

Climate Resilience Plan for Washington Agriculture

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Table of contents

Letter from the Director	5
Abbreviations for select entities.....	6
Section 1. Introduction and how to use this plan.....	8
Introduction	8
Purpose of the Climate Resilience Plan for Washington Agriculture	10
Section 2. Agricultural climate risks and adaptation opportunities	13
Climate change-related risks and opportunities for agricultural production	14
Opportunities and strategies to mitigate risk.....	21
Section 3. Goals, strategies, and actions	24
Principles	25
Goals, strategies, and actions summary	25
Goals, strategies, and actions.....	28
Section 4. Implementation, maintenance, and evaluation	60
WSDA approach to implementation.....	61
Proposed maintenance and evaluation schedule	61
Additional considerations	62
Acknowledgments	63
Appendix A — Policy synthesis: Select climate resilience plans and reports.....	64
Introduction	65
Synthesis of risks and opportunities included in plans.....	65
Highlights from local climate plans.....	67
Washington State plans.....	76
Washington Legislation.....	81
Other state plans.....	84
National plans	86

Appendix B — Scientific synthesis: Anticipated climate impacts on agriculture in Washington state	88
Introduction	89
Changing temperatures, precipitation, and CO2 levels, and their impacts on crops and animal agriculture	89
Impacts on water supply.....	90
Extreme weather	91
Impacts on pests, weeds, and disease	93
Impacts on pollinators	93
Washington state’s relative position.....	93
Considerations beyond impacts on crops, livestock, and aquaculture	94
Areas for future study and climate adaptation	96
Adaptive responses to climate impacts across scales	97
 Appendix C — Engagement summary: Impacts of climate change on producers and other agricultural stakeholders	 99
Methods.....	100
Overarching themes.....	102
Discussion of overarching themes.....	103
Additional takeaways from listening sessions.....	111
Demographics of survey respondents.....	112
 Appendix D — Impacts of Climate Change on Farmworkers in Eastern Washington ...	 115
Executive summary	116
Methods.....	116
Results and overarching themes	118
Strategies adopted.....	121
Recommendations for a more climate-resilient future.....	122
 References.....	 124



Letter from the Director

Dear Stakeholders, Partners, and Members of the Washington state agricultural community,

Washington state's agricultural industry remains a vital part of our state's economy, culture, and community. From rural Eastern Washington to suburban Western Washington, we all depend on agriculture for safe, nutritious, and high-quality food. It's the cornerstone of life.

Yet, as diverse and productive as our agricultural industry is, it is not immune to the profound challenges posed by climate variability.

Flooding, drought, wildfire, extreme heat and cold, and shifting pest and disease pressures already threaten our crops, livestock, aquaculture, and rural communities. These risks demand swift, collective action to ensure the resilience of Washington agriculture and the livelihoods it supports.

Through historic collaboration and stakeholder engagement – from farmers and farmworkers to researchers and policymakers, WSDA and our partners have developed the Climate Resilience Plan for Washington Agriculture. This plan outlines action-based, measurable strategies to enhance the accessibility of funding programs, advance cutting-edge research, increase on-the-ground support, and strengthen cross-sector collaboration, with the goal of not only adapting to climate challenges but also seizing new opportunities for innovation and growth.

The Climate Resilience Plan for Washington Agriculture is the first step toward a sustainable future for our state. Together, we can ensure that Washington agriculture continues to thrive for generations to come.

Sincerely,

A handwritten signature in black ink, appearing to read "Derek I. Sandison".

Derek I. Sandison
Director

Abbreviations for select entities

CCA	Washington's Climate Commitment Act
Commerce	Washington State Department of Commerce
DNR	Washington State Department of Natural Resources
DSHS	Washington State Department of Social and Health Services
ECY	Washington State Department of Ecology
EMD	Washington State Military Department, Emergency Management Division
Farmworkers and their organizations	Farmworkers and their organizations, including individual farmworkers, unions, advocacy groups, and non-profits
FEMA	Federal Emergency Management Agency
Health	Washington State Department of Health
Industry	Industry groups and private sector partners (particularly those working in agriculture, including but not limited to individual farmers and farm operations, packers and processors, seed and chemical sales, agricultural technology and innovation companies)
L&I	Washington State Department of Labor and Industries
NGOs	Non-governmental organizations (particularly those working in agriculture, including but not limited to land trusts, farmer and farmworker advocates, environmental groups)
NOAA	National Oceanic and Atmospheric Association
NWS	National Weather Service
SCC	Washington State Conservation Commission
Tribes and their organizations	Tribal governments and organizations (e.g., Individual or Tribes and their governing agencies, Intertribal Agriculture Council, Northwest Indian Fisheries Commission)
USDA	United States Department of Agriculture
ARS	Agricultural Research Service
FSA	Farm Service Agency
NASS	National Agricultural Statistical Service
NRCS	Natural Resources Conservation Service
WDFW	Washington Department of Fish & Wildlife
WSDA	Washington State Department of Agriculture
WSU	Washington State University



Section 1

Introduction and how to use this plan

Introduction

Diverse climates, extensive irrigation infrastructure, and nutrient-rich soil make Washington state one of the most fertile agricultural regions in the nation. Washington farmers and farmworkers produce over 300 commodities across 13.9 million acres of agricultural land ¹. In 2023, the state's agriculture industries supported over 89,000 direct jobs—not including secondary employment impacts related to agricultural production ² — and added nearly \$14 billion to the state's economy ³.



Long-term climatic changes and associated extreme weather events present myriad risks to Washington's agricultural operations, rural livelihoods, worker safety, and food production. For example, climate change increases the threat of both flooding and drought in the state, which in turn impacts the timing, quantity, and quality of water supply for crop production, livestock operations, and aquaculture. Changing weather patterns also increase the risk of wildfire and wildfire smoke, threatening crop yield and quality, livestock welfare, and the health of agricultural workers. Extreme heat and cold, especially during critical crop growth stages or during calving season, can result in high loss and mortality. Changing temperatures may also threaten pollinators while providing improved conditions for new pests, invasive species, and diseases. Collectively, these risks require adaptive management at the farm, regional, and state scales.

While these threats present significant challenges to the state's agricultural sector, changing climate conditions may also provide new opportunities. Washington state is in a beneficial location and may experience less disruption to agricultural production compared to other states across the country. As such, the state may be a suitable place to grow new crop types previously grown elsewhere and may become even more important to food security and the national agricultural economy. Furthermore, the state has dedicated funding programs to support climate change adaptation and mitigation.

Planning and preparation at multiple scales are key to ensuring that agricultural operations of all sizes, regions, crops, and socioeconomic demographics can respond to climate-related threats and take advantage of opportunities. The Climate Resilience Plan for Washington Agriculture marks a crucial first step in synthesizing challenges, identifying solutions, and fostering collaboration between the public sector and the agricultural community. This initiative aims to strengthen partnerships, align resources, and take action to ensure the strong vitality and viability of Washington agriculture in the face of climate challenges.

Sustaining our harvest: WSDA's plan for climate-resilient agriculture

The Climate Resilience Plan for Washington Agriculture is a critical first step in fostering collaboration across the public sector and with the agricultural community. The goal is to make all agricultural operations more resilient through climate change and ensure the strong vitality and economic viability of the sector.

The importance of agriculture to Washington state's economy

In 2022 Washington state had approximately 32,000 farms spanning nearly 13.9 million acres ¹. Over 80 percent of these farms are classified as small, each generating less than \$350,000 in annual revenues. More than 80 percent are under 180 acres and over 60 percent are under 50 acres. Notably, over 90 percent are family-owned.

Nationally, Washington state is the number one producer of apples, aquaculture, blueberries, hops, onions, pears, spearmint oil, and sweet cherries. Washington apples are particularly valuable, comprising over half of the nation's domestic apple crop and more than 90 percent of the organic apple crop. The state is the second-largest producer of apricots, grapes, potatoes, raspberries, and winter wheat, and the third-largest producer of dried peas, lentils, and peppermint oil. Washington is also a leader in the wine industry. According to the USDA, the top ten commodities in the state by production value are apples (\$2.1 billion), milk (\$1.7 billion), wheat (\$1.7 billion), cattle (\$1.0 billion), potatoes (\$943 million), hay (\$883 million), eggs (\$460 million), hops (\$434 million), cherries (\$408 million), and grapes (\$395 million).

Washington state plays an important role in the global agricultural market as well. In 2022, \$23.39 billion in food and agriculture products were exported via the state's ports. Top agricultural trading partners include Canada, Japan, China, Mexico, and South Korea. Top export products include fish and seafood, frozen french fries, apples, onions, beef, cherries, wheat, dairy, and hay.

Agriculture also provides substantial social and environmental benefits. It is a central contributor in many rural communities in the state, generating tax revenues for roads, schools, and other services. Farmers and farmworkers in these areas often play key leadership roles in community organizations, in addition to providing Washingtonians with food security. Furthermore, they are often guardians of the environmental benefits that agricultural lands provide, including soil and vegetative carbon sequestration, habitat that supports biodiversity, clean air and water, and open space. This stewardship provides many non-market social and environmental benefits to the state.

Purpose of the Climate Resilience Plan for Washington Agriculture

What is the purpose of this plan?

The purpose of the Climate Resilience Plan for Washington Agriculture is to support agricultural viability and vitality through ongoing and future climate change. Informed by extensive research and stakeholder engagement, the Resilience Plan proposes strategies to ensure that diverse agricultural stakeholders have the necessary resources for successful climate adaptation and enhanced resilience.

The Washington State Department of Agriculture (WSDA) supports the viability and vitality of agriculture while protecting consumers, public health, and the environment through service, regulation, and advocacy. WSDA's vision is that agriculture thrives across the state, contributing to the health of its people, economy, and environment. Top climate resilience priorities include:

1. Safeguarding operational resilience, the environment, and workers in the face of climate change impacts such as drought, extreme weather, and increased invasive species, with proactive and emergency response measures.
2. Supporting sector-wide agricultural innovation through research, education, partnerships, and workforce development.
3. Fostering the voluntary adoption of on-farm climate-smart practices.

Who is this plan for?

The Climate Resilience Plan for Washington Agriculture is for WSDA and the state's many agricultural stakeholders in the public, private, and nongovernmental sectors. Information is intended to guide the efficient, effective, and equitable distribution of resources to maximize the adaptive capacity of Washington agriculture.

Successful implementation includes a high level of coordination and collaboration. WSDA anticipates working with the following groups to implement elements of this plan:

- United States (US) federal agencies
- Tribal governments and organizations
- Washington State agencies
- Local agencies and jurisdictions
- Educational institutions
- Nongovernmental organizations
- Farmers and their organizations
- Farmworkers and their organizations
- The private sector

How was it created?

Under the direction of WSDA, the following activities informed the development of this plan:

- **Review of climate plans and reports:** (Appendix A) Researchers from ECONorthwest reviewed regional climate action plans, state climate policies and reports, and national plans to inform the risks, opportunities, goals, strategies, and action items included in this plan.
- **Review of the science:** (Appendix B) Researchers from WSU synthesized the scientific literature on the effects of climate change on crops, livestock, and aquaculture in Washington state. They also identified key gaps and areas for future work.
- **Engagement with agricultural stakeholders:** (Appendix C) Researchers from Triangle Associates and ECONorthwest distributed a survey to agricultural stakeholders and conducted six listening sessions with the Washington Grain Commission, the Washington Wine Commission, the Washington Tree Fruit Research Commission, the Washington Dairy Federation, the Washington State Potato Commission, and the Washington State Cattlemen's Association. Nearly 300 agricultural stakeholders responded to the survey, and approximately 120 participated in the listening sessions.
(Appendix D) To better capture the experiences and expertise of farmworkers, researchers from Semillero de Ideas synthesized results from their ongoing engagement efforts, specific to the impacts of climate change on farmworkers. Over 200 farmworkers participated in Semillero de Ideas surveys and listening sessions.
- **Assessment of current WSDA programs and activities:** Researchers from ECONorthwest and WSDA analyzed current WSDA programs and activities via staff interviews, organizational reviews, and an in-person agency workshop in June 2024. These activities identified how WSDA already addresses climate risks and opportunities, and how these connections could be strengthened. WSDA staff were critical in the formation of goals, strategies, and actions in this plan.
- **Coordination with statewide climate resilience planning:** WSDA represents agricultural interests in statewide interagency climate resilience planning initiatives. These parallel efforts cultivate consistency, enable collaboration, and ensure that the Resilience Plan provides the most current information and resources.

How does it connect to other plans and state efforts?

The Climate Resilience Plan for Washington Agriculture is designed to coordinate with and support key state plans:

The Washington Legislature passed House Bill 1170 (2023) that directed Ecology (ECY) to update the 2012 Integrated Climate Response Plan in collaboration with 10 state agencies, including WSDA. WSDA staff were appointed to the development team and contributed agricultural strategies and actions to the resulting Washington State Climate Resilience Strategy (2024). The Climate Resilience Plan for Washington Agriculture was developed simultaneously, with some actions and strategies appearing in both documents (see Appendix A, Table 1 for a crosswalk of actions in each document). The Climate Resilience Plan for Washington Agriculture is designed to be consistent with the Washington State Climate Resilience Strategy; but with a sole focus on providing resilience information and support for farms and farm communities.

HB 1170 also requires agencies to “...consider current and future climate change impacts... and incorporate climate resilience and adaptation actions as priority activities when planning, designing, revising, or implementing relevant agency policies and programs.” The Climate Resilience Plan for Washington Agriculture is an important step in implementing HB 1170 for WSDA.

Many of the hazards identified in the Washington State Enhanced Hazard Mitigation Plan (2023), led by EMD, are also risks to agriculture and exacerbated by climate change. The Climate Resilience Plan for Washington Agriculture is consistent with the goals and mitigation actions identified in this document.

In addition, WSDA coordinates programs funded by the Climate Commitment Act (CCA) – RCW 70A.65 (2021) to reduce greenhouse gas (GHG) emissions and increase soil and vegetative carbon sequestration. The development of the Climate Resilience Plan for Washington Agriculture was funded by the CCA.

Finally, the Climate Resilience Plan for Washington Agriculture is an important implementation measure of the WSDA Strategic Plan (2022–2025) which states the agency will “...expand future economic opportunities for Washington agriculture by building climate resilience.” The Climate Resilience Plan for Washington Agriculture supports the implementation of relevant WSDA Strategic Plan priorities, including:

“Ensuring that Washington’s agricultural system is equitable, resilient, and prosperous... (by promoting) the voluntary adoption of climate-smart agricultural practices to increase sustainability, operational resilience, and mitigate environmental impacts,” and

“Ensuring the availability, safety, and integrity of Washington’s food supply for humans and animals [by increasing] farm viability associated with flood, fire, drought, and extreme weather disasters by promoting climate change mitigation and adaptation strategies.”

How to use the Climate Resilience Plan for Washington Agriculture and what’s inside

The Climate Resilience Plan for Washington Agriculture is intended to support WSDA and agricultural stakeholders in adaptation planning, including by prioritizing current and future focus and funding. The Resilience Plan includes necessary elements for strong adaptation planning ⁴, including clear and achievable goals; a wide variety of strategies; stakeholder engagement; coordination with external organizations and stakeholders; an implementation and evaluation process; and techniques to address uncertainty. These elements are organized into the following sections:

- **Section 2: Agricultural climate risks and adaptation opportunities.** This section describes the on- and off-farm risks, opportunities, and resilience strategies related to climate change.
- **Section 3: Goals, strategies, and actions.** This section describes goals, strategies, and actions to increase agricultural resilience.
- **Section 4: Implementation, maintenance, and evaluation.** This section discusses WSDA’s approach to the Climate Resilience Plan for Washington Agriculture implementation; a schedule for evaluation, maintenance, and updates; and considerations for conducting future evaluations.
- **Appendix A:** Policy synthesis – Select climate resilience plans and reports.
- **Appendix B:** Scientific synthesis – Anticipated climate impacts on agriculture in Washington state.
- **Appendix C:** Engagement summary – Producers and other agricultural stakeholders.
- **Appendix D:** Engagement summary – Farmworkers in Eastern Washington.

Section 2

Agricultural climate risks and adaptation opportunities

This section summarizes lessons learned from a review of climate resilience plans, reports, and laws in Washington state and elsewhere (Appendix A), the most up-to-date science (Appendix B), and the perceptions and priorities of the state's producers (Appendix C) and farmworkers (Appendix D) described during extensive statewide stakeholder engagement. For a complete list of sources used to inform this work, see the appendices and the associated reference list at the end of the Climate Resilience Plan for Washington Agriculture.



Climate change-related risks and opportunities for agricultural production

This section is organized into on-farm risks and off-farm risks. **Figure 1** details the pathway through which climate change leads to risks for on-farm agriculture in Washington state. Climate changes (#1), like shifts in precipitation patterns, can cause climate hazards (#2), such as reduced or inconsistent water availability. These hazards can result in on-farm impacts (#3), including lower crop yields, more frequent fallowing, and/or the need for greater investment in irrigation infrastructure. Off-farm risks refer to those that affect systems that producers rely on, such as regional irrigation infrastructure, electrical grids, dependable transportation networks, and university and government research programs that help producers adapt to climate change.

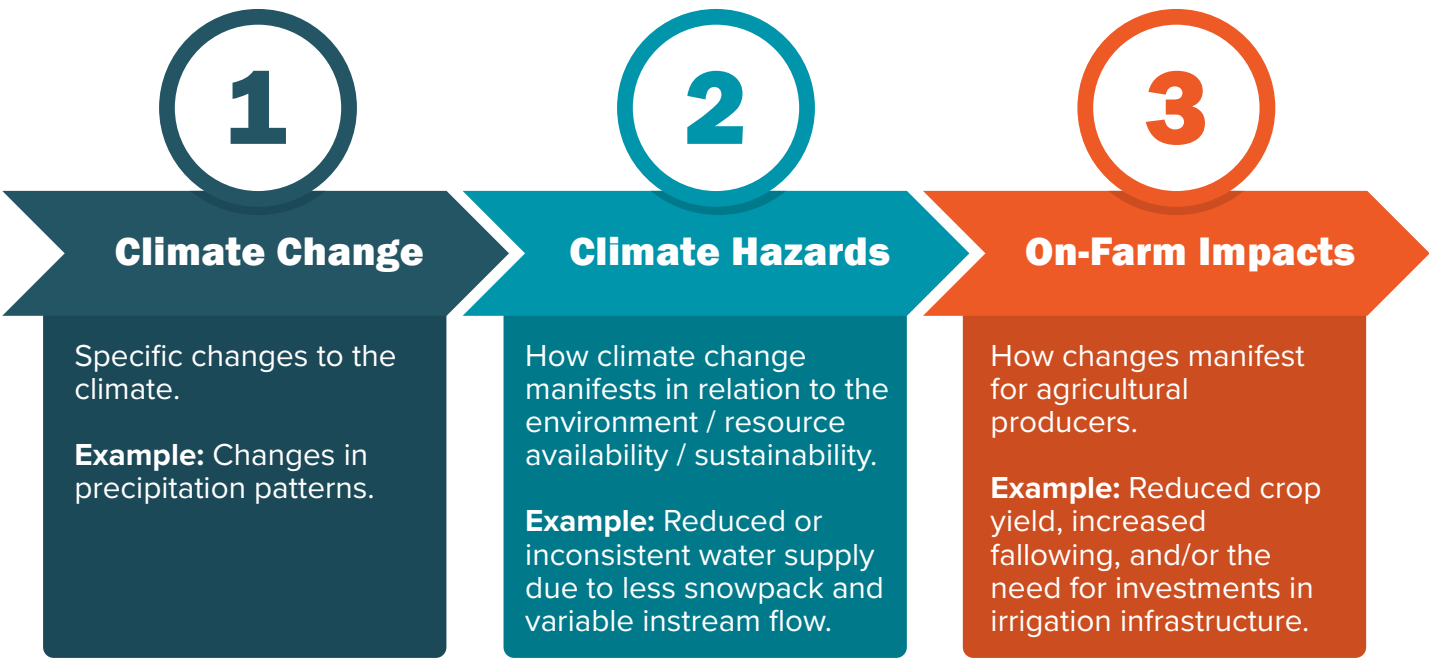
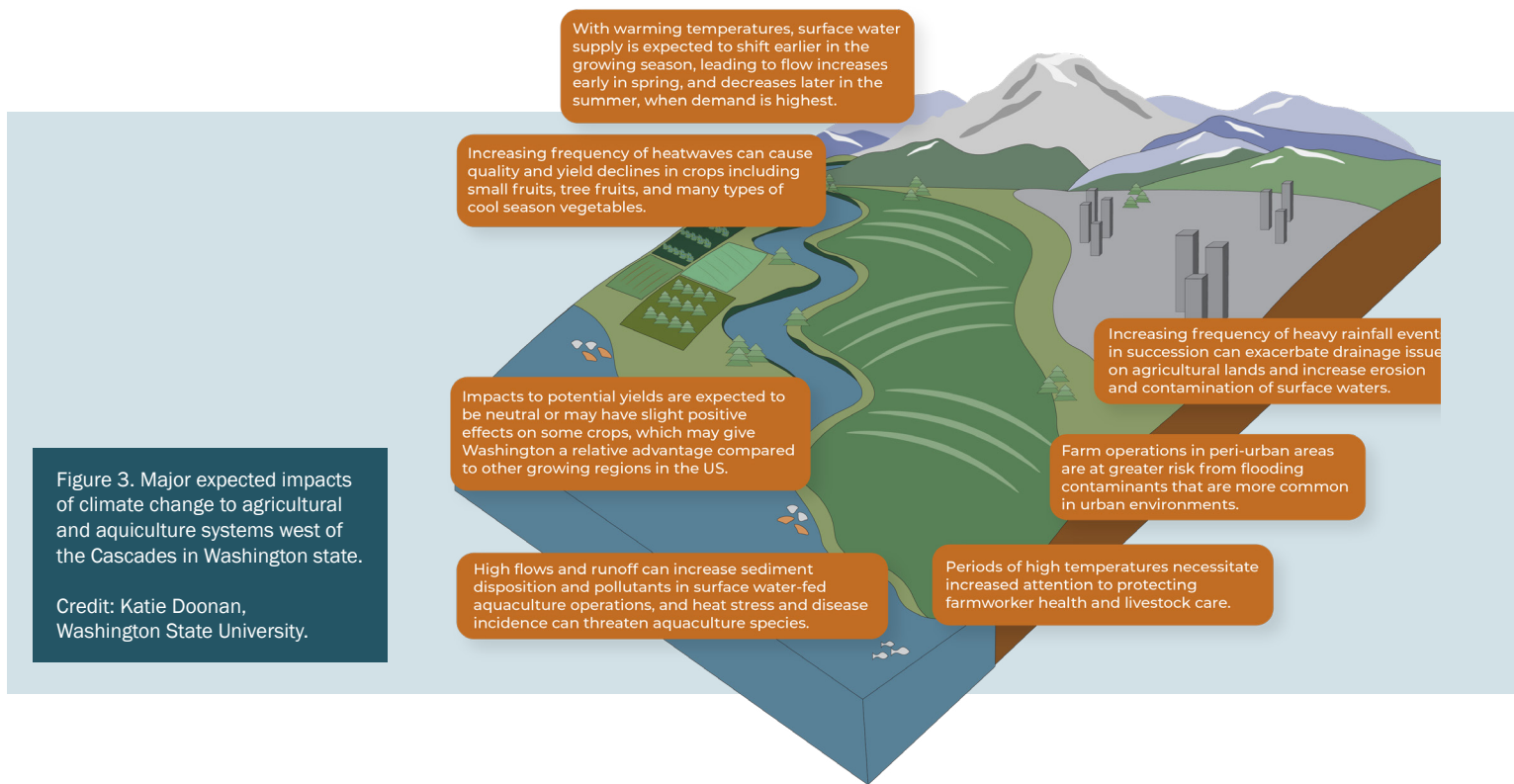
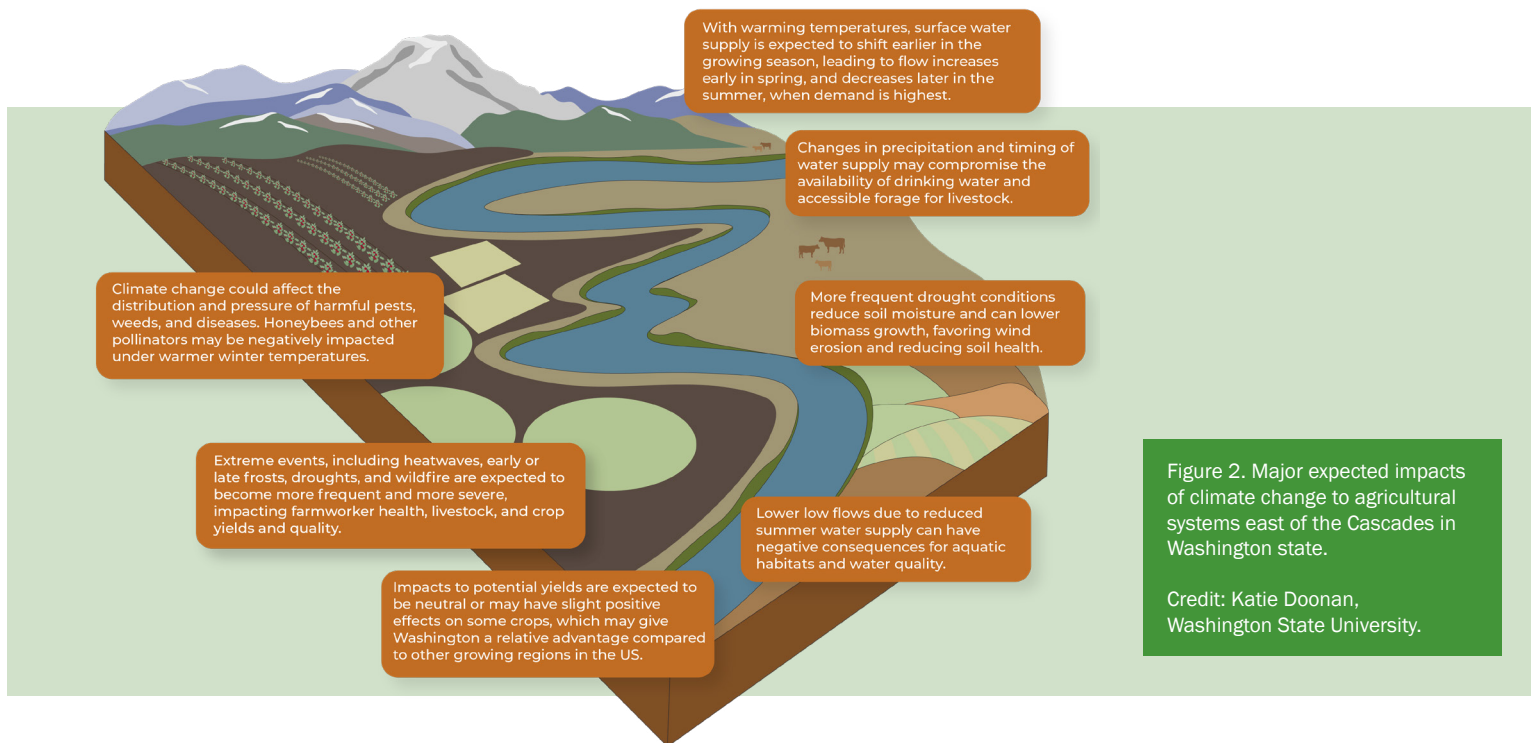


Figure 1. How climate change leads to on-farm impacts, with examples for Washington state.

On-farm climate-related risks

While the diversity in production systems across Washington state creates significant complexity in current and anticipated climate impacts, over-arching risks are described below and summarized in Figures 2 and 3.



Changes to the water supply

Successful crop production relies on water being available at specific times and in anticipated amounts. Warming temperatures and shifts in precipitation patterns will significantly alter the timing and volume of water supply available in many Washington watersheds. Water supply is expected to increase early in the growing season and decrease later in the growing season when demands are highest. This shift will occur in many watersheds in the state, especially those where precipitation is stored in higher elevations as winter snow and snowmelt provide flows to rivers in the spring and through the summer. Junior water rights holders will be disproportionately impacted and may lose partial or full access to water more frequently than they do currently.

It may be more challenging than in the past to ensure that water is adequately stored, distributed, and delivered to irrigated cropping and livestock systems. Changing temperatures that change crop growth patterns are also likely to change the timing and quantity of water demand. Flooding, and increased challenges managing stormwater, are more likely west of the Cascades. Cropping systems that utilize irrigation water from reservoirs and other water storage systems will be more resilient to changing water availability. Both crop and livestock producers, especially those located east of the Cascades where the impacts of drought may be more severe, may need to invest in upgrading water-related infrastructure.

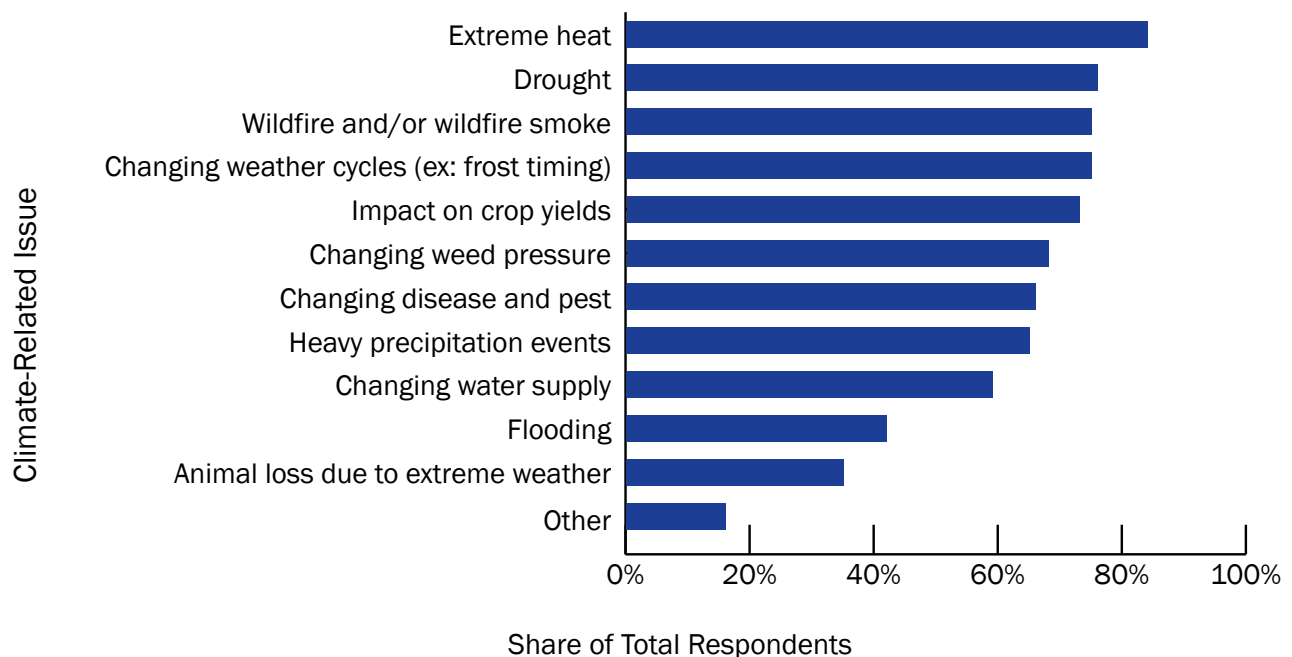


Figure 4. Responses to “Over the last five years, how impactful have the following climate-related issues been to your agricultural operation or the operations you support?” during a survey of producers and other agricultural stakeholders. Bars represent respondents who selected *Extremely Impactful*, *Impactful*, or *Somewhat Impactful* (n=292).

