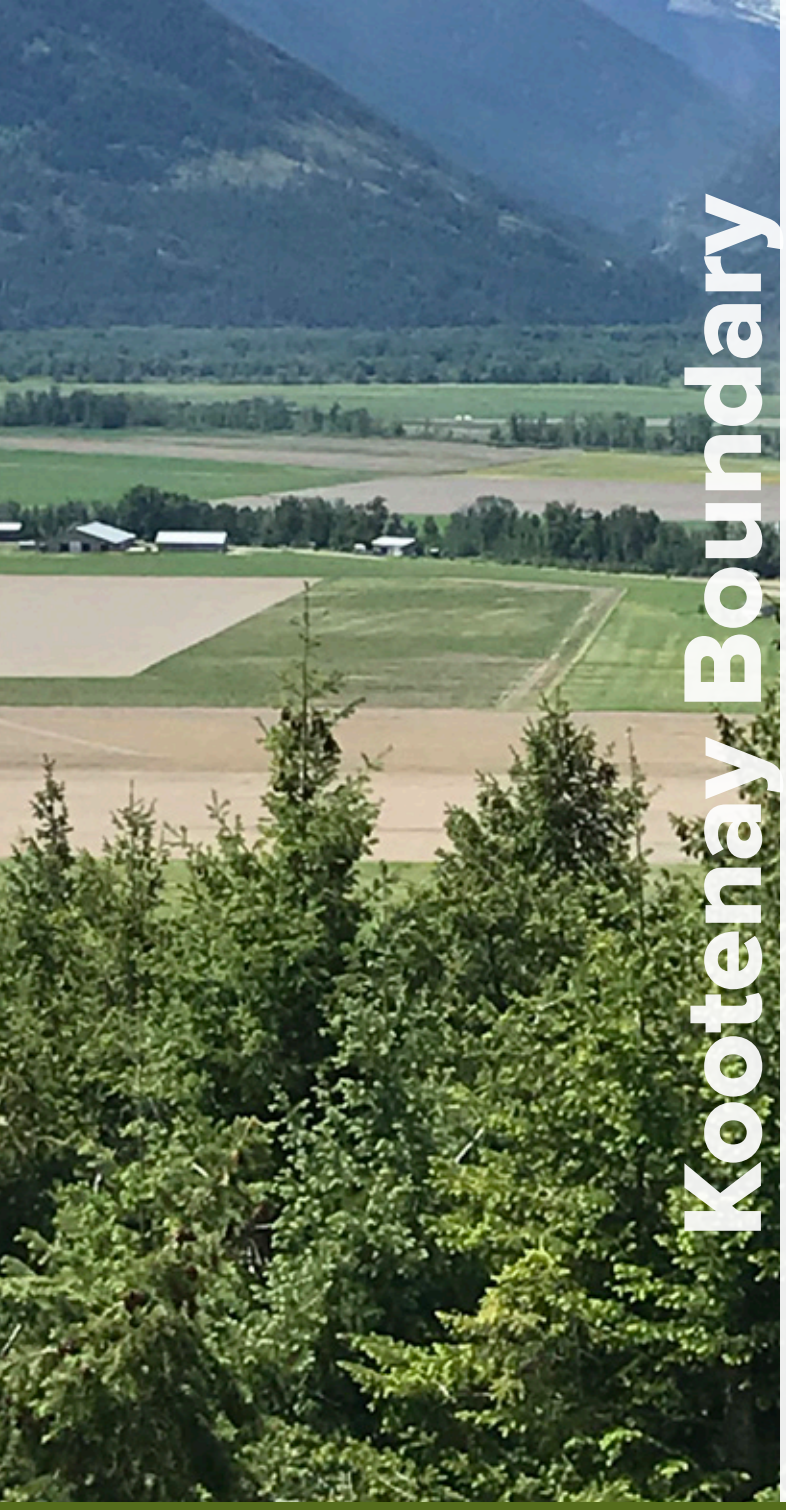
Regional Extension Program

# Environment and Climate REGIONAL GUIDEBOOK Kootenay Boundary

Kootenay Boundary, Central Kootenay, East Kootenay, Columbia-Shuswap

Prepared for the
**B.C. Ministry of Agriculture and Food**
February 2024



Kootenay Boundary

# Contents



Photo: Ministry of Agriculture and Food


## ACKNOWLEDGEMENTS

**Land Acknowledgement**

The Ministry of Agriculture and Food acknowledges the territories of First Nations around B.C. and is grateful to carry out our work on these lands.

**Contributors**

Thank you to the producers and industry representatives who participated in our Regional Extension Committee. The time and expertise committed to this work was indispensable.

**Credits**

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Sustainable Canadian Agricultural Partnership

cleanBC

British Columbia

Canada

# 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.

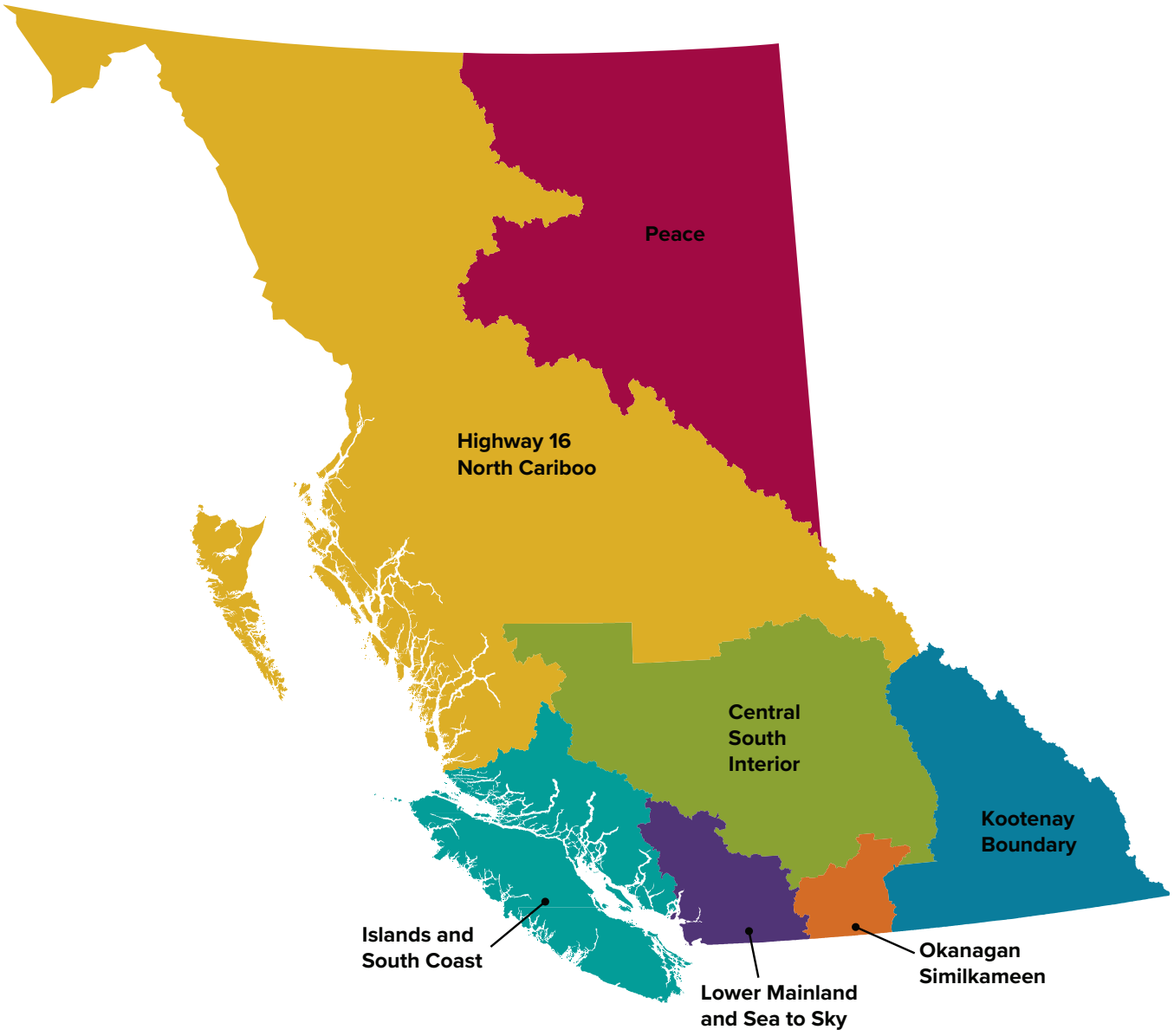
Each priority issue described in this guide includes:

- **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 and 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 the Regional Extension Program, the Kootenay Boundary agricultural extension region comprises the Kootenay Boundary, Central Kootenay, and East Kootenay regional districts, and Electoral Areas A and B in the Columbia-Shuswap Regional District. This region includes the Kootenay agricultural census district. The statistics included throughout this document reference the regions that are used to collect the associated data and may not reflect the regional boundaries for this program.



