Regional Extension Program

Environment and Climate REGIONAL GUIDEBOOK

Highway 16 North Cariboo

North Cariboo, Bulkley-Nechako, Fraser-Fort George, Kitimat-Stikine, North Coast

Prepared for the
B.C. Ministry of Agriculture and Food
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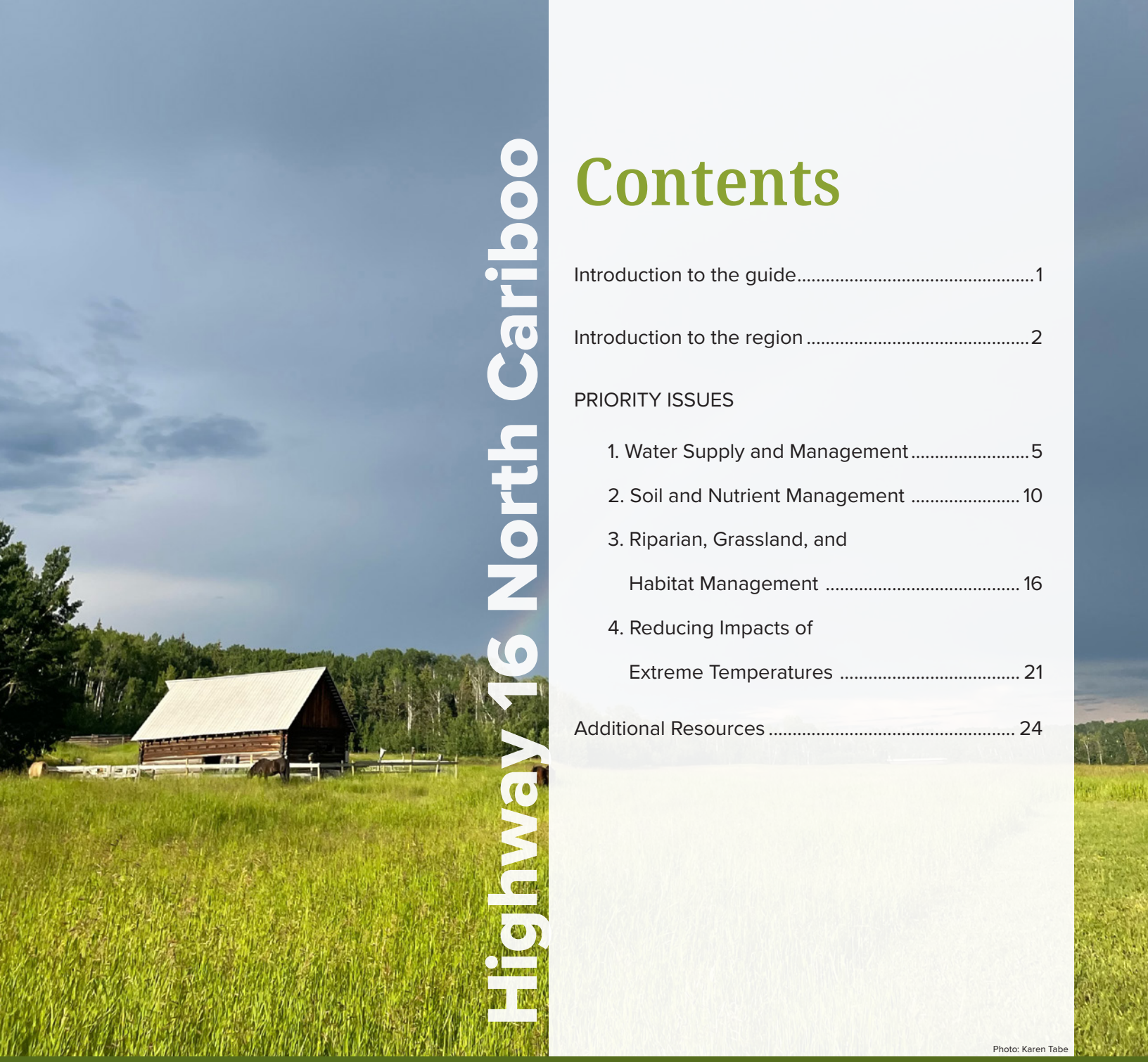

Highway 16 North Cariboo

Contents

Photo: Karen Tabe

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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

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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.

