



**Regional  
Extension  
Program**

**Environment and Climate  
REGIONAL GUIDEBOOK  
PEACE**

Peace River, Northern Rockies



Prepared for the  
**B.C. Ministry of  
Agriculture and Food**  
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Photo: Brenna Schilds

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### Contributors

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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 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 Peace agricultural extension region comprises the Peace River Regional District and the Northern Rockies Regional Municipality. This region includes the Peace River 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: Flickr



Beef Cattle

Photo: B.C.Photo



Grain and Oilseed Crops

Photo: Brenna Schilts



Mixed Livestock

Photo: Nicole Pressey



Market Gardens

Photo: Nicole Pressey



Honey Production

Photo: Bianca Ackerman/Unsplash



Small Fruit Production

(e.g. Haskaps, Sour Cherries)

Photo: Nicole Pressey

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

(Census of Agriculture, 2021)

- ▶ Farm numbers decreased by 9% and farmland area decreased by 10.5% between 2011 and 2021. The Peace experienced the smallest decrease in farm numbers across all agricultural regions of the province.
- ▶ Hay is the dominant production type in the Peace as of 2021, but the number of farms producing hay has decreased by 34.5% since 2011.
- ▶ The Peace hosts 97% of oilseed production and 69% of grain production in the province and make up the majority of B.C.'s export market for these crops.
- ▶ Farm receipts in the Peace have increased by 62% in the last decade, in line with the provincial increase of 63%.
- ▶ The largest loss of farm numbers was for those with annual revenues under \$10,000.
- ▶ There was an increase in the number of farms with annual revenues above \$100,000.

# Regional Climate Change Impacts

The Peace region covers a large area of the province and has variable climatic zones, but all areas within the region are experiencing the impacts of climate change. In general, increase in drier summer conditions, increased wildfire risk, and increased rainfall in spring and fall have been observed. An increase in the number of growing degree days may be favourable for some crops but may also impact staple varieties and bring new pests and diseases.

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

## PCIC Climate Projections: Peace, 2050

**TEMPERATURE** 

2.5°C to 4.4°C increase  
in annual average temperatures

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Average of  
25 to 48 more  
frost free days annually

**PRECIPITATION** 

19% increase  
in spring precipitation

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15% increase  
in fall precipitation

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19% decrease  
in precipitation falling as snow

**EXTREMES** 

Increase in frequency  
and magnitude  
of extreme rainfall events

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Average of  
7 days  
over 30°C annually,  
up from 1 day

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

Photo: Brenna Schilds



# 1 Soil Management

Photo: Shutterstock



Adaptation



Mitigation

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 Peace region.

## 1.1 Why is soil management a priority?

- ▶ **SOIL DEGRADATION reduces resilience to climate change impacts as well as productivity:** 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, suitable pH and adequate soil physical properties. Examples of supportive practices include adequate organic amendments cover cropping and reduced tillage. In the Peace region, the success of cover cropping is site-specific; for example, short growing seasons, shallow hardpan in the soil, and limited irrigation infrastructure increase the challenges of cover crop adoption and establishment. Several regions also have low natural organic matter.
- ▶ **CARBON SEQUESTRATION potential of some soils can be enhanced using certain soil management practices:** Soils that have continuous 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.

## 1.2 What soil management work has been done?

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

Project	Project Resources*	Location	Year
<b>SOIL DEGRADATION</b>			
Interseeding to improve forage quality and quantity	<a href="#">Research summary</a> <a href="#">Factsheet: Foxtail barley infestation management</a> <a href="#">Factsheet: Interseeding with VREDO</a> <a href="#">Factsheet: Winter and frost seeding?</a>	Peace	2019-2022
Soil sampling guidelines for British Columbia	<a href="#">Guide</a>	Provincial	2023
Deep rooted cover crops to improve soil temperature, water holding capacity, and drainage capacity in finer textured soils	<a href="#">Research summary</a>	Peace	2022
Best management for on-farm management of runoff, drainage, and erosion	<a href="#">Project summary</a> <a href="#">Factsheet: Erosion risk mapping</a> <a href="#">Factsheet: Soil, water, and residue management tools</a> <a href="#">Factsheet: Conversations about runoff, drainage, and erosion</a> <a href="#">Full project report</a>	Peace	2020
Improving soil health through enhanced water infiltration	<a href="#">Grab and Go Template for On-Farm Research</a> <a href="#">Webinar: indicators of soil health</a>	Provincial, Kootenay/Boundary	2021
Innovative soil management for resiliency	<a href="#">Factsheet: soil water and resiliency</a> <a href="#">Factsheet: soil quality for resiliency</a>	Peace	2015-2017
Knowledge for Resilience podcast: Soil, forage, livestock	<a href="#">Podcast episodes</a>	Peace	2023
Exploring pasture renovation techniques	<i>In progress, B.C. Ministry of Agriculture and Food</i>	Cariboo, Central South Interior	2023
Demonstrating no-till pasture rejuvenation practices in central and northern interior of B.C.	<a href="#">Research summary</a> <a href="#">Full project report</a>	Cariboo-Chilcotin, Fraser-Fort George	2023
Multi-functional pasture rejuvenation in the Cariboo	<a href="#">Research summary</a> <a href="#">Full project report</a>	Cariboo	2023
Soil quality test kit [Pastures]	<a href="#">Soil quality test kit</a>	Cariboo, Bulkley-Nechako	2018