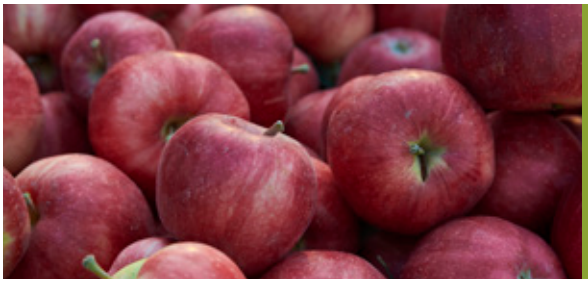
# Agricultural Sector Demographics

Hay and Forage Crops

Photo: Nicole Pressey

Beef Cattle

Photo: Ministry of Agriculture and Food



Tree Fruit

Photo: Emrys Miller

Field Vegetables

Photo: Hanaa Sheikh

Mixed Livestock

Photo: Nicole Pressey

## TRENDS IN FARM NUMBERS, FARM TYPE, AND FARMLAND AREA

*(Census of Agriculture, 2021)*

- Farm numbers decreased by 20% and farmland area decreased by 27% between 2011 and 2021.
- Hay is the dominant production type in the Kootenays as of 2021, but the number of hay farms has decreased significantly in the last decade. The region now hosts 9% of provincial farms producing hay.
- Among all regional commodities, the number of farms producing vegetables and chicken eggs have increased the most since 2011.
- Farm receipts in the Kootenays have increased by 53% in the last decade, below the provincial increase of 63%.
- The largest loss of farm numbers was for those with annual revenues under $10,000. The number of farms operating under $100,000 has also decreased since 2011. There was a small increase in the number of farms with annual revenues above $100,000.

# Regional Climate Change Impacts

The Kootenay Boundary region covers a large area of the province that has variable climatic zones, but all areas are experiencing the impacts of climate change. In general, increase in drier summer conditions, more frequent and intense wildfires, and increased rainfall in spring and fall have been observed.

The changes being observed in this region are consistent with the 2015 Pacific Climate Impacts Consortium (PCIC) 2050 projections. More recent climate models updated continue to show the same trends.

## PCIC Climate Projections: Kootenay Boundary, 2050

### TEMPERATURE

1.9°C to 4.4°C increase
in annual average temperatures

Average of
39 to 63 more
frost free days annually

### PRECIPITATION

12% increase
in average
spring precipitation

12% decrease
in average
summer precipitation

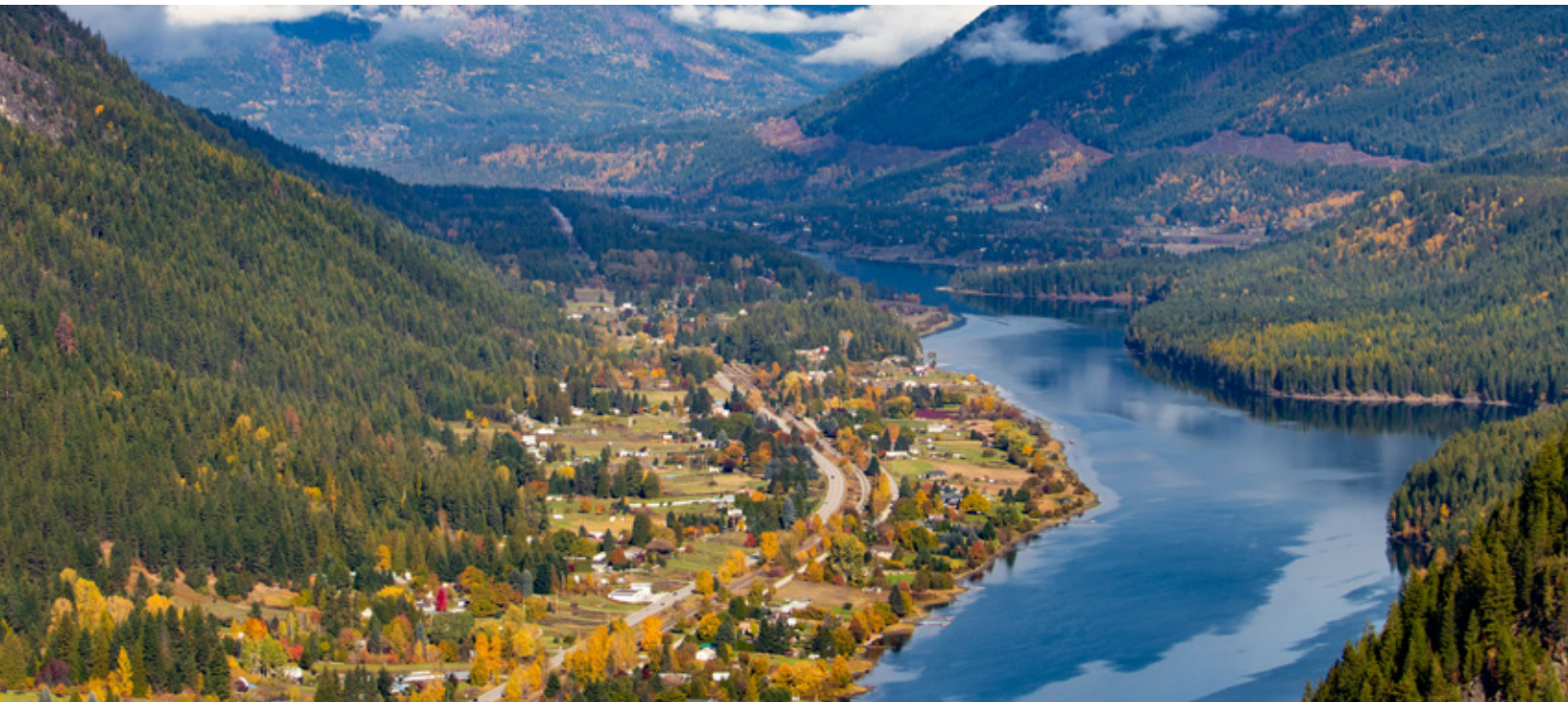
### EXTREMES

Increase in frequency and magnitude
of extreme rainfall events

Average of
17 days
over 30°C annually,
up from 4 days

*Projections provided by the Pacific Climate Impacts Consortium in 2015. 2050 averages are compared to the baseline historical period of 1961-1990.*

Photo: Shelby Bauman/Unsplash



# 1 Water Supply and Management

Photo: Lesley Edwards

Adaptation

Changing climatic, regulatory, and farm management conditions are impacting water supply and management needs in the Kootenay Boundary 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 three of the last five years during summer and/or fall periods.

The 2021 Agricultural Census found 52% of farms in the Kootenay Boundary region are irrigated. Irrigation infrastructure is increasingly necessary for several agricultural areas in the region. As summers become warmer, the region is projecting significantly increased water demand on diminishing water sources.