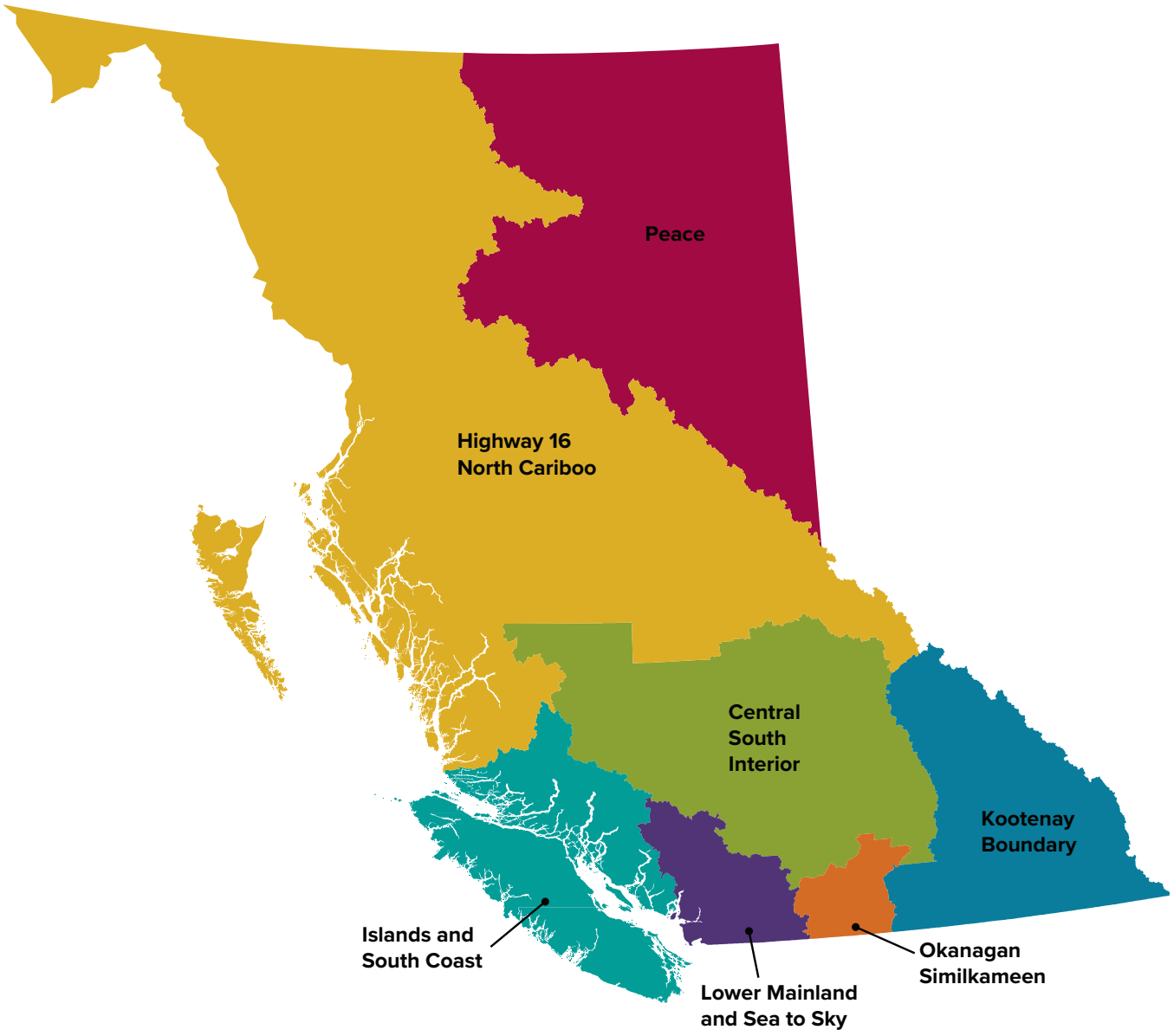
Each priority issue described in this guide includes:

- **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 Highway 16 and North Cariboo agricultural extension region comprises the Cariboo Electoral Areas A, B, C, and I, and the Bulkley-Nechako, Fraser-Fort George, Kitimat-Stikine, and North Coast regional districts. This region includes portions of the Cariboo, Nechako, and North Coast agricultural census districts. 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

Beef Cattle

Photo: Karen Tabe

Hay and Forage Crops

Photo: Karen Tabe

Mixed Livestock

Photo: Nicole Pressey

TRENDS IN FARM NUMBERS, FARM TYPE, AND FARMLAND AREA

(Census of Agriculture, 2021)

- In the Nechako, farm numbers decreased by 12% and farmland area decreased by 14.5% between 2011 and 2021. Hay production has decreased the most – the number of farms producing hay has dropped by 31.5% since 2011.
- Beef cattle have replaced hay as the predominant commodity in the Highway 16 and North Cariboo region in the last decade (now hosts 35% of provincial total by head).
- Farm receipts in the Nechako increased by 24.5% in the last decade, well below the provincial increase of 63%.
- In the North Coast region, farm numbers decreased by 30% and farmland area decreased by 30%. Hay and horse farming sectors lost the greatest number of farms.
- Farm receipts in the North Coast region increased by 176% in the last decade, well above the provincial increase of 63%.
- In both regions the largest loss of farm numbers was for those with annual revenues under $10,000. There was slight growth in farms with revenues over $100,000 in the Nechako and notable growth in farms with revenues over $50 000 in the North Coast.

Regional Climate Change Impacts

The Highway 16 and North Cariboo region covers a large area of the province that has significantly different climatic zones, but all areas are experiencing the impacts of climate change. In general, drier summer conditions, more frequent and intense wildfires, and more intense 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 continue to show the same trends. Because the majority of agricultural production occurs in the North Cariboo, Bulkley-Nechako, and Fraser-Fort George regions, agricultural climate projections and data are focused here.

PCIC Climate Projections: Bulkley-Nechako and Fraser-Fort George, 2050

TEMPERATURE

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

37 to 70 more
frost free days annually

PRECIPITATION

13% increase
in average spring precipitation
(+5% to +21%)

16% increase
in average fall precipitation
(+9% to +26%)

