivity and judgment for consequences of error. WorkSafe claims related to heat stress have increased in the province in recent years.

2.2 What extreme heat management has been done?

** Links in green are producer-oriented resources and tools*

CROSS-COMMODITY			
Project	Project Resources*	Location	Year
CROP PROTECTION			
Reflective tarps to maintain blueberry quality	Factsheet: fruit quality Factsheet: how to use Full project report	Fraser Valley	2023
Tools for climate resilience in tree fruit: foliar spray to protect fruit quality during heat events	Journal article	Okanagan	2023
Using vented orchard covers for protecting fruit	Project presentation Factsheet	Okanagan	2017
LIVESTOCK HEALTH			
Managing extreme heat on dairy farms	Full project report	Fraser Valley	2023
Animal health emergency management	Producer workbook	Provincial	2021
State of practices and technologies assessment for managing extreme heat impacts (berries, poultry, dairy)	Full project report	Fraser Valley	2019
HEALTH AND SAFETY			
Heat, the workplace, and your health	Guide: Heat, the workplace, and your health Guide: Working outside during heat events	Provincial	2023



Photo: Emrys Miller

**Funding Programs:
EXTREME HEAT
MANAGEMENT**

- ▶ [Extreme Weather Preparedness for Agriculture](#)
- *extreme heat preparedness stream*

2.3 What's next: looking ahead

As extreme heat events become increasingly challenging for agricultural producers in the Lower Mainland and Sea-to-Sky region, proactive management and supportive projects and programs will be vital to resilient production. Altering working conditions, increasing cooling infrastructure, and trialing new crop protection measures are suggested strategies.

On-Farm Management Practices

Crop health protection can involve field and cultural practices.

- ▶ Adjusted planting and harvest schedules
- ▶ Irrigation management (e.g., overhead for specific crops during extreme heat events)
- ▶ Heat resistant/tolerant varieties
- ▶ Shade cloth/UV barriers/white-wash and tree wrapping

Livestock health is concerned with provision of adequate shade and water, which are critical for temperature regulation.

- ▶ Climate resilient watering systems (adequate supply during drought)
- ▶ Shade provision (trees/structures)
- ▶ Barn cooling systems (misting, fans, ventilation, monitoring systems/sensor improvements)
- ▶ Farm building design

Farmworker health is concerned with providing employees resources to cope with extreme heat and confidence that their health be prioritized during extreme heat events.

- ▶ Heat stress training and nutrition
- ▶ Farm housing
- ▶ Altered work hours (e.g. earlier starts or shorter days during extreme heat events)
- ▶ Emergency heat planning
- ▶ Access to potable water
- ▶ Personal protection (clothing, sun protection)

Building on Recent Projects

- ▶ Coordinate applied research and demonstration and develop cost-benefit information for heat abatement practices and technologies

3 Soil Management

Photo: Shutterstock



Adaptation

As climate variability and extreme events increase, appropriate soil management practices are critical for agricultural resilience. Soil properties that generally improve the capability of soils to sustain crop production include porosity for air circulation and water infiltration and retention. Site-adequate organic matter is also essential to support soil biological and chemical processes that convert nutrients into plant available forms. Maintaining soil cover and reducing disturbance can often help to maintain and enhance soil properties on-farm. It can also support soil processes that improve crop productivity and enhance overall farm resilience.



Mitigation



Environment

The implementation and success of best soil management strategies is site-specific and differs across the agricultural sectors that operate in the Lower Mainland and Sea-to-Sky region.

3.1 Why is soil management a priority?

- ▶ **SOIL DEGRADATION reduces resilience to climate change impacts:** Degraded soil structure from compaction by equipment or livestock, or intensive tillage practices, reduce the soil's air porosity, which is needed for good water infiltration, water retention, microbial activity and root growth.
- ▶ **NUTRIENT CYCLING processes that support natural soil fertility can be optimized in well-managed soils:** The soil organisms that cycle nutrients and make them available for plants rely on organic matter and suitable pH. Supportive practices include adequate organic amendments, cover cropping, maintaining soil cover, and reducing soil degradation.
- ▶ **CARBON SEQUESTRATION potential of some soils can be enhanced using certain soil management practices:** Soils that have vegetation cover and carbon-based inputs like compost or manure have generally higher organic matter content and can play a role in mitigating climate change by reducing carbon dioxide in the atmosphere. Practices such as intensive tillage, or those that result in bare soil, can reduce carbon sequestration.