Project	Project Resources*	Location	Year
<b>NUTRIENT CYCLING</b>			
Peace Region Living Lab – producer led testing, monitoring, and adoption of best management practices for enhancing agroecosystem services	<i>In progress</i> <a href="#">Project Overview</a>	Peace	2023-2027
Evaluation of economic and agroecological merits of diverse cover cropping sequences with perennial forage seed and annual field crops	<i>In progress, Agriculture and Agri-Food Canada</i>	Peace	2021-2026
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	<a href="#">Extension resources</a>	Provincial	2023
Cover cropping at farm scales	<a href="#">Factsheet</a>	Peace	2023
Cover crop mixes for the North Peace region to improve soil quality and promote adoption	<a href="#">Research summary (2022)</a> <a href="#">Research summary (2021)</a> <a href="#">Research summary (2020)</a>	Peace	2020-2022
Allelopathic effects of cover crops in a crop rotation	<a href="#">Research summary (2022)</a> <a href="#">Research summary (2021)</a>	Peace	2021-2022
Improving forage productivity and profitability in grazing and haying systems	<a href="#">Project summary</a> <a href="#">Factsheet: Locating field benchmarks for monitoring</a> <a href="#">Factsheet: How photogenic is your forage</a> <a href="#">Factsheet: Estimating forage yields</a> <a href="#">Factsheet: Are you happy with your forage stand</a> <a href="#">Factsheet: Manure improvement</a> <a href="#">Factsheet: Bale grazing for pasture improvement</a> <a href="#">Factsheet: Farm decision making</a> <a href="#">Factsheet: Grazing improvements</a> <a href="#">Factsheet: Up your grazing game</a>	Peace	2017-2020
Soil quality survey	<a href="#">Research summary</a> <a href="#">Factsheet: soil quality field kit</a>	Peace	2015-2020
Innovative nutrient management for resiliency	<a href="#">Factsheet: Legumes for resiliency and non-bloating</a> <a href="#">Factsheet: Fertilizer placement, variable rate, and nitrogen losses</a> <a href="#">Factsheet: managing on-farm nutrients to rejuvenate hayland</a> <a href="#">Factsheet: Birdsfoot trefoil</a>	Peace	2015-2017

Project	Project Resources*	Location	Year
Impact of forage grass and legume crops management practices on seed crops in legume based rotation	<a href="#">Factsheet</a>	Peace	2014
<b>CARBON SEQUESTRATION</b>			
Comparison of three biological solutions for enhancing perennial grass productivity and carbon sequestration	<i>In progress, Agriculture and Agri-Food Canada</i>	Peace	2021-2023
Perennial forage mix trails	<a href="#">Research summary</a>	Peace	2022
Impact of management intensive grazing on soil health	<a href="#">Research summary</a> <a href="#">Full project report</a>	Cariboo, Thompson-Okanagan	2018
Crop rotations with perennial forage seed crops: a beneficial low-cost option for the Peace region	<a href="#">Research summary</a>	Peace	2017

### 1.3 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 Peace region, soil management practices generally fall into two strategies.