Drier summer
conditions

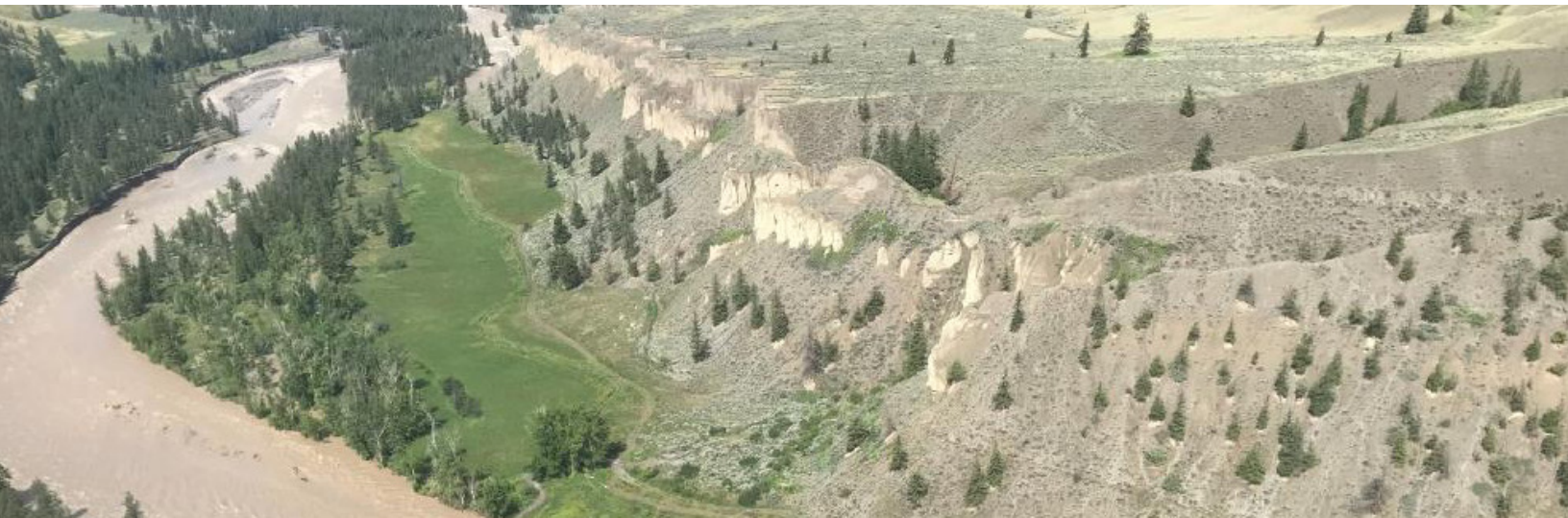
EXTREMES

Increase in frequency and magnitude
of extreme rainfall events

Average of
8 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: Chris Armes



1 Nutrient Management

Photo: Shutterstock

Mitigation

Environment

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 management 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 are outlined in the Code of Practice for Agricultural Environmental Management.

1.1 Why is nutrient management a priority?

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

1.2 What nutrient management work has been done?

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

Project	Project Resources*	Location	Year
OPTIMAL CROP PRODUCTIVITY			
Central interior forage fertilization trial	*In progress, Ministry of Agriculture and Food*	Central Interior	2021-2023
B.C. Living Lab: Cattle & Forage - producer-led testing, monitoring, and adoption of refined nutrient budgeting practices	*In progress* Project overview	Thompson-Nicola and Cariboo	2023-2027
Soil sampling guidelines for British Columbia	Guide	Provincial	2023
B.C. Climate Agri-Solutions nitrogen management projects	Nitrogen management extension resources	Provincial	2023
Modulating nitrogen responses in forage grasses for improved N use efficiency, yield, and grazing tolerance	*In progress, Agriculture and Agri-Food Canada*	Fraser Valley	2022-2024
Innovative nutrient management for resiliency	Factsheet: Legumes for resiliency and non-bloating Factsheet: Fertilizer placement, variable rate, and nitrogen losses Factsheet: managing on-farm nutrients to rejuvenate hayland Factsheet: Birdsfoot trefoil	Peace	2015-2017
NUTRIENT LOSS			
Agricultural environmental code of practice for cattle operations	Webinar	Provincial	2019
Nechako watershed health report	Project report	Bulkley-Nechako	2015
B.C. Living Lab: Dairy - producer-led testing, monitoring and adoption of refined nutrient budgeting and lower emission manure spreading	*In progress* Project overview	Lower Mainland	2023-2027
Phosphorus Index	*In progress, Ministry of Agriculture and Food*	Okanagan, Fraser Valley, Vancouver Island	2023-2024
Balancing nitrogen and phosphorus on organic vegetable farms	Podcast: N and P balance Online workshop Field trial results summary Podcast: Nutrient loss	Pemberton, Fraser Valley, Vancouver Island	2021

Project	Project Resources*	Location	Year
Best management for on-farm management of runoff, drainage, and erosion	Project summary Factsheet: Erosion risk mapping Factsheet: Soil, water, and residue management tools Factsheet: Conversations about runoff, drainage, and erosion Full project report	Peace	2020

1.3 What's Next: Looking Ahead

Optimal nutrient efficiency can help ensure crop quality and yield, cost efficiency, and environmental protection. On-farm management practices for nutrient management can be considered within three main strategies:

On-Farm Management Practices

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

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

Soil and crop management is concerned with improving soil health and managing crops to enhance nutrient cycling. Practices can overlap with other priority areas, such as soil management, and include:

- Soil testing and analysis
- Crop rotation
- Cover cropping
- Reduced tillage
- Residue retention

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
- Effluent management
- Nutrient recovery and recycling
- Riparian protection and restoration
- Appropriate rates of application based on factors above

Funding Programs: NUTRIENT MANAGEMENT

The Ministry of Agriculture and Food, with delivery support from the Investment Agriculture Foundation (IAF), offers the following funding programs that address nutrient management:

- Environmental Farm Plan Program (EFP)
- EFP Beneficial Management Practices Program - *nutrient and waste management projects*
- B.C. Climate Agri-Solutions (Agriculture and Agri-Food Canada) - *nitrogen management stream*

Provincial Toolbox: NUTRIENT MANAGEMENT

- Nutrient Management Calculator
- Nutrient Management Plan Training
- Application Risk Management Tool
- Manure Nutrient Calculator
- Soil Test Phosphorus Converter
- Post-Harvest Nitrate Test Calculator

Building on Recent Projects

B.C. Living Lab:

- Cattle and Forage: Building on extended grazing and nutrient management on-farm trial sites to increase demonstration sites and extension opportunities

Forage crops:

- Explore and trial nutrient optimization for forage stand productivity
- Explore and trial low-emission fertilizer application technologies
- Trial increased legumes in perennial forage stands
- Enhance soil testing and crop nutrient analysis opportunities for forage producers

Photo: Shutterstock

2 Water Storage and Development

Photo: Emrys Miller

Adaptation

Changing climatic, regulatory, and farm management conditions are impacting water storage and development needs in the Highway 16 and North Cariboo 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. Drought levels in 2023 have been prolonged at level 5, marking the worst drought in the region's history.

The 2021 agricultural census indicated that 18% of farms in the Cariboo are irrigated, compared to 10% in Bulkley-Nechako and Fraser-Fort George regions. Both regions may have increased water demand as the need for irrigation in the summer months increases. 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?