## 1.1 Why is water supply and management a priority?

- **DECREASED WATER SUPPLY from changing temperature and precipitation:** Overall provincial trends show decreased snowpack, warmer temperatures, and decreased summer precipitation can result in earlier peak stream flows that reduce surface water supply. Several watersheds in the Kootenay Boundary are experiencing low supply; agricultural areas of the region that rely on primarily surface water may be at increased immediate risks of supply impacts. Depleted watersheds are a new reality of climate change in the province, and all sectors will need to adapt management practices to reduced water availability to conserve remaining supply for shared future use.
- **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 requires improved irrigation infrastructure that can have high up-front costs but result in cost savings over the long term.
- **INSUFFICIENT FORAGE, water, and winter feed for livestock:** In dryland operations reduced precipitation has led to significant declines in hay (particularly in summer 2023), forcing some ranchers to buy feed they would normally grow themselves at demand-surge costs. Loss of livestock ponds, accelerated evaporation in dugouts, and lower streamflow have also impacted water availability. Livestock producers across the province have been challenged with difficult decisions (e.g., reduction of herd size, feeding winter stock early, having pasture not available late in the grazing season) and relying on additional supports and programs.
- **ON-FARM WATER STORAGE that collects water during annual high precipitation periods can be an emergency water strategy for livestock watering:** At the farm level, challenges of implementation include cost and maintenance of storage infrastructure (tanks, dugouts) and volume of storage infrastructure relative to water demand.
- **MORE INTENSE RAINFALL causing flooding, runoff, and erosion:** This results in high economic and ecological costs for producers. Agricultural properties in the Kootenay Boundary region are at risk of freshet and flooding or have been impacted by flooding in recent years.

# 1.2 What water storage and development work has been done?

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

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **DECREASED WATER SUPPLY** | | | |
| **Options to expand availability of weather station data and decision support tools** | Project summary<br>Full project report | Kootenay Boundary | 2020 |
| **Regional agricultural water demand models** | Central Kootenay report<br>Kettle watershed report | Kootenay Boundary | 2013-2019 |
| **Water management resources and knowledge transfer of water best management practices for agriculture in B.C.** | Resource summary<br>Webinar series<br>Full project report | Bulkley-Nechako / Fraser Fort George | 2021 |
| **IRRIGATION EFFICIENCY** | | | |
| **Too much water or too little: climate resilient vegetable farming** | Research summary<br>Factsheet: Soil N dynamics<br>Full project report | Kootenay-Boundary, Fraser Valley, Vancouver Island | 2021 |
| **Farm water fix: climate resilient irrigation systems and management** | Video series | Kootenay/Boundary, Provincial | 2022 |
| **Irrigate better: anatomy, pipe design, emission design, scheduling and monitoring** | Webinar series | Kootenay/Boundary Provincial | 2018 |
| **Identifying water-efficient practices that co-deliver maximum benefits for tree fruit production & climate change mitigation** | *In progress, Agriculture and Agri-Food Canada* | Okanagan | 2021-2025 |
| **Improving irrigation efficiency for managing during dry conditions** | Factsheet series<br>Webinar | Okanagan | 2023 |
| **Post-harvest deficit irrigation in cherries** | Research Summary<br>Fact sheet<br>Full project report | Okanagan | 2019-2023 |
| **Vineyard water use efficiency, cost in vineyards, and how to measure water use** | Factsheet: Vineyard establishment and maintenance practices for water use efficiency<br>Factsheet: Tools to validate<br>Factsheet: The full cost of water<br>Tool: irrigation efficiency calculator<br>Full project report | Okanagan | 2018 |

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **INSUFFICIENT FORAGE** | | | |
| **Resiliency: forage, water, and climate change risk assessment pilots** | *In progress, B.C. Cattlemen's Association, Ministry of Agriculture and Food, Ministry of Forests*<br>*Forthcoming tool: Landscape and range resiliency planning tool for Crown forage, surface water risk and climate change modelling*<br>*Forthcoming factsheets:*<br>• *Forage and Water Resiliency Overview: Managing water and forage resources in a changing climate*<br>• *Reference Evaporation*<br>• *Calculating Carrying Capacity*<br>• *Flow Accumulation* | Interior North, Central, South, Kootenays | 2023 |
| **Pilot use of landscape and range resiliency planning tool** | *In progress, B.C. Cattlemen's Association, Ministry of Agriculture and Food, Ministry of Forests*<br>*Forthcoming factsheets:*<br>• *Climate change mitigation and adaptation case studies* | Cariboo, Highway 16 North, Kootenay | |
| **Forage crop and variety selection for dryland farms** | Webinar | Thompson-Okanagan | 2021 |
| **Ministry of Agriculture: managing forage crops in drought conditions** | Factsheet: irrigation | Provincial | 2015 |
| **Climate resilient livestock surface water in the Cariboo** | Virtual training series 2022<br>Fact sheets<br>Range unit maps<br>Assessment methodology (2017)<br>Site assessment case studies<br>Report on pilot projects (2020) | Cariboo | 2017-2022 |
| **Climate change impact risk assessment tool for livestock water ponds** | Full project report | Cariboo, Bulkley-Nechako | 2017 |
| **MORE INTENSE RAINFALL** | | | |
| **Supporting riparian health on farmland for flood protection** | Full project report | Kootenay Boundary | 2023 |
| **Linking farmland to floodplains** | Webinar<br>Research summary<br>Full project report | Kootenay Boundary | 2022 |

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **Farm flood readiness toolkit** | Toolkit<br>Factsheet: Okanagan<br>Factsheet: landscape level mitigation<br>Video: prepare for flooding<br>Video: protect your farm assets | Okanagan, Fraser Valley | 2022 |
| **Livestock sector emergency preparedness for flooding** | Factsheet | Provincial | 2019 |
| **Horticulture sector emergency preparedness for flooding** | Factsheet | Provincial | 2019 |
| **Agricultural waterways: drainage maintenance and stewardship** | Guide | Provincial | 2018 |
| **ON-FARM WATER STORAGE** | | | |
| **Guidance on farm water storage** | Factsheet | Provincial | 2021 |
| **Enhancing agricultural dams in the Cariboo** | Project Summary<br>Workshop summary<br>Full project report | Cariboo | 2017 |
| **Study of the costs and benefits of dams and reservoirs on B.C. cattle ranches** | Full project report | Cariboo | 2016 |
| **B.C. Farm water dugouts** | Guide | Provincial | 2016 |

## 1.3 What's next: Looking ahead

Sustainable agricultural water management is shaped by regulatory requirements, regional and site conditions, and farm level practices. Field-level water conservation is a primary adaptation strategy for irrigated operations, and on-farm practices that conserve soil moisture can support drought resilience in dryland operations. Livestock watering systems that use pumps instead of relying on direct watering (natural watercourses or dugouts) can be beneficial to livestock and riparian health.

As the climate becomes more variable, installation of water storage infrastructure that can be used in drought conditions is becoming increasingly necessary. Installation of on-farm water development and storage infrastructure can be a large investment; ensuring the type of infrastructure is best suited to operation needs and landscape features is essential.

## On-Farm Management Practices

**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 (nutrient management, contaminated runoff collection, storage, and disposal, safe pesticide handling and application)
- Soil moisture meters or evapotranspiration sensors
- Rainwater collection and storage

**Dugout maintenance** practices can help maintain water quality and maximise the use of stored water during low precipitation periods.