Increased threat to water quality

Flooding and heavy rainfall can cause erosion and soil runoff that increases nutrient loads and sediment in waterways and impacts drinking water quality, aquatic species habitat, and aquaculture production in coastal waters. Runoff can make filter-feeding bivalves, an important part of aquaculture production, unsafe to eat due to the bioaccumulation of toxins or fecal bacteria. Elevated nutrient loads in the water can also promote the growth of harmful algal blooms, which prevent shellfish harvesting. The optimal size of shellfish at the time of harvest is critical for the aquaculture industry and delays in harvesting, caused by water quality issues, can negatively impact economics. Heavy rainfall can also exacerbate existing drainage issues on agricultural lands. Additional runoff from hardscapes in peri-urban areas may contaminate soils with pollutants that are more common in urban environments. Projected increases in winter and spring precipitation have the potential to increase lagoon storage challenges for dairies in Western Washington.

Conditions that reduce river flows, including drought, can concentrate pollutants in waterways and increase water temperatures, negatively impacting water quality. Salmon and trout in the state are highly susceptible to increases in water temperature as it alters their metabolic rate, reduces oxygen availability, and can increase disease susceptibility. Summer high water temperatures in areas with high aquaculture production, such as the Lower Columbia River, are already in the upper tolerance range of native salmon and trout species, and future temperature increases could negatively impact aquaculture production. Drought conditions can also lead to an increase in fallowing, erosion from fallowed fields, and associated air and water quality issues.

Increased impacts and losses from extreme events

Extreme heat and cold events, as well as rain and windstorms during critical developmental periods, can result in significant or complete agricultural losses. Early spring freeze and frost are particularly harmful to perennial fruit crops such as tree fruits, grapes, and berries. Many crops, including small fruits, tree fruits, and various brassicas, experience declines in quality and yield when temperatures exceed certain heat thresholds. Extreme summer heat can also increase irrigation water demand when water availability may already be scarce. For shellfish, extreme heat events that occur during seasonal ultralow tides can result in mass mortality events on aquaculture farms when the shellfish are exposed to an extended period of elevated air temperature. Future increases in the number of high-temperature days per year could make these mortality events more common. Wind and waves from extreme weather events can also damage finfish and shellfish infrastructure or cause coastal erosion that may threaten shellfish operations.

Livestock also suffers when temperature and humidity thresholds are exceeded, with the potential for both short- and long-term health impacts, increased mortalities, and production losses. Dairy cows are among the most susceptible. While higher temperatures and humidity are expected to impact dairy cows, feeder cattle, and cattle on rangeland in the state (as well as other livestock and poultry), the impact may be less than in other regions across the country where thresholds are expected to be exceeded more frequently. Nevertheless, these events can increase mortality rates in the state's livestock systems. Mortality management for both routine and mass mortality events requires rapid response capacity and access to environmentally safe carcass disposal methods.

Flooding and fire can cause significant or total loss of crops, livestock, buildings, and equipment. Rangeland and the livestock they support are at particular risk from wildfire, as systems are extensive, livestock are dispersed, and it can take up to 15 years for rangeland to recover. Moving livestock to other locations or importing feed is expensive. For all types of extreme events, insurance programs may need to evolve to protect against damages, but will likely become more expensive, increasing financial stress on producers.

“The really low [temperature] drops in the wintertime—we had minus 24 to minus 26 degrees [Fahrenheit]—have caused a lot of winter damage and have hit us hard the last few years.”
— Washington Tree Fruit Research Commission listening session participant

“As a producer from Southeast Washington that grazes strictly on dryland pasture, our pastures won't continue to grow into summer like they used to. Our total amount of moisture is staying close to historical normals, but now we don't get our late spring and early summer rains...that bring those pasture green-ups; that is a concern since we will need to change how we rotate and feed the cattle and must buy more hay in the winter beforehand.”
— Washington Cattlemen's Association listening session participant

Risks to crop and forage quality

Climate change may negatively impact important aspects of crop and forage quality. For example, high nighttime temperatures in the fall can reduce the development of red color in apples—a key marketing trait. In listening sessions and surveys, agricultural producers across the state also emphasized that extreme events related to heat, cold, flooding, and wildfire are, and will continue to, impact crop and forage quality. Wildfires and smoke are impacting forage crop harvests and hay storage for livestock producers, as well as the quality of wine, especially in Central and Eastern Washington. Limited evidence also suggests that climate change may decrease certain nutrients and proteins in some plants, as accelerating maturation affects nutrient accumulation. While producers are concerned, more research is needed.

Increased impacts from pests, weeds, and disease

Climate change is likely to affect distributions and pressures from pests, weeds, and disease, threatening agricultural yields and quality. Many pests and weeds also benefit from warmer temperatures and increased carbon dioxide (CO₂). Certain insect pests can emerge earlier and produce additional generations within each growing season. Simultaneously, climate change will also impact beneficial insects and pollinators, creating complex ecosystem impacts. Warmer winter temperatures can cause premature physiological aging of pollinators, weakening managed beehives before critical spring pollination windows. Increased weed pressure may compound existing challenges with herbicide resistance, as noted by representatives from the Washington Grain Commission. Collectively, these challenges can significantly reduce crop yields. Unfortunately, pest management may also be adversely impacted by higher temperatures and wind, by potentially reducing pesticide application windows and increasing spray drift. However, the research is limited, and additional studies are needed to better understand the risks and identify new or updated management practices that reduce risks.

Increased health risks to the agricultural workforce

Climate change is expected to increase the exposure of agricultural workers to heat stress, poor air quality from wildfire smoke and wind erosion, animal-to-human disease transmission, and related health impacts. By mid-century, workers in Eastern Washington, including Yakima, Okanogan, and Benton counties, may experience an additional ~35 days with a heat index over 90 degrees, conditions which are dangerous for workers. In 2023 L&I updated the state's requirements for farmworker safety, requiring additional shade, rest, and acclimatization. However, there is an ongoing need to support implementation, especially in the development of strategies that simultaneously protect workers without reducing farm productivity and worker earnings.

"From experience, I have never seen heat as intense as this year [2024]. It reached up to 113°F for three days, and now it has been three consecutive weeks. Now my blood pressure is higher due to the heat." — Farmworker survey respondent

"During wildfire season, the smoke damages the eyes and lungs. You can't wear a mask and glasses at the same time because the glasses fog up, and you can't remove the face covering because you end up breathing in the smoke." — Farmworker survey respondent

Threat of ocean acidification to aquaculture operations

There is growing concern in the shellfish industry over the full impact that increasingly corrosive water will have on production. Oceans absorb CO₂ from the atmosphere, which reduces the pH of surface water (i.e., ocean acidification). Similarly, the upwelling of deep acidic ocean water and coastal nutrient runoff makes waters more corrosive. This changing ocean chemistry reduces carbonate ion concentration in the water, which is essential for the production and maintenance of bivalve (clams, mussels, oysters, etc.) shells and affects the behaviors of other animals such as salmon. The shellfish industry now commonly employs hatcheries over natural recruitment to have better control over water quality parameters during the sensitive larval life stage. However, ocean acidification is projected to worsen in the future.

Increased financial risk for farmworkers and small, under-resourced, and socially disadvantaged operators

Farmworkers and small, under-resourced, and socially disadvantaged operators may be more vulnerable to climate change impacts, with fewer financial and social resources to invest in climate adaptation infrastructure and practices. Furthermore, these groups have long been excluded from conservation programs and grants that help them cope with extreme events. Small-scale producers may also face challenges specific to diversified production and marketing strategies. For example, many diversified direct market farms rely on crops such as cabbages, broccoli, kale, and spinach that prefer cooler temperatures, and may have reduced season length in a changed climate.

During surveys and listening sessions, Washington farmworkers described how the impacts of climate change extend beyond health (Figure 5). Extreme weather can lead to work disruptions, changes in produce quality, and new challenges in working conditions. Collectively, these impacts can reduce farmworker earnings. Respondents also reported climate-related financial impacts at home, including rising costs due to increased demand for air conditioning or heating, and the cost of daycares that can care for children while workers begin harvest as early as 3 a.m. to avoid peak heat.

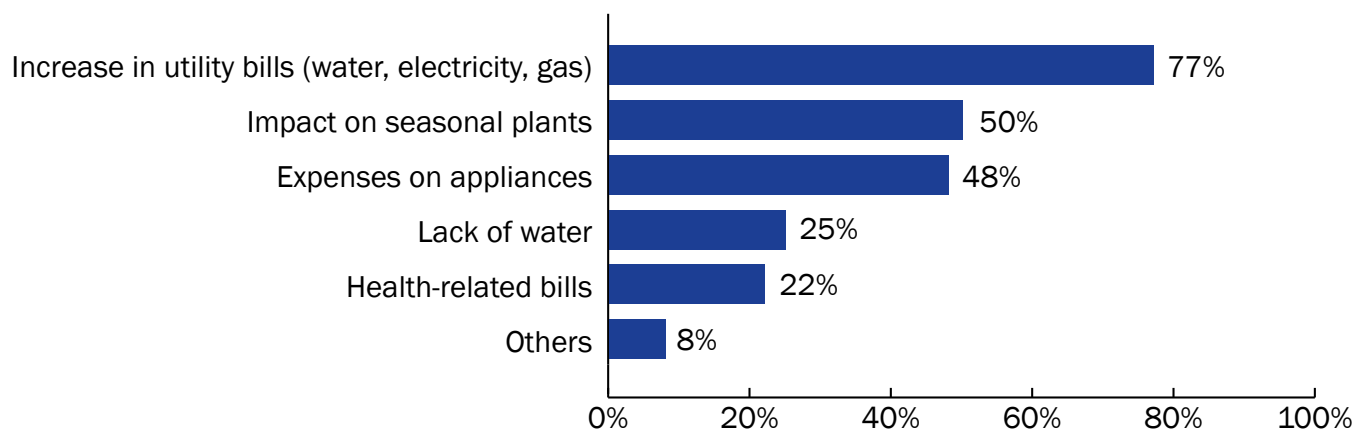


Figure 5: Farmworker survey responses to the question, “In your home, what are the effects of climate change?” (n=211)

Changing crop suitability

Long-term changes in crop suitability are anticipated due to water availability constraints, increased temperatures, and changing weather patterns. Producers indicated a need for information about crops and practices that are resilient to multiple climate stressors, including drought and extreme temperatures.

Off-farm climate-related risks

Increased threats to transportation and utility infrastructure

Multiple producer groups and WSDA staff noted increasing risks of climate change-related disruptions to transportation and power that can raise input and production costs for producers, put harvested products at risk, and reduce income for farmers and farmworkers. Climate change-related impacts can compound other existing infrastructure issues or disturbances. For example, oyster broodstock raised in Hawai'i can die in transit to Washington state during heat waves or transportation system delays. Wildfires, windstorms, and flooding events can damage or shut down roads, requiring lengthy detours or delays in shipments that can impact quality and scheduled delivery of perishable products such as dairy or produce. Similarly, port disruptions can affect produce quality if shipments are delayed. Both the Washington Grain Commission and the Washington Tree Fruit Research Commission listening session participants described transportation volatility as a major concern.

Extreme events, or the threat of such events, can disrupt agricultural processes, particularly through the loss of electric power. Due to wildfire-related liability, many electric companies across the West proactively shut down power when conditions are conducive to wildfires. Loss of power disrupts automated feeding machinery, irrigation systems, and farm office operations, and can result in the loss of agricultural products that require cooling or freezing.

“There are days when I drop my children off at daycare early morning, only to arrive at work and be sent home due to the rain or cold weather. Regardless of whether I work or not, I still have to pay for a full day of daycare, even if I don’t get paid myself”
— Farmworker listening session participant

Increased regulatory costs, risks, and market volatility

The global effects of climate change can lead to local consequences, with fluctuations in food and agricultural input costs, as well as commodity prices, driven by extreme events and other worldwide disruptions. Producers also view current and potential greenhouse gas emissions regulations, along with heightened environmental rules, as risks, since they could raise both costs and the administrative workload of farming. During listening sessions, producers were critical of government regulations, lack of support funding, and the disconnect between policymakers and producers in addressing climate change.

Lack of climate data, research, technical support, and equipment

During climate resilience listening sessions with Washington commodity groups, producers stressed the need for science-based information and technical assistance. Producers also discussed the need for region-specific climate resilience research, and local support to access and understand findings, and to implement solutions on their farms.

While many agree that climate change has made an already unpredictable industry even more challenging, there is a shortage of reliable solutions and local experts to assist. Producers expressed concern about the decline in available services over the years and emphasized the need for more basic and applied research, as well as additional staff for outreach, education, and technical support. Multiple listening session participants and survey respondents asked for additional WSU Extension resources. They also pointed out the disparities in access to these resources across different regions.

Much of the scientific research on climate change impacts on agriculture has been conducted in the last 15 years. Although research continues, there are still significant gaps in knowledge specific to Washington state. Producers and farmworkers particularly pointed out the need for better forecasting to help them prepare for extreme events. They also emphasized the need for more information and support on best management practices to help them adapt to climate change and sustain their resilience in evolving conditions.

"[We have a] lack of adequate research to implement climate solutions, for example, cover crops sound great, but in this [Eastern Washington] water-limited environment, cover crops aren't possible. There are lots of programs for it, but it just doesn't work here, and we don't have university research to prove it. A lot of times we get our desires and funding ahead of our knowledge. — Washington Grain Commission listening session participant

"Flood warning system is not accurate and [provides] late information. We rely on the system for livestock evacuation, it needs to [be] updated to reflect real-time data and more accurate predicted crests. " — Producer survey respondent

"It's always good to know what to do [to] improve the conditions of climate since it affects our lives in every way" — Farmworker survey respondent

Opportunities and strategies to mitigate risk

Climate change poses significant risks to Washington state's agriculture industry. However, due to its agricultural variety, unique landscapes, and location, climate change is anticipated to provide opportunities as well, especially compared to other states across the country. Strategic funding and focus can position the state to take advantage of these opportunities.

Geographic advantages

Negative climate-related impacts on Washington state's agriculture may be less severe than on other production regions in the US, making the state relatively more important in terms of its contributions to the national agricultural economy and food security. The state's relatively temperate climate, surface water availability, extensive irrigation systems, and variety of crops bolster its potential to become an even more agriculturally important region in a climate-changed future. For example, compared to the northwest region, the southwest may be experiencing an increasing trend in meteorological drought severity.

Other influences are also contributing factors. For example, California's San Joaquin Valley could face up to a 20 percent reduction in irrigation water supply by 2040 due to the combination of climate change and policy changes that drastically reduce groundwater withdrawals. Washington is not expected to see comparable reductions.

There remain many consequential impacts from climate change that will affect agriculture in the state. However, strategic investment and management at every scale will support the state's agricultural economy to realize the potential resulting from geographic advantages. Investments in a variety of trials, processing infrastructure, and water storage infrastructure may be key, especially through multi-benefit projects that support people, farms, and aquatic ecosystems.

Increased funding for on-farm climate resilience practices

Federal, Tribal, state, regional, and local governments have increasingly recognized the need to reduce emissions from agricultural production and enhance the resilience of agricultural operations to climate change. According to the USDA, the federal government invested \$3 billion in conservation and climate-smart practices nationwide in 2024. Revenue from Washington State's CCA has also supported the state's agriculture, including through WSDA's Compost Reimbursement and Saving Tomorrow's Agricultural Resources (STAR) programs and the State Conservation Commission's (SCC) Sustainable Farms and Fields (SFF) Program. Along with the Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP), SFF was one of the top-ranked resources used by survey respondents. While there is an ongoing need for more CCA investment into agriculture, future eligible activities include incentives for dairy anaerobic digesters, on-farm renewable energy, farmworker housing weatherization, and farm fleet electrification. It is critical for these potential projects to be realized and implemented through the CCA and other funding sources.

Importantly, there is growing recognition that the most effective funding programs should be implemented before a crisis occurs. For example, Washington State's HB 2147 passed in 2024 to establish the Agricultural Pest and Disease Response Account that can rapidly distribute funds during an invasive species crisis. This will help the state be more resilient through climate change by bolstering early pest detection and rapid response. To better plan and prepare for drought, HB 1138 established a Drought Preparedness Account in 2023. In response to low snowpack and forecasted warm and dry conditions, Washington State made an early drought declaration in April 2024, to ensure emergency funds could be distributed early enough to mitigate existing and anticipated impacts.

While increased funding is important, listening sessions and surveys revealed the following challenges in accessing those funds:

- The administrative burden of applying for, managing, and reporting on grant funds can be prohibitive, even for large farms with advanced administrative capacity. This makes it especially challenging for small or low-income farms to apply for and use grant funds, especially when language, literacy, or technology barriers exist.
- Producers must have significant upfront capital to meet the matching or reimbursement requirements of many grants. This brings further disadvantages to small or low-income farmers.
- Many grant programs that fund on-farm conservation practices have strict implementation requirements. Farmers with unique production practices, geographies, or diversified systems cannot always meet these requirements.
- Tenant farmers and farmworkers are ineligible for many grant programs that may require applicants be landowners or US citizens. There are few programs available to these communities.

"Farmers are on the frontlines of the climate crisis and we're being asked to bear the brunt of investment while prices stagnate and inflation makes the cost of production almost impossible to make a living!" — Producer survey respondent

Advances in climate science, data collection, and research funding

There has been increased focus and funding for developing on-farm management practices that can increase farm resilience. Federal funding for climate science and resilient management strategies could help shape practices in the state. For example, the NRCS used Inflation Reduction Act funds to expand climate-smart agriculture and forestry activities in 2024. In July 2024, the USDA announced \$90 million for Conservation Innovation Grants (CIG), including a \$1.2 million grant to the Whatcom Conservation District to research soil moisture and evapotranspiration-based precision irrigation technologies, and a multistate award that includes

Washington state, to assess 88 new trials of compost application. CCA funds may make similar advances for Washington state researchers and agricultural stakeholders going forward.

In Washington state, SCC, WSDA, and WSU work together to improve soil health through the Washington Soil Health Initiative. This effort works to ensure the adoption of on-farm conservation practices through outreach and education, policy support, research, and diverse economic incentives. Soil health practices were one of the most cited climate resilience practices mentioned by survey respondents in all regions of the state. State funding has also supported an expansion of WSU's Agricultural Weather Sensing Network (AgWeatherNet), which collects and delivers quality spatiotemporal weather data in the state to drive forecasts, models, and decision-support tools.

These are just a few scientific advances supported at the federal and state levels. Additional research and experimentation will help producers implement practices that work best on their farms.

Increased climate investments in infrastructure, energy, buildings, and transportation

Through the Inflation Reduction Act, the federal government and Washington State are investing in climate-resilient roads and utilities, electric vehicles, decarbonized buildings, and other strategies that could benefit agriculture. While some types of on-farm renewable energy are tried and true, others are still relatively new and should be deployed with care. Electric vehicles, for example, must be reliable and “fit-to-purpose” for long and sometimes unpredictable harvest schedules. The production of energy from anaerobic digesters on livestock operations could greatly benefit from significant advancements to overcome issues with scale and economic accessibility. Agrivoltaics—a system in which land is used for both agriculture and solar energy production—has shown promise in academic studies, though field scale implementation has not yet been realized in the state. With appropriate research, careful land use planning, and inclusive stakeholder involvement, this technology may provide additional farm income, support the state in achieving its energy goals, and simultaneously conserve agricultural land and heritage without undermining agricultural production.

Emerging technologies

Many emerging technologies support data-driven precision management on agricultural fields. These technologies may provide opportunities to optimize production, protect worker health, and achieve environmental goals. While some technologies such as autonomous tractors, precision sprayers, and robotic harvest machines require more research and development to overcome challenges of scale and accessibility, other technologies such as soil moisture monitor sensors are increasingly affordable and may be subsidized by public grants. Collectively, these technologies can support the efficient use of fuel, water, and farm inputs, which can reduce GHG emissions, off-target drift of pesticides and nutrients, and farmer input costs.

Expanded climate planning

Increased awareness of climate risks has led to the adoption of new policies and plans related to climate at the state and local levels. Governments are including climate risks in natural hazard mitigation and resilience plans and are factoring in the anticipated future climate (rather than historical climate) into their plans. WSDA has an opportunity to work with counties across the state as they create or update climate action plans to ensure that: agricultural risks and opportunities are included, diverse agricultural stakeholders are part of the planning processes, and planned actions are coordinated and complementary across the state.

*“Fighting climate change is expensive, not doing something will be even more expensive”
— Farmworker survey respondent*

Section 3

Goals, strategies, and actions

This section describes 6 goals, 14 strategies, and 27 actions to address risks and enhance agricultural resilience, guided by 5 overarching principles. Each action includes broad estimates of timeline and budget, select collaborators, effectiveness metrics, and select related existing tools and programs. For these actions to successfully enhance agricultural resilience in Washington state, significant funding and staff resources are required.



Principles

The principles below guided the development of the goals, strategies, and actions in the Climate Resilience Plan for Washington Agriculture. To the greatest extent possible, all climate actions presented in this plan:

- **Safeguard the vitality and viability** of Washington’s agricultural economy, heritage, culture, and communities in the face of climate change.
- **Promote co-benefits** including clean air and water, economic resilience, equity and environmental justice, GHG emissions reductions, soil health, and species and habitat protection.
- **Encompass diverse and collaborative approaches** including research, funding opportunities, technical assistance, policy support, outreach and education, and multi-benefit projects.
- **Ensure that information, support, and resources are available and accessible** to farm operators and workers of all regions, demographics, operation size, and primary spoken languages.
- **Incentivize voluntary participation in climate-resilience initiatives**

Goals, strategies, and actions summary



ACTIONS



GOAL 2

Support the adoption of climate-resilient agricultural practices

STRATEGY 2.1

Support research into on-farm strategies and actions that increase climate resilience in Washington

2.1.1: Establish a coordinated research agenda and funding pathway for the development of climate resilience data, strategies, and tools

2.1.2: Develop conservation practice monitoring tools

2.1.3: Encourage the development and implementation of climate-resilient technological innovation in Washington's agricultural sector

STRATEGY 2.2

Provide producers and farmworkers with education and technical assistance to mitigate the negative impacts of climate change and leverage opportunities

2.2.1: Increase institutional capacity for the provision of climate resilience research, outreach, and technical assistance across Washington

2.2.2: Develop or enhance a centralized source of information for agricultural climate-resilience in Washington

STRATEGY 2.3

Increase quantity and accessibility of funds for implementing on-farm climate resilience and recovery strategies

2.3.1: Work with stakeholders to reduce barriers in accessing funds for GHG emissions mitigation, climate change adaptation, and post-disaster recovery

2.3.2: Increase funding for producers and farmworkers to implement on-farm climate resilience and recovery actions

STRATEGY 2.4

Preserve agricultural land

2.4.1: Support and enhance strategies to protect agricultural land



GOAL 3

Safeguard a sufficient quantity of high-quality surface and groundwater for people, farms, and aquatic ecosystems

STRATEGY 3.1

WATER SUPPLY: Ensure sufficient quantity of water for farms, people, and aquatic ecosystems

3.1.1: Support water management efforts and ensure agricultural interests are represented

3.1.2: Support the adoption of on-farm water conservation technologies

STRATEGY 3.2

WATER SUPPLY: Ensure water quality programs also work towards climate resilience

3.2.1: Expand the goals of existing water quality programs to include resilience to ongoing climate change and extreme events



Figure 6. A graphical summary of the goals, strategies and actions in the Climate Resilience Plan for Washington Agriculture.

Goals, strategies, and actions

The goals, strategies, and actions in this section are described as follows:

WSDA's Role

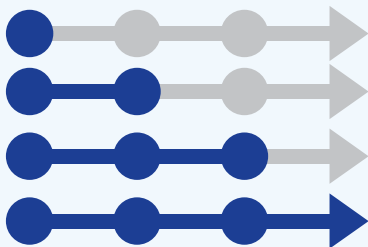
Describes whether WSDA leads and co-leads, convenes, or supports stakeholders in the implementation of the action.

Select collaborators:

Details select agencies and organizations that can play a key role in successful implementation. These collaborators are listed in addition to the farm operators, workers, policymakers, and agricultural stakeholders who are essential to the implementation of every action.

Implementation timeframe:

Describes if the action can begin in 1–2 years, 3–4 years, or is already in process.

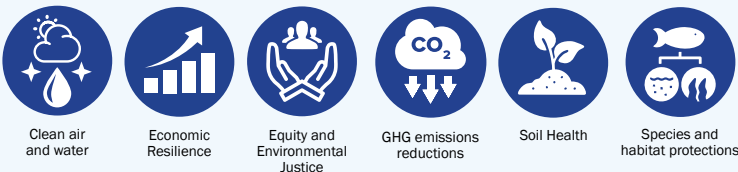


Cost:

Indicates the anticipated cost of implementation: least expensive (\$) under \$249,999; midrange (\$\$) from \$250,000–\$499,999; higher range (\$\$\$) from \$500,000–\$999,999; and highest cost (\$\$\$\$) over \$1 million.



Co-benefits:



Resilience metrics:

Suggests measures of progress for tracking what was done (implementation) and if actions increased resilience (effectiveness).

Select existing programs and tools:

Describes select WSDA and partner programs related to each action. While not comprehensive, these lists may be used to determine whether new programs or tools are required, or if existing resources can be expanded. In limited instances, programs and tools from other states have been included to inform WSDA efforts.

Goal 1: Increase agriculture's preparedness for, response to, and recovery from climate-related extreme events

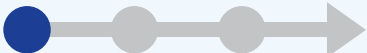
Strategy 1.1. Improve data collection, communication, and resource provision for climate-related extreme event preparedness

Action 1.1.1. Enhance the availability, accuracy, and accessibility of weather data and early warning systems

Inform decision-making before, during, and after climate-related extreme events by enhancing the availability, accuracy, and accessibility of current, historical, and forecasted weather data and climate prediction models. Install new monitoring stations complementary to existing automated weather stations. Where possible, expand the environmental variables that each station records (e.g., air quality or GHG measurements). Ensure variables are recorded and summarized across networks in consistent units and timescales. Using the best available data and predictions, develop user-led decision support systems to inform field operations (e.g., storm predictions, frost warnings, heat advisories, air quality updates, soil moisture forecasts), and ensure they're widely available to producers, farmworkers, and rural communities through culturally inclusive communication, community outreach, early education programming, and in-person promotion.



Action 1.1.1. Details:

WSDA's Role		
Convene, support.		
Select collaborators:		
Conservation districts, ECY, EPA, Health, NWS and other NOAA programs, NRCS (USDA), WSU		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Deployment or upgrade of new or existing monitoring systems to integrate with existing weather station networks • The generation of geographically diverse data to update predictive models • The number of new decision support tools and early warning systems developed using climate data, along with the number of active users • Development and deployment of communication plans and early education curriculum to increase awareness and accessibility of tools and data Effectiveness: • End-user engagement • Increased accuracy of predictive models		
Select existing programs and tools:		
Community Collaborative Rain, Hail & Snow Network; Washington Drought Declaration (ECY); AirNow.gov air quality data (EPA); Agriculture Compliance Unit (L&I); National Ag Safety Database (National Institute for Occupational Safety and Health); Climate Prediction Center–Seasonal Outlook, Drought Early Warning System, Graphical Forecast for Washington, NWS Cold Advisory for Newborn Livestock, NWS Skywarn, Storm Prediction Service/Weather Prediction Service, wireless emergency alerts (NOAA); Agricultural Weather Highlights, Northwest Climate Hub, World Agricultural Outlook Board (USDA); climate-related data and forecasts (University of Washington, Department of Atmospheric and Climate Science); AgWeatherNet, Cattle Comfort Index, crop-specific cold hardiness models, Decision Aid System, Irrigation Scheduler, Worker Heat Awareness (WSU)		

Action 1.1.2. Increase preparedness for livestock sheltering and feeding during climate-related extreme events

Work with collaborators and stakeholders to identify gaps in livestock sheltering infrastructure and emergency feeding capacity, including temporary or contingency solutions for potential seasonal hazards. Catalog existing relief and recovery funding resources (grants, loans, and insurance) through a partnership with SCC, Extension (WSU), and FSA (USDA), and identify coverage gaps to inform emerging state investments or grant opportunities. Develop and maintain a publicly available searchable database of agriculture recovery programs for users to find available situation-based relief programs.

Action 1.1.2. Details:

WSDA's Role		
Support		
Select collaborators:		
Animal control agencies, commodity groups, conservation districts, county emergency management, county fairgrounds, Extension (WSU), industry, livestock nutrient management agencies, local jurisdictions, National Animal Rescue and Sheltering Coalition (National Animal Care & Control Association), non-profit animal organizations, SCC, and FSA (USDA).		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: Comprehensive online searchable database for livestock sheltering during extreme events		
Effectiveness: - Increased capacity to house livestock in safe locations during extreme weather events - Reduced livestock losses during extreme weather events - Database user engagement metrics		
Select existing programs and tools:		
Red Star Rescue (American Humane Association); National Field Response (American Society for the Prevention of Cruelty to Animals); Community Animal Rescue Teams; National Animal Rescue and Sheltering Coalition (National Animal Care & Control Association)		

Strategy 1.2. Mitigate agricultural impacts by enhancing tools, resources, and strategies for collective emergency response

Action 1.2.1. Enhance swift and collective response to climate-related extreme events

Identify and implement measures to minimize impacts on humans, the environment, food systems, and the agricultural sector during extreme weather events or outbreaks of pests or diseases. Develop and deploy culturally and linguistically tailored emergency response training programs for producers and farmworkers to address climate-related risks such as heat stress, wildfire smoke, and flooding. Minimize the time between incidents, stakeholder notification, and collective response by efficiently integrating Emergency Support Function (ESF) 11 activities into agricultural response and recovery efforts. Leverage communication and collaboration mechanisms during emergencies to provide timely and accurate information, guidance, and updates on food safety and agricultural and natural resource impacts and protections.