- **INSUFFICIENT FORAGE and winter feed for livestock due to drought:** In dryland operations, reduced precipitation has led to significant declines in hay and forage yields (particularly in 2023), forcing some ranchers to buy feed they would normally grow themselves at demand-surge costs. Livestock producers across the province have been challenged with difficult necessary actions (e.g., reduction of herd size, feeding winter stock early,) and are relying on additional supports and programs.
- **WATER SUPPLY decreased by changing temperature and precipitation patterns:** Reduced summer precipitation and warmer temperatures are contributing to loss of ponds across rangeland areas of the Highway 16 and North Cariboo region. With decreasing water supplies, water quality is impacted, which can have effects on animal health. Variable snowpack and earlier peak stream flows are also contributing to water supply concerns in the Nechako watershed.
- **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.
- **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
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* *Forthcoming tool: Landscape and range resiliency planning tool for Crown forage, surface water and climate change, modelling* *Forthcoming factsheets:* • *Forage and Water Resiliency Overview: Managing forage and water resources in a changing climate* • *Reference Evaporation* • *Calculating Carrying Capacity* • *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* *Forthcoming factsheets:* • *Climate change mitigation and adaptation case studies*	Cariboo, Highway 16 North, Kootenay	2023
Climate resilient livestock surface water in the Cariboo	Assessment methodology (2017) Site assessment case studies Report on pilot projects (2020) Virtual training series 2022 Fact sheets Range unit maps	Cariboo	2017-2022
Innovative soil management for resiliency	Factsheet: soil water and resiliency	Peace	2017
Ministry of Agriculture: managing forage crops in drought conditions	Factsheet: irrigation	Provincial	2015
WATER SUPPLY			
Climate resilient livestock surface water in the Cariboo	Assessment methodology (2017) Site assessment case studies Report on pilot projects (2020) Virtual training series 2022 Fact sheets Range unit maps	Cariboo	2017-2022
Climate change impact risk assessment tool for livestock water ponds	Full project report	Cariboo, Bulkley-Nechako	2017

Project	Project Resources*	Location	Year
Innovative soil management for resiliency	Factsheet: soil water and resiliency	Peace	2017
Vanderhoof weather station data for agriculture	Full project report	Bulkley-Nechako	2017
IRRIGATION EFFICIENCY			
Improving irrigation efficiency for managing during dry conditions	Factsheet series Webinar	Okanagan	2023
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
Evaluation of irrigation potential in the B.C. Peace region	Factsheet: Supplemental irrigation Factsheet: Irrigation site specifics Factsheet: Economics of supplemental irrigation Full project report	Peace	2017
ON-FARM WATER STORAGE			
Future farm scenarios: Modelling the impacts of adding a solar watering system to cattle operations	Water system scenario	B.C., Alberta	2023
Water management resources and knowledge transfer of water best management practices for agriculture in B.C.	Resource summary Webinar series Full project report	Bulkley-Nechako / Fraser Fort George	2021
Guidance on farm water storage	Factsheet	Provincial	2021
Enhancing agricultural dams in the Cariboo	Project Summary Workshop summary 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

2.3 What's Next: Looking Ahead

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

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 can be achieved through targeted irrigation or watering systems that reduce overapplication and evaporation, and water quality protection measures that safeguard existing water supply. As the Highway 16 and North Cariboo region has primarily unirrigated farmland, all sectors face challenges to bridge the gap during periods of reduced precipitation. Practices to increase water conservation include:

- Water-efficient irrigation systems
- Irrigation scheduling
- Selection of drought-tolerant varieties
- Water quality protection measures (riparian buffers, nutrient management, contaminated runoff collection/storage/disposal, safe pesticide handling and application)
- Soil moisture meters and other technologies
- Rainwater collection and storage

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. within intensive cell pasture system)

Building on Recent Projects

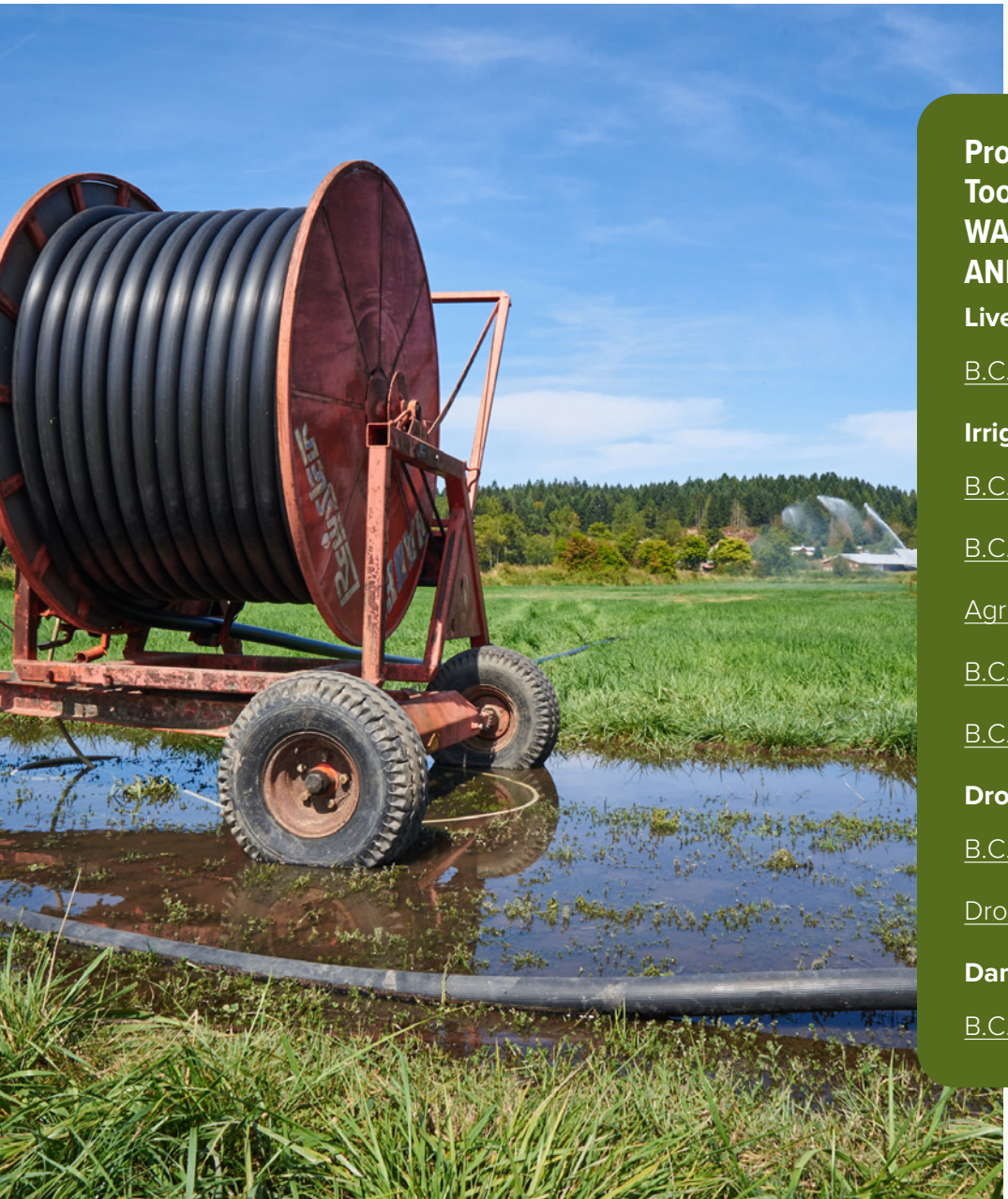
Drought response:

- Provide knowledge transfer resources and local demonstration for water management best practices
- Support field-based water management demonstrations

Water access and storage:

- Improve informational resources and technical support for farm/ranch water storage development
- Complete localized/sub-regional agricultural water supply risk and opportunity assessments
  - 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: Emrys Miller



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

Livestock

B.C. Livestock Watering Handbook

Irrigation

B.C. Agriculture Water Calculator

B.C. Irrigation Water Use Calculator

Agricultural Irrigation Scheduling Tool

B.C. Irrigation Management Guide

B.C. Irrigation Resources

Drought

B.C. Drought Information Portal

Drought in Agriculture

Dams

B.C. Dam Safety Training Course

3 Crop Selection for Resilience

Photo: Emrys Miller

Adaptation

Environment

As the seasons become more variable, specific varieties of key crops that have historically been productive may underperform or become unreliable. Rising temperatures and increasing variability in temperature, frost, and precipitation patterns can reduce crop yields as well as create conditions for increased pest and disease pressures. Regionally adapted cultivars are bred within the region of intended production to ensure crop traits function well in the local area.

As the impacts of climate change accelerate, producers are seeking crop varieties that can still produce well in periods of increased water stress, disease, or pest pressures. Varieties that can endure a broader range of temperatures and precipitation levels are important. Increased climate variability and an increased number of growing degree days may also create opportunities for new crops and varieties in the region. Plant breeding and cultivar development is a slow process; upwards of 10 years may be needed to develop a new variety. This long timeline makes on-farm variety trials an important part of adaptation, so that farmers can better understand how existing varieties or varieties new to the region perform locally, and share farmer-to-farmer knowledge of region-specific data and observations.

3.1 Why is crop selection for resilience a priority?

- **CHANGING TEMPERATURE and extreme weather events can cause staple varieties to underperform.** Drought conditions and extreme events, such as the 2021 Western North America heat dome, have drastically reduced yield in staple varieties across commodities (notably forage). Varieties that are more heat resilient are beginning to be preferred by producers across the province.
- **CHANGING PRECIPITATION patterns cause seeding and harvest timing and frequency to change.** As precipitation load shifts into spring and fall, producers may need to shift seeding and harvest times and frequency. Some commodities may increase harvest frequency, others (e.g., hay) may be reduced.
- **PEST & DISEASE PRESSURE may increase due to changing climatic conditions:** as temperature and precipitation shifts across the province, some regions may become more susceptible to pests and diseases of concern.

3.2 What crop selection for resilience work has been done?

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

Project	Project Resources*	Location	Year
TEMPERATURE & PRECIPITATION			
On-farm research in forage production	*In progress, Ministry of Agriculture and Food*	Cariboo, Central South Interior	2023
Selecting suitable and adaptive dryland forage crops and varieties	Tool: Forage U-Pick (Species Selection) Tool case studies Factsheet: alfalfa Factsheet: brome grasses Factsheet: Forage selection guide Full project report	Bulkley-Nechako, Peace	2023
On-farm forage variety trials	A Guide to On-Farm Demonstration Research: Case Studies 1-4 Research Guide	Bulkley-Nechako and Fraser-Fort George	2016/ 2017
Forage variety trials	Factsheet	Cariboo-Chilcotin	2009-2012
Pollinator and crop/climate assessment	Factsheets Factsheet: crop diversification in forage production Full project report	Bulkley-Nechako	2023
Extending the greenhouse growing season in the Cariboo	Research summary Full project report	Cariboo	2021
Testing new crops with on-farm research	Grab and Go Template for On-Farm Research	Kootenay Boundary	2021
Birdsfoot trefoil: the pasture legume	Factsheet	Peace	2017
B.C. Seed Trials	Variety trial results Variety trial and seed growing resources list	Provincial	2016-2018

Photo: Brenna Schilds

Funding Programs: CROP SELECTION FOR RESILIENCE

- Perennial Crop Renewal Program
- AgriStability and BRM suite of programs - *agriculture income protection*

Provincial Toolbox: CROP SELECTION FOR RESILIENCE

Forage U-Pick (Species Selection Tool)

B.C. Rangeland Seeding Manual

3.3 What's Next: Looking Ahead

The impacts of climate change on crops and associated pests and diseases are increasing, causing producers to implement strategies and practices to ensure crops are resilient. Practices for crop and variety selection for resilience fall into three main strategies.