3.2 What soil management work has been done?

* Links in green are producer-oriented resources and tools

CROSS-COMMODITY			
Project	Project Resources*	Location	Year
NUTRIENT CYCLING			
Provincial Cover Crop Factsheets (23 cover crop species)	<i>In progress, Ministry of Agriculture and Food</i> <i>Forthcoming tool: digital cover crop selection tool</i>	Provincial	2023
B.C. Climate-Agri Solutions cover cropping projects	Cover cropping extension resources	Provincial	2023
Quantification & mitigation of GHG emissions from high value B.C. production systems	Project description Webinar: vegetables Webinar: berries	Fraser Valley	2017-2022
CARBON SEQUESTRATION			
Improving on-farm woody habitat management in the Lower Fraser Valley	Full project report	Delta	2014
SOIL DEGRADATION			
Improving soil health through enhanced water infiltration	Grab and Go Template for On-Farm Research	Kootenay/Boundary	2021
DAIRY & GRAZING LIVESTOCK			
Project	Project Resources*	Location	Year
NUTRIENT CYCLING			
B.C. Living Lab: Dairy – producer-led testing, refinement, monitoring and adoption of cover and relay cropping	<i>In progress</i> Project overview	Lower Mainland	2023-2027
SOIL DEGRADATION			
B.C. Living Lab: Cattle & Forage – producer-led testing, refinement, monitoring and adoption of soil health practices	<i>In progress</i> Project overview	Kootenay/Boundary	2021
B.C. Climate Agri-Solutions rotational grazing projects	Extension resources	Squamish-Lillooet, Vancouver Island	2023
Demonstrating no-till pasture rejuvenation practices in central and northern interior of B.C.	Research summary Full project report	Cariboo-Chilcotin, Fraser-Fort George	2023

DAIRY & GRAZING LIVESTOCK			
Project	Project Resources*	Location	Year
Farmer-led research for innovative corn production practices	Podcast episode Factsheet: interseeding Factsheet: strip tillage Factsheet: variable rate Research summary Full project report	North Okanagan	2023
Exploring pasture renovation techniques	<i>In progress, Ministry of Agriculture and Food</i>	Cariboo, Central South Interior	2023
Impact of management intensive grazing on soil health	Research summary Full project report	Cariboo, Thompson	2018

BERRIES & VEGETABLES			
Project	Project Resources*	Location	Year
NUTRIENT CYCLING			
B.C. Living Lab: Perennial row crops – producer-led testing, refinement, monitoring and adoption inter-row cover cropping	<i>In progress</i> Project overview	Lower Mainland, Okanagan	2023-2027
B.C. Living Lab: Field vegetables – producer-led testing, refinement, monitoring and adoption winter cover cropping	<i>In progress</i> Project overview	Delta	2023-2027
Balancing nitrogen and phosphorus on organic vegetable farms	Podcast: Nutrient loss Podcast: N and P balance Online workshop Field trial results summary	Pemberton, Fraser Valley, Vancouver Island	2021
SOIL DEGRADATION			
Effects of grassland set-asides on soil properties in Delta	Factsheet Journal article	Delta	2019

3.3 What’s next: Looking ahead

Producers are increasingly employing on-farm management practices that aim to improve soil properties and processes that support productivity and resilience. These practices can contribute to climate change adaptation, reduction of net greenhouse gas emissions, and environmental management. In the Lower Mainland and Sea-to-Sky region, soil management practices generally fall into two strategies.

Funding Programs: SOIL MANAGEMENT

- ▶ [Environmental Farm Plan Program](#) (EFP)
- ▶ [EFP Beneficial Management Practices Program](#)
- ▶ [BC Climate Agri-Solutions – cover cropping and rotational grazing streams \(Agriculture and Agri-Food Canada 2022/2023\)*](#)
- ▶ [On-Farm Climate Action Fund – rotational grazing](#) (B.C. Forage Council 2022/2023)*
- ▶ [Delta Farmland & Wildlife Trust](#)

*The rotational grazing stream of the On-Farm Climate Action Fund was delivered through both B.C. Climate Agri-Solutions and B.C. Forage Council in 2022-2023.