#### 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)
- ▶ Organic matter 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

**Pasture rejuvenation strategies** support soil and forage productivity by stimulating release of soil nutrients and creating opportunities for robust root systems of preferential forages to develop. Pasture rejuvenation may also improve water infiltration, facilitate carbon sequestration, and extend the land’s productive life. Pasture rejuvenation practices include:

- ▶ Periodic pasture reseeding/overseeding
- ▶ Mechanical aeration
- ▶ Targeted fertilization

**Grazing management** should operate in ways that optimize livestock, soil, and pasture health. 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 other forage plants to regenerate. As livestock graze, plants have decreased leaf area to support photosynthesis and growth. Effective rest periods allow for plant growth/regrowth and can help maintain vigorous above ground and below ground development. This results in robust roots that maximize water and carbon sequestration and lush vegetation that provides optimal nutrition. Beneficial on-farm management practices include:

- ▶ Grazing management planning
- ▶ Rotational grazing
- ▶ Rest periods for pastures (rotational grazing)
- ▶ Animal impact management (i.e. compaction, riparian areas)
- ▶ Stocking rate/density management
- ▶ Soil health management
- ▶ Bale grazing
- ▶ In-field winter feeding

### Building on Recent Projects

#### Peace Region Living Laboratories Project:

- ▶ Build on soil management practices in on-farm trials to increase demonstration sites and extension opportunities

#### 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

### Funding Programs: SOIL MANAGEMENT

- ▶ [Environmental Farm Plan Program \(EFP\)](#)
- ▶ [EFP Beneficial Management Practices Program](#)
- ▶ [B.C. Climate Agri-Solutions – cover cropping and rotational grazing streams](#)

### Provincial Toolbox: SOIL MANAGEMENT



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

[Nutrient Management Calculator](#)

[Manure Nutrient Calculator](#)



Photo: Emrys Miller

# Water Storage and Development



## Adaptation

Changing climatic, regulatory, and farm management conditions are impacting water storage and development needs in the Peace 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 two of the last five years during summer and/or fall periods. Drought levels in 2023 have been prolonged at level 5, marking the worst drought in the region’s history. Concerns around agricultural water have also 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](#).

## 2.1 Why is water storage and development a priority?

- ▶ **DROUGHT associated with changing temperature and precipitation patterns:** Reduced precipitation and warmer temperatures are impacting dryland crops, and are contributing to loss of livestock ponds, accelerated evaporation in dugouts, and lower streamflow. With decreasing water supplies, water quality is impacted, which can have impacts on animal health. As most of the Peace region is unirrigated, impacts to forage, grain, and oilseed crops are a major challenge.
- ▶ **INSUFFICIENT FEED for livestock:** In dryland operations, reduced precipitation has led to significant declines in hay and forage yields (particularly in summer 2023), forcing some ranchers to buy feed they would normally grow themselves at demand-surge costs. Winter feed stores have also been heavily impacted. Livestock producers across the province have been challenged with difficult necessary actions (e.g., reduction of herd size, feeding winter stock early) 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:** 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.

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

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

Project	Project Resources*	Location	Year
<b>DROUGHT</b>			
<b>Resiliency: forage, water, and climate change risk assessment pilots</b>	<p><i>In progress, BC Cattlemen’s Association, Ministry of Agriculture and Food, Ministry of Forests</i></p> <p><i>Forthcoming tool: Landscape and range resiliency planning tool for Crown forage, surface water risk and climate change modelling</i></p> <p><i>Forthcoming factsheets:</i></p> <ul style="list-style-type: none"> <li>• <i>Forage and Water Resiliency Overview: Managing water and forage resources in a changing climate</i></li> <li>• <i>Reference Evaporation</i></li> <li>• <i>Calculating Carrying Capacity</i></li> <li>• <i>Flow Accumulation</i></li> </ul>	Interior North, Central, South, Kootenays	2023
<b>Climate resilient livestock surface water in the Cariboo</b>	<p><a href="#">Assessment methodology (2017)</a></p> <p><a href="#">Site assessment case studies</a></p> <p><a href="#">Report on pilot projects (2020)</a></p> <p><a href="#">Virtual training series 2022</a></p> <p><a href="#">Fact sheets</a></p> <p><a href="#">Range unit maps</a></p>	Cariboo	2017-2022
<b>Vanderhoof weather station data for agriculture</b>	<a href="#">Full project report</a>	Bulkley-Nechako	2017
<b>INSUFFICIENT FEED</b>			
<b>Climate change impact risk assessment tool for livestock water ponds</b>	<a href="#">Full project report</a>	Cariboo, Bulkley-Nechako	2017
<b>ON-FARM WATER STORAGE</b>			
<b>Water management resources and knowledge transfer of water best management practices for agriculture in B.C.</b>	<p><a href="#">Resource summary</a></p> <p><a href="#">Webinar series</a></p> <p><a href="#">Full project report</a></p>	Bulkley-Nechako / Fraser Fort George	2021
<b>Guidance on farm water storage</b>	<a href="#">Factsheet</a>	Provincial	2021
<b>Enhancing agricultural dams in the Cariboo</b>	<p><a href="#">Project Summary</a></p> <p><a href="#">Workshop summary</a></p> <p><a href="#">Full project report</a></p>	Cariboo	2017
<b>Study of the costs and benefits of dams and reservoirs on B.C. cattle ranches</b>	<a href="#">Full project report</a>	Cariboo	2016
<b>B.C. Farm water dugouts</b>	<a href="#">Guide</a>	Provincial	2016