On-Farm Management Practices

Crop diversity and adaptation focuses on selecting and developing a diverse range of varieties adapted to regional conditions. This strategy requires participation from producers, industry, and academia to develop and trial new varieties. Practices include:

- Regional adaptation of crop varieties with diverse selection
- Diversification of forage mixes
- Selection of climate resilient varieties

Management for pest and disease risks is achieved through a suite of practices that can help reduce losses associated with changing pest and disease pressures. Practices include:

- Crop rotation
- Integrated pest management
- Cover cropping
- Biosecurity to prevent introduction of new pests

Monitoring and adaptive management are critical to track the success of new variety trials. Practices include:

- On-farm research
- Continuous monitoring/scouting and data collection
- Real-time crop performance assessments
- Integration of local and Indigenous knowledge

Building on Recent Projects

- Coordinate local crop trials and farm practice research and demonstration with opportunities for farmer-to-farmer data sharing
- Improve regional weather station coverage and related decision support tools
- Establish and support regional weather network "hubs" to track detailed weather information to provide baseline information for regional crop selection and variety trials

4 Grazing Management Systems

Photo: Brenna Schilds

Adaptation

Mitigation

Grazing management systems are concerned with planning when and where livestock are grazed. They aim to maintain or increase the economic profitability of grazing operations while maintaining the natural integrity of forage, soil, water, and environmental resources. There are several types of grazing systems for sustainable livestock management, depending on the size and type of grazing land and its suitability for natural or managed forage production and the type of livestock involved. Producers in the Highway 16 and North Cariboo are provincial leaders in adopting intensive grazing management practices, which are more common on tame or annual pasture. Silvopasture (a system that intentionally blends management of trees, forages, and livestock on the same land unit) is also used in the region.

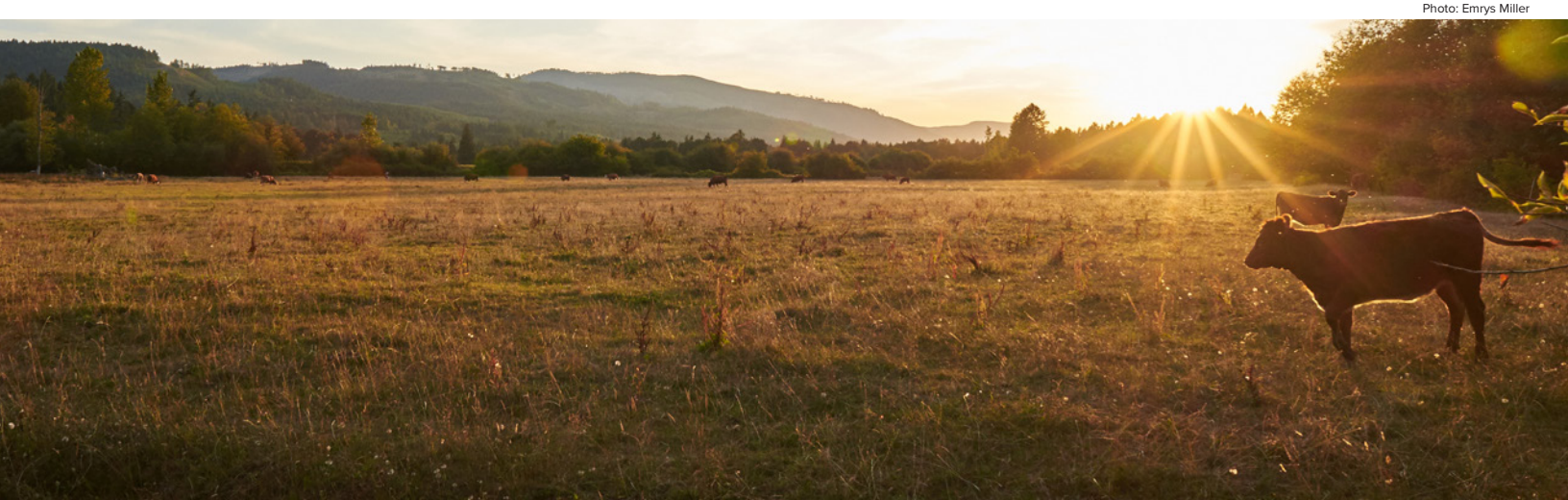
Good grazing management should balance forage productivity and pasture health with livestock production. Indicators of a good grazing management system include consistent pasture cover with healthy and desirable forage plants, good soil water infiltration, good soil structure, healthy riparian areas, and maintenance of wildlife habitat.

Key infrastructure for all grazing management systems includes fencing, water developments, and mineral supplements. Rotational grazing can generate attractive revenues and can improve soil function and sequester carbon, but limited existing infrastructure and high cost of installation are among the challenges in the Highway 16 and North Cariboo region.

4.1 Why are grazing management systems a priority?

- **CROP PROTECTION measures are becoming crucial to avoid severe impacts of extreme heat. DEGRADED PASTURE reduces forage productivity and soil capabilities that support adaptation to climate impacts:** Overgrazing can lead to significant reductions in forage plant health and productivity, while degraded soil structure from a) compaction from equipment or livestock and b) intensive tillage practices reduce the soil's air porosity and organic matter content that are needed for good water infiltration, water retention, and root health.
- **SILVOPASTURE is an agroforesty system that intentionally integrates the management of livestock, forage and trees:** In B.C., use of silvopasture is less common than conventional forestry, range and pasture management but on-farm research and development are in-progress in several regions. Silvopasture can maintain or augment forage resources for both livestock and native ungulates and diversify revenue, while contributing to carbon sequestration, climate change adaptation strategies and environmental stewardship goals such as enhanced riparian area protection.
- **INTENSIVE GRAZING SYSTEMS can optimize pasture health and livestock productivity:** In contrast to continuous grazing where livestock graze a specific area throughout a year or grazing season, intensive grazing management systems divide pastures into intensively managed units where available area, livestock numbers, duration of grazing, and other tools are used to reach management goals. Intensive grazing management can be used to build and maintain pastures where desired forage plants provide nutritious above-ground growth and robust below-ground root systems that sequester carbon and improve water infiltration and soil structure.
- **FEEDING STRATEGIES are essential to good grazing management, as they optimize livestock health and can support better pasture health and nutrient management:** Ensuring optimal nutrition through selection of managed or native forage species safeguards livestock assets, while strategies such as bale grazing and in-field winter feeding can reduce impacts on soil and reduce manure buildup/risk of runoff in smaller wintering sites and corrals.
- **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 Highway 16 and North Cariboo region, ungulates and large predators are particularly challenging for livestock and forage producers. As climate impacts shift wildlife habitats and patterns, impacts on agriculture may shift and require new management strategies.