Action 1.2.1. Details:

WSDA's Role		
Lead, convene		
Select collaborators:		
Conservation districts, Extension (WSU), local jurisdictions, state agencies organized under ESF 11 including DNR, DSHS, ECY, EMD, Health, SCC, WDFW, NWS, and other NOAA programs		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Development and sharing of Essential Elements of Information (EEI). • Use of the Incident Command System (ICS) during extreme events by agricultural stakeholders • Development of agricultural damage assessment metrics Effectiveness: • Use of the Emergency Support Function (ESF) 11 framework to scale response actions • Incorporation of agriculture business and worker impacts into the state damage assessment process • Improved protection and restoration of agricultural and natural resources • Reduction in economic damage to agricultural production operations following climate-related extreme events		
Select existing programs and tools:		
National Response Framework and National Incident Management System (FEMA); Disaster Assistance Program, Washington Shrubsteppe Restoration and Resiliency Initiative (SCC); National Institute of Food and Agriculture Rapid Response Funding (USDA); Comprehensive Emergency Management Plan and Washington Restoration Framework (Washington Military Department); Emergency Support Function 11-Agriculture and Natural Resources (WSDA)		

Action 1.2.2. Expand and create a dedicated funding source for WSDA’s Emergency Food Security Resilience & Relief Program

Expand and establish a permanent funding pathway for emergency food security response, including 1) The ongoing state-driven procurement and management of emergency food reserves and 2) The strategic, transparent distribution of food and funding to enterprises and organizations deemed vital to emergency food security based on a set of stakeholder-informed criteria. Provide ongoing funding for emergency food reserves, from which the state can ensure rapid emergency food distribution to communities impacted by fire, flood, extreme heat, drought, and other climate and/or public health emergencies. Coordinate and establish procurement criteria and distribution priorities that reflect stakeholder values, as well as regional, dynamic emergency distribution plans, which may include emergency food relief for communities and Tribal governments under an emergency declaration; equipment support and financial relief for Washington farm and food businesses operating in or serving a community under a county, state, or federal emergency declaration; and assistance for food banks, food pantries, and meal programs (including child and senior nutrition programs). Regularly evaluate need, stakeholder engagement, consistent inventory and ongoing replenishment, emergency distribution planning, and ongoing distribution. Coordinate across a broad group of essential stakeholders.

Action 1.2.2. Details:

WSDA’s Role		
Lead		
Select collaborators:		
DSHS, EMD, Health, NGOs, philanthropy, policymakers, and producers		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Creation of a stakeholder advisory body to inform the program • Development of an inventory and replenishment system • Creation of an emergency distribution plan Effectiveness: • Number of days under a state of emergency without interruption to emergency food assistance • Volume of emergency food and water distributed within distressed communities during a declared state of emergency		
Select existing programs and tools:		
Commodity Supplemental Food Program; Emergency Food Assistance Program; Local Food Purchasing Assistance Cooperative Agreement Program (WSDA and USDA)		

Action 1.2.3. Establish working groups to develop tools, technology, and strategies for managing flooding and sea level rise

Create cross-agency working groups to investigate strategies and best practices to become more resilient to flooding and sea level rise. Focus investigations on drainage assessments and implementation of mitigation measures for high-value farmland in floodplains and inundation zones. Explore current and emerging site-specific options including water storage, streamflow optimization, wetland easements, managed retreat, infrastructure upgrades, and planting salt-adapted crops.

Action 1.2.3. Details:

WSDA's Role		
Co-lead, convene, support		
Select collaborators:		
Conservation districts, DNR, drainage districts, ECY, industry, irrigation districts, SCC, university partners		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number of farms/acres with deployed mitigation strategies • Public and private investments in reducing flood and inundation impacts Effectiveness: • Reduced acres of inundated/flooded farmland during flooding events • Acres of riparian habitat easements adjacent to or directly benefiting high-value farmland from inundation/flooding • Reduction in economic damage to agricultural production operations following flooding event • Acres of at-risk farmland with reduced risk from intrusion		
Select existing programs and tools:		
Floodplains by Design, Shoreline Master Program (ECY); Watershed Programs of the NRCS (USDA); Nutrient Management Technical Services Program (WSDA)		

Strategy 1.3. Support timely and robust agricultural recovery from climate-related extreme events

For funding related to agricultural recovery, see also: Strategy 2.3 and related actions.

Action 1.3.1. Develop animal composting infrastructure that can accommodate offal from routine and catastrophic livestock deaths

Lead efforts to initiate, develop, plan, support, and incentivize a robust composting infrastructure to provide a viable, alternative disposal method for livestock animal mortalities and organic waste management. Conduct a market analysis for appropriate facility locations and regional needs. Build infrastructure and develop resources to support composting facilities that can routinely manage animal mortalities and offal, and scale up to support carcass management following extreme events. Provide economic incentives for producers and facility owners to deploy environmentally compliant composting management. Where appropriate, enhance support for on-farm mortality management through education, technical assistance, and funding.

Action 1.3.1. Details:

WSDA's Role		
Lead, convene		
Select collaborators:		
Animal agriculture sector, conservation districts, ECY, Health, local health districts, Extension (WSU), industry		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Completion of market analysis • Number of programs, resources, educational events, and incentives supporting composting facilities, livestock producers, and meat processors • Existence of streamlined laws, rules, and policies to facilitate animal composting Effectiveness: • Number of composting facilities routinely accepting animal carcasses • Ability of composters to scale up during extreme animal mortality events • GHG reductions from the appropriate disposal of animal carcasses • Reduced public safety and human health risks from the appropriate disposal of animal carcasses		
Select existing programs and tools:		
Organics Management Law (Washington State); Animal Health Program; Emergency Management Program; Nutrient Management Technical Services Program; Regional Markets Program (WSDA)		

Goal 2: Support the adoption of climate resilience agricultural practices

Strategy 2.1. Support research into on-farm strategies and actions that increase climate resilience in Washington

Action 2.1.1. Establish a coordinated research agenda and funding pathway for the development of climate resilience data, strategies, tools, and practices

Collaboratively create a research agenda to support the development of data-driven, climate-resilient practices and tools. Seek diverse development and implementation partners, particularly with farmers and farmworkers, to leverage local knowledge and expertise while ensuring solutions are practical and useable. Seek participation from Washington's many agricultural peer-to-peer networks. Coordinate across institutions to increase transparency and information sharing. Ensure that all generated data is accessible to agricultural stakeholders and leads to the development of useful decision support tools. Establish a permanent fund to support the execution of the research agenda. Research topics include, but are not limited to:

- Water supply and economic impact projections
- Disease, weed, and pest vector surveillance, prevention, response, and recovery
- Research and development of pest-resilient crops
- Selective breeding and variety trials for climate-resilient species
- Field trials and economic analysis of on-farm best management practices
- Waste management, industrial symbiosis, and biomass utilization
- Impact of practices on outcomes like water quality, animal welfare, farm profitability, soil health, biodiversity, and GHG emissions
- Research on agronomic and economic strategies to enhance the feasibility of practices
- Life cycle assessments for baseline GHG emissions data in different cropping systems
- Short- and long-term impacts of climate change on farmer and farmworker health



Action 2.1.1. Details:

WSDA's Role

Lead, convene, support

Select collaborators:

Animal agriculture sector, conservation districts, ECY, Health, local health districts, Extension (WSU), industry

Implementation timeframe:



Cost:



Co-benefits:



Resilience metrics:

Implementation:

- Development of Climate Resilience Research Agenda for Washington Agriculture
- Development of a permanent funding pathway to support the research agenda
- Dollars dedicated to agricultural resilience research
- Number of research projects and studies conducted
- Number and diversity of development and implementation partners
- Production of data to inform climate-resilience strategies and tools

Effectiveness:

- Creation and use of decision support tools for agricultural stakeholders
- Crop and aquaculture varieties bred with climate tolerances
- Producer perceptions of climate preparedness
- Creation and use of shared databases across agencies and university partners on topics including disease vectors, conservation practice adoption rates, and conservation practice impacts
- Improved preparedness and response to climate-related disasters, including diseases, pests, and extreme events
- Number of farms and acres, and diversity of farm size and demographics, adopting on-farm innovations, conservation practices, and technologies supported by science-based research
- Creation and use of climate-smart agricultural curriculum amongst producers and agricultural consultants
- Number of programs and partners incorporating the research agenda and its findings into decision-making processes, including the allocation of additional funds and resources

Select existing programs and tools:

Long-term agroecological research sites from the Washington Soil Health Initiative (SCC, WSDA, WSU); ARS, Conservation Innovation Grants, Sustainable Agricultural Systems Grants (USDA); Natural Resources and Agricultural Sciences, Nutrient Management Technical Services Program, Organic Program, Specialty Crop Block Grants (WSDA); Western Sustainable Agriculture Research and Education Grants

Action 2.1.2 Develop conservation practice monitoring tools

Develop tools to monitor and model conservation practice adoption and associated impacts on air and water quality, GHG emissions, soil health, and species and habitat protection. Use data integrated from surveys, remote sensing imagery, and projects funded by public institutions to establish a baseline of current conservation practice adoption, against which future progress can be measured.

Action 2.1.2. Details:

WSDA's Role		
Support		
Select collaborators:		
ECY, industry, Science Hub (SCC), NRCS (USDA), university partners		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Development of a tool to monitor the adoption of conservation practices		
Effectiveness: • Use of tool in decision-making processes at the state and federal level, including in decisions about where and how to focus additional dollars and efforts • Use of resulting data in the natural and working lands component of the Washington State GHG Inventory • Increased understanding of effective adaptation and mitigation interventions and practices		
Select existing programs and tools:		
Operational Tillage Information System tool (The Conservation Technology Information Center); ARS, ECY, Soil Carbon Monitoring and Research Network (USDA)		

Action 2.1.3. Encourage the development and implementation of climate resilience technological innovation in Washington state’s agricultural sector

Position Washington state as a leader in agricultural climate innovation through comprehensive, science-driven technology, research, and development. Where applicable, support the development, testing, and implementation of technologies, crop varieties, and management practices—such as on-farm energy production (e.g., biogas, agrivoltaics), virtual fencing, drought- and heat-resistant crop breeding, mechanical harvesting, industrial symbiosis, and precision management technologies—that could enhance agricultural resilience. Encourage collaborative research that involves farmers and farmworkers in identifying proactive climate-resilient strategies and tools. Seek innovative partnerships with the private sector to support operations of all sizes and demographics across the state.

Action 2.1.3. Details:

WSDA’s Role		
Convene, support		
Select collaborators:		
Commerce, conservation districts, farmworkers and their organizations, industry, NGOs, Pacific Northwest National Laboratory, ARS (USDA), university partners		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Research innovative climate adaptation technology and practices • Number of formal partnerships between diverse agricultural stakeholders, including between agricultural and tech industries, farmworker organizations, and research institutions Effectiveness: • Number of innovations that are scaled for widespread deployment • Effectiveness of the innovation in helping producers adapt to climate change • Affordability and accessibility of innovations to farm operators and workers of all regions, demographics, operation size, and primary spoken languages		
Select existing programs and tools:		
Industrial Symbiosis grants, programs, and services provided by the Office of Economic Development & Competitiveness (Commerce); Organics Management Law (Washington State); AgAid Institute (WSU)		

Strategy 2.2. Provide producers and farmworkers with education and technical assistance to mitigate the negative impacts of climate change and leverage opportunities

Action 2.2.1. Increase institutional capacity for the provision of climate resilience research, outreach, and technical assistance across Washington state’s diverse cropping systems and landscapes.

Build agricultural climate resilience support infrastructure, centrally coordinated by leadership at WSDA and WSU, with Extension practitioners in different production systems and regions across the state. Develop place- and context-based solutions to climate challenges in different production systems and regions, and build technical support infrastructure to broadly implement solutions on-farm. Support existing or new peer-to-peer networks for effective knowledge exchange and community building. Develop a funding pathway to add, at minimum, the following positions with regional climate resilience experts in Extension: veterinarian, engineer, agronomist, entomologist, agricultural climatologist, and agricultural economist. Centrally collect and equitably amplify all data, outreach materials, and decision support tools. Deploy creative professional development and retention strategies.

Action 2.2.1. Details:

WSDA's Role		
Co-lead		
Select collaborators:		
Agricultural consultants, farmworkers, conservation districts, industry, NRCS (USDA), WSU (Co-lead)		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number of new technical support staff installed across the state • Number of crop and livestock systems represented by the expertise of hired staff • Number of producers engaged • Number of tools tested, adapted, and developed • Increase in the use of these tools Effectiveness • Adoption of climate resilience strategies by producers		
Select existing programs and tools:		
Conservation technical assistance and resources (conservation districts); Center for Technical Development (SCC); Washington Soil Health Initiative (SCC, WSDA, WSU); ARS and Northwest Climate Hub (USDA); Climate Analogs Academy, Extension (WSU)		

Action 2.2.2. Develop or enhance a centralized source of information for agricultural climate resilience in Washington state

Develop or collaboratively enhance a centralized website for information about agricultural climate change impacts, resilience strategies, and resources related to technical assistance, funding, and policy. Tailor information in multiple formats and languages for diverse agricultural stakeholders, including producers, farmworkers, industry, NGOs, and university partners. Include peer-reviewed articles about the science of climate change, as well as plain talk information about resilience strategies and actions. Compile new data and climate-resilient management practices resulting from the actions in the Climate Resilience Plan for Washington Agriculture, while highlighting existing resource hubs hosted by collaborators.

Action 2.2.2. Details:

WSDA's Role		
Lead, convene		
Select collaborators:		
Commerce, ECY, Science Hub (SCC), university partners, Northwest Climate Hub (USDA), Washington State Commodity Commissions		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Development or identification of a website to host research and resources • Completed communications strategy promoting the website Effectiveness: • Producer and agricultural stakeholder awareness of the website • Number of website visits and information downloads • Accuracy and timeliness of updates and website maintenance		
Select existing programs and tools:		
Regional Integrated Sciences and Assessments (NOAA); Washington Soil Health Initiative's resource website (SCC, WSDA, WSU); Northwest Climate Hub (USDA); Northwest Climate Resilience Collaborative (University of Washington); Extension (WSU)		

Strategy 2.3. Increase quantity and accessibility of funds for implementing on-farm climate resilience and recovery strategies

Action 2.3.1. Work with stakeholders to reduce barriers to accessing funds for GHG emissions mitigation, climate change adaptation, and post-disaster recovery

Address documented concerns regarding the difficulty of accessing funds due to the administrative burden in applying and reporting, matching requirements, reimbursement periods, and inflexible practice specifications not suited for diverse operations. Remove administrative barriers to funding programs and make them easier for producers and farmworkers to access. Work with funders, lenders, and insurance companies to understand and remove the challenges of accessing funds. Promote flexible, easy-to-access financial assistance for climate-resilient agricultural technologies and practices, infrastructure improvements, regulatory compliance, and disaster relief. Enhance the consistency of access for operations of all sizes, demographics, and primary spoken language. Support agricultural viability at all scales, including operations owned or managed by overburdened populations and on federally recognized Tribal lands. Tailor programs to support participation by small and lower-income operations, farmworkers, and tenant farmers. Seek innovative public/private partnerships, including ones with agricultural finance institutions and supply chain partners. Work with diverse funders to conduct an audit and streamline processes where possible. Identify and fund organizations to provide grant writing, application assistance, and case management to diverse farm communities.

Action 2.3.1. Details:

WSDA's Role		
Convene, support		
Select collaborators:		
Agricultural finance institutions including lenders and insurers, farm advocacy NGOs, federal, state, and local funders, industry, university partners		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number and diversity of funders working together to reduce barriers • Number of funding programs audited and streamlined Effectiveness: • Reduced application time • Increased number of applications received • Increased number of small-scale and underrepresented farmers applying for funding • Reduced wait time for payments or reimbursements • Measure applicant satisfaction by surveys and stakeholder engagement		
Select existing programs and tools:		
Federal Funds Grant Writing Assistance Program (Commerce); Disaster Assistance Program (SCC); disaster assistance grants and programs from FSA, NRCS, and Rural Development (USDA)		

Action 2.3.2. Increase funding for producers and farmworkers to implement on-farm climate resilience and recovery actions

Create new or expand existing funding sources to make agriculture more resilient to long-term climate changes and climate-related extreme events, including for on-farm investments and farmworker housing. Reduce the financial burden on private landowners to provide public benefits (e.g., soil health, carbon sequestration, species and habitat protection, open space, and food security). Increase the quantity and accessibility of relief funds available to producers and farmworkers impacted by climate-related disasters. Collaborate with other state grant and loan programs to fund a wide range of on-farm climate-resilience and recovery activities for extreme events and long-term climate change, including but not limited to:

- Preparedness for, response to, and recovery from climate-related extreme events
- Infrastructure investments
- Climate-smart equipment and technology
- Conservation practice implementation including labor, equipment, and amendment costs
- Preservation of agricultural lands at risk of development or loss due to climate-related events
- On-farm water conservation technologies and off-farm water infrastructure
- Workforce safety programs that eliminate or reduce climate-related hazards and provide adequate training to all relevant agricultural stakeholders
- Research, modeling, incentives, policy support, outreach, and technical assistance for early detection and response to pests, weeds, and disease



Action 2.3.2. Details:

WSDA's Role		
Lead, support		
Select collaborators:		
Agricultural finance institutions including lenders and insurers, Commerce, farmworkers, industry, L&I, SCC, NRCS (USDA), university partners		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number of projects funded • Number and diversity of participating farms measured by demographic information, farm size, operation type, and region Effectiveness: • Number of conservation and climate-resilience investments funded, return on investment, change in productivity, water conservation, and other desired outcomes • Reduced loss of livestock, crops, buildings, infrastructure, and other investments during extreme events		
Select existing programs and tools:		
Disaster Assistance Program, Irrigation Efficiencies Grant Program, Office of Farmland Preservation, Sustainable Farms and Fields, and other funding programs (SCC); Washington State Organic & Sustainable Farming Fund (Tilth Alliance); Conservation Reserve Program, EQIP, and other NRCS programs (USDA); Compost Reimbursement Program, Organic Program, Saving Tomorrow's Agriculture Resources, Specialty Crop Block Grant Program (WSDA); Restore Grants (Zero Foodprint)		

Strategy 2.4. Preserve agricultural land

Action 2.4.1. Support and enhance strategies to protect agricultural land

Maintain the cultural, social, economic, environmental, and resilience benefits provided by Washington farms by preserving agricultural land at risk of development or loss due to various factors, including climate-related risks and hazards. Assess the role WSDA can play in supporting and expanding current preservation, zoning, and succession planning efforts. Participate in policy discussions and working groups to explore options for expanding the purchase of conservation easements, securing grants, and leveraging additional tax funds to conserve high-priority farmland.

Action 2.4.1. Details:

WSDA's Role		
Support		
Select collaborators:		
Conservation districts, Land Trust Alliance, local land trusts, NGOs including American Farmland Trust, Office of Farmland Preservation (SCC), NRCS Recreation and Conservation Office (USDA), Washington Association of Land Trusts		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • WSDA representation in workgroups and policy discussions • Number and visibility of initiatives aimed at conserving farmland • Number of counties in compliance with the Growth Management Act through successful participation in the Voluntary Stewardship Program Effectiveness: • Number of agricultural acres kept in production • Number of acres permanently protected for agricultural use • GHG emissions reductions achieved through avoided conversion		
Select existing programs and tools:		
Research and advocacy programs (American Farmland Trust); Employee Ownership Program (Commerce); Conservation Futures, transfer or purchase of development rights programs (select Washington counties); Office of Farmland Preservation's Farmland Protection and Land Access Program, Voluntary Stewardship Program (SCC); NASS data, NRCS Agricultural Conservation Easement and Regional Conservation Partnership Programs (USDA); Growth Management Act (Washington State), Farmland Protection and Affordability Investment Program (Washington State Housing Finance Commission); Farmland Preservation-Washington Wildlife and Recreation Program (Washington State Recreation and Conservation Office)		

Goal 3: Safeguard a sufficient quantity of high quality surface and groundwater for people, farms, and aquatic ecosystems

Strategy 3.1. Water supply: ensure sufficient quantity of water for farms, people, and aquatic ecosystems

Action 3.1.1. Support water management efforts and ensure agricultural interests are represented

Support collaborative policy development and planning related to watershed management strategies in Washington state, including water supply and irrigation infrastructure development and modernization programs. Participate in coordinated discussions with stakeholders representing competing water interests to optimize public benefits and achieve collaborative, solution-oriented progress. Actively seek a participatory role in water management efforts, and work with stakeholders to ensure agricultural interests are included in watershed planning efforts.

Action 3.1.1. Details:

WSDA's Role		
Support		
Select collaborators:		
Conservation districts, ECY, irrigation districts, SCC, Tribal governments and organizations, US Bureau of Reclamation		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • WSDA representation in state and regional water management discussions • Number of enhanced water storage and irrigation infrastructure projects completed, with an emphasis on multi-benefit projects • Number of collaborative watershed management strategies involving agriculture, Tribes, and other stakeholders Effectiveness: • Establishment of multi-benefit watershed management programs in regions with known water supply vulnerabilities • Identification and prioritization of infrastructure enhancements that reduce economic and ecological impacts resulting from water supply shortages		
Select existing programs and tools:		
Columbia Basin Policy Advisory Group (ECY); Columbia Basin Restoration Initiative; Walla Walla Basin Watershed Planning Strategy and contributing partners; Drought Assessment Tool (WSDA); Yakima Basin Integrated Plan and contributing partners		

Action 3.1.2. Support the adoption of on-farm water conservation technologies

See also: Strategy 2.3 and related actions.

Fund research and practice implementation for on-farm water use efficiency, including current and emerging technologies and practices such as soil moisture monitoring, efficient water delivery systems (e.g. drip irrigation), on-farm water storage, conservation practices that increase soil water storage, and aquifer recharge where appropriate for the production system and geography. Improve understanding of system-level impacts of such strategies, both when used singly and in combination.

Action 3.1.2. Details:

WSDA's Role		
Support		
Select collaborators:		
Conservation districts, ECY, irrigation districts, SCC, Tribal governments and organizations, US Bureau of Reclamation		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number of acres implementing efficiency measures Effectiveness: • Decreased depth to groundwater in aquifers • Reduction in water applied per crop produced • Reduced water and nutrient loss through deep percolation • Reduction in hydrologic impacts (groundwater declines, instream flow) associated with agricultural water use		
Select existing programs and tools:		
Drought Response Program (ECY); Irrigation Efficiencies Grant Program (SCC); NRCS EQIP WaterSMART Initiative (USDA)		

Strategy 3.2. Water quality: Ensure water quality programs also work towards climate resilience

Action 3.2.1. Expand the goals of existing water quality programs to include resilience to ongoing climate change and extreme events

See also Strategy 2.1 and Action 2.1.1.

Adapt WSDA's existing water quality programs to address the risk of extreme events, including increased precipitation that may increase off-target movement of pollutants, and drought that may concentrate pollutants in streams and rivers. Provide data, technical assistance, and funding opportunities to safeguard water quality during these events and throughout ongoing climate change. Communicate with producers about best management practices for mitigating the impacts of climate change on water quality issues.

Action 3.2.1. Details:

WSDA's Role		
Lead		
Select collaborators:		
Conservation districts, DNR, ECY, Health, industry, irrigation districts, local jurisdictions		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: - Integration of climate information into water quality monitoring protocols and technical assistance programs - Number and diversity of agricultural stakeholders attending presentations on water quality and climate impacts Effectiveness: - Reduced pollutants in Washington's surface and groundwater		
Select existing programs and tools:		
River and Stream Water Quality Monitoring Program (ECY); Office of Drinking Water (Health); Voluntary Stewardship Program (SCC); National Water Quality Assessment Project (US Geological Survey); Nutrient Management Technical Services Program, Organic Program, Pesticide Usage and Stewardship Programs, Surface and Groundwater Monitoring Programs (WSDA)		

Goal 4: Prepare the agricultural workforce for a changing climate

Strategy 4.1: Facilitate comprehensive farmworker protections from climate-related hazards

Action 4.1.1. Support the development of and compliance with farmworker protections through collaborative policy, program, and outreach efforts

Support efforts to improve farmworker health and safety from heat, outdoor air quality, and other climate-related hazards. Support increased access to shade structures, cooling stations, and cool potable water in fields to mitigate heat stress risks. Ensure diverse agricultural interests, including NGOs that specialize in farmworker rights and health, are represented during the development and deployment of new rules and programs to ensure inclusive policy recommendations. Harmonize regulations across agencies for efficient implementation and increased compliance. Aggregate information into a single resource. Communicate consistent information to all stakeholders. Establish transparent communication channels between government agencies, farmers, and workers. Establish a farmworker advisory board to collaborate with producers and policymakers. Develop simplified, multilingual resources and proactively distribute to build trust and understanding.



Action 4.1.1. Details:

WSDA's Role

Convene, support

Select collaborators:

Farmers, farmworkers and their organizations, Health, industry, L&I, NGOs, university partners

Implementation timeframe:



Cost:



Co-benefits:



Resilience metrics:

Implementation:

- Number and diversity of agricultural stakeholders represented in advisory groups for new health and safety regulations related to heat, air quality, and climate risks
- Awareness and use of existing and new aggregated information resources for all regulations and programs related to farmworker protections
- Increased understanding of laws and compliance strategies
- Percentage of farm operators and owners implementing and adhering to new health and safety regulations related to heat, air quality, and climate risks

Effectiveness:

- Improved health outcomes (lower incidence of heat stroke, asthma, heat-related illness, hospitalizations, or deaths) for farmworkers
- Reduction in workers' compensation claims related to heat exposure, respiratory issues, or other climate-related health conditions due to increased compliance

Select existing programs and tools:

Farmworker Justice; Office of Regulatory Innovation & Assistance (Governor's Office); Federal Migrant Health Program, Pesticide Illness Monitoring and Prevention Program, Temporary Migrant and Farmworker Housing (Health); Agriculture Compliance Unit, Consultation Program, Safety & Health Assessment & Research for Prevention, Wildfire Smoke Exposure Symptom Response Program, and other worker safety programs (L&I); Legal and Healthcare Services (Northwest Justice Project); Pacific Northwest Agricultural Safety and Health Center (University of Washington); Worker Protection Standards Program (WSDA)

Action 4.1.2. Support improved data collection, availability, analysis, and use of climate-related health impacts on farmers, farmworkers, and rural communities

Improve data collection on climate-related health incidents by occupation, both to regulatory agencies and medical institutions. Foster collaboration across agricultural, governmental, and medical institutions to collect occupational and environmental data during patient visits to health clinics. Establish baseline conditions against which to measure compliance and progress. Inform current and future policy development with comprehensive and accurate data. Use data to further identify predictors of injury and illness and develop mitigation opportunities.

Action 4.1.2. Details:

WSDA's Role		
Support		
Select collaborators:		
Farmers, farmworkers and their organizations, Health, industry, L&I, medical institutions, NGOs, university partners		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: - Increased data collection and availability Effectiveness: - Use of data to update or improve policy development and implementation, and training and education initiatives - Use of data to proactively identify and establish mitigation strategies		
Select existing programs and tools:		
Safety & Health Assessment & Research for Prevention, Wildfire Smoke Exposure Symptom Response Program, and other worker safety programs (L&I); Pacific Northwest Agricultural Safety and Health Center (University of Washington)		

Action 4.1.3. Support the development of a statewide farmworker safety communication network

Develop a statewide safety notification system for farm operators and farmworkers to minimize the time between health and safety threats from extreme weather and related mitigation actions. Ensure ease of access by developing multilingual communications distributed through diverse, culturally inclusive media channels including social media, text messages, listservs, and radio bulletins. Increase efficiency and ease of compliance by supporting technological solutions such as push app cell phone notifications tied to local weather stations to automatically alert farmers and workers of air quality and heat hazards.

Action 4.1.3. Details:

WSDA's Role		
Support		
Select collaborators:		
Farmworkers and their organizations, Health, L&I		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number or percentage of farm operators and farmworkers enrolled in communication networks • Extent of network's geographic coverage Effectiveness: • Farmworker engagement with the system and user feedback • Improved health outcomes (lower incidence of heat stroke, asthma, heat-related illness, hospitalizations, or deaths) for farmworkers • Reduction in the number of compensation claims related to heat exposure, respiratory issues, or other climate-related health conditions		
Select existing programs and tools:		
AirNow.gov air quality data (EPA); Heat Safety Tool (Occupational Safety and Health Administration); Wildfire Smoke Text Alert System (Ventura County, California); AgWeatherNet's Worker Heat Awareness (WSU)		

Strategy 4.2: Train, maintain, and diversify an agricultural workforce equipped with the skills and knowledge to promote resilience practices and technologies

Action 4.2.1. Expand and fund agricultural workforce training programs to include climate-resilience curriculum

Address historic agricultural workforce challenges—worsened by climate change impacts—by developing a permanent funding pathway for local agricultural workforce development programs. Finance existing organizations and initiatives related to agricultural climate-resilience career paths, including green job development, agricultural technology training (e.g., precision agriculture, conservation agronomy), workforce diversification, rural job security, and agricultural leadership training. Develop and promote an early education curriculum for climate-resilience in agricultural communities. Develop initiatives to re-train farmworkers who may be displaced by automation, enabling them to transition to other roles within the agricultural sector.

Action 4.2.1. Details:

WSDA's Role		
Lead, support		
Select collaborators:		
Community and technical colleges, farmworkers and their organizations, university partners, Washington State Board for Community and Technical Colleges Centers of Excellence		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number of program graduates • Number of employers participating in programs • Existence of early education curriculum Effectiveness: • Program evaluation surveys • Existence of an agricultural workforce trained and skilled in climate-resilience		
Select existing programs and tools:		
Homegrown by Heroes (Farmer Veteran Coalition); Future Farmers of America programs (local and national FFA); Minorities in Agriculture, Natural Resources, and Related Sciences (MANNRS); Center for Rural Affairs, Farm to School Program, Start2Farm, Support for Beginning Farmers (USDA); Office of Apprenticeship (US Department of Labor); 4-H, Agricultural Leadership Program (WSDA); Climate Analogs Academy (WSU)		

Action 4.2.2. Support farmworker engagement in climate resilience by leveraging their expertise and investing in continued professional development

Facilitate farmworker involvement in developing climate-resilience strategies and tools, ensuring that solutions are practical and worker-centered. Provide training opportunities and leadership development, particularly for crew supervisors, to foster a culture of safety and engagement. Support farmworker peer-to-peer networks for knowledge exchange, leadership development, and enhanced resilience.