Provincial Toolbox: SOIL MANAGEMENT



[B.C. Soil Information Finder Tool](#)

[Nutrient Management Calculator](#)

[Manure Nutrient Calculator](#)

[B.C. Vegetable production guide – soil management](#)

[B.C. Berry production guide – soil management](#)

On-Farm Management Practices

Conservation and management of soil organic matter is critical to climate adaptation and mitigation. Practices such as retention of vegetation and reduced tillage can conserve soil structure and organic matter, but success of implementation is site-specific. Practices include:

- ▶ Cover cropping (and plowing in cover crops)
- ▶ Inter-seeding
- ▶ No-till seeding
- ▶ Reduced tillage
- ▶ Integration of woody perennials (e.g. shelterbelts)
- ▶ Conservation tillage (e.g. tillage retaining crop residues)
- ▶ Nutrient management

Intensive and well-managed grazing strategies are designed to manage livestock in ways that protect or even improve soil properties that enhance forage and pasture production. On-farm management practices aim to reduce animal impact on soils by managing impact over time and space, which allows pastures to rest long enough for grass and forages to regenerate. As livestock graze, plants redirect energy from above-ground growth to below-ground storage in their roots. Rest periods then give time for the plant to use these energy reserves to grow robust roots that maximize water and carbon sequestration and grow lush grass that provides optimal nutrition. Intensive grazing practices include:

- ▶ Rotational grazing
- ▶ Bale grazing
- ▶ In-field winter feeding

Building on Recent Projects

Recommendations from the Minister’s Advisory Group on Regenerative Agriculture and Agritech:

- ▶ Identify and share best soil management practices using a producer-centric approach for implementation and knowledge sharing
- ▶ Identify practical indicators of properties that support soil relevant functions, measure, and communicate baselines values at farm, regional, and provincial levels; determine realistic improvement goals; measure the impacts of practices

B.C. Living Lab:

- ▶ Building on dairy, cattle and forage, vegetable, and perennial row crop cover cropping on-farm trial sites to increase demonstration sites and extension opportunities



Nutrient Management Practices

Photo: Shutterstock



Mitigation

Nutrient management is an essential step in maintaining soil function and optimizing crop yield and quality. Nutrient management practices involve applying the right type of nutrient sources, such as manure, fertilizer, or compost in the right amount, in the right place and at the right time for the specific crops being grown. Soil analysis and understanding crop nutrient requirements are important for informing nutrient application decisions.



Environment

A major reason for soil testing is to evaluate soil fertility, the ability of the soil to supply crops with nutrients. Effective nutrient amendment maximizes crop productivity and saves producers unnecessary costs of overapplication. Nutrient management is also crucial for environmental health, as undermanaged nutrient containment, storage, or application risks polluting surrounding water resources or producing greenhouse gas emissions. B.C.'s regulations surrounding nutrient management that are outlined in the [Code of Practice for Agricultural Environmental Management](#).

4.1 Why are nutrient management practices a priority?

- ▶ **OPTIMAL CROP PRODUCTIVITY can be achieved through effective nutrient management:** Crop yields and crop quality depend on optimal nutrient availability and uptake. Producers need soil test results and knowledge of crop nutrient requirements to make informed management decisions. Crops have different fertility needs and require commodity specific nutrient management to optimize productivity.
- ▶ **COST EFFICIENCY is achieved when producers don't bear the costs of unnecessary nutrient supply:** Input costs can be reduced as nutrient use efficiency is optimized.
- ▶ **NUTRIENT LOSS poses an environmental risk to water resources:** Excess nitrogen and phosphorus that are not used by crops can get into surrounding waterways or aquifers. Nutrients and pathogens from manure can pose health risks to humans and animals when they are consumed in drinking water. Nutrients (most commonly phosphorus) can cause algae blooms that damage aquatic ecosystems. The density of agricultural operations in the Fraser Valley makes nutrient loss a concern.
- ▶ **NITROGEN EMISSIONS pose climate and health risks:** Ammonia emissions can reduce air quality and negatively impact human health, and nitrous oxide is a potent greenhouse gas that contributes to climate change.

