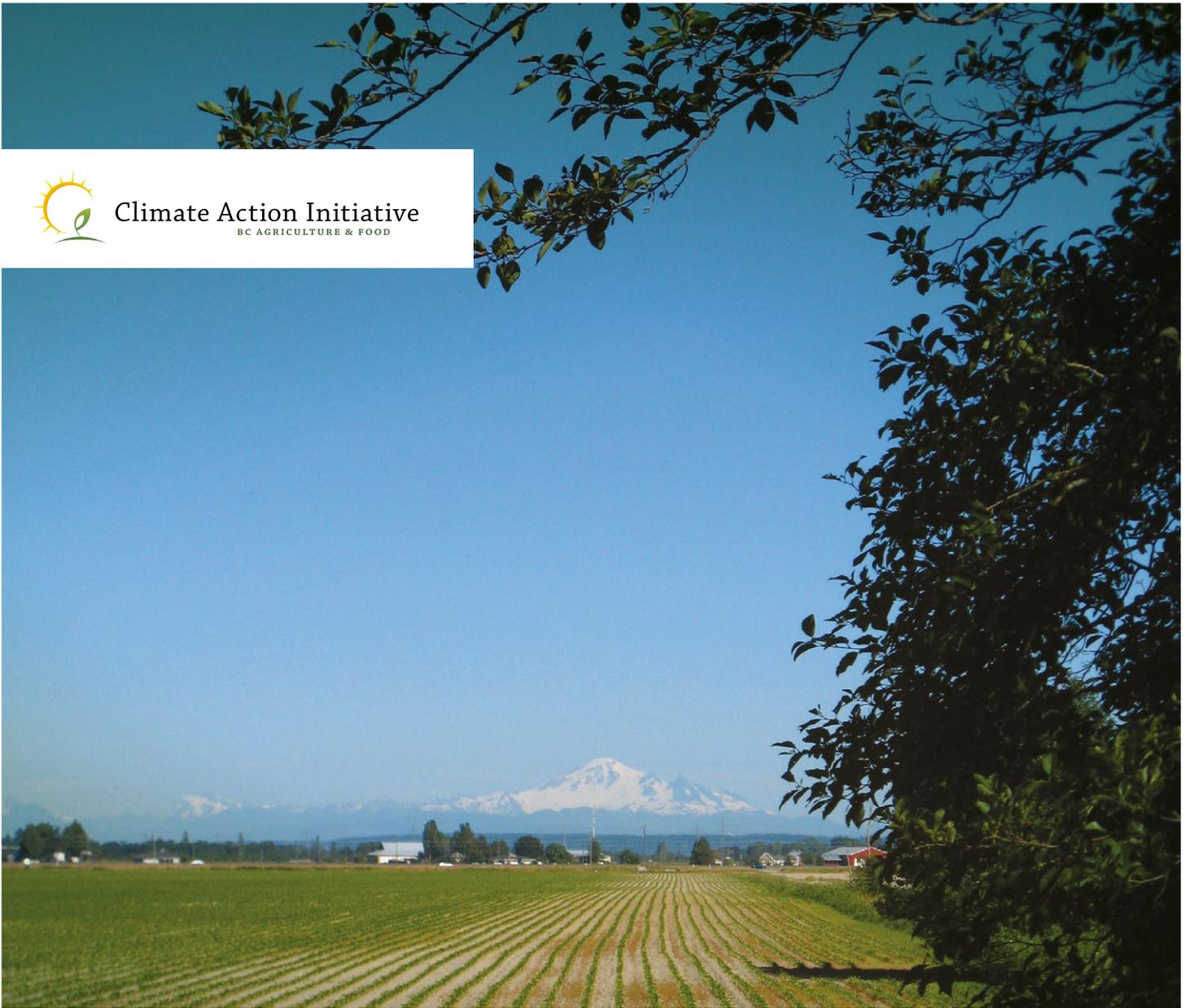




Climate Action Initiative
BC AGRICULTURE & FOOD



BC Agriculture
Climate Change Adaptation
Risk + Opportunity Assessment

Provincial Report
EXECUTIVE SUMMARY



Climate Action Initiative

BC AGRICULTURE & FOOD

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The Action Plan is available at:
www.BC.AgClimateAction.ca

This project involved contributions from many people in different capacities from its early stages through to its completion. The project management team assisted in developing, guiding and executing the project: Dr. David Connell (University of Northern BC), Jennifer Pouliotte (BC Ministry of Environment) and Allen James (BC Agriculture Council). In addition, Dr. Connell played a key role in developing the focus group design and providing background research. Rachelle Beveridge assisted with background research, focus groups, analysis of the interviews and development of Chapter 4 of the Provincial Report. Lauren Klose helped with background research and materials for the focus groups.