Action 4.2.2. Details:

WSDA's Role		
Support		
Select collaborators:		
Community and technical colleges, farmworkers and their organizations, university partners, Washington State Board for Community and Technical Colleges Centers of Excellence		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Farmworker participation in the development of climate research, technology, and funding • The existence and use of farmworker advisory groups for climate-related innovation, program development, and rulemaking • Participants in leadership development programs Effectiveness: • Farmworker perceptions of team culture, safety, and engagement • Number of farmworker-led innovations supported and implemented		
Select existing programs and tools:		
Innovation Challenge (Semillero de Ideas), Pacific Northwest Agricultural Safety and Health Center (University of Washington), Agricultural Leadership Program (WSDA)		

Goal 5: Minimize impacts from pests, weeds, and disease

Strategy 5.1. Increase preparedness for emerging pests, weeds, and disease

Action 5.1.1. Develop and expand resources for the early detection of pests, weeds, and disease

Develop and expand permanent funding pathways for increased preparedness to existing and emerging pests, weeds, diseases, and harmful algal blooms. Finance research, modeling, incentives, policy support, outreach, and technical assistance specific to agricultural threat preparedness. Participate in cross-agency threat surveillance through the development and use of a shared database for environment-to-animal-to-human disease transmission. Develop tools that allow farmworkers to participate in pest identification, reporting, and threat mitigation. Ensure data and resources are available and accessible to broad agricultural interests.

Action 5.1.1. Details:

WSDA's Role		
Lead, support		
Select collaborators:		
ECY, Health, Animal and Plant Inspection Service (USDA-APHIS), university partners, WDFW, Washington State Commodity Commissions, Washington Invasive Species Council (Washington State Recreation and Conservation Office)		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Amount of secured funding • Number of incentives funded • Number of predictive models providing information on threats to Washington's diverse agricultural operations • Existence of shared surveillance database Effectiveness: • Reduced time to identify and respond to emerging threats • Containment of pests, weeds, and disease • Reduced agricultural losses due to pests, weeds, and disease		
Select existing programs and tools:		
Washington and Global One Health Collaboratives (Health and partner agencies); U.S. Climate Resilience Toolkit (NOAA); Northwest Regional Invasive Species and Climate Change; State Noxious Weed Control Board (Washington State); Animal Disease Traceability Program, Animal Health Program, Avian Health Program, Pest Program (WSDA); Decision Aid System, Pacific Northwest Herbicide Resistance Initiative (WSU)		

Action 5.1.2. Educate producers and farmworkers on emerging pests, weeds, and diseases

Educate agricultural stakeholders on the identification of emerging pests, weeds, and diseases, including the importance of early detection in reducing the economic impacts on Washington state's agricultural economy. Promote best management practices for the effective response to emerging pests, weeds, and diseases for leading commodities.

Action 5.1.2. Details:

WSDA's Role		
Lead		
Select collaborators:		
Agronomists and their organizations, Extension (WSU), industry, Washington State Commodity Commissions		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Number of outreach programs • Number of emerging pests, weeds, and diseases covered Effectiveness: • Quantification of pest/weed/disease-specific economic damages		
Select existing programs and tools:		
PNW Herbicide Resistance Initiative; Plant Protection Division (WSDA); Extension (WSU)		

Strategy 5.2. Improve and expand the response to emerging pests, weeds, and diseases

Action 5.2.1. Develop and expand communications and reporting networks for the rapid response to pests, weeds, and disease threats

See also Action 1.2.1 and Action 2.1.1.

Expand and develop communications networks related to new and emerging pests, weeds, and disease outbreaks, to support a rapid and coordinated multiagency and multijurisdictional response. Ensure diverse commodity groups, trade partners, and agricultural stakeholders are represented in the network.

Action 5.2.1. Details:

WSDA's Role		
Lead, convene		
Select collaborators:		
Washington State Commodity Commissions, Washington State Noxious Weed Control Board, Washington Invasive Species Council (Washington State Recreation and Conservation Office), Extension (WSU)		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Development of a multijurisdictional reporting and tracking system Effectiveness: • Measured response time between outbreak and response		
Select existing programs and tools:		
National Incident Management System (FEMA); Northwest Regional Invasive Species and Climate Change Network; PNW Herbicide Resistance Initiative; Incident Command System (USDA)		

Goal 6. Ensure that laws, policies, and regulations efficiently work towards the dual outcomes of climate-resilience and agricultural viability

Strategy 6.1. Enhance the development of and compliance with environmental and climate-related laws, policies, and regulations

Action 6.1.1. Convene stakeholders to explore the development of coordinated and efficient regulations that reduce administrative and financial burden while enhancing climate resilience, worker safety, and other co-benefits

Work across state agencies and stakeholder groups to explore, develop, and support efficient, harmonized regulations that simultaneously support public benefits, worker safety, climate-resilience, and agricultural viability. Develop new thinking and models of success in this arena, especially in developing and implementing strategies that increase compliance while securing farm productivity, profits, and worker earnings. Evaluate permitting and regulatory processes for the inclusion of climate-resilience. Actively seek a participatory role in the development of climate policies and rulemaking, and work with agricultural stakeholders to ensure diverse agricultural interests are included.

Action 6.1.1. Details:

WSDA's Role		
Lead, support, convene		
Select collaborators:		
Washington State Commodity Commissions, Washington State Noxious Weed Control Board, Washington Invasive Species Council (Washington State Recreation and Conservation Office), Extension (WSU)		
Implementation timeframe:	Cost:	Co-benefits:
Resilience metrics:		
Implementation: • Number of legislative or other policy efforts on which WSDA and diverse agricultural stakeholders provide input • Number of permitting and regulatory processes evaluated and updated Effectiveness: • Successful inclusion of climate-resilient agriculture into legislation, policy, and regulatory activities • Reduced discrepancies between laws, policies, and regulations across state agencies		
Select existing programs and tools:		
Existing collaborative workgroups such as Environmental Justice Council, Food Policy Council, and Riparian Roundtable can inform the development of future collaborative efforts.		

Action 6.1.2. Support producers in achieving and maintaining environmental and climate-related regulatory compliance

Provide technical assistance, research, and funding to producers and farmworkers to support the efficient navigation of and compliance with environmental and climate-related regulations. Collaborate with agricultural stakeholders to collect and amplify best practices or effective mechanisms for maintaining compliance, including through peer-to-peer networks. Coordinate across different Washington cropping systems and geographies to share challenges, solutions, and best management practices.

Action 6.1.2. Details:

WSDA's Role		
Lead, support, convene		
Select collaborators:		
ECY, Extension (WSU), Washington State Commodity Commissions		
Implementation timeframe:	Cost:	Co-benefits:
		
Resilience metrics:		
Implementation: • Staff hired to provide support • Funding dedicated to pay for implementation support Effectiveness: • Number of operations in compliance		
Select existing programs and tools:		
Office of Regulatory Innovation & Assistance (Governor's Office); Natural Resources and Agricultural Sciences Program, Nutrient Management Technical Services Program, policy team and staff (WSDA); Extension (WSU)		

Section 4

Implementation, maintenance, and evaluation

Climate change presents multiple pressing challenges to agricultural producers and stakeholders across Washington state. Section 2 outlines these challenges and explains why a multi-pronged approach is necessary to build resilience. Section 3 outlines the principles, goals, strategies, and actions to guide internal efforts and identify opportunities for collaboration with external organizations and stakeholders. This section discusses WSDA's approach to implementing the Climate Resilience Plan for Washington Agriculture, including a proposed schedule for evaluation, maintenance, updates, and considerations for conducting future evaluations.



The Climate Resilience Plan for Washington Agriculture is just the first step towards safeguarding Washington's critical agricultural system and the many benefits it provides. Some actions described in Section 3 can be implemented using existing authority and resources. However, significant additional funding, staff, and coordinated efforts will be required at WSDA, and across the state, for this work to successfully enhance Washington's agricultural resilience.

WSDA approach to implementation

A key principle in WSDA's 2022–2025 Strategic Plan is “to expand future economic opportunities for Washington agriculture by building climate resilience.” WSDA staff are increasingly integrating climate resilience into their daily activities while collaborating with and supporting the efforts of other organizations, as reflected in the programs listed in Section 3.

To increase efficiency, WSDA created an internal Climate Working Group to coordinate WSDA climate-related activities. This group will be the driving force to implement the actions in the Climate Resilience Plan for Washington Agriculture, monitor progress, and coordinate reporting and evaluation of climate resilience actions. The Climate Working Group is supported by WSDA programs that have direct responsibility for implementation. Staff will work directly with external stakeholders and guide reporting, updates, and evaluations.

While WSDA has an important and central role in the viability of Washington's agricultural production in the face of climate change, the work cannot be done alone. Much of WSDA's work requires coordination with a wide variety of stakeholders and agricultural producers across the state. WSDA is committed to working collaboratively with key stakeholders to implement strategies and actions and to adaptively update the Resilience Plan based on changing conditions and stakeholder feedback. The agency is dedicated to learning from its partners, incorporating feedback, and collaboratively facilitating successful implementation and progress.

Successfully implementing the Resilience Plan requires resources including staff with subject matter expertise, research, infrastructure, on-farm investments, and relationships with diverse and varied stakeholders. Many actions described in the Resilience Plan will require new funding. However, WSDA remains committed to identifying opportunities to reduce harm from climate change regardless of future funding availability.

Proposed maintenance and evaluation schedule

The Climate Resilience Plan for Washington Agriculture is a significant step in an ongoing effort to make agriculture in Washington more resilient through climate change. Provided sufficient staffing, WSDA will create yearly work plans, track implementation, and evaluate the effectiveness of the Resilience Plan. The proposed maintenance schedule is:

- **Work plan — Every year:** WSDA's Climate Lead, in collaboration with the WSDA Climate Working Group, will develop an annual work plan to define responsibilities within the agency in coordination with other state agencies and external stakeholders. Yearly work plans will allow the agency to prioritize actions, adapt and respond to current funding availability, consider the latest research, and address pressing climate-related challenges and opportunities.
- **Action tracking — Every 2 years:** In the first year of implementation (2025), WSDA will work to establish a baseline analysis of resources and adaptation efforts at WSDA. Progress on baseline conditions, annual work plans, and Resilience Plan implementation will be collected every two years (2027, 2029, etc.). While the first report will likely focus on implementation metrics (described in Section 3), subsequent reports may include additional information on the impact of the actions

(effectiveness metrics, described in Section 3). This information will also contribute to WSDA reporting requirements for the Washington State Climate Resilience Strategy (2024).

- **Resilience Plan update — Every 4 years:** Consistent with the Washington State Climate Resilience Strategy (2024) timeline, every four years WSDA will evaluate whether the Resilience Plan requires updating to better align with statewide efforts, evolving conditions, and updated priorities for WSDA and the State of Washington. The WSDA Climate Working Group will determine which sections require revision, including the science and policy reviews and the goals, strategies, and actions; and whether additional outreach to the public and agricultural stakeholders is needed. Updates to the Resilience Plan may also include snapshots of past climate conditions (e.g., temperature, precipitation, and extreme event data from the previous 4 years) as well as related impacts on agricultural production.
- **Resilience Plan evaluation — Every 8 years:** To assess the effectiveness of the strategies and actions in achieving the Resilience Plan's goals, an in-depth evaluation will be conducted approximately eight years after adoption, or first in 2033. This timeframe allows for initial implementation of actions and for the effects of actions to have a measurable impact. To ensure a well-rounded and objective assessment of the Resilience Plan's effects, WSDA will consult an external research partner to carry out the evaluation.

Additional considerations

A key part of the implementation, maintenance, and evaluation of the Resilience Plan is tracking which communities benefit from climate resilience efforts and which face unintended costs. WSDA will make every effort to engage and measure impacts within small, under-resourced, and socially disadvantaged farmer and farmworker communities and to collaboratively incorporate feedback into updated versions of the Resilience Plan.

The Resilience Plan is designed to achieve the 6 goals described in Section 3. WSDA will evaluate the outcome of these goals to determine if the strategies and actions are effective and enhance Washington's agricultural resilience amidst climate change. While WSDA is committed to this formal evaluation, the agency also realizes that many impacts of climate change are still unknown. Furthermore, many confounding variables (e.g., natural climate variability, other geopolitical influences, and concurrent climate resilience efforts from other Washington and federal entities) will complicate the evaluation.

While this work is challenging, WSDA is committed to increasing agricultural resilience and to addressing the challenges presented by climate change. This Resilience Plan provides the roadmap for WSDA to leverage the strengths, experience, and expertise of agency staff, external collaborators, and agricultural stakeholders.

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Appendix A

Policy synthesis: Select climate resilience plans and reports



Introduction

Local and state agencies, Tribes, and farming communities in Washington state and across the US have developed climate resilience plans to mitigate the impacts of climate change on agriculture. These plans encompass a variety of approaches, from on-farm resilience practices such as agroforestry, managed grazing, reduced tillage, and biochar amendments; to off-farm initiatives like infrastructure investments, public outreach and education, financial and technical assistance, and promotion of renewable energy in agriculture. Key objectives include but are not limited to the preservation of farmland, the enhancement of drainage infrastructure, the effective and multi-benefit management of water resources, flood protection, and the implementation of integrated pest management strategies.

This literature review examines select climate vulnerability assessments, resilience plans, and related Washington State legislation at the local, state, and national levels to support the development of the Climate Resilience Plan for Washington Agriculture.

Method and organization

Climate resilience plans that focus on agriculture are limited. Three local Washington state plans were examined for areas east of the Cascades, and four plans for areas to the west. All western plans were produced by counties, while eastern plans were produced by a county, a conservation district, and a Tribe. This review is neither exhaustive nor regionally comprehensive; rather, reports were selected to capture a representative set of local and regional climate risks and opportunities for agriculture. Plans that did not directly address agriculture were not included. Local hazard mitigation plans were generally excluded; instead, the Washington State Enhanced Hazard Mitigation Plan was reviewed as a proxy.

Plans from California, Idaho, and Oregon were included to assess how neighboring states are addressing climate and agriculture. Several national studies were also examined. This information can be used to understand and leverage local, state, and federal strategies and actions to address climate risks and opportunities for agriculture.

The literature review is organized into 5 sections:

- **Local Plans:** includes the following select climate plans:
 - West of the Cascades: King, Snohomish, Thurston, and Whatcom counties
 - East of the Cascades: Chelan County, Methow Valley, and the Territories of the Yakama Nation
- **Washington State Plans** summarize the Washington State Climate Resilience Strategy (2024) and the Enhanced Hazard Mitigation Plan (2023).
- **Washington Legislation** describes select climate-related legislation that has implications for agriculture.
- **Other State Plans** describe agricultural plans, reports, and research for California, Idaho, and Oregon.
- **National Plans** include summaries of the Fifth National Climate Assessment (2023) and the National Institute of Food and Agriculture Climate Adaptation and Resilience Plan (2022).

Synthesis of risks and opportunities included in plans

Available local and Tribal climate plans highlight the risks and opportunities for agriculture and agricultural producers in different parts of the state. These risks and opportunities are generally consistent with those identified at the state and national level. While the majority of plans focus on agricultural adaptation and resilience to climate change, several also include climate change mitigation strategies.

Common risks described in most plans include:

- **Extreme weather events:**
The escalating frequency and severity of extreme weather events like floods, storms, and wildfires pose significant threats to crop viability, soil health, infrastructure integrity, and the well-being of livestock. The risks of extreme heat, wildfire, and flood are present statewide, though areas east of the Cascades are at higher risk for extreme heat events and wildfire. The Puget Sound and Northwestern regions are considered the most vulnerable to flooding. Smoke impacts crop quality as well as the health of workers and livestock.
- **Water availability:**
Water stress emerges as a pressing concern across numerous plans, with declining water availability, changing snowpack levels, drought, seasonal changes in irrigation demand, and potential water shortages affecting crop productivity (quality and yield), planting practices, and livestock welfare. Junior water rights holders may experience greater reductions in water available for agriculture.
- **Water quality:**
Extreme precipitation events and flooding may lead to runoff and soil erosion, which can lower water quality by introducing pollutants, excess nutrients, and sediments. Moreover, higher temperatures, with irregular precipitation patterns and prolonged droughts, can accelerate evaporation, intensify contaminant concentrations, and further degrade water quality. Decreased water quality poses a significant threat to agricultural food systems and aquatic habitats.
- **Changing temperature:**
Temperature changes, including rising temperatures and shifting climate patterns, impact crop types, pest pressures, and the overall suitability of some agricultural practices. Plant hardiness zones are changing, shifting plant suitability. Frost free periods are longer, requiring adjustments to crop selection and equipment usage. For livestock, increased heat and humidity can lead to lower weight gains and milk production, greater susceptibility to parasites and disease pathogens, and—in extreme cases—death.
- **Expanding impacts and range of pests, weeds, and disease:**
Increased temperatures can contribute to the proliferation of new and existing pests, weeds, and diseases. For example, invasive cheatgrass often thrives in areas burned by wildfires. Impacts associated with pests, weeds, and disease can increase production and operation costs, decrease yields, and increase food safety issues. They can have negative implications for human and livestock health.
- **Sea level rise:**
Sea level rise and saltwater intrusion along coastal areas pose risks to some farmland and crops. Associated land subsidence and aggradation can exacerbate drainage challenges, flood risks, and soil stability issues.
- **Threat to Tribal food systems and medicinal plants:**
Water shortages, drought, wildfires, and other climate-related risks threaten the availability of traditional food systems and medicinal plants for Tribal members.
- **Increased food costs and food insecurity:**
Extreme events and longer-term droughts can disrupt food production and availability, increasing costs and decreasing the availability of food.

These documents commonly identified the following strategies to address risks:

- **Promote on-farm conservation practices:**
Management techniques like no-till farming or cover cropping are recommended to improve soil health and enhance carbon sequestration, water retention, and nutrient availability. Investments in on-farm infrastructure, technology, renewable energy, and precision agriculture are also highlighted as a means of improving farm efficiency, reducing environmental impacts, and enhancing adaptive capacity.
- **Expand and increase access to funding, technical assistance, and conservation programs:**
Conservation programs, funding, and technical assistance can be instrumental in the successful execution of on-farm resilience practices.
- **Support water conservation and efficiency measures:**
Irrigation upgrades and drought planning are emphasized to mitigate water stress and ensure long-term water security for agricultural operations.
- **Encourage diversification of agriculture products:**
Diversification is encouraged to support ecosystem resilience and expand local markets. Collaboration, education, and stakeholder engagement play a key role in implementing these strategies, with plans advocating for partnerships, policy changes, funding mechanisms, and community involvement to support climate adaptation and mitigation efforts.
- **Bolster ecosystem services through agricultural preservation:**
In addition to providing food, agricultural land can absorb and filter water, provide habitat for some species, and sequester carbon. Protecting agricultural land from development ensures that it can continue providing these and other essential ecosystem services.
- **Expand and increase opportunities to reduce GHG emissions and sequester carbon:**
There are multiple opportunities to reduce GHG emissions through farming practices, including manure management and the efficient use of fuel, fertilizer, and on-farm energy. Carbon sequestration may be enhanced through increased use of perennial plantings via hedgerows or through compost application, cover cropping, conservation tillage, and other management practices.

Local and national climate plans underscore the interconnectedness of climate risks, agricultural practices, and community resilience. These connections highlight the need for proactive planning, innovation, and adaptive strategies to address the complex challenges posed by climate change in Washington's agricultural sector.

While climate plans from nearby states identify a similar set of climate impacts, local plans provide unique insight into how Washingtonians are addressing risks across varied land types and through different statewide partnerships. Similarly, national plans highlight the same or similar risks but offer access to a more comprehensive inventory of data, research, and best practices from across the nation.

Highlights from local climate plans

This section provides an overview of select climate action and resilience plans from localities that explicitly investigated agriculture. While some entities have hazard mitigation plans for specific hazards (i.e., floods and wildfires), few have plans specifically tailored to identify and address the interconnected impacts of climate change. Even fewer investigate the impacts of climate change on agriculture. Where available, local climate plans with an agricultural component provide valuable insights into priority areas and the innovative strategies adopted by local communities to bolster resilience. The synthesis presented below highlights unique aspects of each plan, including the climate science and modeling included by localities.

Snohomish Conservation District Agriculture Resilience Plan (2019) ⁵

The Snohomish Conservation District Agriculture Resilience Plan was developed by the Snohomish Conservation District in partnership with the Snohomish County farming community, to build an agricultural landscape that is more resilient to the pressures associated with “development, population growth, flooding, shifts in weather and climate change.” The Snohomish County plan is the only local document included in this review that focuses exclusively on agriculture. It includes a comprehensive impact assessment as well as a priority needs assessment.

Snohomish County is experiencing notable climate challenges that affect its agricultural production and are projected to intensify in the coming decades. Projections indicate that by mid-century, the area inundated during a 2-year flood event could more than quadruple in the Stillaguamish River Watershed and more than double in the Snohomish River Watershed. These increases will exacerbate issues such as bank erosion, flood debris removal, and crop damage, presenting continuous challenges for local farmers. Rising sea levels are compounding these problems by creating what is known as a “coastal squeeze.” Farms near river mouths face increased risks of drainage difficulties, saltwater intrusion, and pressure on sea dikes. Groundwater modeling indicates that by the 2050s, spring field access may be delayed by up to four weeks, with delays potentially extending to five weeks by the 2080s. Low-lying farmlands, especially those close to the Puget Sound coast, are particularly vulnerable to these impacts.

In addition to these environmental stressors, increasing air temperatures are projected to alter the region's agricultural landscape. Summers are expected to become warmer with reduced precipitation, potentially affecting crop yields negatively. Conversely, a longer growing season could open opportunities for new types of agricultural production. By mid-century, crops like corn, barley, and potatoes could mature about a month earlier, with further advancements expected by the end of the century. This shift may allow for double cropping and the cultivation of crops currently suited to warmer climates, potentially expanding market opportunities.



The Snohomish County plan proposes resilience practices and priority needs and actions. The on-farm resilience practices described in the Snohomish County plan are well aligned with those in other plans and largely represented in the synthesis section above. Notable action items include, but are not limited to:

- Explore options for increasing funding to conserve high-priority farmland, especially within floodplains (i.e., expanding the Transfer of Development Rights (TDR) program, securing grants, and leveraging additional taxes). Snohomish County has developed a priority mapping element, which ranks farmland for preservation based on criteria such as farmland quality and proximity to development threats.
- Conduct drainage needs assessments and implement projects to enhance existing drainage infrastructure capacity; assist in acquiring permits, complying with regulations, and securing funding for drainage improvements.
- Develop compensation agreements with local jurisdictions to offset costs and reduce runoff through projects or initiatives, as increased runoff from upland development exacerbates drainage challenges for farmers.
- Allocate additional funding to incentivize drought resilience practices; conduct research and on-farm trials for new drainage infrastructure (i.e. controlled release of water from drain tiles or drainage ditches) to address hotter and drier summers.



Whatcom County Climate Action Plan (2021) ⁶

The Whatcom County Climate Action Plan details the county's goals, strategies, and actions for safeguarding its natural environment from the impacts of climate change. A dedicated subsection centers on agriculture, highlighting local climate risks and proposing relevant measures to enhance resilience. As of 2017, Whatcom County ranked in the top three percent of US farm production. However, compared to the rest of Western Washington, the county lost nearly three times as many farm acres between 1997 and 2017. Whatcom County has since established a goal to maintain and preserve at least 100,000 acres to support agriculture.

The Whatcom County plan includes a vulnerability assessment, which shows that the agricultural sector's sensitivity to climate change is relatively high, but exposure and adaptive capacity may help counteract climate issues in the near term. Whatcom County identifies six strategies and actions for climate resilience in agriculture, generally focusing upon **emissions reduction, water storage, and streamflow optimization, farmland preservation, research and development of drought and heat-resistant crops:**

- Establish a water bank to facilitate water spreading, leasing, and transfer, in coordination with Natural Resource Market development.
- Develop a carbon credit program that compensates farmers for sequestering carbon.
- Provide incentives for anaerobic digesters and other manure treatment technologies to reduce methane emissions and produce renewable energy.
- Explore renewable methane markets and other economic incentives that encourage farmers to reduce emissions and chemical fertilizer use, and to install nutrient treatment systems.
- Promote small-scale, diversified farming through farm transition planning, internship programs, and partnerships with organizations that support new and small-scale farmers.
- Protect 100,000 acres of farmland through the rezoning of rural areas and the expansion of the Conservation Easement Program; collaborate with farmers to develop strategies that incentivize retiring farmers to sell land to new farmers.

Relative to their inland counterparts, counties in Western Washington benefit from greater water availability, proximity to urban markets, and milder coastal climates. Nevertheless, western counties face ongoing challenges from climate change. Whatcom County's agriculture sector is vulnerable to short- and long-term summertime droughts, which are projected to increase in frequency and severity under climate change. Irrigation water usage in the county typically sees a 25 percent increase during dry years. As precipitation patterns shift due to climate change, there will be greater demand for irrigation water, coinciding with reduced supply. Agricultural irrigation accounts for 44 percent of the county's water usage and peaks in August when streamflow is low. With reduced snowpack, more winter precipitation flows directly into streams and rivers when fields are fallow, and crops do not require irrigation; meanwhile, there is decreased water availability during the summer irrigation season.

Whatcom County features six Watershed Improvement Districts (WIDs) that collaboratively tackle agricultural water issues such as quantity, quality, and drainage. Despite their efforts, challenges with water rights persist, and there is a need for increased funding and resources. The transnational Abbotsford-Sumas Aquifer is likely to generate increased competition for water as climate change influences aquifer recharge. With increasingly dry summers and heightened water usage, the aquifer may no longer meet the region's sustainable water demands. This exacerbates the existing issue of over appropriated streams in the Nooksack River watershed, where many farms

already struggle with insufficient water rights, highlighting the urgent need for equitable water allocation as a critical aspect of climate change adaptation.

Agriculture in the county is also vulnerable to pests and diseases that affect production across Western Washington. Warmer winter temperatures and fewer freezing days have already brought northward movement of insect pests, such as the spotted-winged fruit fly (*Drosophila suzukii*) that attacks raspberries and blueberries. Since the fruit fly appeared, some farmers have had to return to the intensive spraying practices of the early 2000s. In addition, fungal pests such as Botrytis, or gray mold, and Monilinia, or mummy berry, affect raspberries, blueberries, strawberries, wine grapes, and other crops. Moreover, the relative extremity of climate impacts in other parts of the nation may encourage more people to relocate to Whatcom, thereby increasing development pressures on agricultural lands.





Chelan Climate Resiliency Strategy (2020) ⁷

The Chelan County Climate Resiliency Strategy identifies opportunities to prepare the county for both current and future climate-related challenges. Although this plan does not include a detailed assessment of agricultural risks and strategies, it does address agriculture in the context of a broader discussion of wildfire risk and water supply/demand challenges.

Chelan County has experienced several wildfires in recent history, which have burned unusually large areas at high severity. Wildfire activity is expected to increase in Central and Eastern Washington as temperatures rise. Compared to the 1980–2006 average, the area burned in Central Washington’s forests is projected to double by the 2020s and quadruple by the 2040s. Burned areas in grassland and shrub-steppe ecosystems are also expected to double by the 2040s. The Chelan County plan highlights fire and smoke damage to agricultural infrastructure and crops, crop loss, and growing season disruptions.

The Chelan County plan proposes broad strategies related to **enhancing water storage, conservation, and drought planning** which are similar in scope to those detailed in previous sections. In addition to these strategies, Chelan County details its participation in the Voluntary Stewardship Program, which supports agricultural producers to address critical area protection and promote sustainable agriculture. Through the program, producers have adopted various conservation practices such as enhancing irrigation efficiency, choosing less water-intensive irrigation methods, and upgrading or maintaining irrigation systems to minimize water waste.

Maximum summer temperatures in the county are forecasted to rise by 6.3 to 12.8 °F by the 2050s. Most climate models predict decreased summer precipitation, though accurate predictions are complicated by the region's already low summer precipitation and the complex nature of convective storms. Through the 2030s, agricultural water demand in the Columbia River Basin is expected to decrease slightly due to warmer, wetter springs and a shift to less water-intensive crops. However, as temperatures rise, this decline in irrigation demand may not continue. For Chelan County, future changes in irrigation water demand are uncertain. The county's crop mix is predominantly fruit trees, unlike the Columbia River Basin's mix of annual crops, fruit trees, and pasture. Development pressures may lead to land use changes rather than crop mix changes, impacting future water demands. Moreover, the timing of irrigation for fruit trees is less flexible than for annual crops, as trees need water post-harvest. These shifts in water supply and demand could lead to more frequent water curtailments for rights holders, especially early in the irrigation season.



Climate Action Plan for the Territories of the Yakama Nation (2019) ⁸

The objective of the Climate Action Plan for the Territories of the Yakama Nation is to "honor, protect, enhance, and restore all human and natural resources that support historical, cultural, spiritual, and economic practices of the tribes." The Yakama Nation plan was developed through collaboration between Tribal staff and Tribal members, to identify existing and emerging climate change impacts affecting the reservation, and to devise an associated action plan.

In addition to encouraging sustainable farming practices and conducting and sharing research related to the diverse impacts of climate change on agricultural activities, the Yakama Nation plan proposes a variety of strategies, many of which are related to water infrastructure critical for agriculture:

- Evaluate the locations, costs, and benefits of constructing re-regulating reservoirs in strategic locations within the WIP district and consider a storage assessment of the potential of WIP or other sources to provide irrigation water to the Toppenish-Simcoe Unit.
- Support aquifer recharge and assess the feasibility of applying water to croplands outside the normal growing season when excess water is available.
- Install devices to accurately measure water use at all turnouts and throughout the WIP system at appropriate locations.
- Implement shrub-steppe restoration initiatives (i.e. seeding native grasses, controlling cheatgrass, and planting native shrubs like sagebrush).
- Collaborate with the Bureau of Indian Affairs to manage cattle permits for landscape health.

Relevant areas of concern within the Yakama Nation plan include farmland, shrub-steppe, and rangelands. The reservation's agricultural sector spans about 72,000 acres owned by Tribal members, mainly concentrated along the Yakima River, Satus Creek, and Toppenish Creek. This land sustains an agricultural industry that contributes significantly to the Yakama culture and economy. The reservation's 400,000 acres of shrub-steppe lands provide essential foods and medicines and serve as livestock rangeland.

The Wapato Irrigation Project (WIP), part of the larger Yakima Irrigation Project managed by the US Bureau of Reclamation, is a critical surface water source for almost all farmland on the reservation, 95 percent of which relies on irrigation. Data indicate that water shortages in the Yakima Basin, which already affect areas like the Toppenish-Simcoe Unit, are projected to worsen due to climate change. By the 2080s, under low-to-medium emissions scenarios, water shortages could limit delivery to junior water rights holders in 3 to 8 out of every 10 years. This increasing frequency of shortages will place additional stress on the already aging WIP infrastructure, necessitating improvements to enhance resilience.