**Funding Programs:  
WATER STORAGE  
AND DEVELOPMENT**

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

**Provincial  
Toolbox:  
WATER  
STORAGE  
AND DEVELOPMENT**



[B.C. Livestock Watering Handbook](#)

[B.C. Peace Agri-Weather Network](#)

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

[B.C. Dam Safety Training Course](#)

## 2.3 What's next: Looking ahead

Increasing water storage and development in the Peace region is a challenge that requires collaborative action at farm, regional, and regulatory levels. 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. Good on-farm management practices can help maintain water quality.

### On-Farm Management Practices

**Farm-level storage infrastructure** varies depending on operation needs and features of the natural landscape (e.g., groundwater or surface water). Types of infrastructure include:

- ▶ Dugouts (with multiple year precipitation capacity)
- ▶ Rainwater collection into storage tanks
- ▶ Reservoirs
- ▶ Livestock watering developments (reduce direct access to dugouts)

**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

### Building on Recent Projects

**On-farm water storage:**

- ▶ Support the development, enhancement, and maintenance of climate resilient farm water storage
- ▶ Improve informational resources and technical support for farm/ranch water storage development

**Drought response:**

- ▶ Support field-based water management demonstrations
- ▶ Apply and trial new tools for livestock surface water risk assessment process
- ▶ Support demonstration of resilient water developments in high-risk range units



# Sustainable Water Management

Photo: Karen Taber



## Adaptation

As the Peace region experiences lower than normal precipitation in the summer months, water needs for crops and livestock are increasing. Sustainable water management is a priority for producers to maintain the health of their livestock and the productivity of their crops. The 2021 agricultural census indicated that 1% of farms in the Peace region are irrigated; decreased precipitation and extended dry periods in the summer months therefore present a major challenge to forage, grain, and oilseed producers. Installing irrigation may be feasible in specific circumstances, and ensuring efficiency in new and existing irrigation infrastructure can support adaptation. Innovative strategies for livestock watering such as solar and geothermal watering systems can compensate for reduced water from natural sources (ponds, watercourses).

## 3.1 Why is sustainable water management a priority?

- ▶ **CROP MANAGEMENT in dryland operations is becoming increasingly challenging during drought conditions:** Producers have felt yield impacts from reduced precipitation. In the absence of water for crops, management practices like good variety selection and fertility management can help operations be more resilient.
- ▶ **IRRIGATION infrastructure may be increasingly considered by some producers as drought is more frequently experienced:** Operations that are irrigated can also benefit from improved irrigation efficiency.
- ▶ **LIVESTOCK WATER DEVELOPMENTS that are resilient to climate impacts can support livestock health and productivity through drought conditions:** Natural water systems like ponds, streams, rivers, and even dugouts may be less reliable for direct watering through dry periods and warm temperatures and can have increased environmental risks from livestock use.