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The results of this project will be applied to two new Climate Action Initiative projects in 2012–2013. The *On-Farm Adaptation Practices* project will explore appropriate farm level adaptation practices for BC agriculture. The *Regional Agricultural Adaptation Strategies* project will pilot a collaborative adaptation planning process involving local and regional government and the agriculture industry organizations as partners.

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Project Rationale & Methodology

THE BC AGRICULTURE CLIMATE CHANGE ADAPTATION RISK & OPPORTUNITY ASSESSMENT is intended to improve collective knowledge of how changes to the climate may impact agricultural commodities in key regions of BC, and the risks and opportunities associated with these impacts.

This project was initiated by the BC Agriculture Council's Climate Action Initiative (CAI) to begin addressing the priorities identified in the *BC Agriculture Climate Change Action Plan*. Technical support and expertise for this project was provided by a project advisory committee with representation from a number of agencies and organizations.

This assessment has gathered perspectives from agricultural producers about their ability to adapt to current and projected challenges and opportunities, and to identify approaches, tools and resources required to better support adaptation. In addition to extensive background research, original data was collected through 37 interviews and 12 focus groups with producers and specialists across the province.

The overall findings of this project are available through a provincial report, as well as a series of five region/commodity "snapshot" reports. The snapshot reports communicate the findings and key actions associated with production of specific commodities in each region of focus.

The incredible diversity of the BC agriculture sector cannot be captured through one project. This study offers a foundation or baseline; a starting point for further dialogue as well as guidance for development of approaches and resources to enhance BC's agriculture sector in a changing climate.

The results of this project will be applied to two new Climate Action Initiative projects in 2012–2013. The *On-Farm Adaptation Practices* project will explore appropriate farm level adaptation practices for BC agriculture. The *Regional Agricultural Adaptation Strategies* project will pilot a collaborative adaptation planning process involving local governments and agriculture industry organizations as partners.

This Executive Summary provides a high level summary and the key findings in each section of the provincial report including:

- Background on the BC agriculture sector;
- Factors affecting the industry's current resilience and capacity to adapt;
- Projected climate changes for the 2020s in BC;
- Potential impacts, risks and opportunities associated with climate change; and
- Key actions to enhance the adaptive capacity and resilience of agriculture in BC.



BC Agricultural Profile

THE BC AGRICULTURE SECTOR is unusual in many respects and is embedded within a unique context. BC has an unusually limited agricultural land base, an uncommon level of diversity within the sector (with respect to geography and products) and a relatively high number of small family farms. These factors influence agriculture's current role in BC's communities, economy and society as a whole. They have also strongly influenced the current state of the industry and consequently, the findings of this report.

Agricultural land base

Less than 5% of the province's land base is considered to be arable, although it is estimated that up to 15% has some agricultural potential.¹ Approximately 1% of BC's land base is classified as prime farmland.² With some exceptions, much of the best farmland in BC is in close proximity to growing communities. This places considerable pressure on the province's agricultural land base and led to the creation of the Agricultural Land Reserve in the 1970s. The average value of BC's farmland varies but is more than twice the Canadian average and considerably higher for farms close to urban centres.³

Farms & farm operators

There are approximately 19,800 farms in the province and it is estimated that BC agriculture produces about 200 different commodities.⁴ Despite the incredible array of products, specialization has occurred in

certain regions largely according to their historical or existing competitive advantages.⁵ Although they range considerably in size, the majority of BC's farms are family businesses.⁶ BC has a relatively high proportion of small farms with almost 65% of farms less than 70 acres and 27% less than 10 acres. In recent years there has been an increase in the smallest farms, as well as the largest, with the number of mid-sized farms in decline.⁷

The overall demographic trends for Canadian farm operators indicate an aging population with a limited number of new entrants into the industry to replace them. BC's trends are the most pronounced in the country with 45% of farm operators 55 or over and only 6% under 35.⁸

Farm revenues

The primary agriculture and food processing sectors in British Columbia generated \$9.6 billion in 2010 with farm cash receipts for primary agriculture estimated at \$2.4 billion.⁹ For a range of reasons, the average farm gross receipts in BC are consistently lower than the national average.¹⁰ In 2006, 10.2% of the province's farms generated about 80% of the provincial gross farm receipts.¹¹ Commodities generating the largest revenues in 2010 included dairy, poultry, floriculture & vegetable greenhouse and beef. In recent years, net farm income in BC has consistently been negative, in part due to costs of production outstripping farm revenues.¹²



Current Resilience & Adaptive Capacity

ADAPTING TO CHANGING & CHALLENGING CONDITIONS of all kinds is a constant element of agricultural practice, and producers have long been in the business of maximizing their resources to adjust to variability. This variability can occur in a range of areas including weather, markets, input prices and regulations. To effectively manage their operations farmers have to continually learn, change and adjust their approaches, as well as collaborate with a broad range of partners.