Periods of drought can cause severe impacts, as in 2015 when water supply dropped to about 70 percent. These droughts can exacerbate inequalities in irrigation distribution and directly impact Tribal revenues from irrigated lands. Flooding events can further stress WIP infrastructure. Regulatory policies, including enforcement of the Tribal water code, will become increasingly important for managing these challenges. Furthermore, potential agricultural impacts from rising insect populations (i.e., Mormon crickets) pose a significant threat to crop yields.

Wildfires present an additional risk to the vegetation and land in shrub-steppe and rangeland areas, often resulting in the removal of extensive areas of sagebrush, the spread of invasive cheatgrass, and the emergence of grazing restrictions that can last over 3 years. This can affect ranchers, Tribal households reliant on lease income, and the wider economy.



King County

King County Strategic Climate Action Plan (2020) ⁹

King County's 5-year Strategic Climate Action Plan (SCAP) integrates climate action into all county operations, collaborating with cities, partners, and communities. Section I, Reducing GHG Emissions, includes a chapter

on forests and agriculture with a focus on the carbon and climate benefits of maintaining, protecting, restoring, and expanding farms and forests in the county. King County has approximately 48,000 acres of farmland, comprising about three percent of their land base. Most of King County's 1,800 farms are classified as small operations.

Under a high emissions scenario, Puget Sound is expected to experience a 200 percent increase in "very hot days," a 70 percent reduction in snowpack, a 34 percent increase in winter streamflow, and a 44 percent decrease in summer streamflow as soon as the 2060s. These impacts are associated with agricultural risks such as irrigation shortages, challenges to water supplies, river flooding, costly stormwater management and flood protection, more frequent harmful algal blooms, and threats to the health and well-being of outdoor workers.

Increased oceanic CO₂ is also listed as a climate impact that can harm marine food webs and shellfish. Although the King County plan does not expand on these risks in detail, it does propose strategies that—on a broader scale—aim to develop the body of research around climate change impacts and opportunities for resilience, promote on-farm resilience practices, and preserve existing farmland in the face of development pressures.

Some unique strategies described in King County plan include:

- Evaluate the costs and interest in increasing the use of recycled water for agricultural irrigation in the Sammamish Valley. This could address projected changes to summer streamflow low, by connecting new irrigation customers where feasible.
- Enhance coordination between departments for landslide response, reporting, and risk reduction in King County.
- Support collaboration between the Water and Land Resources Division and the Flood Control District, farmers, and other partners to reduce flooding risks. Provide access to higher ground for farm animals and equipment and construct new farm pads if feasible.
- Investigate the benefits of compost and support King County farmers in applying compost to improve soil health and demonstrate its value (i.e., conduct a literature review on the full-cycle GHG impacts of compost use on agricultural lands and, if positive, initiate at least one pilot project applying compost on county-owned farmland).
- Assist producers with enrollment and participation in federal disaster insurance programs.



Thurston County Climate Mitigation Plan (2020) ¹⁰

The Thurston County Climate Mitigation Plan addresses the current and projected impacts of climate change in Thurston County, outlining specific actions for local governments to achieve measurable progress in reducing GHG emissions.

Unlike other local plans included in this review, the agricultural segment of the Thurston County Climate Mitigation Plan places less emphasis on climate risks to agriculture and focuses instead on the role of agriculture in exacerbating climate change. GHG targets under Thurston County's plan 'Agriculture, Forests, and Prairie's' sector include:

- Reduce acres of conventionally fertilized land by 20 percent by 2030, and 50 percent by 2050.
- Manage 6,600 acres of agricultural land to store carbon through regenerative agriculture practices by 2050.
- Manage forestland and prairies sufficient to sequester 375,000 tons of CO₂ annually by 2050.

Agriculture in Thurston County encompasses large commercial dairy and egg operations, orchards, and specialty vegetables cultivated on small urban plots. The average farm size is approximately 14 acres. Approximately 500 farms raise cattle and chickens, while a significant amount of agricultural land is used for grazing and hay production. Thurston County loses over 1,000 acres of farmland annually, impacting local food networks, open space, and wildlife habitats. Programs like the Washington Wildlife and Recreation Program and Thurston County's Conservation Futures aim to preserve farmland through property or development rights purchases. Preservation of working farmland is critical for local food supply and climate change mitigation.

Two main strategies are proposed to attain these targets: Providing education and incentives (i.e. grants, loans, technical assistance) to encourage practices that reduce emissions from manure and fertilizer, and supporting the expansion of regenerative agricultural practices that increase organic matter content and water retention in soils. The Thurston County plan includes performance indicators such as acres of fertilized farmland, tons of sequestered carbon, and acres of land using regenerative agricultural practices, but does not specify how these indicators are measured.



Methow Valley Climate Action Plan (2021) ¹¹

The Methow Valley is home to many family farms that raise livestock and cultivate fruit, vegetables, grain, and hay across nearly 9,000 acres of both dryland and irrigated land. The Methow Valley Climate Action Plan represents a collaborative effort between Methow Valley community members and the Resilient Methow Planning Team and Task Force. It is among the few plans specifically developed for a region east of the Cascades.

Unique actions associated with these broad strategies include:

- Create an adaptation grant fund to help farmers purchase resiliency-enhancing tools (e.g., shade and wind protection, hail and insect barriers, emergency feed, equipment upgrades, and infrastructure improvements).
- Determine the feasibility of a carbon offset program to compensate farms for stewardship, restore abandoned farmlands to carbon banks, and develop a biochar pilot project.
- Lobby to fully fund and staff the Okanogan County Extension office.
- Support the Methow Conservancy's "Carbon Farming Learning Group," which provides educational resources such as planning software, training, field trips, and soil testing.

Projections indicate that average temperatures in the valley will be 3–8°F warmer by the 2050s. The snow season is expected to see a reduction of 21–47 days in the 2040s and 2080s, respectively, with April 1 snowpack reduced by 46 percent in the 2080s. Higher peak flows and earlier seasonal flooding are also expected, with January streamflow increasing 164 percent by the 2080s. July average streamflow is projected to be 48 percent and 65 percent less in the 2040s and 2080s, respectively.

Broad agricultural impacts listed in the Methow Valley plan include but are not limited to pollinator loss, crop and livestock stress and loss, reduction in water availability for production, increased irrigation needs, new limits on some irrigators, increased soil erosion, and infrastructure loss. Most proposed strategies encompass **information-sharing, growing the financial sustainability of farms, expanding access to technical assistance and conservation programs, and increasing opportunities for on-farm carbon storage.**

Washington State plans

Washington State has adopted multiple climate policies and plans over the past two decades. The Washington State Climate Resilience Strategy was adopted in 2024, updating its 2012 predecessor, the Washington State Integrated Climate Response Strategy. This review includes the 2024 Strategy and the Washington State Enhanced Hazard Mitigation Plan.

The risks outlined in this section align closely with those identified in local plans, with the Washington State Enhanced Hazard Mitigation Plan offering valuable supplemental details on observed and projected risks and impacts. Similarly, the strategies aimed at mitigating these risks generally mirror those in local plans. Nevertheless, the Washington State Climate Resilience Strategy (2024) provides unique insights into the necessary statewide coordination and collaboration among agencies and stakeholders required to implement cross-jurisdictional goals. This collaboration extends to partnerships with local governments, Tribal nations, industry stakeholders, nonprofit organizations, and academic institutions.

Washington State Climate Resilience Strategy (2024) ¹²

The Washington State Legislature directed ECY, in partnership with nine other state agencies (including WSDA), to update the state's Integrated Climate Response Strategy (2012) and prepare a new Washington State Climate Resilience Strategy (RCW 70A.05). The strategy addresses the greatest climate risks facing Washington, highlights existing agency efforts that support climate resilience, and proposes new actions agencies can take to help communities, infrastructure, and natural and working lands become more resilient to:

- Drought and reduced water availability
- Marine and coastal changes
- Flooding
- Extreme heat
- Wildfire and smoke

The Climate Resilience Strategy identifies eight strategies to focus agency efforts on addressing the impacts of climate change. These include responses to climate-driven hazards and emergencies, support for Tribes and local governments to implement resilience actions, resources to help agriculture and working lands adapt to changing climate conditions, infrastructure improvements, and improved water management for people, farms, and ecosystems. The actions detailed under each strategy recognize the unequal impacts of climate change on overburdened communities and vulnerable populations, and help agencies center environmental justice through their efforts. Strategy four specifically focuses on supporting the vitality and viability of agriculture.

The Climate Resilience Plan for Washington Agriculture and the Washington State Climate Resilience Strategy were developed concurrently. As such, they are intended to complement each other and amplify the need for significant investments into agricultural resilience, which supports overall state resilience. The following topics are covered under actions in both state plans:

Table 1. A crosswalk of topics included in both the Climate Resilience Plan for Washington Agriculture and the Washington State Climate Resilience Strategy, and associated action numbers.

	WSDA Climate Resilience Plan for Washington Agriculture	Washington State Climate Resilience Strategy
Data Collection and Sharing	Actions 1.1.1, 1.2.3, 2.1.1, 2.1.2, 2.1.2, 2.2.1, 2.2.2, 4.1.2	Actions 4C, D
Farmland Preservation	Action 2.4.1	Action 4A
Food Security	Action 1.2.2	Action 2J
Funds for On-Farm Climate Adaptation	Actions 2.3.1, 2.3.2	Action 4B
Hazard Preparedness	Actions 1.1.2, 1.2.1, 4.1.1, 4.1.3, 6.1.2	Actions 2A-E, H, I, K, 3D, 6A
Offal Composting	Action 1.3.1	Action 2G
Pest and Disease Mitigation	Actions 5.1.1, 5.1.2, 5.2.1	Action 2F
Regulatory Efficiency	Actions 4.1.1, 6.1.1, 6.1.2	Action 3A
Water Use Efficiency	Actions 3.1, 3.1.2	Actions 6A, 6F-H
Water Quality	Action 3.2.1	Actions 5B, C, 8L
Workforce Development	Actions 2.2.1, 4.2.1, 4.2.2	Action 4C

Washington State Enhanced Hazard Mitigation Plan (2023) ¹³

The Washington State Enhanced Hazard Mitigation Plan (SEHMP) addresses the dynamic and rapidly changing hazard landscape in the state, driven by population growth, urban development, and climate change. Washington state has witnessed more frequent and severe wildfires, storms, floods, and secondary effects like landslides and diminished air quality in recent years. The SEHMP serves as a comprehensive resource for assessing risks and vulnerabilities and implementing long-term, targeted mitigation actions. It contains a Hazard Inventory and Vulnerability Assessment (HIVA) to identify specific risks and vulnerabilities, followed by a Mitigation Strategy outlining state actions for risk reduction.

Although the SEHMP does not comprehensively address the intersection of hazard planning and agriculture, it briefly highlights the implications of wildfires and floods for the movement of farm equipment and products, the impacts of wildfires on transmission lines and powerplants that support agricultural processes, and the effects of drought on critical irrigation systems. Moreover, many natural hazards included could have significant impacts on agricultural production and operations, even when the connection is not explicitly addressed. The SEHMP identifies the following relevant hazards and their regional influences:

- Drought is especially severe in regions east of the Cascade Range. More than half of the state's land area experienced severe (or worse) drought conditions in 2021 (Figure 7). Distribution of drought hazards across the region is expected to increase as climate change continues, with Western Washington becoming more drought prone.



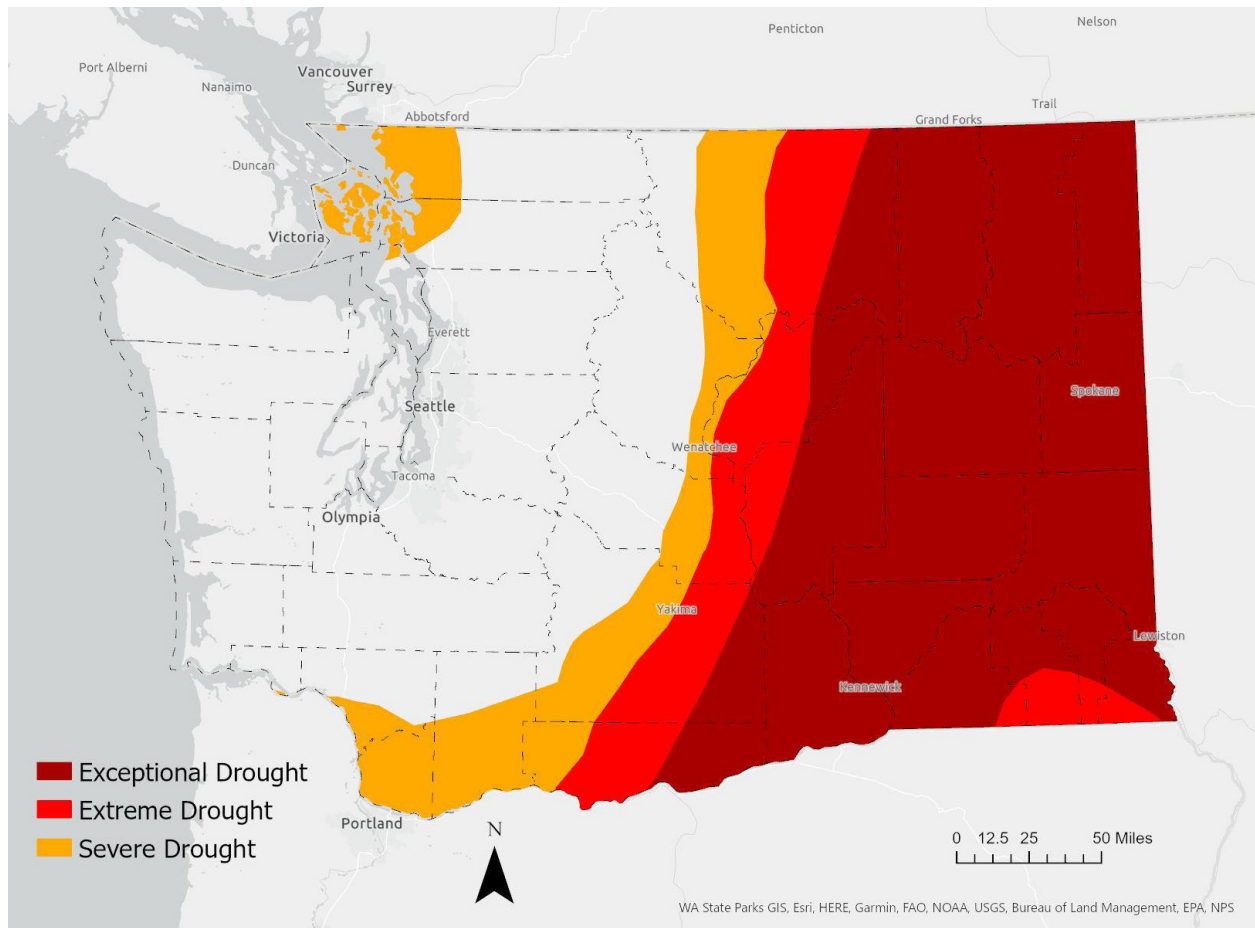


Figure 7. Map of Washington drought conditions in 2021. Source: Washington State Enhanced Hazard Mitigation Plan (2023) ¹³

- Increased outbreaks of animal disease, crop disease, and pest infestations can cause widespread devastation of livestock and crops.
- More than 400,000 properties in Washington state (13 percent of state properties) have a greater than 26 percent chance of being affected by flooding within the next 30 years. The Puget Sound and Northwestern regions are at the highest risk of flooding due to the frequency of coastal and riverine flood disasters and the vulnerability of communities and critical assets in that area (Figure 8). About 2.5 percent of the state's public roads are in 1 percent or 0.2 percent annual chance flood zones.

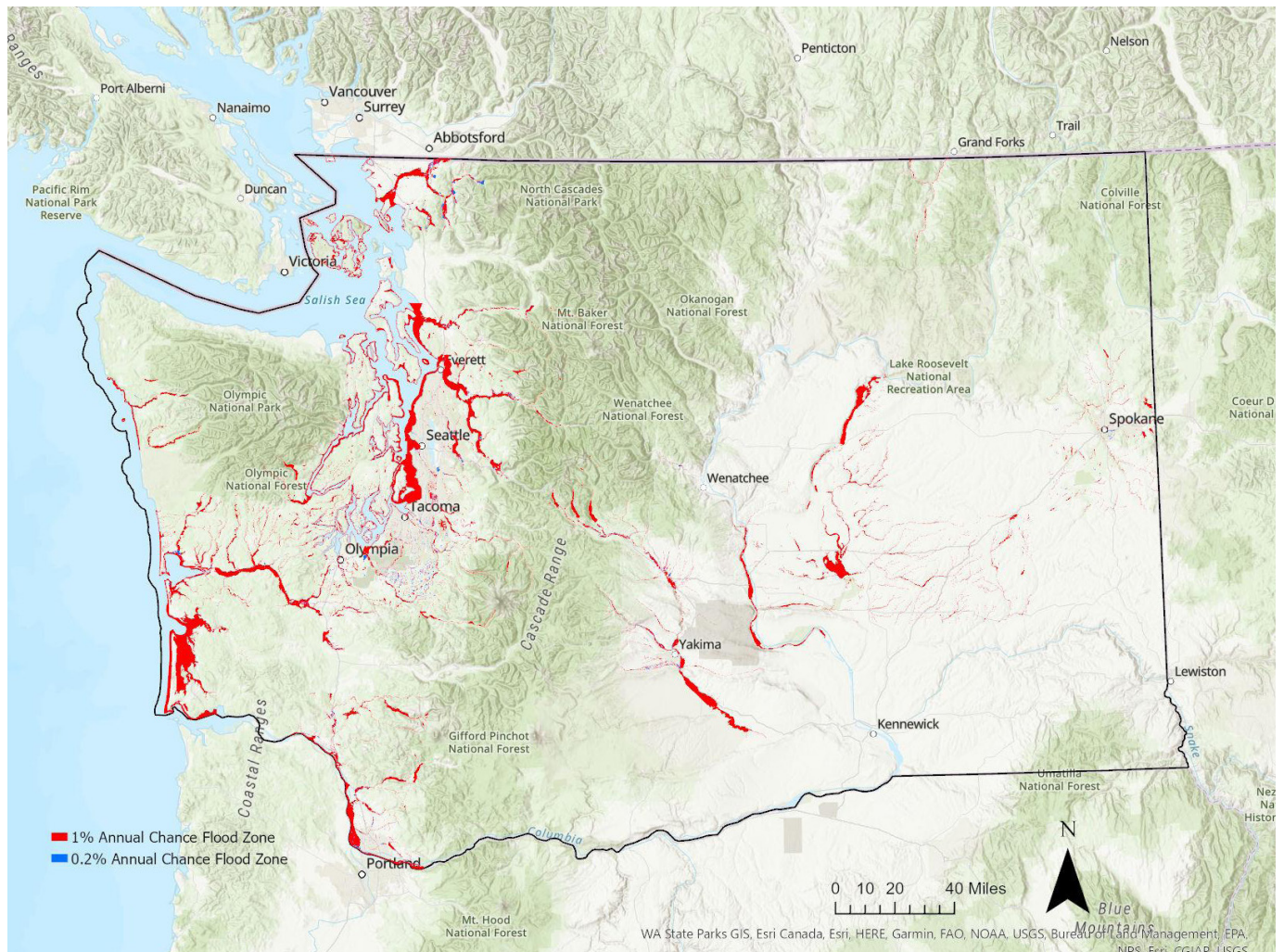


Figure 8. Map of regions in Washington with a 1 percent (in red) and 0.2 percent (blue) annual chance of flooding. Note: Areas without shown do not indicate no flood zones, but rather a lack of available spatial data. Source: Washington State Enhanced Hazard Mitigation Plan (2023) ¹³

- An estimated 2,000 state-owned or -leased facilities, 20,000 miles of public roads, 3,000 miles of transmission lines, and 18 percent of power plants are situated within the most wildfire-prone regions in Washington. Wildfire hotspots are primarily located in Central and Eastern Washington (Figure 9).

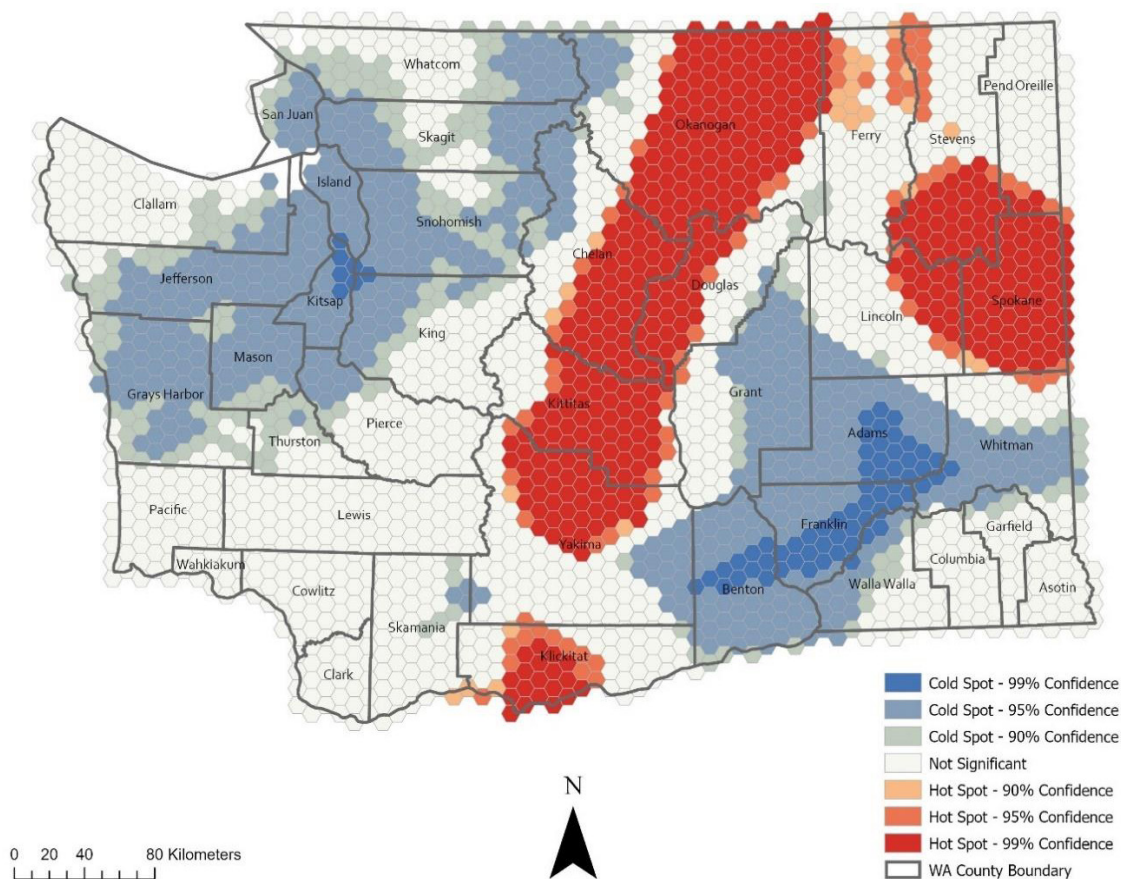


Figure 9. Wildfire hot spots and cold spots based on wildfire activity between 1970 and 2020. Source: Zerbe et al., (2022) in Washington State Enhanced Hazard Mitigation Plan (2023) ¹³

- Extreme weather events in Washington include atmospheric rivers, tornadoes, heat waves, and hailstorms. Each year, there is a 72 percent chance of a disaster declaration due to extreme weather, with Western Washington being the most vulnerable (Figure 10). At least 18,000 miles of public roads—including more than 2,000 miles of national and state highways—are situated in counties where extreme weather events are most prevalent.

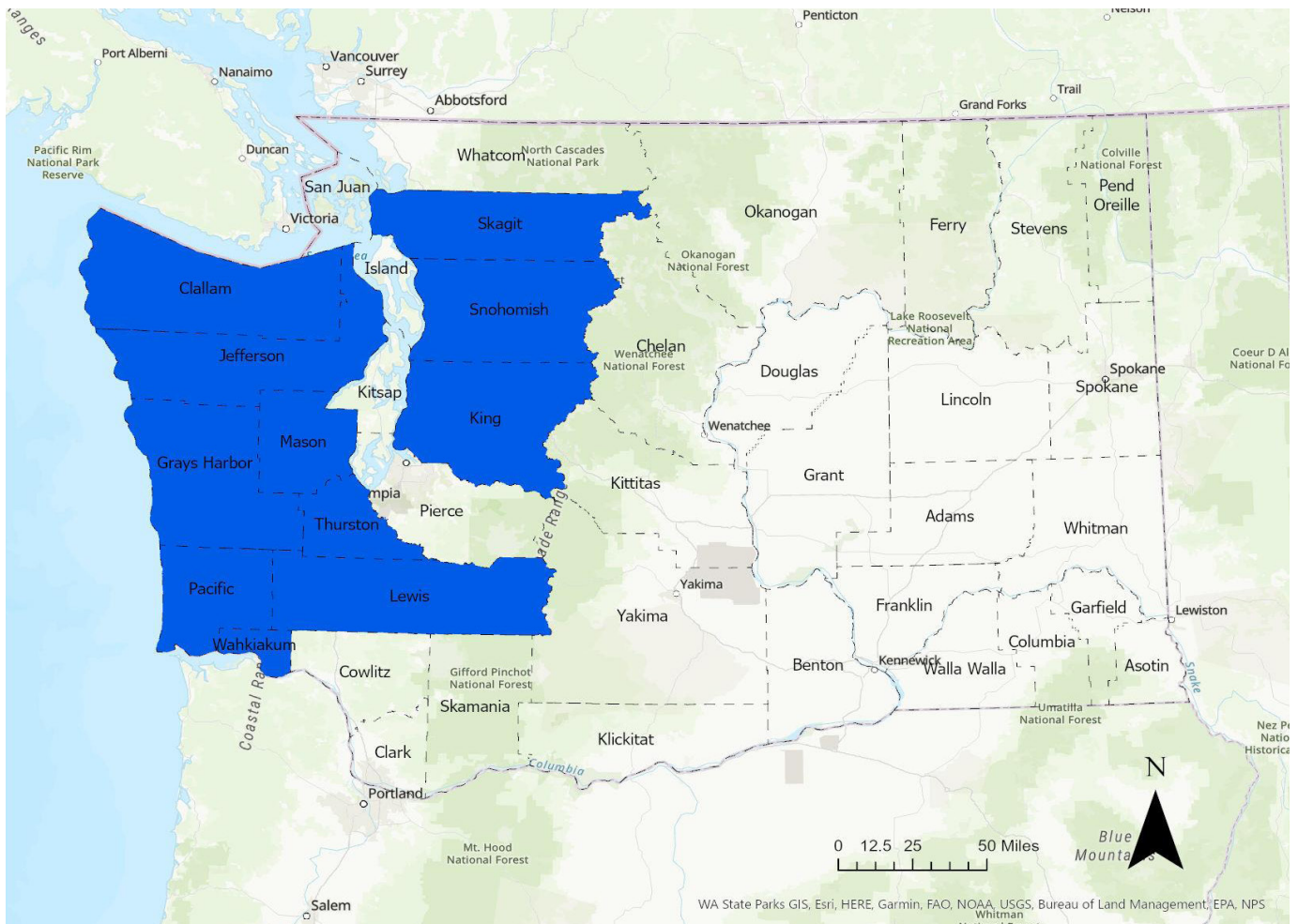


Figure 10. Areas in the 75th percentile for weather-related disasters since 1980. Source: Washington State Enhanced Hazard Mitigation Plan (2023) ¹³

Washington legislation

Washington State has actively pursued climate policies for the past several years. These initiatives reflect the state's commitment to climate resilience, mitigation, and adaptation. State-level efforts include requirements for agencies to outline climate resilience priorities and plans, address gaps in resilience strategies, and coordinate implementation efforts. The legislation also focuses on integrating climate considerations into comprehensive plans, reducing GHG emissions, promoting clean energy technologies, and enhancing workforce training for climate-related industries. The state has implemented GHG "cap-and-invest" systems and is committed to achieving ambitious emission reduction targets, signaling a shift towards clean energy and climate-friendly practices across various sectors. Relevant legislation is highlighted below. Where possible, specific implications for the agricultural sector are included.

HB 1170 (2023-2024): HB 1170 and the companion SB 5093 mandated an update to Washington State's 2012 Integrated Climate Response Strategy. As detailed above, these activities resulted in the collaboratively produced Washington State Climate Resilience Strategy (2024). Participating agencies, including WSDA, will revise the strategy every 4 years and report progress biennially to the Governor's office. HB 1170 also requires agencies to "...consider current and future climate change impacts... and incorporate climate resilience and adaptation actions as priority activities when planning, designing, revising, or

implementing relevant agency policies and programs.” The Climate Resilience Plan for Washington Agriculture is an important step in implementing HB 1170 for WSDA.

HB 1181 (2023-2024). HB 1171 proposed updates to the Growth Management Act (GMA) by incorporating new climate change and resilience goals. It introduced a mandatory climate change and resilience element that certain counties and cities must include in their comprehensive plans under the GMA. The bill mandates these jurisdictions to address the adverse impacts of climate change, outlining actions to reduce GHG emissions and vehicle miles traveled. The Department of Commerce is tasked with developing model guidance and publishing action-oriented guidelines for counties and cities. The bill also requires annual publication of per capita vehicle miles traveled by the Department of Transportation, updates to Shoreline Master Program guidelines by the Department of Ecology to address sea level rise, and inclusion of climate change impacts in optional comprehensive flood control management plans. Furthermore, the Department of Health is directed to ensure that water system plans initiated after June 30, 2025, incorporate a climate resilience element at the time of approval, with an accompanying guidebook update for implementation assistance.

The Washington Department of Commerce’s Climate Element Planning Guidance ¹⁴ provides guidance relevant to the implementation of HB 1181. As part of this guidance, jurisdictions are tasked with exploring climate impacts, auditing plans and policies, assessing vulnerabilities and risks, setting emissions reduction targets, developing measures and implementation plans to achieve targets, integrating measures into comprehensive plans, and evaluating progress. The following information from this process is relevant to Washington’s agriculture sector:

- Potential climate-related agricultural impacts identified in the guidance include changes in crop yields; increased exposure of farmworkers to extreme heat; potential for “double cropping”; increased heat stress on crops and livestock; reduced water availability for crops, livestock, and processing, along with warmer growing seasons; alteration in weeds and plants that grow with crops; increased pest and disease outbreaks as well as weeds which impact lending opportunities and crop insurance for farmers; and increased food scarcity after hazards that disrupt both food transportation and distribution.
- A crosswalk with the GMA identified the following shared goals:
 - Reduce sprawl
 - Promote economic development
 - Maintain and enhance natural resource industries
 - Protect and enhance the environment
 - Promote and prioritize climate change mitigation and resilience
- Priority actions in the agricultural sector include:
 - Reducing agricultural pollution
 - Using agroecology, agriculture land management, and livestock practices for absorbing carbon
 - Preserving land for agriculture, recreation, open space, and rural/wild purposes

HB 1176 (2023-2024). HB 1176 develops opportunities for service and workforce programs to support climate-ready communities. In brief, it establishes the Washington Climate Corps Network to enhance climate-related service opportunities for young adults and veterans. It also forms the Clean Energy Technology Workforce Advisory Committee, tasked with advising policymakers on expanding the clean energy technology workforce in Washington and developing strategies to address the challenges associated with policy transitions related to climate change. Additionally, the bill directs the Washington State Workforce Training and Education Coordinating Board to assess the needs of the clean energy technology workforce and provide recommendations to the Governor and Legislature.