- Vegetation buffer zones around dugouts
- Water quality protection measures (nutrient management, contaminated runoff collection, storage, and disposal, safe pesticide handling and application)
- Dugout water testing

**Climate-resilient livestock watering systems** can help ensure livestock have steady water supply through drought or freezing conditions. There are many types of pump energy and infrastructure, that can be weighed against cost, producer preference, seasonality, number of livestock etc. Specific infrastructure can include:

- Access ramps to direct sources
- Moveable stock tank (e.g. on a trailer)
- Geothermal watering systems
- Solar/wind/streamflow/gravity/electricity/fuel powered pumps
- Pumped gravity flow reservoirs
- Nose pumps/frost free nose pumps (has integrated drain-back system)
- Pipelines (e.g. in intensive pasture cell system)

## Funding Programs: WATER SUPPLY AND 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 SUPPLY AND MANAGEMENT

**Irrigation**

B.C. Agriculture Water Calculator

B.C. Irrigation Water Use Calculator

Agricultural Irrigation Scheduling Tool

B.C. Irrigation Management Guide

**Drought**

B.C. Drought Information Portal

**Livestock**

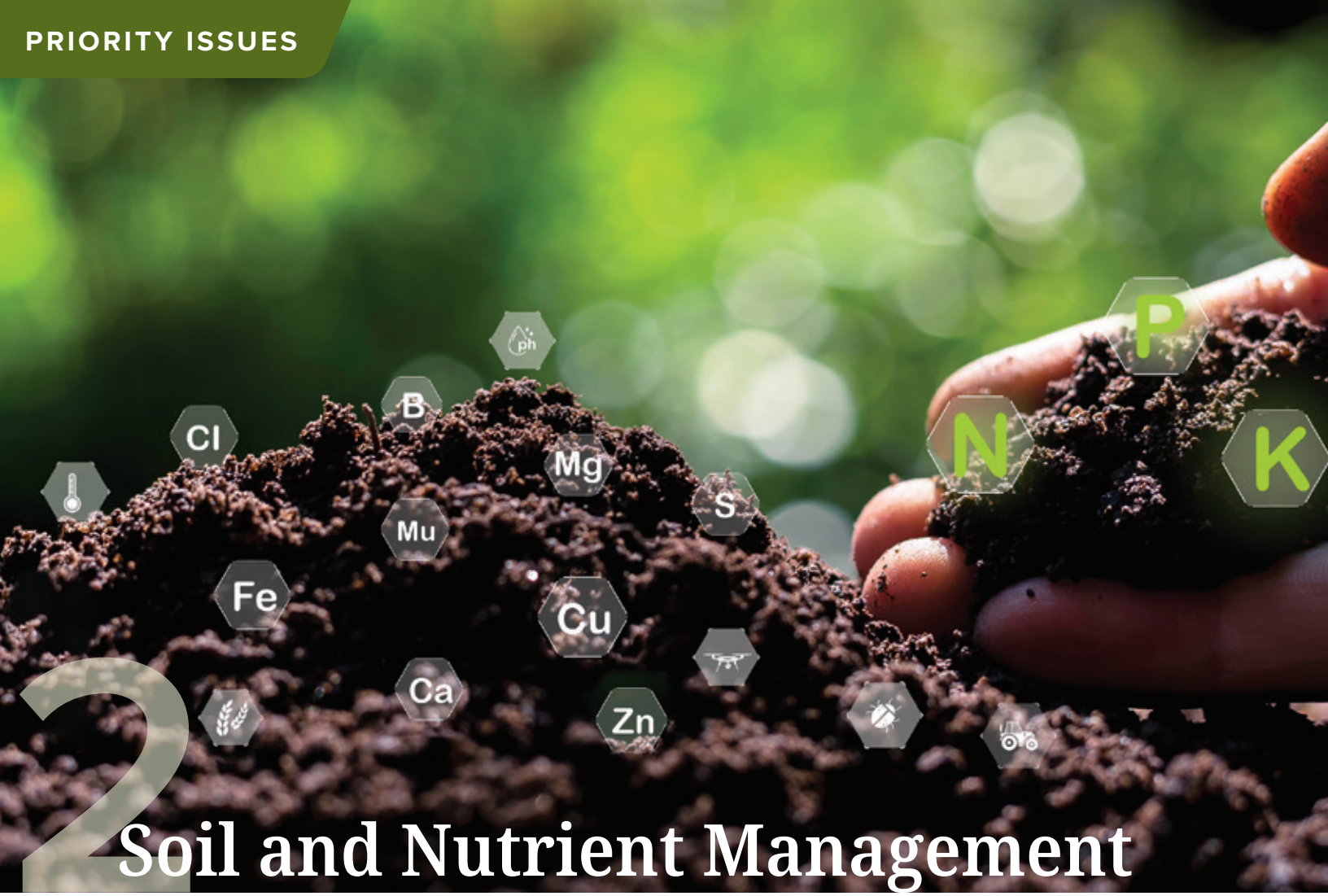
B.C. Livestock Watering Handbook

**Flooding**

B.C. Flood Study Explorer

B.C. River Forecast Center

AgSafe Emergency Planning Resources - Flooding




# 2 Soil and Nutrient Management

Photo: Shutterstock

**Mitigation**

**Environment**

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. The implementation and success of best soil management strategies is site-specific and differs across the agricultural sectors that operate in the Kootenay Boundary region.

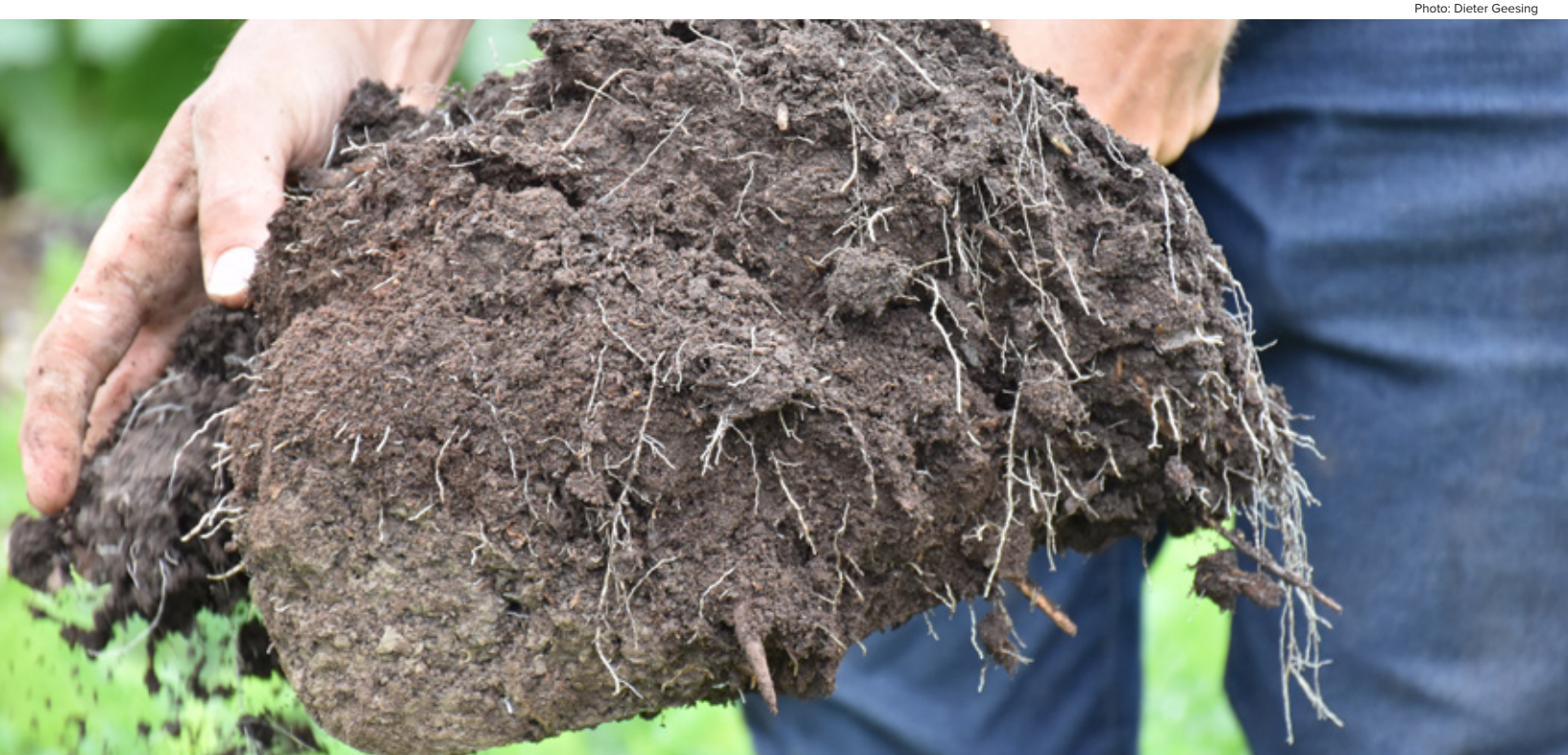
Nutrient management is an essential step in maintaining soil function and optimizing crop yield and quality. Nutrient management practices involve applying the right type of nutrient sources, such as manure, fertilizer, or compost in the right amount, in the right place and at the right time for the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

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.