Adaptive capacity describes the *presence of necessary resources* and the *ability to mobilize those resources* to effectively respond to various challenging conditions in both the immediate and long-term. Resources may be at the farm or sector level, or a result of the broader social, biophysical, economic, or institutional context. In addition, the ability to re-organize and capacity for ongoing learning are critical to developing effective responses to climate change.¹³ In this study, these elements are expressed as five interrelated types of resources (depicted in Figure 1): *financial, physical, human & social, knowledge* and *policy & regulatory*.¹⁴

Interviews conducted with producers and other specialists focused on existing resources and tools employed to manage through variability or difficult conditions, as well as current barriers or challenges to adapting and overall resilience. The majority of the data used to evaluate current adaptive capacity was drawn from these interviews; additional data was collected throughout the focus group sessions. The following summary highlights some of the key findings concerning current adaptive capacity in the BC agriculture industry.

The ability of agricultural producers to cope with challenging and changing conditions is strongly influenced by the availability of sufficient and stable *financial resources*. While parts of the industry have strong and stable incomes, the relatively low farm revenues and negative net farm income across portions of the sector is a limiting factor in the overall ability to manage through challenging conditions. Farm businesses struggling with marginal economic circumstances are not likely to invest in new approaches, equipment or technologies.

While various strategies (consolidation, diversification, input reduction, off-farm income) are employed by producers to improve their financial circumstances, up front resources and supports are often required to adapt. Additionally, for operations with insufficient financial resources, a strategy may be adopted because it appears to be the only option available, rather than because it is the optimal approach for enhancing resilience.

To manage through uncertain, changing or difficult conditions, some producers participate in government Business Risk Management programs.¹⁵ These programs are intended to assist in stabilizing farm incomes or providing compensation when losses occur and at present serve as a substantial component of efforts to manage variability. However, producers raised concerns with the degree to which the programs are assisting with the types of challenges and losses being experienced on the ground.

The sector's *human and social resources* strongly influence the capacity to adapt. The previously noted demographics of BC's producers impact the planning

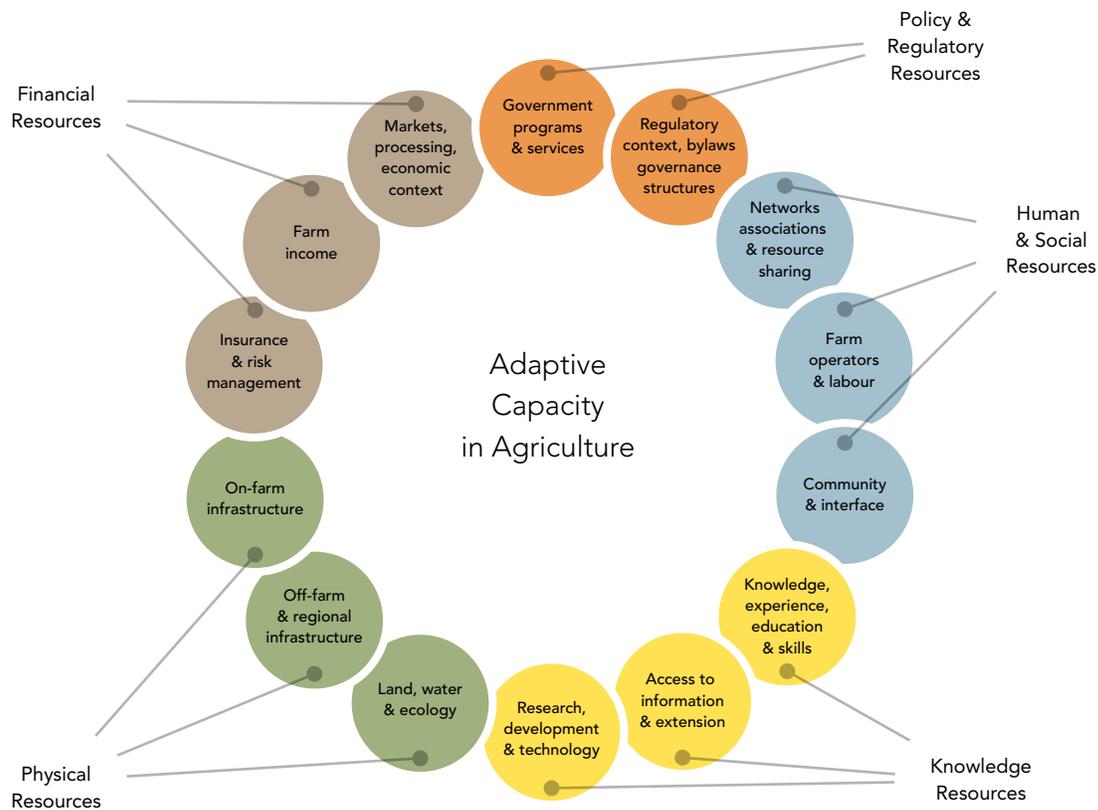


FIGURE 1. ADAPTIVE CAPACITY IN BC AGRICULTURE

horizons and options considered when managing through difficult conditions. Producers nearing retirement are less likely to invest in new practices or technologies. However, those with longer planning horizons (including succession plans) are more likely to contemplate the resilience of their operation. Those portions of the industry that are most profitable and financially stable are encountering less difficulty with this issue.