## 3.2 What sustainable water management work has been done?

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

Project	Project Resources*	Location	Year
<b>CROP MANAGEMENT</b>			
<b>Resiliency: forage, water, and climate change risk assessment pilots</b>	<i>In progress, B.C. Cattlemen’s Association, Ministry of Agriculture and Food, Ministry of Forests</i>  <i>Forthcoming tool: Landscape and range resiliency planning tool for Crown forage, surface water and climate change, modelling</i>  <i>Forthcoming factsheets:</i> <ul style="list-style-type: none"> <li>• <i>Forage and Water Resiliency Overview: Managing forage and water resources in a changing climate</i></li> <li>• <i>Reference Evaporation</i></li> <li>• <i>Calculating Carrying Capacity</i></li> <li>• <i>Flow Accumulation</i></li> </ul>	Interior, North, Central, South, Kootenays	2023
<b>Soil water and resiliency in forage crops</b>	<a href="#">Factsheet</a>	Peace	2017
<b>Ministry of Agriculture: managing forage crops in drought conditions</b>	<a href="#">Factsheet: irrigation</a>	Provincial	2015
<b>IRRIGATION</b>			
<b>Evaluation of irrigation potential in the B.C. Peace region</b>	<a href="#">Project report</a> <a href="#">Factsheet: Supplemental irrigation</a> <a href="#">Factsheet: Irrigation site specifics</a> <a href="#">Factsheet: Economics of supplemental irrigation</a>	Peace	2017
<b>Farm water fix: climate resilient irrigation systems and management</b>	<a href="#">Video series</a>	Kootenay/Boundary, Provincial	2022
<b>Irrigate better: anatomy, pipe design, emission design, scheduling and monitoring</b>	<a href="#">Webinar series</a>	Kootenay/Boundary, Provincial	2018
<b>LIVESTOCK WATER DEVELOPMENT</b>			
<b>Climate resilient livestock surface water in the Cariboo</b>	<a href="#">Virtual training series 202</a> <a href="#">Fact sheets</a> <a href="#">Range unit maps</a> <a href="#">Assessment methodology (2017)</a> <a href="#">Site assessment case studies</a> <a href="#">Report on pilot projects (2020)</a>	Cariboo	2017-2022
<b>Future farm scenarios: Modelling the impacts of adding a solar watering system to cattle operations</b>	<a href="#">Water system scenario</a>	B.C., Alberta	2023

Project	Project Resources*	Location	Year
Study of the costs and benefits of dams and reservoirs on B.C. cattle ranches	<a href="#">Project report</a>	Cariboo	2016

### 3.3 What’s next: Looking ahead

Sustainable agricultural water management is shaped by regional and site conditions, appropriate infrastructure, and farm level practices. For dryland operations, on-farm practices that conserve soil moisture can support drought resilience, while field-level water conservation is a primary adaptation strategy for irrigated 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.

#### On-Farm Management Practices

**Climate-resilient livestock watering systems** can help ensure livestock have steady water supply through drought or freezing conditions. Natural water systems like ponds, streams, rivers, and even dugouts may be less reliable for direct watering through dry periods and warm temperatures and can have increased environmental risks from livestock use. Pumps and associated infrastructure can be useful alternatives. Many types of energy can be used to pump water and can be weighed against cost, producer preference, seasonality, number of livestock, etc. Specific infrastructure can include:

- ▶ Access ramps to direct sources
- ▶ Water gap fencing
- ▶ 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)

**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 keeping vegetation in the soil and targeted irrigation or watering systems that reduce overapplication and evaporation. Practices to increase water conservation include:

- ▶ Keeping the soil covered
- ▶ Water-efficient irrigation systems
- ▶ Irrigation scheduling
- ▶ Water quality protection measures
- ▶ Soil moisture meters and evapotranspiration sensors
- ▶ Rainwater collection and storage

**Funding Programs:  
SUSTAINABLE 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 and extreme heat preparedness streams
- ▶ [AgriStability](#) - agriculture income protection

**Building on Recent Projects**

**Water management:**

- ▶ Complete localized/sub-regional agricultural productivity and water risk and opportunity assessment
- ▶ Provide knowledge transfer resources and local demonstration for water management best practices
- ▶ Support field-based water management demonstrations

**Livestock watering systems:**

- ▶ Improve informational resources and technical support for livestock water development
- ▶ Re-evaluate needs for agricultural dugout maintenance and upgrades
- ▶ Pilot collaborative improvements of agricultural dams
- ▶ Apply and trial new tools for livestock surface water risk assessment process
- ▶ Support demonstration of resilient water developments in high-risk range units

Photo: B.C.Photo

**Provincial  
Toolbox:  
SUSTAINABLE  
WATER  
MANAGEMENT**



[B.C. Livestock Watering Handbook](#)

[B.C. Agriculture Water Calculator](#)

[B.C. Irrigation Water Use Calculator](#)

[Agricultural Irrigation Scheduling Tool](#)

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

[B.C. Irrigation Management Guide](#)



# 4

# Biodiversity and Habitat

Photo: Brenna Schilds



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. 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.