4.2 What nutrient management work has been done?

* Links in green are producer-oriented resources and tools

CROSS-COMMODITY			
Project	Project Resources*	Location	Year
OPTIMAL CROP PRODUCTIVITY			
Soil sampling guidelines for British Columbia	Guide	Provincial	2023
NUTRIENT LOSS			
Phosphorus Index	<i>In progress, Ministry of Agriculture and Food</i>	Fraser Valley, Okanagan, Vancouver Island	2023-2024
B.C. Manure and crop nutrients study	Project report	Lower Mainland	2015
Water quality evaluation of agricultural runoff in Lower Fraser Valley	Factsheet	Fraser Valley	2016

DAIRY & GRAZING LIVESTOCK			
Project	Project Resources*	Location	Year
OPTIMAL CROP PRODUCTIVITY			
Modulating nitrogen responses in forage grasses for improved N use efficiency, yield, and grazing tolerance	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2022-2024
B.C. Living Lab: Cattle & Forage - producer-led testing, monitoring and adoption of refined nutrient budgeting	<i>In progress</i> Project overview	Thompson-Nicola, Cariboo	2023-2027
NUTRIENT LOSS			
Phosphorus recommendations in silage corn systems; agri-environmental indicator for risk of P transfer to water sources	<i>In progress, Agriculture and Agri-Food Canada</i>	Okanagan, Fraser Valley	2023
NITROGEN EMISSIONS			
B.C. Living Lab: Dairy - producer-led testing, monitoring and adoption of refined nutrient budgeting and lower emission manure spreading	<i>In progress</i> Project overview	Lower Mainland	2023-2027

BERRIES & VEGETABLES			
Project	Project Resources*	Location	Year
OPTIMAL CROP PRODUCTIVITY			
B.C. Living Lab: Perennial row crops - producer-led testing, refinement, monitoring and adoption of improved fertilizer management	<i>In progress</i> Project overview	Lower Mainland, Okanagan	2023-2027
B.C. Living Lab: Field vegetables - producer-led testing, monitoring and adoption of 4R nutrient management	<i>In progress</i> Project overview	Delta	2023-2027
Enhanced establishment, yield, and quality of blueberry crops through alternative nutrient inputs	Project description	Fraser Valley	2018-2023
Optimizing water and fertilization management practices with B.C. potato varieties in a changing climate	<i>In progress, Ministry of Agriculture and Food</i>	Lower Mainland	2023
Effects of grassland set-asides on soil nutrient availability and crop yields	Factsheet Journal article	Delta	2020
Delta fertilizer trials: reduced phosphorus in potatoes	Research summary	Delta	2017
NUTRIENT LOSS			
B.C. Climate Agri-Solutions nitrogen management projects	Nitrogen management extension resources	Provincial	2023
Too much water or too little: climate resilient vegetable farming	Research summary Factsheet: Soil N dynamics Project Webpage	Kootenay-Boundary, Fraser Valley, Vancouver Island	2023
Balancing nitrogen and phosphorus on organic vegetable farms	Podcast: Nutrient loss Podcast: N and P balance Online workshop Field trial results summary	Pemberton, Fraser Valley, Vancouver Island	2021
Fraser Valley soil nutrient study – berries	Project report: blueberries Project report: raspberries	Fraser Valley	2015

**Funding Programs:
NUTRIENT MANAGEMENT**

- ▶ [Environmental Farm Plan Program \(EFP\)](#)
- ▶ [EFP Beneficial Management Practices Program](#) - *nutrient and waste management projects*
- ▶ [B.C. Climate Agri-Solutions \(AAFC 2022/2023\)](#) - *nitrogen management stream*

**Provincial
Toolbox:
NUTRIENT
MANAGEMENT**



[Nutrient Management Calculator](#)

[Nutrient Management Plan Training](#)

[Application Risk Management Tool](#)

[Manure Nutrient Calculator](#)

[Soil Test Phosphorus Converter](#)

[Post-Harvest Nitrate Test Calculator](#)

4.3 What's next: Looking ahead

Nutrient management is a key component of agricultural management for producers, as optimal nutrient efficiency can help ensure crop quality and yield, cost efficiency, and environmental protection. On-farm management practices for nutrient management can be considered within three main strategies.