Industry organizations are the primary means by which producers generate collective solutions to challenges they are facing. Although industry organizations provide a number of important services for producers, the demands on these organizations are growing and they are increasingly stretched to meet the needs of the sector. Limited financial and human resources can lead to an “emergency response” orientation where immediate problems are addressed but longer term planning or investments are necessarily set aside.

At the root of all adaptive decision-making is knowledge and information. Producers and industry generate and draw from a wide range of *knowledge resources* to guide their decision-making. With the provincial government’s reduced role in providing extension and informational supports, individual producers and producer organizations endeavour to fill the emerging gaps. Many producers utilize paid extension but for those without the financial resources this is not a viable option.

In some areas, collaborative research (government, academia and industry) is showing promise but research gaps are notable, particularly at the local/ regional level. These gaps frequently relate to emerging problems or issues — for example, the monitoring and management of unfamiliar pests or diseases, or the development of variety trials for crops better suited to changing conditions. In other cases, producers noted that although information is being

collected or research conducted, data is not available in a form that is accessible.

The condition and efficacy of *on-farm physical resources* is important for farm resilience and producers are continually investing in, improving and adjusting their equipment, technology and practices. In many cases, investing in certain technology or practices can help to reduce damage and losses associated with weather conditions including extreme heat, frost, wind, erosion and excessive moisture. However, the extent to which producers invest in adaptive physical resources depends on a range of other factors. Once again, the financial circumstances of the producer impact their flexibility, but the availability of informational and planning tools to guide producers in their decision-making is also important.

How *local and regional physical resources* are managed, including land, water and infrastructure, has a substantial impact on the capacity of producers to adapt to challenging conditions, particularly in relation to variable and extreme weather. Decisions

made beyond the farm can impact the availability and accessibility of water and can alter landscapes and hydrology in ways that create additional management challenges for producers. These decisions can also have a substantial impact on the ability to maintain productivity in adverse conditions and on the range of options available in the future.

The *policy and regulatory* framework shapes the interface between government and the agriculture sector. Agriculture is embedded in a complex regulatory context including numerous government agencies. Each government agency has a distinct mandate and priorities. This can create a challenging and fragmented environment for producers managing through difficult or variable conditions. In some cases, producers noted that policy and regulation can have unintended negative consequences for agriculture, often through limiting options and flexibility. These issues primarily arise in areas where cross-agency and cross-jurisdictional cooperation is required, and where more flexible approaches that acknowledge management complexity would facilitate more resilient agricultural systems.



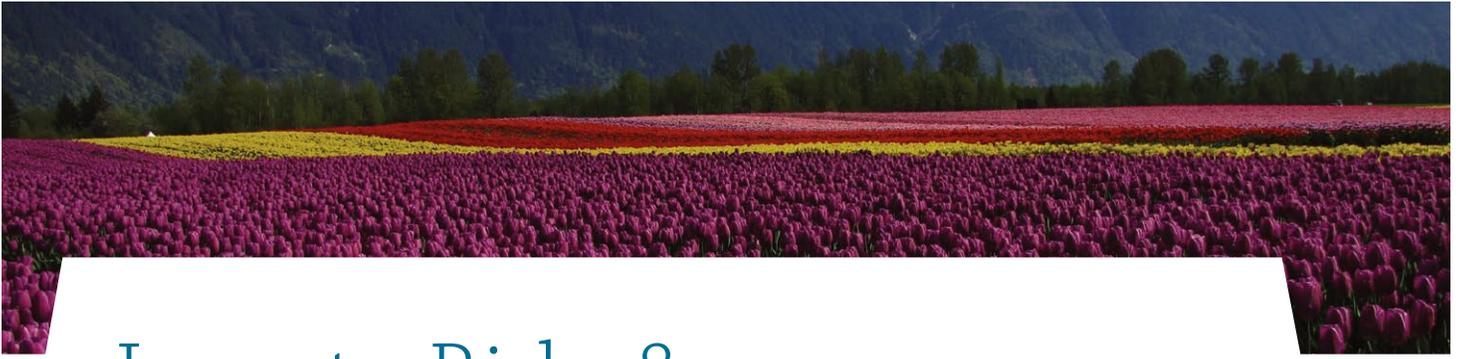
BC's Climate in the 2020s

ACCORDING TO THOUSANDS OF CLIMATE SCIENTISTS analyzing climate data around the world, the evidence to date is unequivocal: the global climate is changing, and becoming warmer.¹⁶ This does not, however, mean that conditions everywhere are becoming consistently warmer year after year. All of the variables that impact climate will continue to influence the weather in many different ways.