## 2.1 Why is soil and nutrient management a priority?

- **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, suitable pH, and suitable soil physical properties. Supportive practices include adequate organic amendments, cover cropping, maintaining soil cover, and reducing soil degradation.
- **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.
- **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 porosity, which is needed for good water infiltration, water retention, microbial activity and root growth.
- **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.
- **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. a

Photo: Dieter Geesing



# 2.2 What soil and nutrient management work has been done?

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

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **SOIL DEGRADATION** | | | |
| **Kootenay Boundary Farm Advisors regional soil workshops** | Workshop descriptions and resources | Kootenay Boundary | 2023 |
| **Improving soil health through enhanced water infiltration** | Grab and Go Template for On-Farm Research<br>Webinar: indicators of soil health | Provincial, Kootenay Boundary | 2021 |
| **Exploring pasture renovation techniques** | *In progress, Ministry of Agriculture and Food* | Cariboo, Central South Interior | 2023 |
| **Demonstrating no-till pasture rejuvenation practices in central and northern interior of B.C.** | Kootenay Boundary Research Summary<br>Producer Panel: Kootenay Boundary<br>Cariboo Research Summary<br>Cariboo Full Project Report | Kootenay Boundary, Cariboo-Chilcotin, Fraser-Fort George | 2023 |
| **Multi-functional pasture rejuvenation in the Cariboo** | Research summary<br>Full project report | Cariboo | 2023 |
| **Soil quality test kit [Pastures]** | Soil quality test kit | Cariboo, Bulkley-Nechako | 2021 |
| **NUTRIENT CYCLING** | | | |
| **B.C. Living Lab: Tree fruit and wine grape – producer led testing, monitoring, and adoption of interrow cover crops to improve soil health** | *In progress*<br>Project overview | Okanagan, Lower Mainland | 2023 |
| **B.C. Living Lab: Field vegetables - producer led testing, monitoring, and adoption of cover crop and fertilizer management** | *In progress*<br>Project overview | Lower Mainland | 2023 |
| **B.C. Living Lab: Cattle & Forage Practices - producer-led testing, refinement, monitoring and adoption of winter cover cropping** | *In progress*<br>Project Overview | Thompson-Nicola and Cariboo | 2023-2027 |
| **Provincial Cover Crop Factsheets *(23 cover crop species)*** | *In progress, Ministry of Agriculture and Food*<br>*Forthcoming tool: digital cover crop selection tool* | Provincial | 2023 |
| **Water and nutrient management strategies to integrate cover crops into vineyards to enhance sustainability and productivity** | *In progress, Agriculture and Agri-Food Canada* | Okanagan | 2018-2023 |
| **Okanagan vineyard cover cropping** | *In progress, Winegrowing B.C. & Ministry of Agriculture and Food* | Okanagan | 2023 |

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **B.C. Climate-Agri Solutions cover cropping projects** | Cover cropping extension resources | Provincial | 2023 |
| **OPTIMAL CROP PRODUCTIVITY** | | | |
| **Nitrogen management in viticulture and enology; precision N management** | *In progress, Agriculture and Agri-Food Canada* | Okanagan | 2018-2023 |
| **Using GIS and imaging tools to guide precision management for nitrogen** | *In progress, Agriculture and Agri-Food Canada* | Okanagan | 2018-2023 |
| **B.C. Climate Agri-Solutions rotational grazing projects** | Extension resources | Lillooet, Vancouver Island | 2023 |
| **Demonstration of innovative corn production technologies** | Research summary<br>Factsheet: interseeding Factsheet: strip tillage<br>Factsheet: variable rate<br>Full project report | North Okanagan | 2023 |
| **Interpretations for soil test phosphorus and potassium** | Guide | Provincial | 2020 |
| **Innovative nutrient management for forage resiliency** | Factsheet: Fertilizer placement, variable rate, and nitrogen losses<br>Factsheet: managing on-farm nutrients to rejuvenate hayland | Peace | 2015-2017 |
| **Soil quality for resiliency** | Factsheet<br>Factsheet: Using a soil quality test kit [pastures] | Peace, Bulkley-Nechako | 2017 |
| **NUTRIENT LOSS** | | | |
| **Too much water or too little: climate resilient vegetable farming** | Research summary<br>Factsheet: Soil N dynamics<br>Full project report | Kootenay-Boundary, Fraser Valley, Vancouver Island | 2021 |
| **Phosphorus Index** | *In progress, Ministry of Agriculture and Food* | Okanagan, Fraser Valley, Vancouver Island | 2023-2024 |
| **Phosphorus recommendations in silage corn systems; agri-environmental indicator for risk of P transfer to water sources** | *In progress, Agriculture and Agri-Food Canada* | Okanagan, Fraser Valley | 2023 |
| **B.C. Climate Agri-Solutions nitrogen management projects** | Nitrogen management extension resources | Provincial | 2023 |
| **Soil sampling guidelines for British Columbia** | Guide | Provincial | 2023 |

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **Balancing nitrogen and phosphorus on organic vegetable farms** | Podcast: Nutrient loss<br>Podcast: N and P balance<br>Online workshop<br>Field trial results summary | Pemberton, Fraser Valley, Vancouver Island | 2021 |
| **Best management for on-farm management of runoff, drainage, and erosion** | Project summary<br>Factsheet: erosion<br>Factsheet: soil, water, and residue management<br>Factsheet: runoff, drainage, and erosion<br>Full project report | Peace | 2020 |
| **CARBON SEQUESTRATION** | | | |
| **Impact of management intensive grazing on soil health** | Research summary<br>Full project report | Cariboo, Thompson-Okanagan | 2018 |

## 2.3 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. 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 soil and nutrient management can be considered within four main strategies:

### On-Farm Management Practices

**Conservation and management of soil organic matter** is critical to climate adaptation and mitigation. On-farm management 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)
- Organic amendments (i.e. compost)
- Inter-seeding
- No-till seeding
- Reduced tillage
- Integration of woody perennials (i.e. shelterbelts)
- Conservation tillage (i.e. tillage retaining crop residues)
- Nutrient management
- Crop rotation

**Nutrient application and sourcing** focus on how, when, and which nutrients are applied to support optimal efficiency. Increased efficiencies in nutrient management practices can result in reduced

greenhouse gas emissions. Practices include:

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

**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. Practices include:

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

**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

Photo: Brenna Schilds

## Funding Programs: SOIL AND NUTRIENT MANAGEMENT

- Environmental Farm Plan Program (EFP)
- EFP Beneficial Management Practices Program - *nutrient and waste management projects*
- B.C. Climate Agri-Solutions - *nitrogen management, cover cropping, and rotational grazing streams*