On-Farm Management Practices

Nutrient application and sourcing focus on how, when, and which nutrients are applied to support optimal efficiency. Efficient use of nitrogen on farms can result in reduced greenhouse gas emissions. On-farm management practices include:

- ▶ Soil testing and analysis
- ▶ 4R nutrient management: right time, right place, right rate, right source
- ▶ Precision application (e.g. low trajectory manure spreading/injecting)
- ▶ Variable rate application

Soil and crop management is concerned with improving soil function and managing crops to enhance nutrient cycling. On-farm management practices can overlap with other priority areas and include:

- ▶ Crop rotation
- ▶ Cover cropping
- ▶ Reduced tillage

Reducing risks to the environment from nutrient pollution occurs by reducing nutrient losses from the field to surrounding terrestrial and aquatic areas. Environmental protection is largely supported by effective nutrient, soil, and crop management strategies. On-farm management practices include:

- ▶ Buffer zones surrounding manure storage
- ▶ Effluent management (manure and fertilizer)
- ▶ Nutrient recovery and recycling
- ▶ Riparian protection and restoration
- ▶ Appropriate rates of application based on factors above

Building on Recent Projects

- ▶ Industry-funded dairy manure solids separation technology study and pilot
- ▶ Building on the B.C. Living Labs dairy manure injection field trials to increase demonstration sites and extension opportunities

5 Pest Management

Photo: BC Ministry of Agriculture and Food



Adaptation

As climate impacts shift temperature and precipitation patterns, pest and disease presence, population cycles, and severity are changing. Warmer winters may allow some pests to survive for longer and emerge earlier, while drier summers may increase the number of reproduction cycles and/or increase susceptibility in crops and livestock.



Environment

As the timing of pest cycles becomes less predictable, some pest management practices will be less effective. If pest outbreaks become larger or more frequent, a wider range of strategies, management practices or treatments will be needed.

Adaptation to pests includes strategies aimed at reducing the impact of pests on crops while minimizing negative outcomes for biodiversity and habitat, which can provide benefits for agriculture production. This is commonly termed Integrated Pest Management (IPM). Pest insects, diseases, weeds, waterfowl, and migratory birds are primary issues for yield losses in the Lower Mainland and Sea-to-Sky region and are often addressed through a suite of integrated management strategies.

Natural habitats and biodiversity can support pest and disease management through services like pollination and predation on pests. Agricultural systems that steward ecosystem services, habitat connectivity, native refugia, and riparian area health alongside production may better balance pest management with biodiversity conservation.

5.1 Why is adaptation to changing pests a priority?

- ▶ **PEST DAMAGE leading to yield losses is increasingly challenging to manage due to shifting climate patterns:** Pests that may not have been a problem previously may have increasing population numbers due to warming temperatures, while changing weather patterns can also mean new pests are being introduced to the region. Pests can range from insects and nematodes to birds, rodents, and larger predators.
- ▶ **DISEASE prevalence and severity are increasing with warmer temperatures:** Both crop and livestock sectors are at risk of outbreaks or new diseases as climatic conditions create favorable conditions.
- ▶ **PESTICIDE RESISTANCE makes previously useful pesticides ineffective:** Pesticide resistance can be exacerbated by climate change as rising temperatures and altered precipitation patterns can create more favorable conditions for pests, increasing the likelihood of resistance development.
- ▶ **BIODIVERSITY is supported by on-farm landscape connectivity features:** Landscape elements such as vegetation buffers can provide habitat that boosts biodiversity and improves connectivity between agricultural and wild areas.