The provincial report describes past trends and future climate projections for BC and by region, based on published studies and data. In summary, over the

past century the average annual temperature in BC has increased 1.2°C on average (between 0.5 and 1.5°C)¹⁷. Annual precipitation has also increased, on average by 22% (ranging from 10 to 50% by region), and with the greatest increase in winter and spring.¹⁸ In terms of extremes, this area has seen an increase in heavy rainfall events in the spring, and an increase in extreme wet and extreme dry conditions in summer.¹⁹ There has also been an increase in extreme hot and decrease in extreme cold temperatures,²⁰ along with more frequent and severe wildfires.²¹ The table below outlines the projected 2020s climate change scenario for BC (on average).

Variable	Year	Change	Description (BC average)
Temperature ²²	2020s	increase	<ul style="list-style-type: none"> Continuing warming trend Greater warming in north than south, inland than coastal, winter than summer Increasing frost free days and growing degree days
Precipitation ²³	2020s	increase	<ul style="list-style-type: none"> Continuing increase in annual precipitation (e.g., 0% to +7% by the 2020s) Increase in precipitation in fall, winter, spring, and a decrease in summer Significant decrease in winter and spring snowfall in most regions
Extremes ²⁴	2020s	increase	<ul style="list-style-type: none"> Continuing increase in extreme hot and decrease in extreme cold temperatures Intensity and magnitude of precipitation events is projected to increase More frequent and severe wildfires
Hydrology ²⁵	2020s	varies	<ul style="list-style-type: none"> Total amount of runoff is projected to increase while the peak flows in the spring decline and continue to occur earlier Lengthening of the period of dry conditions and low flows in the summer Previously snowmelt-dominated or hybrid systems will be in transition to hybrid and rain-dominated regimes, which experience more unpredictable peak flows and increased risk of flash flooding in the winter There is little data available on soil moisture in BC. Snow-dominated and hybrid basins are likely to see increase in spring soil moisture
Sea Level Rise ²⁶	2100	increase	<ul style="list-style-type: none"> 80 to 120 cm at the Fraser River Delta 50 to 80 cm at Nanaimo



Impacts, Risks & Opportunities for BC Agriculture

THE TYPES OF RISKS & OPPORTUNITIES associated with climate change are influenced by both the projected changes described previously, and the capacity of the agriculture sector to adapt. What might appear at first glance to be an opportunity for enhanced production in BC is in fact a great deal more complex. Potential opportunities have associated costs and risks, and the range of projected conditions poses increasing challenges for an industry that is already under pressure.

The themes emerging in focus groups around the province pointed to some key ways that the nature of risks and opportunities for agriculture will shift with climate change.

Common issues of concern were:

- **Increased variability** — The projected increase in variability of conditions is a key concern for producers, particularly because this introduces a new level of uncertainty into the decision-making process. In the context of increasing variability, producers face a greater range of potential conditions and extremes, which must be factored into their planning and decision-making.
- **Changes to both averages & extremes** — Changes to average conditions will require adjustments and could eventually drive significant transitions in agricultural production systems. Increases in extreme conditions and the potential for abrupt shifts (e.g., the introduction and establishment

of a new pest or disease) pose an acute risk to production systems and may not be manageable with current options and approaches. In particular, the unpredictability in timing and frequency of such events makes it difficult to plan for, or invest in, options to effectively manage the risk.

- **Increased complexity** — Overall, climate change increases the complexity of management and decision-making for producers and the sector as a whole. The scale and pace of climate change is unlike anything producers have dealt with in the past.
- **Cumulative impacts** — A succession of smaller climate change impacts can build to have a large effect. Large, high impact events are a major concern but a series of smaller events can also create significant pressure, and typically there is less awareness and support in this kind of scenario.

To assess the implications of climate change for BC's agriculture sector, regional climate scenarios for the 2020s were presented to producers to interpret how those changes would impact operations, and to identify factors affecting the ability to manage potential risks and opportunities.

A summary of the potential impacts identified through this process is presented in the table that follows. More regional and commodity specific results are available through the five snapshot reports.