The Climate Commitment Act (CCA), RCW 70A.65 (2021). The CCA aims to reduce GHG emissions to address climate change. The legislation sets targets, requiring a 45 percent reduction below 1990 levels by 2030, 70 percent by 2040, and net-zero emissions by 2050. To achieve these targets, Washington implemented an economy-wide “cap-and-invest” system, making it the second state with a declining, enforceable limit on climate pollution. The program supports emission reductions from large emitters, thereby raising revenue for investments to transition the state to a resilient, net-zero emissions economy by 2050. The cap-and-invest program is seen as a critical component of meeting science-based GHG reduction targets, complemented by sector-specific policies such as the Clean Energy Transformation Act. Enforcement of emission reductions began in 2023.

The CCA has significant implications for Washington state agriculture. Although agriculture is exempt from reporting GHG emissions and participating in cap-and-invest auctions, it is still affected economically and environmentally. The CCA has raised substantial funds, including for agricultural projects like STAR, the Compost Reimbursement Program, and Sustainable Farms and Fields (SFF), supporting conservation practices and climate-smart projects. While there is an ongoing need for more CCA investment into agriculture, future eligible activities include incentives for dairy anaerobic digesters, on-farm renewable energy, farmworker housing weatherization, and farm fleet electrification.

SB 5116 (2019–2020). The Clean Energy Transformation Act is a commitment on the part of the state to achieve a greenhouse-gas-emissions-free electricity supply by 2045. This shift towards clean electricity will empower residents and businesses in Washington state to fuel their buildings, homes, vehicles, and appliances using carbon-free sources like wind and solar energy. By reducing reliance on fossil fuels, this initiative aims to enhance community health, stimulate economic growth, generate family-sustaining jobs, and help the state reach its climate objectives.

Clean Fuel Standard, HB 1091 (2021–2022). The Clean Fuel Standard in Washington state mandates that fuel suppliers reduce the carbon intensity of transportation fuels, aiming to cut statewide GHG emissions by 4.3 million metric tons annually by 2038 and stimulate economic development in low-carbon fuel production. This standard complements the CCA and aligns with similar standards in California, Oregon, and British Columbia. Fuel suppliers must progressively lower carbon intensity to 20 percent below 2017 levels by 2034 through various methods such as process efficiency improvements, producing/blending low-carbon biofuels, or purchasing credits from low-carbon fuel providers, including electric vehicle charging providers. This bill has the potential to create new revenue streams for dairy producers, who may be newly incentivized to install methane capture technologies for biofuel production.

The Healthy Environment for All (HEAL) Act, RCW 70A.02 (2021). The Healthy Environment for All Act (HEAL) was passed by the Legislature in 2021. It is the first statewide law to create a coordinated and collaborative approach to environmental justice, making it part of the mission and strategic plans of key state agencies. The law requires WSDA, ECY, Commerce, Health, Natural Resources, Transportation, and the Puget Sound Partnership to identify and address environmental health disparities in overburdened communities and for vulnerable populations by developing and implementing a community engagement plan and Tribal consultation framework and conducting an environmental justice assessment on significant agency actions, among other changes. The law also created the Environmental Justice Council (EJC), made up of 16 members who are community, youth, Tribal, and agency representatives.

Agriculture occurs across Washington state’s diverse geographies and landscapes, including in many overburdened communities with health disparities due to environmental exposures and other socioeconomic factors. The HEAL Act is expected to bring significant funding and focus to agricultural communities to address these challenges.

Other state plans

Climate resilience plans and studies from other states can provide valuable insights into the climate risks and priority focus for agriculture in the Pacific Northwest and Intermountain West region. California's Natural and Working Lands Climate Smart Strategy is one of the most comprehensive state strategies that addresses agriculture. Oregon's initiatives, outlined in Executive Order 20-04, are at an earlier stage, serving as a first step to assess the impacts of climate change on agriculture in Oregon. Research on the economic impacts of climate change on agriculture in Idaho offers lessons and approaches that can inform WSDA's efforts to enhance agricultural resilience and sustainability in Washington state. Common themes across the plans include the importance of **nature-based solutions, community engagement, science-driven policies, and adaptive management practices.**

California Natural and Working Lands Climate Smart Strategy (2022) ¹⁵

California's lands play a vital role in the state's mission to achieve carbon neutrality and climate resilience. The Natural and Working Lands Climate Smart Strategy defines the state's landscapes, details how their improved management can support climate goals and broader objectives, highlights key nature-based climate solutions and identifies opportunities for regional climate-smart land management.

Although this document shares many broad climate risks and resilience strategies with other plans, it also provides guidance on tracking actions and measuring outcomes, including success indicators that could prove relevant in the regional and regulatory contexts of Washington and other states. Agriculturally relevant indicators include:

- Acres of natural and working lands being managed to deliver climate benefits (i.e., acres of land under durable conservation easements that include climate-smart management requirements).
- Potential to apply nature-based solutions (i.e. through the use of COMET Planner or similar tools).
- Agricultural acres benefitting from on-farm technical assistance, demonstration projects, and incentives.
- Percent change in soil organic matter and soil moisture content.

Agriculturally relevant infrastructure indicators include the existence of:

- Regional, local, and traditional food harvesting, processing, storage, and related infrastructure to support the agriculture industry and food security.
- Managed aquifer recharge capacity, especially in over-drafted basins and areas in need of long-term groundwater storage.
- Compost infrastructure capacity.

Oregon Department of Agriculture: E0. 20-04 Climate Report (2020) ¹⁶

The Oregon Department of Agriculture (ODA) plays an important role in leading and supporting local food systems, agriculture, livestock, aquaculture, and natural resources. With Oregon agriculture contributing significantly to the state's economy and employment, climate change adaptation is essential to sustaining competitiveness in diverse markets.

Climate change impacts pose challenges to ODA's mission and operations in 4 key areas: planning, budgets, investments, and policy decisions. Executive Order 20-04 and its predecessor direct state agencies to integrate climate change considerations into these key areas. The order focuses on planning, including

stakeholder engagement, prioritizing work with a nexus to climate, allocating staff resources to climate-related work, and identifying opportunities to reduce GHG emissions from agency facilities and operations. The order also considers the budget, investments, and policy initiatives necessary for the agency to complete climate-related work.

Economic Impacts of Climate Change on Agriculture in Idaho¹⁷

The Economic Impacts of Climate Change on Agriculture in Idaho, authored by the University of Idaho's McClure Center for Public Policy Research, provides a comprehensive overview of the unique impacts of climate change on soil, weeds, crops and commodities, and water. Documented impacts align with those from other plans and focus on challenges with soil health, weed pressure, crop and livestock stress, and water availability. Additionally, the report highlights 3 case studies that demonstrate current adaptation and experimentation within various agricultural sectors. These case studies have the potential to inform future resilience efforts.

- **Case study 1:** In response to reduced groundwater availability, Idaho farmers in the Eastern Snake Plain Aquifer region have adapted to address water resource constraints. A survey of farmers conducted in 2018 revealed that a majority of the 265 respondents undertook at least one adaptation action, with an average of 9 distinct adaptations reported. Common strategies included improving irrigation system efficiency, reducing spending on inputs or equipment, irrigating less frequently, changing crop rotation, and adopting more efficient irrigation systems. While some opted for extreme measures like selling land or exiting farming altogether, the diverse array of adaptations highlights the need to incentivize and support agricultural adjustments to climate change while considering local farming practices.
- **Case study 2:** Developed by University of Idaho researchers and The Nature Conservancy in collaboration with ranchers in Oregon and Idaho, RangeSAT is a decision-support tool that offers near-real-time estimates of biomass through Landsat satellite data for adaptive grazing management. It enables end-users to access pasture- and ranch-specific maps and graphs of above-ground biomass, normalized difference vegetation indices, and climate variables from 1984 to the present. Ranchers utilize RangeSAT to plan livestock movements, assess past management decisions, and visualize vegetation changes over time. The tool has been used in bunchgrass prairie and select sagebrush steppe locations in Southern Idaho. RangeSAT and similar tools (including Washington's StockSmart) aim to enhance conservation outcomes and ranch sustainability amidst climate variability. However, challenges in usability and awareness persist, requiring further refinement for effective adoption by ranch operators.
- **Case study 3:** Herbicide resistance on inland Pacific Northwest farms is a problem expected to intensify with climate change. Given the increasing resistance of weeds to common herbicides, community-based management at a regional level is becoming increasingly important. A 2018 survey of PNW wheat growers revealed awareness of herbicide resistance issues, with 60 percent engaging in communication with neighbors and 67 percent recognizing the necessity of cooperative management. Drawing on Dr. Elinor Ostrom's community management principles, a toolkit was developed to guide the creation of community-based herbicide resistance management strategies. Community groups in Idaho and Washington are utilizing this toolkit to develop region-specific plans, emphasizing cooperation, cost reduction, and engagement with policymakers.

National plans

Fifth National Climate Assessment (2023) ¹⁸

The Fifth National Climate Assessment addresses the human welfare, societal, and environmental implications of climate change and climate variability for 10 regions of the US, including the Northwest, which covers Idaho, Oregon, and Washington state. The report covers 20 national topics, paying special attention to observed and projected risks and impacts of climate change, as well as the prospects for risk reduction, and the implications of various mitigation pathways. Chapter 11, “Agriculture, Food Systems, and Rural Communities,” focuses on the impacts of climate change on agricultural productivity through altered rainfall patterns, increased occurrences of climate variation, and evolving pest pressure patterns. Adaptation techniques include **climate-friendly farming and management strategies, the adoption of new technologies, and the modification of production inputs.**

This assessment details the socioeconomic and ecological costs of climate change in food systems. For instance, total factor productivity (TFP), which has grown steadily in the US (1.4 percent per year) since 1948, has seen a 12 percent reduction in growth over 54 years (1961–2015). Unless US agricultural innovation and adaptation can double TFP growth rates relative to recent historical trends, agricultural TFP is expected to decline to pre-1980s levels by 2050, with crop prices increasing significantly. For instance, the price of corn is projected to increase by around 26 percent in response to a 5.5 percent reduction in production. Soybean prices are expected to increase by 30 percent in response to a 19 percent reduction in production.

Moreover, in labor-intensive fruit and vegetable systems, high temperatures and humidity affect farmworker productivity, safety, and earnings. Instances of heat-related stress and death are much more common among farmworkers than among all other US civilian workers.

Another notable and relevant risk described in this plan is that of crop migration. Plant hardiness zones are projected to migrate northward and towards higher altitudes with climate change, prolonging frost-free periods and requiring adjustments in agricultural methods like crop selection and equipment usage. Plant hardiness zones help local farmers and gardeners identify optimal crops to plant and when to plant them.

In response to these risks, the assessment proposes several on-farm agroecological approaches to land management that mitigate climate impacts and reduce agricultural emissions, along with select adaption strategies. For example, innovations in alternative food production, including urban agriculture, controlled-environment farming, and sustainable aquaculture, show potential for reducing emissions. Aquaculture, with its high feed-conversion efficiency and lower overall GHG emissions compared to other animal proteins, is highlighted for its potential to increase protein production, human nutrition, and food availability. Importantly, the assessment notes that certain production approaches can involve more infrastructure or energy inputs per unit of food production, increasing their GHG emissions compared to conventional farming practices, so careful planning is required.

Advancements in analytic capabilities can help policymakers understand risk variations that are influenced by social, economic, and ecological factors. For example, metrics that capture a community's ability to prepare, adapt, and recover from disruptions highlight a greater risk to rural communities than previously quantified using only expected annual loss due to natural hazards.

National Institute of Food and Agriculture (NIFA) Climate Adaptation and Resilience Plan (2022) ¹⁹

Through an agency-wide survey effort in 2021, the National Institute of Food and Agriculture (NIFA) identified the following climate vulnerabilities: water quantity and quality, agroecosystem productivity and sustainability, food and nutrition security, resilience to extreme weather, the education pipeline, and continuity of operations. Risks not addressed extensively elsewhere include:

- **Pollinator health:** Pollinators are critical to agricultural production. Extreme weather events and shifting weather patterns threaten pollinator health by interfering with the timing of flowering and pollination. Native pollinators also face impacts arising from forage and host plant biodiversity loss and from the emergence of pests, invasive species, and pathogens.
- **Supply chain disruptions:** Supply chain disruptions are another major concern related to extreme and variable weather events. Disasters caused by naturally occurring hazards can impact commodities at all stages of the supply chain—production, processing, distribution, and consumption. In turn, this can hinder innovation and research due to higher costs or delays in supply manufacturing and distribution.

NIFA's climate adaptation actions encompass five topic areas: new NIFA programming, strategic planning, organizational effectiveness, stakeholder outreach and education, and cross-cutting actions. An additional task is to improve reporting mechanisms that track climate change expenditures and impacts via:

- **Metrics:** The Climate Change Priority Team at NIFA will identify which impact metrics are useful and practical to gather from grant applicants. For specific funding opportunities related to climate change science, NIFA will ask applicants to propose and report metrics on climate adaptation, GHG mitigation, and related co-benefits.
- **Tracking:** NIFA will review its current methods for tracking awards to better identify climate change projects and will train staff in these tracking techniques. These steps will enhance the accuracy of NIFA's climate change expenditure reporting to leadership and the Office of Management and Budget.
- **Open Data:** NIFA aims to develop advanced analytics (such as artificial intelligence) and visualization dashboards for climate change science projects that are available internally and to the public.
- **Impacts:** NIFA plans to increase analyses of climate-related investments by jurisdiction and institution to determine their effects on climate adaptation in various communities.

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Appendix B

Scientific synthesis: Anticipated climate impacts on agriculture in Washington state



Introduction

The investigation into climate change impacts on agriculture— including cropland, livestock, and aquaculture systems — is relatively new, with most studies produced in the last 15 years. This document summarizes what is known about the anticipated climate impacts on the agricultural sector in Washington state. The literature is far from comprehensive, with some geographic areas and types of production systems better covered than others. Given the diversity of conditions, agricultural products, and production systems across the state, it is unsurprising — yet noteworthy — that there is significant complexity in the anticipated impacts. Climatic differences east and west of the Cascade Range, in combination with other factors, have led to distinct production systems. The biggest or best-studied climate change impacts are therefore sometimes different east and west (see Figures 1 and 2 in Section 2: Agricultural Climate Risks and Adaptation Opportunities) of the mountains. While some overall patterns can be discerned, there is an ongoing need for research to provide a more complete understanding and to support adaptation.

Changing temperatures, precipitation, and CO₂ levels, and their impacts on crops and animal agriculture

Increased temperatures can accelerate crop growth and maturity, which ultimately reduces crop biomass and therefore potential yields ^{20,21}. However, the carbon dioxide (CO₂) effect — in which increased atmospheric CO₂ increases the rate of photosynthesis and improves crop water use efficiency for many crops — generally improves plant yields ^{20–22}. Combined with potential management adaptations such as changing planting dates or crop varieties, the effect of a warming planet (with increased atmospheric CO₂) is generally positive for potential crop yields in Washington state. Similarly, rangeland net primary productivity is expected to increase through the end of the century ²³. It is important to note that studies cited above are limited in multiple ways. They assume ideal conditions - meaning adequate availability of irrigation water, nutrients, and other factors. They also do not account for impacts from extreme weather, weed and pest pressures, or reductions in crop quality, all of which can reduce actual crop yields or performance.

For the shellfish aquaculture industry, elevated atmospheric levels of CO₂ are more problematic and can cause acidification of the water (i.e., ocean acidification), which reduces the availability of carbonate minerals that are necessary for bivalve shell deposition ^{24,25}. Ocean acidification has been shown to negatively impact shell calcification, early embryonic development, growth, attachment, and survival ^{26–28}. The economic losses contributed to ocean acidification are estimated to be in the billions of dollars annually for the global shellfish industry, and farmers in the state will be impacted by increasingly acidic waters in the coming decades ²⁹.

Changes in precipitation and the resulting agricultural impacts are more difficult to predict ³⁰. Tubiello et al. (2002) reported that simulations with increased precipitation led to higher yields for dryland production systems ³¹. Stöckle et al. (2010) used regional climate projections that indicated increases in both annual and growing season precipitation for multiple dryland sites across Washington state; however, these increases in precipitation were not as impactful on potential yields compared to increases in temperature and CO₂ concentrations ²⁰. Overall, Stöckle et al. (2010) projected potential yield increases for the main agricultural commodities in Eastern Washington through mid- to late-century, primarily due to the positive influence of the CO₂ effect. For irrigated systems, the effect of precipitation is largely dependent on watershed type, which is discussed in *Impacts on Water Supply* below.

Although the CO₂ effect may benefit crop yields and rangeland production, higher CO₂ levels may decrease certain nutrients and proteins in some plants as accelerating maturation affects nutrient accumulation ^{32–35}, which could negatively impact nutrition for both humans ³⁶ and livestock ³⁷.

Elevated temperatures can also change certain phenological processes such as chill accumulation in tree fruit³⁸, which could impact yields. While chill accumulation is expected to decrease in the fruit and berry growing regions of the Southwest^{39,40} and Southeast⁴¹, the Pacific Northwest is, in comparison, more resilient³⁸. Changing crop phenology can also increase the risk of frost and cold damage⁴², especially for varieties that have lower chill requirements. For example, recently introduced blueberry varieties in Washington state have lower chill requirements, but also bloom earlier and are therefore more susceptible to cold damage.

Impacts on water supply

Impacts on water supply for Washington state will be influenced by three main factors: warmer temperatures, reduced precipitation in summer months, and increased precipitation in winter months⁴³. How these changes impact specific areas will largely depend on the watershed type (i.e., snow-dominated, rain-dominant, or mixed rain/snow), the extent to which the watershed is currently experiencing water supply-related issues, the type of agricultural production (dryland versus irrigated, perennial versus annual, etc.), access to water storage infrastructure, and the seniority of the water rights agricultural producers hold.

Streamflow — an important determinant for the surface water supplies that irrigated agriculture relies on — is expected to increase in the fall, winter, and spring, and decrease in the summer⁴⁴. Effects will be most pronounced for mixed rain/snow and warmer snow-dominated watersheds, where small changes in temperatures can substantially impact snow accumulation and melt.

Streamflow reductions in rivers with instream flow rules could prompt more frequent and deeper curtailments (temporary shutoffs of full or partial access to water) for junior rights holders⁴⁵, which could limit irrigation water for these producers. Hall et al. (2024) concluded that in the future, curtailments are more likely to occur, and may occur over a longer timeframe within a given year⁴⁵. Even with increased curtailments, rivers may have insufficient flows to support fish populations and riverine function in affected river basins. In addition, low flows could exacerbate water quality issues, such as by increasing water temperatures or by concentrating nutrients or other pollutants^{46–48}. Enhanced planning at multiple levels (e.g., statewide, basin-wide, on-farm) will be necessary to adequately store and deliver water for irrigated agriculture as the amount and timing of water availability shifts earlier in the growing season, and droughts and floods potentially become more common⁴³.

Dryland agriculture will also be impacted by changes in the amount and timing of precipitation. Effects on soil moisture at seeding time will be especially important for water-limited dryland systems^{49,50}. Increased atmospheric evaporative demands and early season evapotranspiration^{21,51} can also impact the timing and magnitude of soil moisture availability for plant growth during the growing season. In response, growers may have to fallow more land⁵², limiting production. However, there are many site-specific factors and constraints that will determine how individual growers can best respond to changes in precipitation patterns and soil moisture⁵³.

Rangelands will also be impacted by shifting precipitation patterns, coupled with increasing temperatures. Decreased precipitation in the summer months and the potential for increased evapotranspiration pose a risk to forage availability in the later growing season through limited soil water availability⁵⁴, which could pose challenges in maintaining historical stocking rates^{37,55,56}. Water access — and the availability of forage in sufficient proximity to drinking water — may become more limited throughout grazing areas. This could cause an increasing need for additional water infrastructure and greater feed supplementation in the traditional forage grazing season to support animal growth.

Extreme weather

Extreme weather events will continue to cause severe disruptions to agricultural systems. The Northwest chapter of the Fifth National Climate Assessment notes increasing crop insurance loss payments due to extreme events and impacts, an indicator associated with economic disruption of agricultural production⁵⁹⁻⁶¹. The following sections discuss particular types of extreme events that are relevant to Washington state agriculture.

Heat

As temperatures warm, heatwaves are becoming more frequent, more extreme, and longer lasting⁶². The June 2021 Pacific Northwest heatwave reduced yields of many crops, including spring wheat, barley, canola, cherries, grapes, and raspberries, among others, in nearby British Columbia by roughly 20-30 percent compared to expected yields for that year⁶³. Many crops grown in Washington, such as blueberries, apples, and some types of Brassicas, have been shown to suffer quality and yield reductions from various forms of heat damage when temperatures reach certain thresholds⁶⁴⁻⁶⁷. Impacts usually begin occurring around 90°F and include sunburn, sun spotting, shriveling or wrinkling, and cell death. Heatwaves can also affect crop quality by raising nighttime temperatures, as in apples where red color development — a key marketability trait — is lessened when fall night temperatures are too high⁶⁶.

The higher temperatures expected in the Western US under climate change increase the likelihood of reaching the critical heat-humidity thresholds where heat stress impacts animal health and productivity⁶⁸⁻⁷⁰. Vulnerability varies depending on the species, breed, life stage, nutritional status, genetic potential, size, and previous exposure of the animal. However, high-yielding individuals and breeds tend to be more susceptible, with dairy cows among the most vulnerable⁶⁸. Projected changes in heat stress events for dairy cows⁷¹ and cattle on rangelands⁷² are anticipated to be impactful, but are less severe in Washington state compared to other regions of the US.

The cold-water finfish and shellfish aquaculture species cultured in Washington state are particularly vulnerable to elevated water temperatures as they cannot regulate their internal body temperature (i.e., they are ectotherms) and are adapted to the natural cool water of the region. The salmon and trout cultured in river systems across the state are already experiencing summer high water temperatures that can induce stress⁷³. Marine shellfish aquaculture has also experienced severe high mortality events associated with the recent marine heat waves, with June 2021 representing a particularly devastating event^{74,75}. Shellfish are not only vulnerable to elevated water temperatures^{76,77} but can experience mortality events when extreme low tides occur during days with abnormally high air temperatures. This can expose the animals to high air temperatures for an extended period of time⁷⁵.

Droughts and floods

As discussed in the *Water Supply* section, droughts, heavy rainfall, and flooding may become more common in the future. Though relatively understudied, these events are expected to reduce crop yields^{78,79}. Washington state's 2021 drought, for example, reduced access to irrigation water and resulted in yield loss for several crops^{59,80}. Tohver et al. (2014) predict that some rain-dominated and mixed rain/snow basins in the state are expected to experience summer low flows around half of their historical minimum, as early as the 2040s, an indication that future droughts may be more severe⁴³.

Flooding is also likely to increase in frequency and severity across both mixed rain/snow basins, and in warm, rain-dominated basins where peak flows occur in the late fall or winter. Tohver et al. (2014) found that by 2080, shifts in climate in some mixed rain/snow basins are projected to lead to floods that are between 1.5 and 2 times greater in magnitude than the historical baseline⁴³. Flooding can devastate agricultural

operations, as illustrated in the Chehalis basin of Western Washington in 2007, in which 19 out of 30 dairies were flooded ⁸³. Two operations suffered a complete loss of animals, despite being sheltered in barns that were historically safe from flooding.

Changes to hydrology and precipitation patterns, including sea level rise, more winter precipitation, and higher intensity rainfall events, could also exacerbate pre-existing agricultural drainage issues, already prevalent in Western Washington, by overwhelming drainage infrastructure, flooding fields, and increasing runoff from agricultural lands ^{84,85}. Increasing runoff can cause a variety of compounding concerns including topsoil loss ⁸⁶, nutrient and pesticide contamination of water bodies ⁸⁷, and deterioration of salmon spawning habitat ⁸⁸.

To understand the impacts of flooding on shellfish aquaculture, it is important to recognize these animals' influence on water quality. As filter feeders, shellfish have important ecological functions and can improve water quality in enclosed ecosystems. Shellfish aquaculture can reduce the impacts of terrestrial nutrient inputs that can increase eutrophication of the water. However, flooding and the associated runoff from urban or agricultural land can degrade water quality in marine culture environments by promoting harmful algal blooms or introducing wastewater effluents. This may contaminate shellfish with harmful fecal bacteria or result in increased levels of pollutants bioaccumulated in shellfish ⁸⁹⁻⁹¹.

Coastal storms

The increased prevalence and intensity of coastal storms associated with climate change will add additional challenges to shellfish farmers. Storms can damage aquaculture equipment or tidal beds which can result in economic losses and increased labor costs to growers.

Wildfire and wildfire smoke

Wildfires across the Western US, including in Washington state, have become larger, hotter, more severe, and more deadly over the last several decades, due to a suite of factors that includes, but is not limited to, climate change ^{92,93}. Wildfire events pose a threat to animal safety and can have enterprise-threatening impacts on ranchers in the region ⁹⁵. Rangelands and surrounding areas can take 3-15 years to recover after a wildfire depending on weather patterns (especially precipitation) and rangeland vegetation composition ^{96,97}. Resting those lands as they recover takes significant acreage out of production for that period. Finding alternative grazing land or supplemental feed to offset this loss is a significant economic burden. Forage composition can also be permanently altered, as invasive annual grasses can recover from wildfires more effectively than native species ⁹⁸. Invasive grasses — most notably cheatgrass — also become a fuel source for future fires, as their abundance creates a continuous fuel bed and they senesce and dry out earlier than perennial grasses. In this way, invasives and wildfires reinforce each other, creating a positive feedback loop that leads to ongoing losses of productive forage in affected rangelands ^{57,99-101}.

Even for crops and animals not directly in harm's way, indirect impacts from smoke can be consequential. For livestock, smoke inhalation and the stress from confinement or evacuation have not been well studied, but are likely to reduce productivity. Potential impacts include poor weight gain, reduced milk production and milk quality, respiratory illnesses, and negative immune and reproductive impacts ^{94,102,103}. Heat stress compounds these negative effects, which can persist even after air quality improves. Impacts to young animals are particularly concerning given potential for long term impacts ^{103,104}. Wildfire smoke can also impact crops such as wine grapes ¹⁰⁵. Wine made from smoke-tainted grapes will have compromised aroma and flavor, and may require additional processing to restore quality ¹⁰⁶.

Impacts on pests, weeds, and disease

Overall, there is limited information on how pests, weeds, and diseases may impact cropping systems in a climate-changed future. Generally, warmer temperatures increase threats from insect pests¹⁰⁷. For example, Stöckle et al. (2010) and Noorazar et al. (2022) modeled the impact of climate change on codling moths in the Pacific Northwest, concluding that moths will emerge earlier and have the potential for additional generations within each growing season, exerting additional pressures on apple production systems^{20,108}.

Stöckle et al. (2010) also modeled changes in the occurrence of cherry and grape powdery mildew, two common crop diseases in the Pacific Northwest. Results varied by climate model, though most projections predicted no change or only a slight increase in disease incidence²⁰. Though Northwest-specific work is lacking, climate change is likely to lead to changes in some livestock infectious diseases, particularly those with pathogens or vectors whose development or transmission is influenced by climatic factors^{68,109}. Impacts could include changes in spatial distributions, annual and seasonal cycles, disease incidence and severity, and susceptibility of livestock to illness⁶⁸. Changes in climate could cause new or currently uncommon crop or livestock diseases to spread in the region, though this requires further investigation and monitoring.

Elevated water temperatures can increase the susceptibility of cold-water aquaculture species to diseases, as thermal stress has negative impacts on immune function and may promote the growth of some pathogens. More studies are needed to fully understand how aquatic pests and diseases will impact the aquaculture industry. Clear associations between the prevalence of *Vibrio* bacteria and water temperature have been identified in Washington state^{110,111}. *Vibrio* are pathogenic to humans and prevent the harvest of shellfish during outbreaks which, results in economic losses to growers¹¹². Changes in Washington state marine water conditions have also been linked to the increased occurrence of harmful algal blooms that can kill shellfish or make them toxic for human consumption¹¹³⁻¹¹⁵.

Climate change is expected to benefit many weed species. For example, increased temperatures and elevated CO₂ benefit invasive annual grass growth over native grasses in rangeland systems, which could reduce forage quality^{72,98}. Lawrence and Burke (2015) found that climate change impacts on downy brome (i.e. cheatgrass), a common Washington weed in dryland systems, could make current herbicide regimens less effective in the future as herbicide-resistant biotypes spread further and the weed reaches seed maturity earlier in the spring when precipitation is expected to increase¹¹⁶. Climate change is expected to benefit many weed species. For example, increased temperatures and elevated CO₂ benefit invasive annual grass growth over native grasses in rangeland systems, which could reduce forage quality^{72,98}. Lawrence and Burke (2015) found that climate change impacts on downy brome (i.e. cheatgrass), a common Washington weed in dryland systems, could make current herbicide regimens less effective in the future as herbicide-resistant biotypes spread further and the weed reaches seed maturity earlier in the spring when precipitation is expected to increase¹¹⁶.

Impacts on pollinators

Many berry, fruit, and vegetable crops are reliant on managed honeybees and native pollinators. Climate change can alter the species distribution of native pollinators¹¹⁷, create a mismatch between the timing of forage availability and foraging needs^{118,119}, and result in an increased risk of honeybee colony failure¹²⁰. For example, warmer winters cause premature physiological aging in bees that were previously less active in the colder winters. Cold storage for hives may become important in the future¹²⁰.

Washington state's relative position

Though climate impacts will be mixed and differ by location and cropping system, Washington may overall fare better than many other regions of the US^{121,122}. Drought risk may be increasing more for other regions compared

to the Northwest, with the Southwest US experiencing an increasing trend in meteorological drought severity ¹²³.

Other influences beyond climate change are also contributing factors. For example, California's San Joaquin Valley could see as much as a 20 percent reduction in irrigation water supplies by 2040 due to the combination of climate change and changes in policy that drastically reduce groundwater withdrawals and require greater water releases for environmental flows ¹²⁴. Without intervention, these changes could lead to losses of more than 50,000 jobs in the region and reductions in agricultural revenue of more than \$10 billion in a worst-case scenario. Even in the best-case scenario, nearly 500,000 more acres will be fallowed compared to baseline (2003 - 2010) conditions.