5.2 What pest management work has been done?

* Links in green are producer-oriented resources and tools

CROSS-COMMODITY			
Project	Project Resources*	Location	Year
PEST DAMAGE			
Developing a biovigilance framework to address the threat of invasive and emerging pests under changing climatic conditions	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2021-2024
Sustainable pest management using winter cover crops	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2018-2023
Important agricultural weeds in the Fraser Valley	Factsheet	Fraser Valley	2018
British Columbia plant health strategy for agriculture	Guide	Provincial	2021
BIODIVERSITY			
Assessing waterfowl use of agricultural lands in Delta and Richmond	Grazed cover crop report Full project report	Delta	2022-2023
The role of insect community composition in predicting pest control rates and organic matter decomposition	<i>In progress, Delta Farmland and Wildlife Trust/ UBC</i>	Fraser Valley	2023
Planning for biodiversity: a guide for B.C. farmers and ranchers	Guide	Provincial	2019
Farming with Barn owls in B.C.	Factsheet	Provincial	2015

DAIRY & LIVESTOCK			
Project	Project Resources*	Location	Year
PEST DAMAGE			
Pest management in poultry: darkling beetle	Factsheet	Fraser Valley	2021-2024
DISEASE			
Animal health emergency management	Producer workbook	Delta	2022-2023
Livestock health emergency management handbooks: B.C.	Beef cattle Dairy cattle Sheep/goats Pigs Equine Bison Poultry	Provincial	2021-2023

BERRIES			
Project	Project Resources*	Location	Year
PEST DAMAGE			
Biopesticide for sustainable pest management of Blackheaded fireworm in Canadian cranberries	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2022-2024
Assessment of herbicide layering in newly renovated and established cranberry fields	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2021-2024
Berry entomology projects	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2018- 2023
Development of diagnostics for plant parasitic nematodes	<i>In progress, Agriculture and Agri-Food Canada</i>	Provincial	2018- 2023
Ecological pest management of spotted wing drosophila	<i>In progress, UBC</i> Factsheet	Fraser Valley	2018-2023
Assessment of herbicide layering in newly renovated and established cranberry fields	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2021-2024
Evaluating mass trapping as a tool for non-chemical spotted-wing drosophila management	Research summary Full project report	Lower Mainland	2023
Winter and spring surveillance for spotted wing drosophila – progress report	Full project report	Fraser Valley	2021
Priority pest issues in the Fraser Valley: berry crops	Factsheet: Mummy berry Factsheet: Two spotted spidermite Factsheet: Weevils Factsheet: Spotted wing drosophila Factsheet: Caterpillars Factsheet: Powdery mildew in strawberries Factsheet: Blueberry scorch virus Full project report: pest inventory analysis Pest inventory Full project report: enhancing information for managing emerging pests	Lower Mainland, Squamish-Pemberton	2016-2022
Evaluating Thrips mass trapping in strawberries	Factsheet	Fraser Valley	2019
Vole ID and management in orchards and tree nurseries	Factsheet	Provincial	ND
DISEASE			
Assessing waterfowl use of agricultural lands in Delta and Richmond	Grazed cover crop report Full project report	Delta	2022-2023
The role of insect community composition in predicting pest control rates and organic matter decomposition	<i>In progress, Delta Farmland and Wildlife Trust/ UBC</i>	Fraser Valley	2023

VEGETABLES			
Project	Project Resources*	Location	Year
PEST DAMAGE			
Development of tools to monitor click beetle pest species to reduce insecticide usage on farmland	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2022-2024
Developing a biovigilance framework to address the threat of invasive and emerging pests under changing climatic conditions	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2021 - 2024
Sustainable pest management using winter cover crops	<i>In progress, Agriculture and Agri-Food Canada</i>	Fraser Valley	2018 - 2023
Potato integrated pest management newsletter	<i>In progress, Ministry of Agriculture and Food</i>	Lower Mainland	2023
Priority pest issues in the Fraser Valley: vegetable crops	Factsheet: Carrot rust fly Factsheet: Two spotted spidermite in cucumbers Factsheet: Downy mildew in onions Factsheet: Powdery mildew in cucurbits Factsheet: Caterpillars in cole crops Factsheet: Tuber flea beetle Factsheet: Thrips in potatoes Factsheet: Western corn rootworm Full project report: pest inventory Full project report: enhancing information for managing emerging pests	Provincial	2018-2022
Improving cutworm risk forecasting in the Fraser Valley	Full project report	Fraser Valley	2021
Forecasting seedcorn maggot infestations in field peas and beans	Full project report	Fraser Valley	2021
Southern B.C. potato research priorities	Full project report	Lower Mainland and Sea-to-Sky	2021
Evaluating thrips mass trapping in cabbage	Factsheet	Fraser Valley	2019
Evaluating thrips in potatoes in a changing climate	Full project report	Fraser Valley, Delta	2017
Protecting Pemberton seed potatoes	Factsheet	Squamish-Lillooet	
BIODIVERSITY			
Invertebrate community surveys of grassland set aside margins and crop fields	Full project report	Delta	2019