## 4.1 Why is management for biodiversity and habitat 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 are planned to balance benefits to agriculture 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. 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 crop 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 71% of farms in the Peace region contain vegetative buffers, shelterbelts, or windbreaks.

## 4.2 What biodiversity and habitat work has been done?

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

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

Project	Project Resources*	Location	Year
Silvopasture producer demonstrations – private land planning	<a href="#">Factsheet</a>	Cariboo	2017
<b>WILDLIFE CONFLICT</b>			
3D wildlife fencing project: Phase 2	<a href="#">Project description</a> <a href="#">Factsheet: Grounding electric fences</a> <a href="#">Factsheet: Wildlife fence behaviour</a> <a href="#">Factsheet: Responding quickly to wildlife pressure</a> <a href="#">Factsheet: Luring wildlife to your fence</a> <a href="#">Factsheet: Provincial adoption of 3D fencing</a>	Peace	2015
3D wildlife fencing project: Phase 1	<a href="#">Project description</a> <a href="#">Factsheet: Keeping wildlife away</a> <a href="#">Factsheet: Grain bags with 3D wildlife fence</a> <a href="#">Factsheet: Stackyard with 3D wildlife fence</a> <a href="#">Factsheet: Winter feeding with 3D wildlife fence</a> <a href="#">Factsheet: Does 3D fencing pay?</a> <a href="#">Factsheet: Silage bags with 3D wildlife fence</a> <a href="#">Factsheet: Adjustable 3D wildlife fence</a> <a href="#">Factsheet: Snow depth adjustments in 3D fencing</a> <a href="#">Factsheet: Types of 3D fencing</a>	Peace	2012
Best management practices for livestock protection	<a href="#">BMP Guide</a> <a href="#">Loss Prevention Practices for Cattle</a> <a href="#">Loss Prevention Practices for Sheep</a>	Provincial	N/A
Wildlife damage on fescue	<a href="#">Project report</a> <a href="#">Research summary</a> <a href="#">Factsheet: elk damage</a>	Peace	2012
<b>POLLINATION</b>			
Pollinator and crop/climate assessment	<a href="#">Factsheets</a> <a href="#">Factsheet: crop diversification in forage production</a> <a href="#">Full project report</a>	Bulkley-Nechako	2023
Investigating bee mortality from Varroa mites in B.C.	<i>In progress, B.C. Honey Producers' Association, UBC, Ministry of Agriculture and Food</i>	Peace Region, Provincial	2023
Electronic hive monitoring in the Peace region	<a href="#">Research summary</a>	Peace Region	2014

## 4.3 What's next: Looking ahead

Biodiversity-based practices 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 Peace 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
- ▶ Stackyard fencing
- ▶ Lambing/calving area management

**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 matter amendments

### Building on Recent Projects

- ▶ Expand knowledge transfer and professional supports for implementation of riparian enhancement activities in agricultural areas
- ▶ Create a green flood infrastructure strategy and endowment for agriculture

Photo: Bianca Ackermann/Unsplash



### Funding Programs: BIODIVERSITY AND HABITAT

- ▶ [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: BIODIVERSITY AND HABITAT



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



Photo: Emrys Miller

# Extreme Rainfall Management



Adaptation

Extreme rainfall events are increasingly frequent and severe across the province. Increased precipitation in spring and fall has resulted in freshet or flood events in the Peace region in recent years.

Beyond flooding, there are a range of risks to agricultural operations from extreme precipitation events in the Peace. For example, extreme precipitation can create soil erosion that degrades topsoil and/or results in nutrient runoff, break seedlings, or promote disease. Saturated soil can result in specific issues including higher greenhouse gas emissions because of anaerobic conditions, and higher risk of compaction from equipment use and grazing. Reducing traffic on the soil during periods of saturation can create challenges with achieving field work including implementation of on-farm management practices.

## 5.1 Why is extreme rainfall management a priority?

- ▶ **FLOODING is an increasing risk in agricultural areas located in river valleys during extreme rainfall events:** increased precipitation or temperatures causing rapid snowmelt can create unprecedented surges that can devastate agricultural operations.
- ▶ **EROSION is a high risk during extreme rainfall events for degraded or bare soils, and in sloping areas:** Valuable organic matter and nutrients can be lost via extreme precipitation and create risks for nutrient pollution in water resources and siltation impacts on downslope properties. Wet soils are also susceptible to compaction by equipment use or livestock trampling which further increases runoff and erosion risk.
- ▶ **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.