Photo: Emrys Miller



4.2 What grazing management systems work has been done?

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

Project	Project Resources*	Location	Year
DEGRADED PASTURE			
Exploring pasture renovation techniques	*In progress, Ministry of Agriculture and Food*	Cariboo, Central South Interior	2023
Strategies for rejuvenating forage and pasture lands impacted by drought	Resource guide	Provincial	2023
Demonstrating no-till pasture rejuvenation practices in central and northern interior of B.C.	Research summary Full project report	Cariboo-Chilcotin, Fraser-Fort George	2023
Multi-functional pasture rejuvenation in the Cariboo	Research summary Full project report	Cariboo	2023
Interseeding to improve forage quality and quantity	Research summary Factsheet: Foxtail barley infestation management Factsheet: Interseeding with VREDO Factsheet: Winter and frost seeding?	Peace	2019-2022
Grassland monitoring manual for B.C.: A tool for ranchers	Manual	Provincial	2019
Riparian management field workbook for streams and small rivers	Field workbook	Provincial	2019
Soil quality test kit [Pastures]	Soil quality test kit	Cariboo, Bulkley-Nechako	2018
Improving forage productivity and profitability in grazing and haying systems	Project summary Factsheet: Locating field benchmarks for monitoring Factsheet: How photogenic is your forage Factsheet: Estimating forage yields Factsheet: Are you happy with your forage stand Factsheet: Manure improvement Factsheet: Bale grazing for pasture improvement Factsheet: Farm decision making Factsheet: Grazing improvements Factsheet: Up your grazing game	Peace	2017-2020

Project	Project Resources*	Location	Year
SILVOPASTURE			
Modular silvopasture training workshop development – Phase 2	*In progress, Ministry of Agriculture and Food*	Cariboo, Central South Interior	2023
Grazing and fine fuels reduction BMP tools	*In progress, Ministry of Agriculture and Food*	Cariboo, Central South Interior	2023
Silvopasture pilots: Crown Land	*In progress, Ministry of Agriculture and Food*	Central South Interior, Thompson-Okanagan, Highway 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* Factsheet Video: Wildfire risk mitigation	Central South Interior, Kootenay-Boundary	
Riparian restoration: debris barriers reduce effects of livestock grazing	Factsheet: live stakes Factsheet: debris stakes Journal article: Debris barriers reduce effects of livestock grazing along streams after timber harvest Factsheet: live stakes Factsheet: debris stakes	Okanagan	2022
Riparian management field workbook for streams and small rivers	Field workbook	Provincial	2019
Silvopasture strip thinning pilot	Master's student dissertation	Cariboo	2018
Silvopasture producer demonstrations – private land planning	Factsheet	Cariboo	2017
Targeted knowledge transfer and development of producer experience case studies in silvopasture	*In progress, Ministry of Agriculture and Food*	Thompson-Nicola, North Okanagan	2023
INTENSIVE GRAZING			
Impact of management intensive grazing on soil health	Research summary Full project report	Cariboo, Thompson	2018
B.C. Climate Agri-Solutions rotational grazing projects	Extension resources	Lillooet, Vancouver Island	2023
FEEDING STRATEGIES			
B.C. Living Lab: Cattle & Forage Practices - producer-led testing, monitoring, and adoption of extended feeding strategies	*In progress* Project Overview	Thompson-Nicola, Cariboo	2023-2027

Project	Project Resources*	Location	Year
Legumes for resiliency and non-bloating	Factsheet	Peace	2017
WILDLIFE CONFLICT			
Best management practices for livestock protection	BMP Guide Loss Prevention Practices for Cattle Loss Prevention Practices for Sheep	Provincial	N/A
Elk exclusion fencing	*In progress, Ministry of Agriculture and Food* Factsheet: Elk exclusion fencing 3D fencing	Provincial	2015-2023
3D wildlife fencing project: Phase 2	Project description Factsheet: Grounding electric fences Factsheet: Wildlife fence behaviour Factsheet: Responding quickly to wildlife pressure Factsheet: Luring wildlife to your fence Factsheet: Provincial adoption of 3D fencing	Peace	2015
3D wildlife fencing project: Phase 1	Project description Factsheet: Keeping wildlife away Factsheet: Grain bags with 3D wildlife fence Factsheet: Stackyard with 3D wildlife fence Factsheet: Winter feeding with 3D wildlife fence Factsheet: Does 3D fencing pay? Factsheet: Silage bags with 3D wildlife fence Factsheet: Adjustable 3D wildlife fence Factsheet: Snow depth adjustments in 3D fencing Factsheet: Types of 3D fencing	Peace	2012
Wildlife damage on fescue	Research summary Factsheet: elk damage Full project report	Peace	2012

4.3 What's Next: Looking Ahead

Producers are increasingly employing on-farm management practices that are included in sustainable grazing management systems. These practices can contribute to climate adaptation, reduction of net greenhouse gas emissions, and environmental management. In the Highway 16 and North Cariboo region, on-farm grazing management practices generally fall into two strategies:

Funding Programs: GRAZING MANAGEMENT SYSTEMS

- Environmental Farm Plan Program (EFP)
- EFP Beneficial Management Practices Program
- Species At Risk Partnerships on Agricultural Land (B.C. Cattlemen's Association)
- BC Climate Agri-Solutions *–rotational grazing streams* (Agriculture and Agri-Food Canada)