5.3 What's next: Looking ahead

Integrated pest management strategies and robust pest monitoring programs can support producers in managing damage to crops and livestock. Implementing habitat and biodiversity on-farm management practices is also shown to have positive outcomes for farm resilience and environmental health. Through provision of ecosystem services, biodiversity-based practices can contribute to climate adaptation, mitigation and environmental sustainability.

On-Farm Management Practices

In the Lower Mainland and Sea-to-Sky region, on-farm management practices for pest adaptation generally fit into three strategies.

Integrated pest management is a holistic approach that combines various strategies to manage pests while minimizing environmental impact.

- ▶ Scouting and monitoring pest populations
- ▶ Setting economic and environmental thresholds
- ▶ Biocontrol measures
- ▶ Crop rotation
- ▶ Crop cultivar diversity
- ▶ Targeted pesticide application

Habitat management integrates areas and landscape features that support biodiversity within or around agricultural lands. Specific habitat management practices include:

- ▶ Shelterbelts/windbreaks/hedgerows
- ▶ Riparian restoration
- ▶ Conservation set-asides
- ▶ Wildlife corridors
- ▶ Agroforestry/silvopasture

Wildlife conflict management aims to reduce negative impacts to wildlife while maintaining agricultural productivity. Specific practices include:

- ▶ Electric fencing
- ▶ Non-lethal deterrents
- ▶ Tree fruit netting
- ▶ Crop selection and timing
- ▶ Electronic monitoring systems

Building on Recent Projects

Integrated pest management:

- ▶ Enhance coordinated surveillance and integrated pest management training

Funding Programs: PEST MANAGEMENT

- ▶ [Bee B.C.](#)
- ▶ [Agriculture Wildlife Program](#)
- ▶ [Environmental Farm Plan Program \(EFP\)](#)
- ▶ [EFP Beneficial Management Practices Program - pest management and biodiversity projects](#)
- ▶ [Farmland Advantage](#)
- ▶ [Delta Farmland & Wildlife Trust](#)

Provincial Toolbox: PEST MANAGEMENT AND BIODIVERSITY



[Plant Health Laboratory](#) – provides diagnoses for plant health problems

[Habitat and Biodiversity Assessment Tool](#) – forthcoming from CFGA (2023 update)



Photo: Queenie Hewitt

Additional Resources

Climate change mitigation

- ▶ [Regenerative Agriculture and Agritech Working Group: Final Report and Recommendations](#) (B.C. Ministry of Agriculture and Food, 2022)
- ▶ [Opportunity Assessment of British Columbia's Agricultural Greenhouse Gas Reductions and Carbon Sinks](#) (Ministry of Agriculture and Food/ UBC, 2021)

Regional adaptation strategies

(B.C. Climate Change Adaptation Program)

- ▶ [Fraser Valley Adaptation Strategies \(2015\)](#)
- ▶ [Fraser Valley Adaptation Strategies – Update \(2018\)](#)
- ▶ [Delta Adaptation Strategies \(2013\)](#)
- ▶ [Delta Adaptation Strategies – Update \(2018\)](#)

Organic BC

- ▶ [Podcast series](#)
- ▶ [Organic Innovation video series](#)

Scientific publications

- ▶ [Long-term use of regenerative agricultural practices enhances mitigation and adaption to climate breakdown in river delta soils of southwestern British Columbia, Canada \(2023\)](#)
- ▶ [Irrigation water demand model for assessing effects of land use changes on agricultural crops in the Lower Fraser Valley \(2021\)](#)



Photo: Sneha Cecil/Unsplash



For more information, visit our [website](#).



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