Issue	Changing conditions	Potential agricultural impacts
Increasing amounts and variability of precipitation	<ul style="list-style-type: none"> ▪ Increased fall, winter, spring precipitation ▪ Increased overall precipitation ▪ Increased variability and magnitude of precipitation events 	<ul style="list-style-type: none"> ▪ Accumulation of moisture exceeding drainage capacity ▪ Water-logged soils, localized flooding ▪ Lower crop productivity and quality — crop damage & losses ▪ Increased difficulty planning for and managing planting and harvesting ▪ Changes to livestock grazing management ▪ Nutrient leaching, input losses ▪ Increased potential for regional water storage
Widespread flooding	<ul style="list-style-type: none"> ▪ Increased storminess and precipitation-driven floodwaters ▪ Rising sea level ▪ Dike overtopping and/or dike breach 	<ul style="list-style-type: none"> ▪ Widespread inundation of farmland ▪ Crop and infrastructure damage and loss ▪ Relocation or loss of livestock ▪ Interruptions to supply lines ▪ Prolonged recovery time ▪ Salinated soils (in case of sea dike overtopping or breach)
More frequent extreme weather events	<ul style="list-style-type: none"> ▪ Increased frequency of extreme heat events ▪ Increased storminess ▪ Increased frequency and intensity of extreme rainfall events 	<ul style="list-style-type: none"> ▪ Reduced quality and productivity (both crops & livestock) ▪ Damage to plants, crops, livestock and infrastructure ▪ Interruption of critical supply lines (feed, inputs etc) ▪ Damage to regional infrastructure ▪ Increased risk of flash floods, soil erosion, landslides ▪ Increased awareness of importance of local food supplies (within communities)
Seasonally dry conditions (and water supply effects)	<ul style="list-style-type: none"> ▪ Reduced proportion of precipitation falling as snow ▪ Earlier peak flows ▪ Reduced runoff and soil moisture in summer ▪ Decreased summer precipitation ▪ Higher evapotranspiration rates and crop water demand ▪ Increased frequency of drought 	<ul style="list-style-type: none"> ▪ Water deficits ▪ Increased productivity/quality if irrigation is possible (depending on crop and within specific temperature range) ▪ Less costly and easier to harvest (in drier conditions) ▪ Reduced productivity/quality if moisture is inadequate ▪ Water restrictions leading to reduction in management options for extreme heat, sun scalding, frost and pests ▪ Reduced water quality and quantity for livestock watering ▪ Better hay production and longer grazing season ▪ Migration of salt wedge further upstream on the Fraser, cutting off irrigation earlier ▪ Increased overall demand for water use ▪ Reduced soil moisture, worsened in case of successive hot and dry years ▪ Substantial crop/financial losses with consecutive years of drought

continued on next page

Issue	Changing conditions	Potential agricultural impacts
Shifting range of conditions (affecting suitability of varieties, crops, livestock)	<ul style="list-style-type: none"> ▪ Shifted average conditions ▪ Increased variability and extremes ▪ Increased temperatures and growing degree days ▪ Decreased summer precipitation 	<ul style="list-style-type: none"> ▪ Increased uncertainty, costs, loss and damage ▪ Improved productivity and quality ▪ Opportunity to switch to higher value products ▪ Opportunity to diversify crops and livestock ▪ Improved suitability for longer maturing varieties ▪ Increased number of harvests possible ▪ Longer <i>potential</i> growing season, but <i>actual</i> growing season limited by variability and extremes
Changes to biological and ecological interactions	<ul style="list-style-type: none"> ▪ Milder winter conditions ▪ Changed climatic regime overall ▪ Increased spring rainfall and extreme rainfall ▪ Accelerated rate of change ▪ Increased variability 	<ul style="list-style-type: none"> ▪ Increased reproduction and survival rates of pests and diseases, and of beneficial insects (predators) ▪ Increased number of pest cycles in a season ▪ Establishment of new pests, diseases, other invasive species ▪ Increased survival and reproduction rates of some wildlife and bird populations ▪ Impeded pollination ▪ Lower productivity, crop damage and loss
Changing economic factors: input costs, consumer demand and markets	<ul style="list-style-type: none"> ▪ Increased variability and extremes ▪ Warmer winter temperatures ▪ Warmer summer temperatures ▪ Climate change impacts in other growing regions 	<ul style="list-style-type: none"> ▪ Increased input and management costs ▪ Decreased heating costs ▪ Increased ventilation costs ▪ Increased feed costs ▪ Increased prices and demand for BC products ▪ More upward pressure on agricultural land values



Toward a More Resilient Agriculture Sector

DURING THIS PROJECT'S YEAR LONG engagement process, a consistent message from producers across the province was that much of the sector is already being strained in ways that are undermining its resilience. Factoring in the complexity and challenges associated with climate change, it is clear that immediate attention to agriculture's capacity to adapt is needed.

Although beyond the scope of this study, the broader impacts of climate change to food production globally, create additional incentive to prioritize sustaining and enhancing BC's agricultural production. Climate change places different pressures on decision-making

systems from the farm to government to the marketplace. It also poses new challenges that demand particular attention from producers, industry associations, academia, the public, and all levels of government. Fundamentally different approaches are required.

Therefore, an environment that is supportive of adaptation to climate change will include not just new tools, resources and information, but also a shift in the underlying approach to development of policies and decision-making at all levels. The following *Principles of Adaptation* will better enable adaptation to climate change.