## Provincial Toolbox: SOIL AND NUTRIENT MANAGEMENT

B.C. Soil Information Finder Tool

Nutrient Management Calculator

Nutrient Management Plan Training

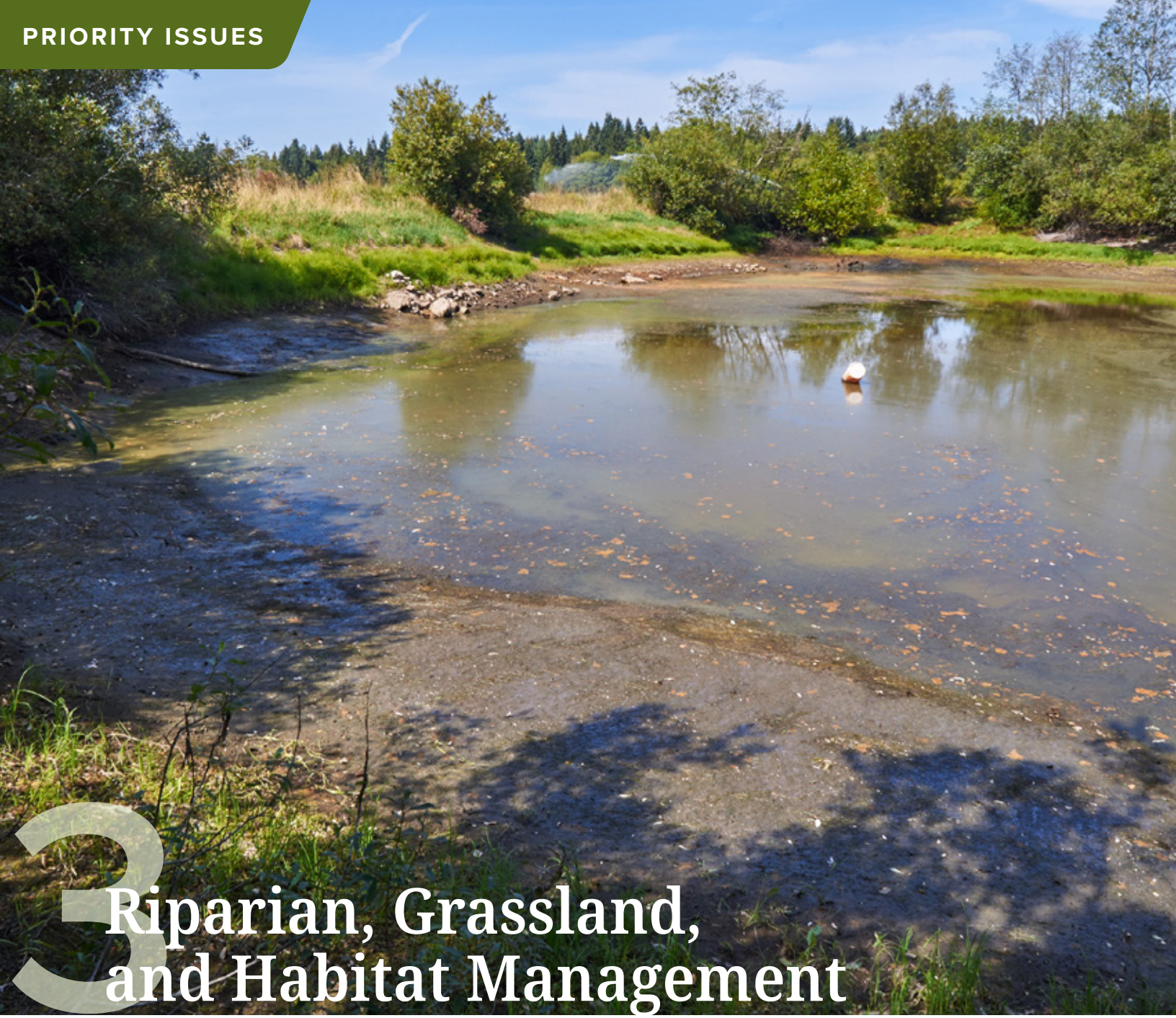
Application Risk Management Tool

Manure Nutrient Calculator

Soil Test Phosphorus Converter

Post-Harvest Nitrate Test Calculator

B.C. Tree Fruit Production Guide – Fruit tree nutrition



# 3 Riparian, Grassland, and Habitat Management

Photo: Emrys Miller

Mitigation

Environment

Natural habitats and biodiversity provide benefits for agriculture production. For example, restoring or improving riparian areas can provide ecosystem services, including lowering flood risk and increasing biodiversity. Grasslands often host good agricultural soils but are also sensitive habitats for species at risk. Critical ecosystem services such as habitat connectivity, native refuge, food webs, and riparian area health have been impacted across the province from a variety of land use practices. Agriculture has a unique position in land stewardship because it is fundamentally connected to wildlife habitat and often integrates habitat features and practices that can support biodiversity.

There can be conflicts between agricultural lands and the wildlife that inhabit them. Achieving a balance that protects wildlife and their habitats and maintains agricultural productivity is essential. Producers may need to implement creative strategies and infrastructure to protect crops or animals from wildlife damage or interference.

## 3.1 Why is riparian, grassland, and habitat management a priority?

- **HEALTHY RIPARIAN AREAS provide ecosystem services that may help reduce the risk of flooding:** Healthy riparian areas are more resilient to extreme precipitation events and flooding, which can prevent extreme erosion and costly damage to arable land and infrastructure.
- **AGROFORESTRY includes integrated management systems blending agriculture, forestry, and conservation practices on the same land unit. The systems purposefully integrate growing trees with crop or livestock management, and balance benefits of agricultural production with habitat and other environmental values.** In B.C., use of silvopasture (which purposefully integrates the management of livestock, forage, and trees) is less common than conventional forestry, range and pasture management. Silvopasture can maintain or augment forage resources for both livestock and native ungulates and diversify revenue, while also contributing to carbon sequestration and environmental stewardship goals such as enhanced riparian area protection.
- **WILDLIFE CONFLICT creates tension between agricultural production and biodiversity conservation:** Striking a balance between agricultural production and wildlife conservation goals requires multi-faceted strategies and ongoing collaboration. In the Kootenay Boundary region, elk are a particularly challenging issue for agricultural producers. As climate impacts shift wildlife habitats and patterns, impacts on agriculture will shift and require new strategies.
- **POLLINATION ecosystem services are critical for many crops:** Impacts on managed honeybee colonies from varroa mites and other stressors are impacting pollination services and bee mortality. Wild pollinators also make significant contributions to tree fruit and forage pollination. Habitat loss and lack of food sources for pollinators can negatively impact farm productivity.
- **BIODIVERSITY CONSERVATION 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. The 2021 Census of Agriculture indicated that 39% of farms in the Kootenay Boundary region contain vegetative buffers, shelterbelts, or windbreaks.

Photo: Shutterstock

# 3.2 What riparian, grassland, and habitat work has been done?

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

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **HEALTHY RIPARIAN AREAS** | | | |
| **Riparian restoration: debris barriers reduce effects of livestock grazing** | Journal article: Debris barriers reduce effects of livestock grazing along streams after timber harvest | Okanagan | 2021 |
| **Riparian management field workbook for streams and small rivers** | Field workbook | Provincial | 2019 |
| **Agricultural benefits of riparian rehabilitation** | Factsheets<br>Full project report | Okanagan | 2018 |
| **Grazing impacts on wetland habitat** | Journal article: Livestock grazing in intermountain depressional wetlands: effects on breeding waterfowl | Thompson-Nicola | 2017 |
| **Riparian forest buffers** | Manual: Riparian forest buffer establishment<br>Worksheet: designing riparian forest buffers | Peace | N/A |
| **GRASSLANDS** | | | |
| **Grassland monitoring manual for B.C.: A tool for ranchers** | Manual | Provincial | 2019 |
| **AGROFORESTRY** | | | |
| **Restoring and maintaining rangelands in the East Kootenay** | Full project report | Kootenay Boundary | 2016 |
| **Modular silvopasture training workshop development – Phase 2** | *In progress, Ministry of Agriculture and Food* | Cariboo, Central South Interior | 2023 |
| **Targeted knowledge transfer and development of producer-experience case studies in silvopasture** | *In progress, Ministry of Agriculture and Food* | Thompson-Okanagan | 2023 |
| **Silvopasture pilots: Crown Land** | *In progress, Ministry of Agriculture and Food* | Central South Interior, Thompson-Okanagan, Hwy 16 | 2020-2023 |
| **Silvopasture 5-year knowledge transfer plan** | *In progress, Ministry of Agriculture and Food* | Provincial | 2022 |
| **Targeted grazing pilots** | *In progress, Ministry of Agriculture and Food*<br>Factsheet<br>Video: Wildfire risk mitigation | Central South Interior, Kootenay Boundary | 2017-2023 |
| **Planning for biodiversity: a guide for B.C. farmers and ranchers** | Guide | Provincial | 2019 |