## 5.2 What extreme rainfall work has been done?

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

Project	Project Info/Results	Regions	Year
<b>FLOODING</b>			
Peace agri-weather network monitoring and enhancement	<a href="#">Project report</a> <a href="#">Factsheet</a> <a href="#">Video series</a> <a href="#">Tool: Peace Agri-Weather Network</a>	Peace	2022/23
Livestock sector emergency preparedness for flooding	<a href="#">Factsheet</a>	Provincial	2019
Farm flood readiness toolkit	<a href="#">Factsheets and worksheets</a> <a href="#">Landscape level approaches to mitigate flood impact</a>	Provincial	2022
<b>EROSION</b>			
Best management for on-farm management of runoff, drainage, and erosion	<a href="#">Project report</a> <a href="#">Project summary</a> <a href="#">Factsheet: Erosion risk mapping</a> <a href="#">Factsheet: Soil, water, and residue management tools</a> <a href="#">Factsheet: Conversations about runoff, drainage, and erosion</a>	Peace	2020
<b>DRAINAGE</b>			
Agricultural waterways: drainage maintenance and stewardship	<a href="#">Guide</a>	Provincial	2018
Improving soil health through enhanced water infiltration	<a href="#">Grab and Go Template for On-Farm Research</a>	Kootenay/Boundary	2021

Photo: Stephen Andrews/Unsplash



## Funding Programs: EXTREME RAINFALL MANAGEMENT

- ▶ [Extreme Weather Preparedness for Agriculture](#) - *flooding preparedness stream*
- ▶ [AgriStability](#) - *agriculture income protection*
- ▶ [Farmland Advantage](#) - *payment for ecosystem services: riparian areas*
- ▶ [Environmental Farm Plan Program \(EFP\)](#)
- ▶ [EFP Beneficial Management Practices Program](#) - *water infrastructure projects*

### Provincial Toolbox: EXTREME RAINFALL

[B.C. Flood Study Explorer](#)

[B.C. River Forecast Center](#)

[AgSafe Emergency Planning Resources - Flooding](#)

[B.C. Dam Safety Training Course](#)



## 5.3 What's next: Looking ahead

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, diversion and storage infrastructure, and soil management practices that maximize soil water infiltration, retention, and drainage can support farm resilience during excess precipitation events.

### On-Farm Management Practices

In the Peace region, excess precipitation management includes physical diversion, field practices, and planning strategies:

**Drainage systems** are critical for channeling water from excess precipitation away from crops and livestock as well as preventing waterlogging. Drainage systems can be natural (i.e. watercourses) or engineered (i.e. ditches). Observation of farm level and watershed level topography can indicate areas susceptible to waterlogging and/or flooding. Specific on-farm management practices for drainage include:

- ▶ Dikes
- ▶ Surface drainage (ditches, culverts, waterways)
- ▶ Subsurface drainage systems (tile drains, French drains)
- ▶ Swales
- ▶ Raised/mounded beds (in low-lying areas)
- ▶ Riparian restoration
- ▶ Riparian Fencing
- ▶ Bank Stabilization and Restoration
- ▶ Implementation and restoration of wetlands
- ▶ Alternative livestock watering systems
- ▶ Improved stream crossings

**Practices that optimize soil water dynamics** typically have a suite of benefits for soil function, crop productivity, and climate change adaptation and mitigation. On-farm management practices that conserve organic matter, maintain soil structure, and keep roots in the soil are particularly important for water infiltration and retention. Specific practices include:

- ▶ Rotational grazing
- ▶ Cover cropping
- ▶ No-till seeding
- ▶ Reduced tillage
- ▶ Integration of woody perennials

**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

#### Erosion:

- ▶ Develop joint/cross-farm erosion management projects
- ▶ Pilot and develop farm erosion risk reduction planning process/tool
- ▶ (with potential for integration into program cost-share supports)
- ▶ Conduct demonstration and knowledge transfer for soil health and erosion management practices

#### Riparian management:

- ▶ Expand knowledge transfer and professional supports for implementation of riparian enhancement activities in agricultural areas

Photo: Foster Richardson

# Additional Resources

## 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

- ▶ [UPDATE Peace Regional Adaptation Strategies](#) (2018)
- ▶ [Peace Regional Adaptation Strategies](#) (2013)

## Organic BC

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



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



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