Principle	Application
Integrated	Interrelated aspects of the whole system are taken into account. Process and different actors are coordinated. Climate change information and adaptation considerations are a standard part of decision-making.
Flexible	Policy and regulations enable decision-making and action that is responsive and adequately flexible to deal with unexpected and changing conditions.
Collaborative	Collaborative approaches to knowledge generation, planning and decision-making contribute to building capacity to deal with uncertainty and complexity. Decision-making and actions are enabled across levels of governance and stakeholders. Local and regional scales play a primary role.
Transparent	With a flexible system, the need for transparency, communication and trust increase. Transparency also facilitates shared decision-making and responsibility.
Proactive & future oriented	Decision-making and actions are enacted in advance of pending challenges, rather than waiting for the worst-case scenario. The best knowledge available is applied, taking into account that uncertainty is an inherent part of climate change. Climate change requires a longer term view than most political and financial systems apply.
Resilient	Overall, policies and regulations enhance the capacity of the system to cope with change, variability and shocks; and to learn and adapt to new information and experience. Continual re-evaluation and adjustments are made.

The engagement process with producers and specialists was the basis for development of many key actions for enhancing the ability of the agriculture sector to adapt to climate change.

For each type of climate change impact a web of actions are required to effectively enable adaptation. For example, addressing the impacts associated with pest and disease management involves policy and regulation, research and development, monitoring and communication systems, extension services and on-farm management.

Therefore, action items are intended to involve the broad range of actors who have roles to play in adaptation of agriculture to climate change including: various levels of government, citizens, research institutions and agriculture sector organizations and producers.

*KEY ACTIONS: Governance & Policy*²⁷

- Integrate consideration of agricultural resilience and climate change adaptation into decision-making frameworks concerning agriculture by:
 - Developing tools tailored for various levels of government, agencies such as the Agricultural Land Commission and for sector organizations and individual farm businesses
 - Factoring into decision-making both climate change impacts in BC and impacts of global changes and medium to long term implications (See *Overarching Research Priorities*)
- Review impacts of the regulatory regime on BC's agricultural businesses to better understand its relationship to agricultural adaptation; evaluate for coordination, flexibility, consistency and transparency
- Identify and implement strategies to strengthen agricultural organizations and facilitate their participation in community, regional and provincial dialogue and decision-making (See *Human & Social Resources*)

- Continue to focus on greenhouse gas emission reductions in order to prevent the most extreme potential impacts of climate change

KEY ACTIONS: Financial Resources

- Focus investment and programming on business development, economic sustainability and financial resilience for BC farms. For example:
 - Explore regional competitive advantages, diversification options and opportunities to increase and stabilize farm income
 - Identify and promote transferable business models that are tested and profitable within BC or comparable jurisdictions
 - Assist farm businesses with costs associated with planning and transitioning to more diversified and resilient business models
 - Identify and address gaps in processing, value-added and marketing infrastructure
 - Foster development of collective/cooperative systems for purchasing, processing, distribution, marketing, insurance and infrastructure, particularly for smaller producers/industries or more isolated regions
 - Develop educational and planning resources to support profitability and increased economic resilience for small and new farms
 - Promote buying local agricultural products to enhance regional production and markets
- Conduct multi-criteria cost-benefit analyses²⁸ of adaptive practices and technologies (incorporating climate change projections) at both the regional and farm levels
- Develop financial tools to support on-farm planning, innovation and infrastructure for adaptation to climate change. For example:
 - Bolster incentives for adoption of adaptive farm practices included in existing programs such as the Environmental Farm Plan and Beneficial Management Practices Programs
 - Identify alternate financial mechanisms to support investment in on-farm

adaptive practices and technologies (e.g., ecological goods and services)

- Utilize business risk management supports for transitioning to more adaptive systems (for example: linking premiums or payouts to incentives for investing in adaptation)
- Identify mechanisms to manage and share new types of risk for farm businesses associated with climate change impacts including:
 - Incremental (and compounding) impacts from more frequent small events
 - Successive years of extreme weather event impacts

KEY ACTIONS: Human & Social Resources

- Identify strategies for increasing interest and participation in farming amongst young people in BC, for example:
 - Supporting and promoting post-secondary training and education in agricultural fields
 - Developing resources to fill gaps in industry training/education within BC
 - Facilitating the transfer of knowledge from experienced producers to new or young farmers
- Bolster commitment and support for the Agricultural Land Commission, with a particular focus on its mandate to “encourage and enable farm businesses in BC”
- Bolster producer and industry organizational capacity by:
 - Identifying mechanisms to support industry organizations with long-term and strategic planning and action, and provide incentives for innovation and experimentation at the farm level
 - Minimizing overlap across industry organizations by developing cross-cutting services, resources and tools that are needed by all producers
 - Increasing communication and collaboration across commodities, regions and communities to address key issues and challenges for the sector