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **Silvopasture strip thinning pilot** | Master's Student Dissertation | Cariboo | 2018 |
| **Silvopasture producer demonstrations – private land planning** | Factsheet | Cariboo | 2017 |
| **WILDLIFE CONFLICT** | | | |
| **Best management practices for livestock protection** | BMP Guide<br>Loss Prevention Practices for Cattle<br>Loss Prevention Practices for Sheep | Provincial | N/A |
| **Elk exclusion fencing** | *In progress, Ministry of Agriculture and Food*<br>Factsheet: Elk exclusion fencing<br>3D fencing | Provincial | 2015-2023 |
| **3D wildlife fencing project: Phase 2** | Project description<br>Factsheet: Grounding electric fences<br>Factsheet: Wildlife fence behaviour<br>Factsheet: Responding quickly to wildlife pressure<br>Factsheet: Luring wildlife to your fence<br>Factsheet: Provincial adoption of 3D fencing | Peace | 2015 |
| **3D wildlife fencing project: Phase 1** | Project description<br>Factsheet: Keeping wildlife away<br>Factsheet: Grain bags with 3D wildlife fence<br>Factsheet: Stackyard with 3D wildlife fence<br>Factsheet: Winter feeding with 3D wildlife fence<br>Factsheet: Does 3D fencing pay?<br>Factsheet: Silage bags with 3D wildlife fence<br>Factsheet: Adjustable 3D wildlife fence<br>Factsheet: Snow depth adjustments in 3D fencing<br>Factsheet: Types of 3D fencing | Peace | 2012 |
| **Wildlife damage on fescue** | Project report<br>Research summary<br>Factsheet: elk damage | Peace | 2012 |
| **POLLINATION** | | | |
| **Bee BC: Tackling bee health in Creston** | Project summary | Kootenay Boundary | 2019 |
| **Bee BC: Enhancing bee forage in the Boundary region** | Project summary | Kootenay Boundary | 2019-2020 |

### Funding Programs: RIPARIAN, GRASSLANDS, AND HABITAT MANAGEMENT

- Bee BC
- Environmental Farm Plan Program (EFP)
- EFP Beneficial Management Practices Program - biodiversity projects
- Farmland Advantage - *payment for ecosystem services: riparian and grasslands*
- Agriculture Wildlife Program
- Species at Risk Partnerships on Agricultural Land (BCCA)
- Wetland Restoration (Ducks Unlimited Canada)

### Provincial Toolbox: RIPARIAN, GRASSLANDS, AND HABITAT MANAGEMENT

Habitat and Biodiversity Assessment Tool - *forthcoming from CFGA (2023 update)*

# 3.3 What's next: Looking ahead

On-farm management practices for riparian, grassland, and habitat health can contribute to climate adaptation, reduction of net greenhouse gas emissions, and environmental stewardship. Implementing habitat and biodiversity beneficial management practices is shown to have positive outcomes for farm resilience and environmental health by fostering soil function and healthy ecosystems.

## On-Farm Management Practices

In the Kootenay Boundary region, habitat and biodiversity conservation practices generally fall into three strategies:

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

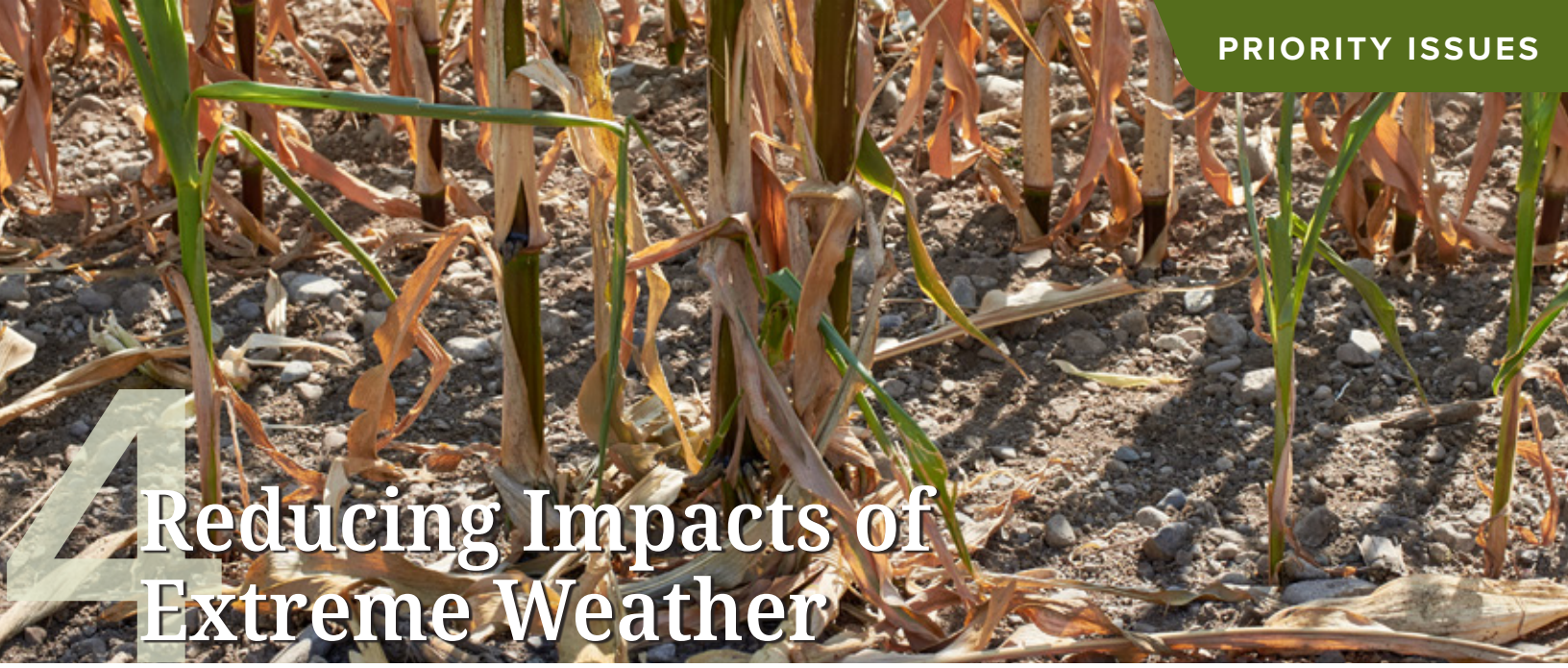
- Vegetative buffers/hedgerows
- Riparian restoration
- Conservation set asides
- Wildlife corridors
- Agroforestry/silvopasture
- Riparian fencing
- Bank stabilization and restoration
- Implementation and restoration of wetlands
- Alternative livestock watering systems
- Improved stream crossings
- Habitat structures and enhancement

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

- Wildlife-friendly fencing
- Electric fencing
- Non-lethal deterrents/guard animals
- Crop selection and timing
- Electronic monitoring systems

**Biodiversity-friendly farm practices** aim to maintain agricultural productivity while minimizing impacts to habitat and biodiversity. These beneficial management practices can overlap with those in priority areas such as soil and nutrient management and include:

- Cover cropping
- Reduced tillage
- Integration of woody perennials
- Integrated pest management
- Organic amendments



# 4 Reducing Impacts of Extreme Weather

Photo: Emrys Miller

Adaptation

Extreme heat and cold events have occurred with increasing frequency in recent years, with temperatures in the Kootenay Boundary region exceeding seasonal average highs and lows. Extreme heat waves such as those in 2021-2023 have highlighted worst-case risks to production systems (especially forage, tree fruits, berries, and livestock), farmworkers, and infrastructure, and recent cold events have caused extensive damage to fruit trees and wine grapes. Damage to crops, stress on livestock health, and stress on farmworker health are cited challenges.