Provincial Toolbox: GRAZING MANAGEMENT SYSTEMS

Grazing Management Guide

FaRM B.C. Advanced Grazing Systems Course

On-Farm Management Practices

Intensive grazing strategies can be 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 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 growth development resulting 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
- 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

Resource and ecosystem conservation are key outcomes of good grazing management that reflect grazing livestock production's integration with natural systems in the Highway 16 and North Cariboo region. Practices such as riparian management, fencing, and habitat enhancement help livestock coexist with wildlife and natural systems. Practices include:

- In-field water developments
- Exclusion fencing
- Wildlife friendly fencing
- Riparian conservation
- Invasive species management
- Wildlife habitat enhancement
- Agricultural/wildland fuel management
- Stackyard fencing
- Conflict reduction planning
- Non-lethal deterrents and livestock protection practices

Building on Recent Projects

- Improve informational resources and technical support for farm/ranch water storage development
- Develop a pilot project and resources for pasture health assessments and plans
- Conduct multi-year monitoring of the Bulkley-Nechako/Fraser-Fort George agricultural wildland interface fuel management pilot site

5 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.

Soil health outcomes are influenced by many factors. Some issues and management strategies are sector specific, but several are common challenges across commodities in the Highway 16 and North Cariboo region. These include limited access to soil testing, diverse soil conditions that make the applicability of recommended soil management practices unclear, and lack of soil classification data.

5.1 Why is soil health management a priority?

- **SOIL DEGRADATION reduces resilience to climate change impacts:** Degraded soil structure from compaction by equipment or livestock, or intensive tillage practices, reduce the soil's air porosity, which is needed for good water infiltration, water retention, microbial activity and root growth.
- **NUTRIENT CYCLING processes that support natural soil fertility can be optimized in well-managed soils:** The soil organisms that cycle nutrients and make them available for plants rely on organic matter, suitable pH and adequate physical soil properties. Supportive practices include adequate organic matter amendments, cover cropping, maintaining soil cover, and reducing soil degradation. In the Highway 16 and North Cariboo region, the success of cover cropping is site-specific; for example, short growing seasons and limited irrigation infrastructure increase the challenges of cover crop adoption and establishment.
- **CARBON SEQUESTRATION in some soils can be enhanced using certain soil management practices:** Soils that have vegetative 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 soil carbon sequestration.

5.2 What soil management work has been done?

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

Project	Project Resources*	Location	Year
SOIL DEGRADATION			
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.	Research summary Full project report	Cariboo-Chilcotin, Fraser-Fort George	2023
Multi-functional pasture rejuvenation in the Cariboo	Research summary Full project report	Cariboo	2023
Improving soil health through enhanced water infiltration	Grab and Go Template for On-Farm Research Webinar: indicators of soil health	Provincial, Kootenay/Boundary	2021
Soil quality test kit [Pastures]	Soil quality test kit	Cariboo, Bulkley-Nechako	2018
Best management for on-farm management of runoff, drainage, and erosion	Project summary Factsheet: erosion Factsheet: soil, water, and residue management Factsheet: runoff, drainage, and erosion Full project report	Peace	2020
Innovative soil management for resiliency	Factsheet: soil water and resiliency Factsheet: soil quality for resiliency	Peace	2015-2017
NUTRIENT CYCLING			
Provincial Cover Crop Factsheets (23 cover crop species)	*In progress, Ministry of Agriculture and Food* *Forthcoming tool: digital cover crop selection tool*	Provincial	2023
B.C. Climate Agri-Solutions cover cropping projects	Extension resources	Provincial	2023
B.C. Living Lab: Cattle & Forage Practices - producer-led testing, refinement, monitoring and adoption of winter cover cropping	*In progress* Project Overview	Thompson-Nicola and Cariboo	2023-2027
CARBON SEQUESTRATION			
Impact of management intensive grazing on soil health	Research summary Full project report	Cariboo, Thompson-Okanagan	2018

5.3 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 Highway 16 and North Cariboo, soil health management practices generally fall into two strategies:

On-Farm Management Practices

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. On-farm practices include:

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

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; several areas of the region have low natural soil organic matter. Practices include:

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

Building on Recent Projects

B.C. Living Laboratories Projects:

- Cattle and Forage: Building on extended grazing and cover cropping on-farm trial sites 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

The Ministry of Agriculture and Food, with delivery support from the Investment Agriculture Foundation (IAF), offers the following funding programs that address soil management:

- Environmental Farm Plan Program
- EFP Beneficial Management Practices Program
- B.C. Climate Agri-Solutions – *cover cropping and rotational grazing streams* (Agriculture and Agri-Food Canada)

Provincial Toolbox: SOIL MANAGEMENT

B.C. Soil Information Finder Tool

Nutrient Management Calculator

Manure Nutrient Calculator

Additional Resources

Photo: Lisa Zabek

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 (BC Ministry of Agriculture and Food/UBC, 2021)

Regional adaptation strategies

(B.C. Climate Change Adaptation Program)

- Applied Adaptation Research Strategic Plan (Cariboo Agricultural Research Alliance, 2020)
- Bulkley-Nechako and Fraser-Fort George Regional Adaptation Strategies (2019)

Organic BC

- Podcast series
- Organic Innovation video series

This guidebook needs to
be 32 pages
(multiples of 4 for print).
So the following blank pages need to be
filled with other content:

e.g.

Photo and/or Quote or message

OR

“Additional Resources” can be put on the
Back Cover, in order to make 28 pages.

Reply from Bree (Dec. 18)

Since this version will be digital, we can
cut out the extra pages and not toss the
additional resources on the back cover.
Thanks for clarifying though!!

Reply from AC (Jan 5):

Great!, no worries for the digital version.
Content is still needed for these 3 pages
for the print version, though.

For more information, visit our website.

Or email us:
AgriServiceBC@gov.bc.ca