- Increasing cooperative approaches to industry representation in government processes and consultations (to maximize resources)
- Facilitating participation of agricultural producers and organizations in planning and decision-making processes (e.g., per diems, consider timing of meetings, maximize time of participants, etc)

KEY ACTIONS: Knowledge Resources

Knowledge & education

- Increase availability of informational and extension resources for producers about climate change, potential impacts and adaptation, transition management, and building adaptive capacity
- Translate weather and climate science into applied tools for producers, industry and other decision makers (local and regional government)
- Improve public/community understanding of agriculture and climate change adaptation, specifically around agricultural water needs, how this will change over time, and current work to improve efficiency

Overarching research priorities

- Develop thorough and detailed “impacts and options” evaluations for key commodities/regions in the province²⁹
- Review regional and global climate change impacts for agricultural production to evaluate implications for BC markets and competitors
- Improve data and modeling of current and future groundwater supplies

Weather & climate science research

- Ensure ongoing availability and reliability of seasonal and shorter weather forecasts
- Increase the network of weather stations for standardized data collection

- Build on existing informational tools³⁰ to expand the weather and climate information available for agricultural planning and management
- Expand the network of snowpack monitoring
- Develop climate projection reports specific to agriculture for all major agricultural regions of BC
- Evaluate potential for alternate varieties and breeds to be better suited to changing conditions in BC
- Assess potential for new crops and varieties in different areas of BC (including evaluation of soils, water availability, etc) and, where promising, support trials or demonstration

Pests, diseases & invasive species

- Increase investment in downscaled climate projections and information specific to agricultural applications.
- Improve data on future risk of extremes, floods, water demand and other climate conditions of consequence for agriculture
- Conduct suitability modeling for new and existing production systems and varieties under projected climate and specific local conditions (soils, etc)
- Increase comprehensiveness and coordination of early identification and monitoring for pests, diseases and weed threats
- Invest in development of quantitative modelling, improved management practices, and area-wide pest management³²

KEY ACTIONS: Physical Resources

- Improve understanding of yields, nutrient value, productivity of new and existing crops under projected conditions
- Undertake collaborative regional consultations and develop strategies to ensure that infrastructure development, land use and planning processes are supportive of agricultural adaptation.³³ Key areas for infrastructure improvements include:
 - regional and on-farm water supply, storage, and irrigation capacity
 - regional and on-farm drainage, ditch and dike infrastructure and pumping capacity
- Conduct a review of regional infrastructure (such as dykes and transportation networks) for potential impacts of extreme events that would affect the agriculture and food system
- Integrate agricultural adaptation considerations into land use planning processes and decision-making through mechanisms such as:
 - Local and regional government Official Community Plans
 - Government infrastructure and asset management plans
 - Agricultural Land Commission policies
- Identify and implement mechanisms to promote improvements (e.g., water source development, drainage etc) to leased land

Farm practices, technology transfer & variety trials

- Review and evaluate adaptive on-farm practices, technologies and approaches that could potentially be applied in BC³¹
- Support piloting of new or transferable practices and technologies with adaptation potential (for example: reward innovation and experimentation, share risks taken by individual producers that benefit the entire industry)
- Strengthen proactive breeding and variety trial programs through incorporation of adaptation considerations. For example:
 - Test crops and varieties with enhanced resilience to projected conditions
 - Evaluate variety trials and breeding in other jurisdictions with conditions similar to projected conditions for BC regions

- Integrate *agricultural adaptation impact assessments* into environmental impact assessments for new developments and industrial activities (e.g., impacts to hydrology, drainage, pollination capacity, etc)
 - Bolster commitment to, and support for, the Agricultural Land Commission, with a particular focus on its mandate to preserve agricultural land
- Ensure continued access to adequate water supplies for agriculture (e.g., through development of an *Agricultural Water Reserve*)
 - Ensure integration of climate change projections and impacts into water management policy, planning and decision-making
 - Streamline and coordinate ditch and drainage regulations (including mechanisms to address agricultural needs and fisheries and habitat legislation)

Emergency management & planning

- Improve emergency management planning and preparation for extreme events at the producer, industry and government levels. For example:
 - Increase integration of agricultural needs into the provincial emergency management system
 - Integrate supports for farm level emergency management into planning and programming
- Invest proactively and strategically in water storage to ensure flexibility and the ability to deal with variability and extremes
- Invest proactively in water supply improvements (past examples of government support include the National Water Supply Expansion Program)

Water management

- Strengthen coordination and integration of water management governance with particular attention to the role of agriculture. For example:
 - Include agricultural adaptation issues in water-related provincial and regional/local decision-making
- Improve and expand on modeling of future crop water demand and regional demand relative to supply in regions across BC (building on work underway in the Okanagan³⁴)
- Further develop and expand decision support tools for effective on-farm water and irrigation management, and soil and nutrient management practices

Endnotes

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