Producers are identifying the need for support for crop and livestock protection, as well as for cooling infrastructure such as shade, hydration stations, misting systems, augmented refrigeration, and increased ventilation. Because the impacts of extreme heat on farmworkers and infrastructure have only become major issues in the province in the last three years, there is limited research and extension materials addressing this area.

## 4.1 Why is extreme weather management a priority?

- **CROP PROTECTION measures are becoming crucial to avoid severe impacts of extreme heat**. In the 2021 heat dome, many fruit and berry crops experienced major losses due to scorching, and. 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, including increased susceptibility to pests and diseases or slowed productivity. Extreme cold events can also result in long-term crop damage and/or necessitate orchard/vineyard plant replacement.
- **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.

## 4.2 What extreme weather work has been done?

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

| Project | Project Resources* | Location | Year |
|---|---|---|---|
| **CROP PROTECTION** | | | |
| **Tools for climate resilience in tree fruit: foliar spray to protect fruit quality during heat events** | Journal article | Okanagan | 2023 |
| **Impacts of adverse temperature and water conditions on fruit set in sweet cherry in the early growing season** | *In progress*<br>Project description | Okanagan | 2018-2023 |
| **Modeling winegrape phenology for a warming Okanagan** | Factsheet: budbreak<br>Factsheet: flowering<br>Full project report | Okanagan | 2022 |
| **Forage crop and variety selection for dryland farms** | Webinar | Thompson-Okanagan | 2021 |
| **Using vented orchard covers for protecting cherries** | Project presentation<br>Factsheet | Okanagan | 2017 |
| **LIVESTOCK HEALTH** | | | |
| **Managing extreme heat on dairy farms** | Full project report | Fraser Valley | 2023 |
| **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<br>Guide: Working outside during heat events | Provincial | 2023 |

## 4.3 What's next: Looking ahead

As extreme weather events become increasingly challenging for agricultural producers in the Kootenay Boundary region, proactive management and supportive projects and programs will be vital to resilient production. Altering working conditions, increasing cooling infrastructure, and trialing novel crop protection measures are suggested strategies.

### On-Farm Management Practices

**Crop protection** can involve field and cultural practices, and often involves providing shade or barriers to prevent sunburn.

- Adjusted planting and harvest schedules
- Irrigation management (e.g., overhead for specific crops during extreme heat events)
- Heat resistant varieties
- Shade treatments
- Foliar protectant sprays, stem white-wash or tree-wrap

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

- Climate resilient watering systems (adequate supply through drought)
- Shade provision (trees/structures)
- Barn cooling systems (misting, fans, ventilations, monitoring systems/sensor improvements)

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

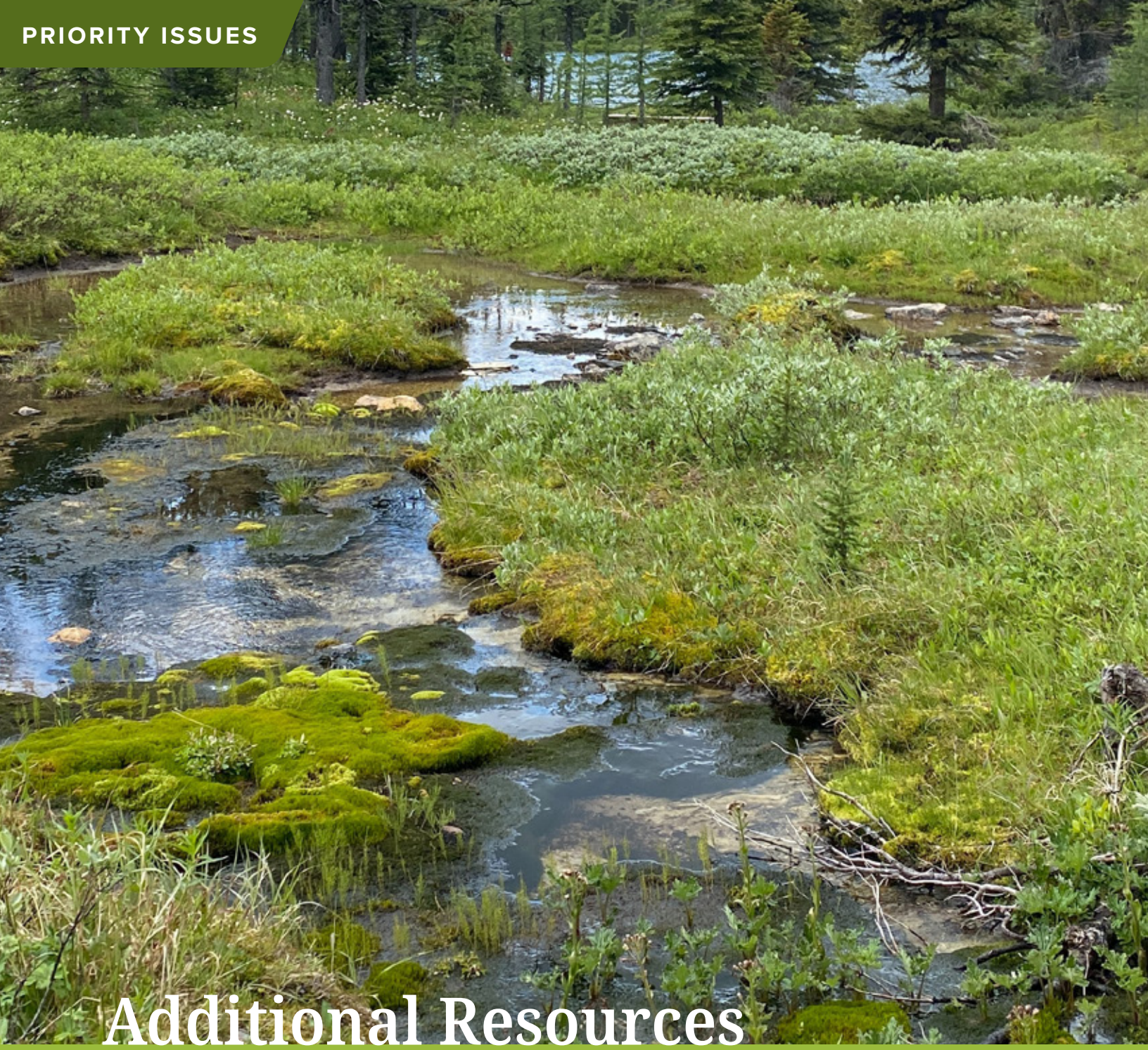
- Heat stress training and nutrition
- Farm housing
- Altered work hours (e.g., earlier starts or shorter days during extreme heat events)
- Emergency heat planning
- Access to potable water
- Personal protection (clothing, sun protection)
- New technology to reduce labour-intensive tasks (e.g., harvesting and pruning platforms)

**Cooling infrastructure** supports crop, livestock, and farmworker health, and is also concerned with provision of adequate farm level infrastructure to safeguard harvests.

- Misting stations
- Ventilation systems
- Community level refrigeration access

## Funding Programs: EXTREME WEATHER

- Extreme Weather Preparedness for Agriculture - *extreme heat preparedness stream*
- AgriStability - *agriculture income protection*



# Additional Resources

Photo: Jillian Amatt/Unsplash

## Climate change mitigation

- Regenerative Agriculture and Agritech Working Group: Final Report and Recommendations (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

- Kootenay and Boundary Regional Adaptation Strategies (2019)

## Organic BC

- Podcast series
- Organic Innovation video series



For more information, visit our website.

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