Comparatively, most regions in Washington with irrigated agriculture are more surface-water dependent, and not under environmental pressures of the same magnitude (with some notable exceptions). Thus, the state's relatively temperate climate, surface water availability, extensive irrigation systems, and variety of crops bolster its potential to become a more agriculturally important region in a climate changed future. However, there are still many consequential impacts from climate change that will affect Washington state agriculture. Strategic management will be vital to realize potential production increases.

Considerations beyond impacts on crops, livestock, and aquaculture

Impacts on human health

Increasing temperatures under climate change will bring increased exposure of agricultural workers to dangerous levels of heat ¹²⁵ and contribute to negative health outcomes including heat-related illness, kidney injury, adverse pregnancy and birth outcomes, and mental health effects, as well as increased risk for traumatic injury ^{126,127}. In Washington, workers' compensation claims for heat-related illness spike during years with higher average maximum outdoor temperatures ¹²⁸, a trend that is expected to worsen under climate change ¹²⁹ International Classification of Diseases 9/10 codes, and medical review to identify accepted and rejected Washington State (WA). Areas in Eastern Washington such as Yakima, Okanogan, and Benton counties are expected to experience increases in the number of days with a heat index $\geq 90^{\circ}\text{F}$ by mid-century compared to historical (1971 - 2000) conditions ($\sim +35$ days; ClimateToolbox.org), representing a sharp increase in dangerous working conditions.

Increased frequency or severity of wildfires that lead to deteriorating air quality can create additional negative impacts, sometimes occurring concurrently ¹³⁰. Heat and drought can also drive increased rates of wind erosion which can elevate levels of particulate matter in the air ¹³¹, exposure to which has been linked to increased chronic respiratory symptoms and the worsening of lung and heart disease ¹³². Rules and protocols related to agriculture, human health, and workers' exposure to hazards have recently been updated to include requirements for shade, rest, and acclimatization while lowering the temperatures at which some preventive actions must be taken ¹³³. However, there is an ongoing need to support implementation and further adaptation, especially the development and implementation of strategies that do not reduce farm productivity and profits or worker earnings ¹²⁵.

Impacts on environmental quality

Climate change, specifically through its potential to increase floods and droughts, may impact environmental quality by increasing issues with soil erosion. Climate change-driven increases in droughts may lead to increased wind erosion ¹³⁴ and associated reductions in air quality ¹³⁵. Though increased biomass growth due to warmer temperatures and higher CO₂ concentrations could temper water- ¹³⁶ and wind-driven erosion

¹³¹ in the inland Pacific Northwest, Farrell et al. (2007) projected more than a doubling of soil erosion in conventionally tilled dryland systems by mid-century in this region ¹³⁶. Droughts also lead to reductions in crop biomass and corresponding residue inputs to soil, which may translate to declines in soil organic matter and degraded soil structure, negatively affecting crop yields and further increasing rates of erosion ¹³⁷.

Changes in precipitation patterns can also impact manure management needs and strategies for dairy operations ¹³⁸, particularly in Western Washington. Over the last decade or more, dairy farmers in Western Washington and Oregon have anecdotally noticed changes in seasonal rainfall patterns that align with regional climate change projections for increased winter and spring season precipitation ^{30,139}. A preliminary analysis in Whatcom County indicated an increased frequency of large storms that lagoon capacity is not designed for, and therefore, an increased risk of lagoon overflow is likely (Rajagopalan, unpublished results). Understanding these climate change-related impacts is critical, as lagoons are long-term infrastructure investments that can last up to 40-50 years.

Regulatory and market considerations

Although climate change will cause important impacts on agricultural systems, it is just one of many factors that producers must consider and may not be of most concern ¹⁴⁰. In a survey of Pacific Northwest wheat producers, changes in cost of inputs and crop prices were ranked ahead of any climate-related considerations in terms of the risk they posed ¹⁴¹. Furthermore, most producers in this survey perceived climate change-related *policies* as posing a higher risk to their operations than less reliable precipitation, despite the fact that most wheat producers lack irrigation. In a similar vein, supporting processing and other agriculturally associated businesses and infrastructure is likely to be important to ensure the ongoing viability of agriculture in Washington state.

Most agricultural markets are global, and these markets have a substantial impact on the economic outlook of agriculture in Washington. This reinforces the conclusion that impacts on production in Washington state need to be assessed alongside the likely impacts on production elsewhere in the US and world ^{122,142}. This includes impacts that are policy-related, for example, resulting from the impacts of climate-related policy in the state that are different from policies that impact producers elsewhere. Climate change is also likely to impact food consumers in the state and elsewhere, with the potential for increasing food prices; negative impacts on those who rely on hunting, fishing, foraging, and subsistence farming; and adverse impacts on culturally important foods, including but not limited to salmon ^{142,143}.

Meanwhile, some agricultural systems face pressures from consumers and buyers to meet regulatory standards for emissions reductions or otherwise implement environmentally friendly production practices ¹⁴⁴, or, in the case of cropping systems, to move toward production of specialty crops ¹⁴⁵. In some cases, this may complement, and in other cases, this may complicate efforts to adapt systems to address climate impacts. It will be key to recognize these other factors when prescribing policy or promoting programs that seek to support producers' attempts to adapt to projected climate impacts ¹⁴⁶ as new soil carbon initiatives are created by public, private, and philanthropic entities. It has also led to confusion over what is possible or practical to achieve through agricultural management, as soil carbon formation and storage is complex, and its response to management is context-dependent. This can pose challenges to decision makers tasked with creating defensible, science-informed policies and programs for building and protecting soil carbon. Here we summarize the science concerning the potential for agricultural soils to serve as a natural climate solution, in order to frame a discussion of current approaches in United States (US).

Specific challenges for small operations and socially disadvantaged farmers

There is some evidence that smaller farms may be more economically vulnerable to climate change impacts

¹⁴⁰ likely due to their relatively limited financial base and lack of other resources (e.g., irrigation) to help them ameliorate impacts compared to larger farms ¹⁴⁷. This can be expected to extend to other small farm situations, even those that produce livestock, livestock products, or diversified vegetables or fruits. A growing number of small farmers in Washington represent historically underserved and socially disadvantaged populations including women, Latino, Asian, and immigrant farmers, who possess additional vulnerabilities that are likely to make it even harder to adapt to climate change ¹⁴⁸.

Many diversified small farms participate in direct-to-consumer markets with farms typically providing products on a weekly or even more frequent basis to customers. In Western Washington, many of the operations growing vegetables and fruit have traditionally grown cool-season crops such as cabbages, broccoli, kale, and spinach during summer months, as well as other specialty crops like warm-season vegetables, berries, or apples. As the climate warms and heatwaves become more intense, cool-season crops could become less viable ^{65–67} during periods in which they have historically been grown, perhaps necessitating adaptation for these small farms.

There is some evidence that small operations have been able to adapt quickly during previous disruptions, including during the COVID-19 pandemic ¹⁴⁹. However, small, under-resourced, and socially disadvantaged farmers are less likely to qualify for or use government support programs ¹⁵⁰, causing them to bear more of the economic burden of adapting. Farmers with limited literacy or limited English proficiency may also struggle to successfully navigate support programs, even when they are made available. Similar issues arise with many conventional farming education models that are not tailored to farmers with limited access to land, water, and capital, or who lack English proficiency ¹⁴⁸. This underscores the need for governments to keep small and socially disadvantaged farms and farmers in mind when crafting policy to help adapt to climate change.

Additionally, lack of capacity to address climate change impacts may push small farmers to a higher reliance on off-farm income. While this can buffer potential losses ¹⁴⁰, it may also be a concerning symptom of economic distress and reduced economic viability of small-scale agriculture.

Areas for future study and climate adaptation

Climate change impacts on Washington state's agriculture are varied and complex and interact with other existing risks and uncertainties faced by production systems. Simultaneously, some climate-driven changes could result in opportunities.

Key messages from the literature include the need to plan for ongoing shifts in water supply to rangelands, irrigated agriculture, and dryland agriculture. While there is a larger body of work on water supply impacts on irrigated agriculture, knowledge gaps remain, such as understanding the likely additional water demands to supply overhead evaporative cooling used in some cropping systems in response to extreme temperatures. Additional study is also required on impacts on and mitigation strategies for rangeland and dryland systems.

Climate science related to identifying probabilities of exposure to extreme weather events has advanced rapidly over recent years but continues to develop. While this facilitates our ability to better understand likely risks, predicting the exact impacts of extreme weather and ways to adapt remain gaps that warrants further exploration. This includes impact assessments and adaptation studies that are specific to extreme weather-related challenges. Large ensemble datasets and downscaled datasets from regional climate models will support these efforts.

Additional work is also needed to fully understand potential impacts on crop and forage quality, and to pests, weeds, diseases, and beneficial insects including pollinators, given the complexity of interconnected risks. This work must go beyond understanding the impacts of climate change, to identify management strategies to mitigate the deleterious effects.

While climate change presents clear challenges for Washington state's agriculture, there is also the potential that negative impacts may be less severe than elsewhere in the Western US. With successful management of negative impacts, there is the potential that the state could become more important in terms of national agricultural production. There is a strong need for ongoing work that positions agricultural producers at all scales to take advantage of opportunities where they exist, and that proactively identifies and addresses any unintended negative impacts of such strategies.

Adaptive responses to climate impacts across scales

Many climate impacts are unavoidable, and response or recovery efforts are needed alongside climate change mitigation efforts. Unfortunately, robust studies that provide concrete evidence of the effectiveness of climate adaptation solutions for agriculture are scarce. There is a pressing need for additional work evaluating climate adaptation responses, including strategies to prepare for changes in water supply, pest pressures, and in some cases, shifts to novel crops that may be suitable in Washington state's future. Investigation into adaptation should include strategies for state, regional, and local entities as well as for commodity groups and individual farmers and farmworkers.

Some impacts can be avoided or mitigated through implementing farm-scale management practices. Examples of these strategies include adjusting planting dates of dryland crops as growing seasons lengthen ²⁰, or installing shade netting or evaporative cooling for fruit trees to reduce physiological disorders from heat stress ⁶⁶. In some cases, decision-support tools may be key to supporting individual producer adaptation, especially when decisions are complex ⁸³. This may occur through enhancement of existing decision support systems (such as Washington State University's AgWeatherNet or Decision Aid System ¹⁵¹) or the development of new tools (such as StockSmart ^{152,153}). There are also opportunities to implement on-farm practices with multiple co-benefits to producers and the environment. For example, practices that increase soil organic matter can increase the soil's water-holding capacity ^{154,155}, while supporting other essential soil functions and overall resilience. However, it is important to acknowledge the limits of these strategies in terms of their ability to consistently deliver benefits across regions, soil textures, and cropping systems, as well as the barriers to implementing these practices across cultural, social, and economic contexts.

Other adaptation strategies may be most appropriately implemented by people or entities working in support of growers and ranchers. For example, via increased adoption by beekeepers of indoor temperature-controlled hive storage to reduce physiological aging and the consequent increased colony failure risks. Another example is increased education by a variety of agricultural support entities on worker safety requirements (e.g. required acclimatization, rest, shade, and water availability) and strategies (e.g. hydration, light and ventilated clothing), especially in areas that have not historically experienced extremely high temperatures.

Still, other impacts will require solutions that involve shared infrastructure, policy, extensive incentive programs, or other support. These solutions are mostly if not fully outside the decision-space of individual growers and ranchers and would need engagement from a variety of decision-makers. Examples of this type of adaptation include addressing many water supply challenges: aquifer recharge projects, better and earlier drought and seasonal forecasts, supporting effective water markets, shifting the time-of-use rules on water rights, and infrastructure improvements ^{44,78,78,161-165}. Other examples address the need to strengthen institutional responses that prepare for and respond to extreme weather impacts, and to enhance weed, pest, and disease monitoring to respond to changing risks to crops and animals ^{109,166}. Related activity in Washington state includes the establishment of the Agricultural Pest and Disease Response Account that can rapidly distribute funds during an invasive species crisis ¹⁶⁷ and a Drought Preparedness Account to mitigate existing and anticipated drought impacts ¹⁶⁸.

Given the complexity involved, it is important that decision-makers explore the limits of particular adaptation

strategies^{83,156}, as well as the potential unanticipated consequences of the solutions themselves and the trade-offs they pose. For example, Hall et al. (2021, 2024) found that areas with vulnerabilities to changes in surface water supplies frequently coincided with groundwater declines^{44,45}. This convergence suggests that preparing for and mitigating water supply changes must include options beyond switching to alternative water sources.

While climate change is likely to exacerbate existing challenges, it also emphasizes the need for creative, new solutions that holistically support viable, sustainable agricultural systems. Some example areas where new thinking and new solutions are needed include strategies to better manage invasive species on rangelands⁹⁸, or strategies that protect farmworker health without negative impacts on worker earnings, farm profitability, and agricultural viability. In addition, developing adaptation strategies will require enhanced collaboration across entities, and increased research and extension capacity that is production system-specific. Prior stakeholder engagement efforts identified the need for enhanced partnership along the research-extension-practice continuum to explore the economic and environmental costs and benefits of climate change adaptation and mitigation strategies⁸³. Novel methods have been proposed to strengthen extension capacity for supporting local agricultural adaptation planning, such as identifying production practices from other climatic regions to envision Washington's future opportunities and challenges¹⁶⁹. As more examples arise of tried and tested adaptation actions at different scales, and as our understanding of impacts and their relative importance to agriculture continues to improve, entities and individuals in this sector will together make progress toward comprehensively addressing the complex impacts of a changing climate on Washington state's agricultural systems.

To cite appendix B, use:

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Engagement summary: Impacts of climate change on producers and other agricultural stakeholders

This report details the results of statewide engagement for the Climate Resilience Plan for Washington Agriculture. The content below outlines the engagement methods and a list of overarching themes identified through engagement. The themes are discussed in detail, along with the results of the associated survey data. Participant quotes are included below and throughout the broader Climate Resilience Plan for Washington Agriculture.



Methods

Listening sessions

Triangle and WSDA staff conducted 6 listening sessions between January and March of 2024 by attending existing meetings of the following Washington agricultural associations: Washington Grain Commission, Washington State Dairy Federation, Washington State Wine Commission, Washington State Potato Commission, Washington Tree Fruit Research Commission, and Washington Cattlemen’s Association. These meetings comprised small groups of individuals representing their respective commodity groups and, in many cases, producers themselves. The purpose of these listening sessions was to gather in-depth information in a small group setting, forge relationships between WSDA staff and partners, and distribute the online survey. Triangle and WSDA facilitators attended these meetings online, with the exception of an in-person session with the Washington Wine Commission. **An estimated 120 agricultural stakeholders were engaged as part of these listening sessions.** Figure 11 contains a promotional flyer and agenda for each listening session.

WSDA Climate Resilience Plan

Listening Sessions

WSDA wants to hear from you and your membership about how the changing climate is impacting agricultural operations in Washington.



Washington
State Department of
Agriculture



What to expect in a listening session:

- 1 WSDA will share information about the coming Climate Resilience Plan, and how producer perspectives will inform WSDA programs and funding priorities.
- 2 WSDA seeks to understand how producers are experiencing climate change, what resources they currently use, and what support they need in the future.
- 3 WSDA and consultants will distribute the Climate Resilience Producer Survey and encourage Commissioners to share it with their networks.
- 4 WSDA seeks to build relationships with the commissioners.

Time	Agenda for 30-minute listening session
7-10 min	Introduction and Project Overview
20 min	Facilitated Discussion on the Impacts of a Changing Climate
3-5 min	Next Steps

Figure 11. Listening session agenda and promotional materials.

Producer survey approach

Triangle worked with WSDA, Washington State University (WSU), and EConorthwest to develop an online survey to solicit feedback from agricultural stakeholders, including farm owners, operators, employees, industry representatives, and farm advisors. The survey included questions on the impacts of climate change on agriculture and asked about current and future resources that would support producers. The survey's purpose was to hear from a broader cross-section of agricultural stakeholders and supplement the in-depth information captured during listening sessions. Triangle and WSDA launched the online survey on January 8th in English and Spanish. The survey was widely promoted to WSDA's stakeholders through newsletters, listservs, social media, and in-person events. **The survey was completed by 292 individuals.** Figure 12 provides an overview of the geographic distribution of survey respondents per county. See the *Demographics of Survey Respondents* section below for detailed demographic information.

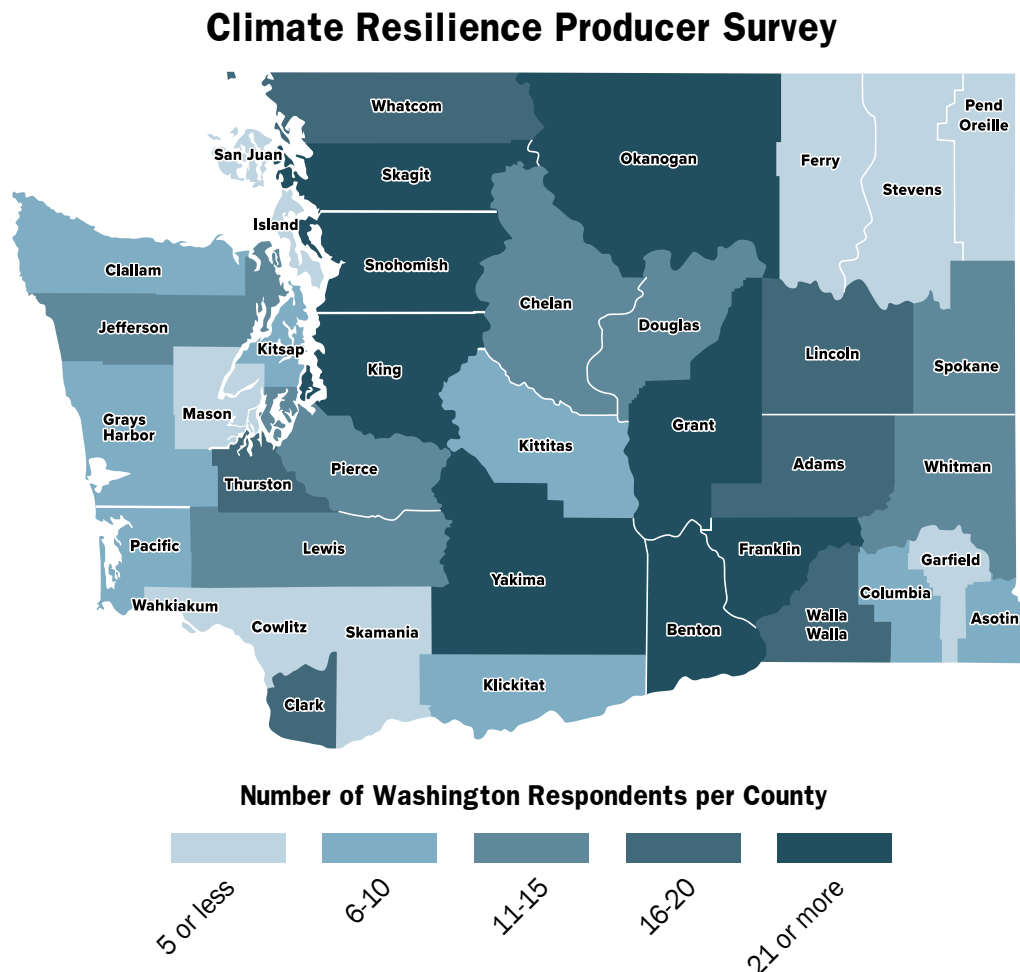


Figure 12. In seven weeks, 292 responses to the agricultural climate impacts survey were received, with at least two responses from every county in Washington.

Overarching themes

While feedback varied by operator identity, commodity type, geography, and farm size, broad themes emerged from both the survey and listening sessions (Table 2). Of these themes, many were identified in multiple listening sessions (Table 3) as well as in the survey responses. **The consistency in responses indicates that addressing the issues outlined below would likely benefit a broad range of Washington state producers.**

Table 2. Overarching themes that emerged through the agricultural climate impacts survey and during listening sessions with agricultural associations.

Category	Overarching Theme	
	4. Climate-related challenges and on-farm resilience strategies	Theme 1A. Climate-related hazards have increased the unpredictability and risk of farming operations; hazards vary by cropping system and geography. Theme 1B. Producers and farmworkers are taking action to mitigate climate impacts through resilience strategies, though continued support is necessary.
	2. Current and future resource needs for mitigating climate impacts	Theme 2A. Governmental agencies, universities, online platforms, and peer networks currently provide information, funding, support, and education. These resources will become more necessary in the future.
	3. Gaps in resources to mitigate climate impacts	3A. Market volatility, high cost of production, and regulatory pressures have increased the need for flexible, responsive funding. 3B. A historic reduction in agricultural research and technical assistance funding and staff has limited producers' ability to respond to climate impacts. 3C. Regulations, taxes, difficult-to-use grant programs, and an overall disconnect between policymakers and producers have led to programs and funding that do not always meet diverse agricultural needs.
	4. Strategies to address resource gaps and increase climate resilience	Theme 4A. Increased education, research, and expertise is necessary to inform agricultural decision making in the context of a changing climate. Theme 4B. Investment in public and private infrastructure and innovation is required to mitigate the impact of climate hazards.

Table 3. Overarching themes identified during climate listening sessions, organized by commodity association.

Listening Session	Listening Sessions: Convergence with Overarching Themes						
	1A	2A	3A	3B	3C	4A	4B
Washington Grain Commission	X			X	X	X	X
Washington Wine Commission	X		X	X	X	X	X
Washington Tree Fruit Commission	X	X	X		X	X	
Washington Dairy Federation	X		X		X	X	X
Washington State Potato Commission	X		X	X	X	X	
Washington State Cattlemen's Association	X	X	X		X		X

Discussion of overarching themes



1. Climate-related challenges and on-farm resilience strategies

Theme 1a: Climate-related hazards have increased the unpredictability and risk of farming operations and vary by cropping system and geography

The most prevalent climate-related issues reported in the survey were changing weather cycles, extreme heat and drought, wildfire and/or wildfire smoke, and changing disease and pests (See Figure 4 in *Section 2: Agricultural Climate Risks and Adaptation Opportunities*). These responses mirrored those from the listening sessions, which called to attention the impact of unpredictable, extreme events such as heat, cold, flooding, and wildfire; the impacts of these events on crop quality were emphasized throughout the listening sessions.

Theme 1b. Producers are taking action to mitigate climate impacts through resilience strategies, though continued support is necessary

To mitigate impacts, survey respondents across regions most frequently cited the use of soil health practices, experimentation with new crops or crop varieties, irrigation investments, and crop weather protection (Figure 13). These practices require continued support through the provision of funding to support research and planning resources. See Theme 3 (Gaps in Resources) for more discussion.

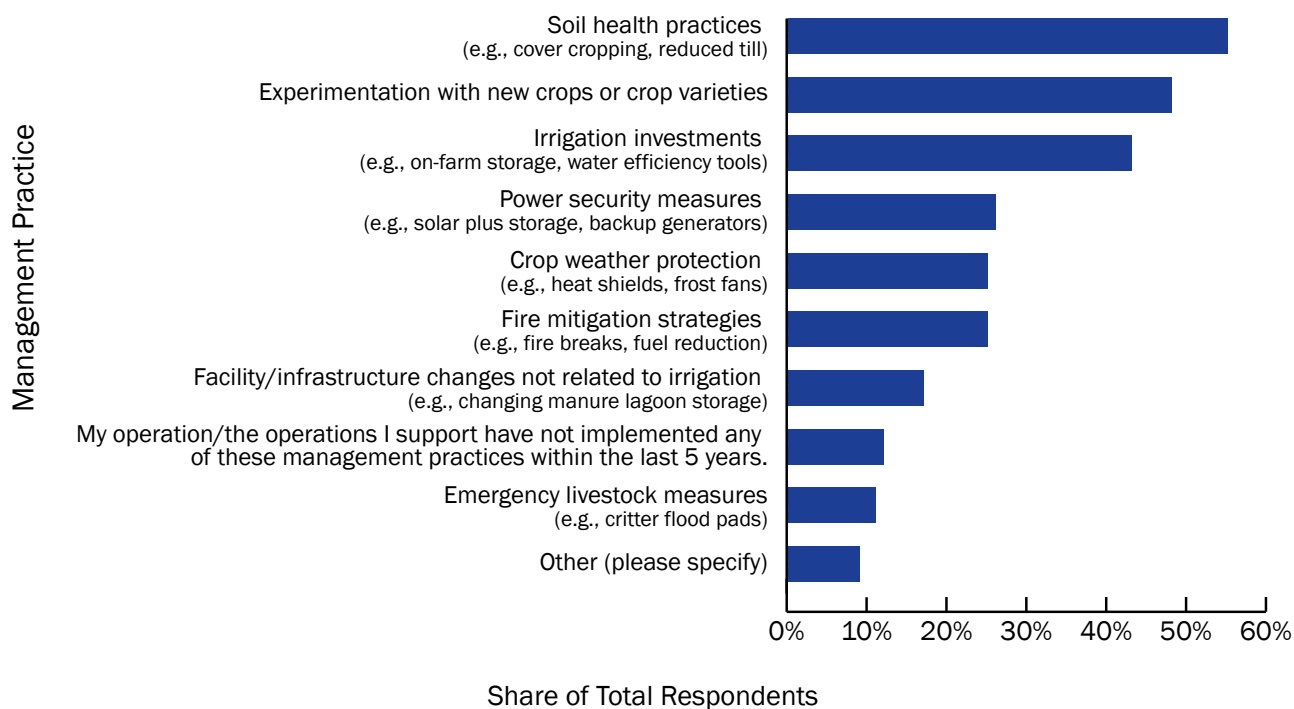


Figure 13. Responses to “Has your operation or the operations you support implemented any of the following management practices in the last five years?” during a survey of producers and other agricultural stakeholders (n=292).



2. Current and future resource needs for mitigating climate impacts

Theme 2a: Governmental agencies, universities, online platforms, and peer networks currently provide information, funding, support, and education. These resources will become more necessary in the future

In the survey and listening sessions, participants were asked to describe the existing resources they use to mitigate climate impacts, and those they anticipate needing in the future (Figures 14 and 15). Participants reported relying on governmental agencies, educational institutions, online platforms, and peer networks for information, funding, support, and education.

The top-ranked resources for addressing current and future challenges were:

1. Conservation incentive programs such as the Natural Resources Conservation Service’s (NRCS) Environmental Quality Incentives Program (EQIP) and the State Conservation Commission’s Sustainable Farms and Fields Program
2. Peer-to-peer learning

In the write-in portion of the survey, resources frequently mentioned were:

- Conservation Districts
- WSU Extension
- USDA - mentioned in various contexts, including USDA offices and USDA programs like the Organic Program
- Sustainable Agriculture Research and Education (SARE)
- YouTube - mentioned frequently as a source of information and learning
- NOAA (National Oceanic and Atmospheric Administration) - mentioned for weather forecasting and data



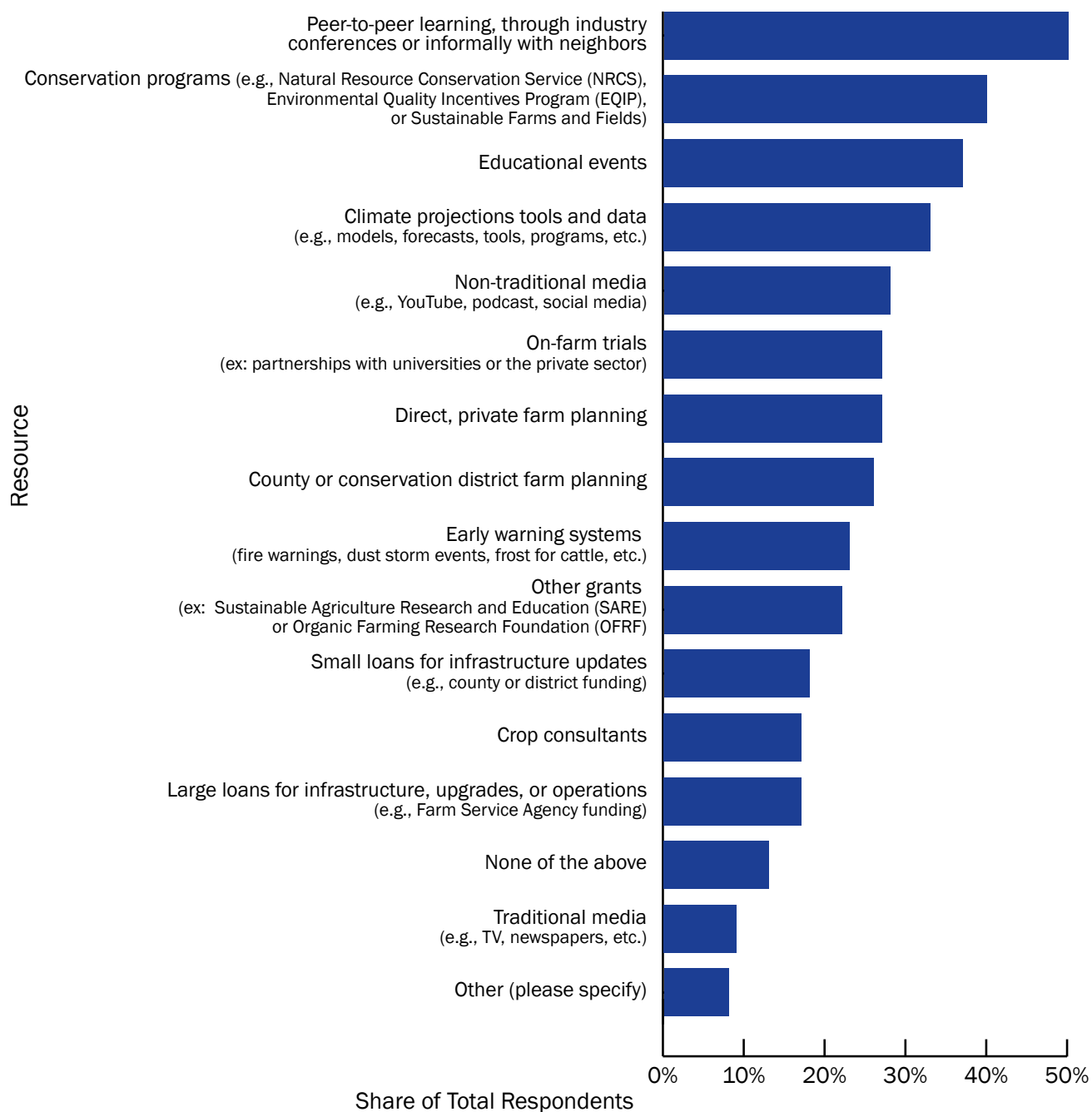


Figure 14. Responses to “What resources help you manage the impacts of a changing climate?” during a survey of producers and other agricultural stakeholders (n=292).

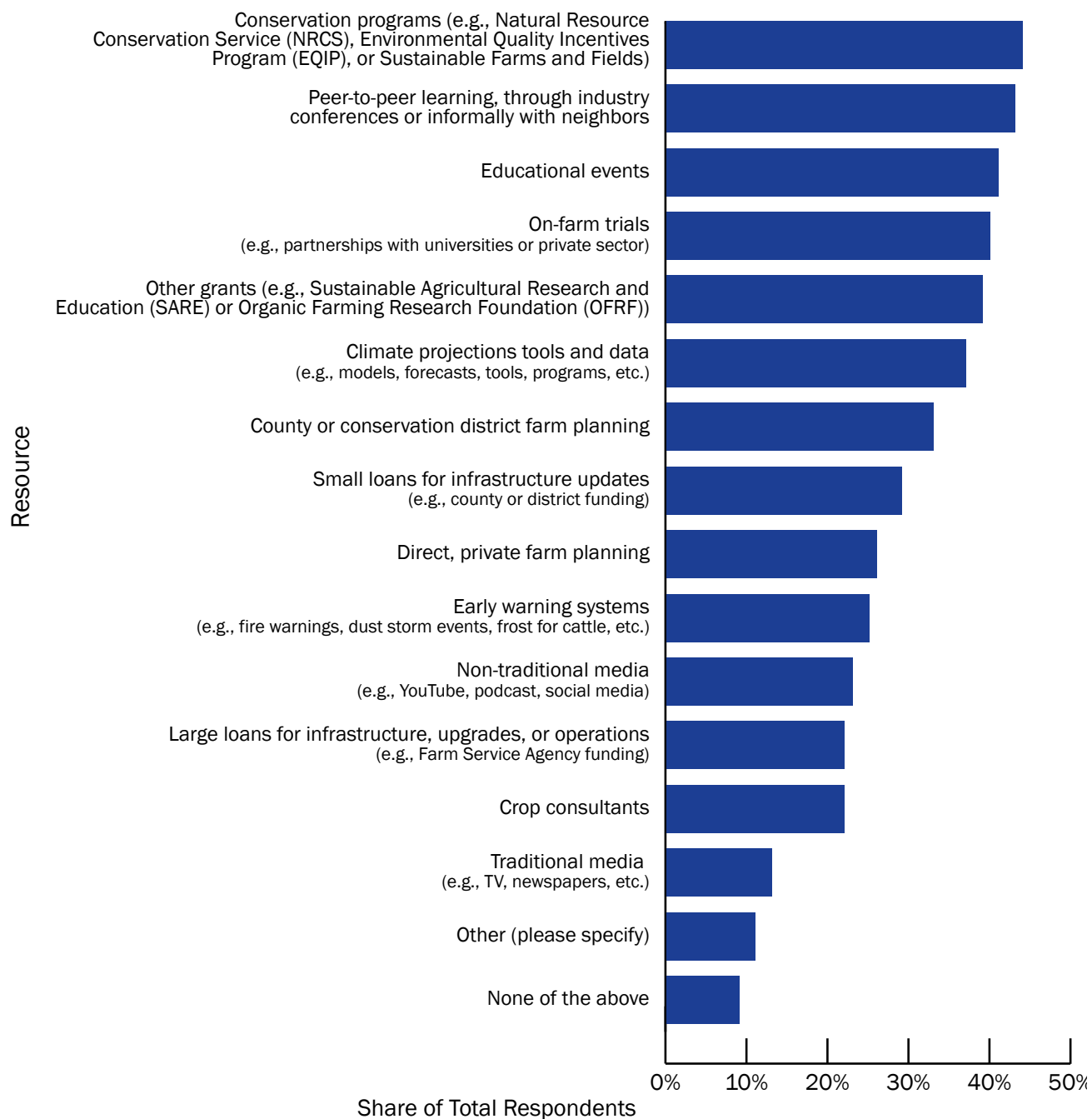


Figure 15. Responses to “What additional resources would you be most likely to use to manage the impacts of a changing climate?” during a survey of producers and other agricultural stakeholders (n=292).



3. Gaps in resources to mitigate climate impacts

Theme 3a. Market volatility, high costs of production, and regulatory pressures have increased the need for flexible, responsive funding

Respondents noted stringent regulations and high operational costs as an indirect impact of climate change. Respondents expressed the need for more flexible and supportive policies, including tax reductions, streamlined permitting processes for agricultural projects, and financial assistance to offset the costs of new equipment, infrastructure improvements, and compliance with evolving regulations.

The following feedback reflects the various challenges and limitations producers face when trying to meet funding needs:

- Access to funding for small farms: Many small-scale farmers highlighted the difficulty in accessing funding, especially when grants are tailored for larger-scale projects that may not suit their needs or project sizes.
- Grant limitations and restrictions, and slow application processes: Respondents noted prohibitions for infrastructure investments for many grants, which hinder their ability to invest in new, innovative equipment. Slow turnaround times for grant applications and decision-making processes also discourage many from applying. Many respondents cited a lack of staff at Extension offices, NRCS, and other agencies as a driver of this inefficiency. See Theme 3B for further discussion.
- Insufficient funding to support specific resilience infrastructure projects, such as:
 - Water storage and conservation: dew catchment, rainwater harvesting, efficient irrigation, etc.
 - Backup systems for power outages due to extreme weather events
 - Extreme heat/cold mitigation: Hoop houses, greenhouses, high tunnels, and shade cloth
- Producers expressed a need for additional or enhanced insurance and emergency assistance programs that mitigate the impacts of extreme weather on infrastructure, crops, and livestock.

Theme 3b. A historic reduction in agricultural research and technical assistance funding and staff has limited producers' ability to respond to climate impacts

Respondents emphasized the need for more research staff, particularly Extension specialists, to provide direct support and updated information on climate-resilient agricultural practices.

Participants identified the following research and technical assistance needs facing their operations:

- Availability and accuracy of weather and climatic prediction systems: The importance of accurate systems was noted throughout the survey as a top concern for producers to inform decision-making.
- Identification of resilient crops and practices: Farmers called for research to identify crops, plants, and farming practices that increase resilience to multiple climatic stresses such as droughts and temperature extremes, floods, storms, and wildfires.
- Access to crop consultants and research experts: Respondents identified a growing gap in the availability of research expertise either within university Extension offices and local technical assistance providers or through private crop consultants. Respondents noted that adequate staffing is crucial for timely assistance and implementation of projects. This disparity was noted to be regionally varied, with some agricultural communities having less access to expertise than others.

Theme 3c. Regulations, taxes, difficult-to-use grant programs, and an overall disconnect between policymakers and producers have led to programs and funding that do not always meet diverse agricultural needs

Survey respondents identified changing markets, economic pressures, and regulatory concerns as issues they anticipate being most impactful to their operations in the next 5–10 years (Figure 16). Many respondents in listening sessions and survey write-in responses criticized governmental inaction, lack of funding, and the disconnect between policymakers and producers in addressing climate change in agriculture. These frustrations were tied to the recognition among producers that environmental regulations (including but not limited to climate regulations) are not written with the practical needs of producers in mind and often have negative unintended consequences.

“[We should be] lobbying for cutting regulations and unnecessary fuel taxes. With more money in the bottom line, there is more flexibility and, therefore more innovation. The best innovation will always come from the farmers, not mandates.” — Survey respondent

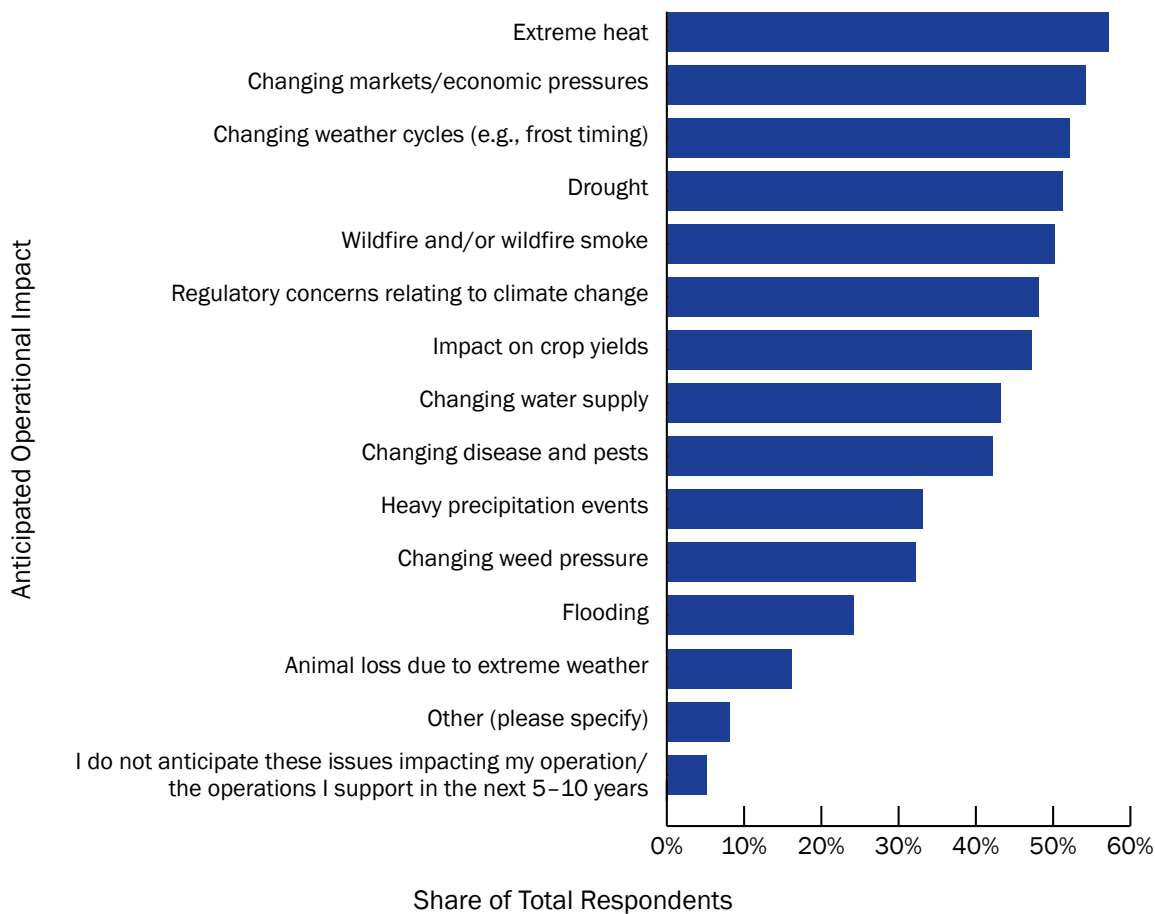


Figure 16. Responses to “Which of the following do you anticipate impacting your operation or the operation you support in the next 5 to 10 years?” during a survey of producers and other agricultural stakeholders (n=292).



4. Strategies to address resource gaps and increase climate resilience

Theme 4a. Increased education, research, and expertise are needed to inform agricultural decision-making in the context of a changing climate

Survey respondents most frequently reported relying on universities (46 percent), friends, family, and neighbors (45 percent), and WSDA (43 percent) for support in managing the impacts of climate change (Figure 17). However, respondents and listening session participants expressed a desire for more: on-farm research to test and develop climate change mitigation approaches specific to their local conditions and farming practices; a need to identify resilient crops and farming practices; and accurate, timely climate data (Figures 14 and 15).

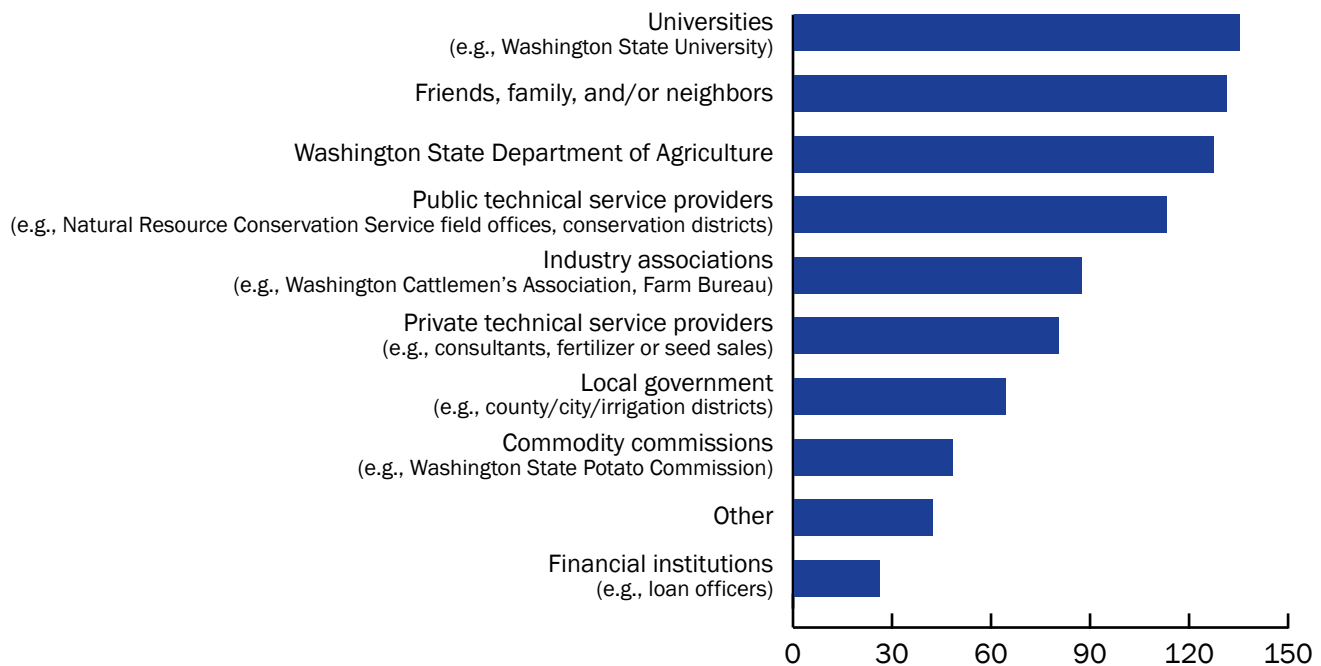


Figure 17. Responses to “From whom are you most likely to receive support to manage the impacts of a changing climate?” during a survey of producers and other agricultural stakeholders (n=292).

The following tools and data were described as being especially important during emergency events such as flooding, wildfire, and during extreme cold or heat:

- Predictive, regularly available climate data (Including AgWeatherNet)
- Farm planning with Best Management Practices (BMPs) by local experts
- Data on plant health issues and recommendations of new crop varieties to support decision-making
- Support for adopting technological advancements to improve farm efficiency and productivity

"By learning new practices, it allows us to prepare for climate change events in the future. "
— Survey respondent

Theme 4b. Investment in public and private infrastructure and innovation is required to mitigate the impact of climate hazards

Respondents identified specific infrastructure needs to improve their operational resilience to climatic extremes and emergency events, underscoring the diverse challenges producers face in adapting to climate change and highlighting the importance of investing in infrastructure and technology. Respondents expressed the need for funding to support infrastructure upgrades and equipment purchases, such as installing:

- Shade cloth
- High tunnels
- Manure management systems
- Rainwater harvesting systems
- Forest resilience practices to reduce fuel loads
- Backup systems for well pumps and/or alternative water sources

"In 2022 our crop yield was greatly diminished due to spring rains, high temps, and early frost. Being able to receive a grant for high tunnel gives hope that yield will be better for 2024."
— Survey respondent

Additional takeaways from listening sessions

Commodity-specific concerns that emerged during the listening sessions are included below (Table 4). These discussion points emphasize the need for a region and crop-specific examination of agricultural climate impacts and needs.

Table 4. Additional takeaways from agricultural climate impacts listening sessions, organized by commodity association.

Listening Session	Additional Takeaways
Washington Grain Commission	• Changing weed pressure and herbicide resistance impacting crop yields • Difficult to maintain crop quality in an inconsistent climate • Volatile product transportation methods not controlled by farmers
Washington Wine Commission	• Increased severity of wildfire smoke for Eastern and Central Washington impacts product quality • Lack of research on breeding for resilient varieties and rootstocks • Lack of research on changes to phenology timing (bloom and ripening) • Lack of support for worker safety implementation and labor needs under changing harvest conditions
Washington Tree Fruit Commission	• Climate-related events impacting product transportation • Orchards newly located in traditionally colder regions increase challenges with cold snaps, frost, and winter kill • Changes in pest management practices due to change in pest lifecycles • Lack of climate change programs and incentives that benefit producers in the short-term • Lack of research on how carbon sequestration may be an additional revenue source for tree fruit farmers • Need for more ways to communicate industry information directly to farmers

Washington Dairy Federation	• Increased pressure to reduce carbon footprint from supply chains • High input costs associated with greenhouse gas reduction technologies challenge a farm's competitiveness and viability. • Increased flooding impacts lagoon storage, livestock loss, and operation income • Issues with new invasive species • Volatile feed supply during crises and weather events
Washington State Potato Commission	• Longer heat seasons increase insect and pest pressures • Crops moving north from California (i.e., processing tomatoes) will introduce competition for land • Limited access to affordable insurance programs due to the high value of crops • A need for reliable, clean energy for storage, pumps, and nitrogen fertilizer
Washington State Cattlemen's Association	• Fire and smoke impacting forage crop harvest and hay storage • Lack of infrastructure on public lands (decommissioned roads, inadequate watering) limits grazing and leads to a higher risk of wildfire

Demographics of survey respondents

Respondents were primarily farm owners and farm operators, followed by year-round employees, farm advisors, and industry representatives (Table 5). Survey respondents were well distributed across their years of experience (Table 6) and the size of their operation in gross revenue (Table 7).

Table 5. Responses to “Which of the following best identifies you?” during a survey of producers and other agricultural stakeholders (n=292). Respondents were allowed to select multiple options.

Survey Responses: Respondent Identity	Count
Farm owner	190
Farm operator	141
Year-round farm employee	58
Farm advisor (private or public)	38
Industry representative	23
Other (please specify)	22
Seasonal farm employee	15
University researcher	12

Most respondents (60 percent) worked in agriculture for more than 10 years (Table 6). Respondents primarily represented operations with an annual revenue less than \$250,000 (Table 7).

Table 6. Responses to “How long have you worked in agriculture?” during a survey of producers and other agricultural stakeholders (n=292).

Survey Responses: Years in Operation	Count
Less than one year	11
1–5 years	49
6–10 years	58
11–20 years	51
21–30 years	34
31 or more years	88

Table 7. Responses to “What was your operation’s gross average revenue in 2022?” during a survey of producers and other agricultural stakeholders (n=292).

Survey Responses: Revenue Bracket	Count
Not applicable	49
\$1,000–\$9,999	38
\$10,000–\$99,999	74
\$100,000–\$249,000	28
\$250,000–\$499,000	29
\$500,000–\$999,000	28
\$1,000,000 or more	40

Most respondents (65 percent) selected multiple commodities when asked what they produce. The most common categories selected were vegetables and small fruits (n=129), field crops (n=103), and tree fruit and nuts (n=103) (Table 8).

Table 8. Responses to “What types of crops/livestock does your operation produce?” during a survey of producers and other agricultural stakeholders (n=292). Respondents were allowed to select multiple options.

Survey Responses: Commodity/Crop Type	Count
Vegetables/small fruits (e.g., onion, potatoes, sweet corn, melons, blueberries, etc.)	129
Field crops (e.g., alfalfa, hay/haylage, wheat, corn/silage, cotton, etc.)	103
Tree fruit and nuts (e.g., apples, grapes, pears, cherries, citrus, etc.)	103
Livestock and poultry products (e.g., milk, eggs, manure, wool, etc.)	70
Livestock and poultry (meat)	68
Pasture	68
Seed crops	38
Other (please specify)	36
Nursery crops	35
Forest/timber products	24
Apiary products and pollination services	23
Hops	14
Aquaculture	8

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Appendix D

Impacts of Climate Change on Farmworkers in Eastern Washington



Executive summary

Climate change is impacting Washington state farmworkers in a variety of previously unreported ways. Historical attempts to document climate change impacts have not sufficiently captured the farmworker voice, though these communities are on the frontlines of climate change impacts. This is in part because traditional survey efforts have not been produced in the appropriate languages or distributed through the appropriate methods.

The work described here addresses those shortcomings by directly engaging farmworkers about the ways in which they have been impacted by climate change. Semillero de Ideas staff (hereafter referred to as “Semillero”), A Washington state based non-profit rooted in the farmworker community, worked with farmworkers in the summer of 2024. Semillero developed a survey tool in close collaboration with farmworkers, ensuring the questions were understandable and readily made sense. They deployed members of the greater farmworker community to places where farmworkers regularly gather and engaged in trust-building conversations with workers. This collaborative and relational approach led to the successful engagement of 211 farmworkers across Eastern Washington. Methods are described below in greater detail and can serve as a playbook for future engagement efforts that seek to capture the farmworker voice.

Approximately 95 percent of respondents reported being directly impacted by climate change, with significant effects in their professional lives. The following extreme events were most commonly reported by farmworkers: heat waves (91 percent), wildfires (59 percent), droughts (44 percent), and severe storms (20 percent). These impacts often led to work disruptions, changes in established schedules, and new challenges in working conditions. Collectively, these impacts led to reduced incomes for the majority of respondents (67 percent). Farmworkers also highlighted several health consequences, including an increase in heat-related illnesses.

The survey and listening sessions revealed that climate change impacts extend beyond the workplace and influence farmworkers' home lives. Respondents detailed rising living costs due to increased demand for air conditioning or heating. They also reported challenges in finding daycares that accommodate harvest schedules that begin as early as 3 a.m. to avoid peak heat. These working hours also reduce the ability of workers to be present with their children for activities like taking them to school or reading them a bedtime story.

Despite these challenges, farmworkers are actively seeking ways to adapt and mitigate impacts and are eager to be included in discussions on potential solutions. Farmworkers described several current adaptations they've made in work attire and in strategies to stay hydrated. For longer-term resilience, Semillero and farmworkers collaboratively developed recommendations following an analysis of surveys and interviews. These recommendations aim to foster collaboration for farmworker engagement, inform policymakers and industry, promote economic resilience, and ensure farmworker inclusion in research and technology. Collectively, these recommendations are aimed at enhancing worker safety and well-being through the impacts of climate change, which will enhance a thriving Washington agricultural landscape.

Methods

Guiding principles

Engaging farmworkers and building trust between agricultural stakeholders is crucial to the success and future of the agricultural industry. To accurately capture farmworker voices, Semillero recommends that engagement efforts:

- Be facilitated by a known, trusted organization
- Meet farmworkers where they are, physically and culturally

- Foster peer-to-peer engagement
- Center farmworkers as the experts on their own lives and work
- Are collaborative and relational, not extractive
 - Farmworkers' ideas and input are valued as essential to decision making
 - Farmworkers are regularly informed about the results and insights gathered from the survey they participated in and how their input is being used
 - Farmworkers are involved in developing the outcomes and recommendations produced from engagement data

Surveys

Through a grant from the Washington State Department of Health, Semillero conducted a series of surveys with farmworkers. These surveys involved one-on-one discussions with agricultural workers, with a **total of 211 participants** engaging in the process. Respondents included 122 individuals who identified as male and 89 who identified as female, with ranges of experience working in agriculture from 0.5 to 40 years. The primary objective of the survey was to gain insights into the impacts of climate change on farmworkers, including its effects on their work, health, and home life, and the adaptive strategies they employ to address challenges they encounter.

95 percent of farmworkers shared that they have been directly impacted by climate change.

This survey was developed in collaboration with a doctoral student at the University of California, Berkeley. Collaborators designed a sample questionnaire, and 20 workers were surveyed to assess the clarity and comprehension of questions. A revised survey was then uploaded to tablets using Google Forms.

Semillero intentionally visited locations where farmworkers and their families are often present, such as the local grocery store, flea markets, and community events, to administer the survey. Farmworkers who participated resided in the following cities, listed in alphabetical order: Aberdeen, Beverly, Bridgeport, Chelan, Cowiche, Grandview, Kennewick, Mabton, Othello, Pasco, Prescott, Quincy, Richland, Royal City, Selah, Sunnyside, Wenatchee, Whiteswan, Yakima, and Outlook. The most common systems supported by survey respondents were tree fruit, blueberry, livestock and row crop vegetable systems.

To facilitate the survey process, Semillero carried tablets with the climate change survey and engaged farmworkers in one-on-one conversations. The goal was to provide a trusted, trained Spanish- and English-speaking community partner who could make the survey more accessible by asking questions aloud, fostering a meaningful and effective dialogue within the community. Through these conversations, the team was also able to identify farmworkers who wanted to learn more about the issue of climate change in future listening sessions.

Listening sessions

Following the completion of surveys, Semillero organized its first listening session in December 2024, with 8 participants in Sunnyside. The primary objective was to share survey results with farmworkers and learn more about what further ideas they have on how to mitigate the impacts of climate. Semillero also followed up with 30 survey participants through one-on-one phone calls and WhatsApp messages to revisit previous

discussions and gather further insights. These ideas are featured below in *Recommendations for a More Climate-resilient Future*.

Quotes from survey and listening session participants are included below and throughout the broader Climate Resilience Plan for Washington Agriculture.

Results and overarching themes

The data collected and the voices shared reflect the lived experiences of farmworkers. Surveys, listening sessions, and follow-up discussions revealed the impacts of climate change on farmworkers’ professional life, health, and home life (Figure 18).

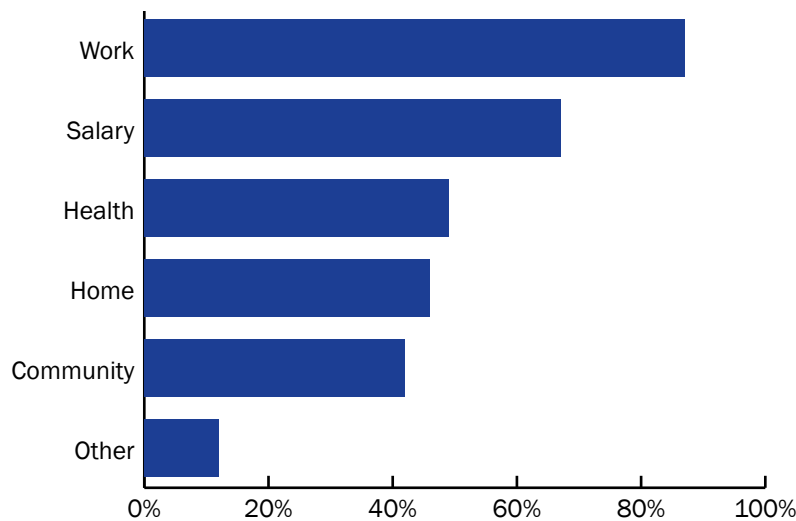


Figure 18. Farmworker survey responses to the question, “Where do you feel the negative impacts of climate change?” (n = 211)

Ninety-five percent of farmworkers interviewed shared that climate change has impacted their work in agriculture, their health, and their life at home. Figure 19 describes the specific climate change impacts that farmworkers have experienced firsthand: heat waves (91percent), wildfires (59percent), droughts (44percent), severe storms (20 percent), and flooding (3 percent). These impacts have presented significant daily challenges for farmworkers in Washington state.

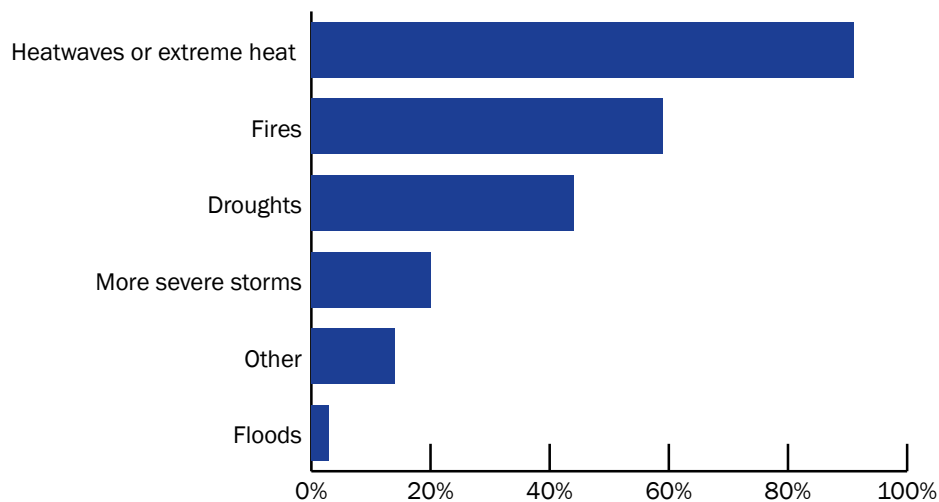


Figure 19. Farmworker survey responses to the question, “What effects of climate change have you experienced?” (n = 211)

Professional life

A significant majority of farmworkers surveyed reported that their annual income and wages have been negatively affected by climate change (Figures 18 and 20). Farmworkers highlighted several challenges, including changes in soil health, an increase in pests, a decline in the quality of produce they are asked to harvest, and reduced water availability, all of which negatively impact crop yields and in turn farmworker earnings. Farmworkers reported that, with less quality fruit available to pick, wages are significantly lower than in previous years (Figure 20).

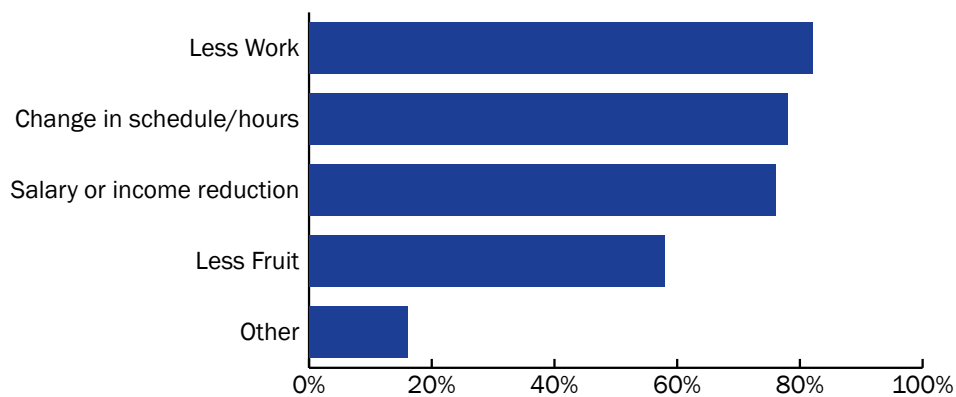


Figure 20. Farmworker survey responses to the question, “In your work, what effects of climate change have you noticed?” (n = 211)

“During the harvest, the trees no longer produce the same amounts of fruits and the work lasts less because there isn’t enough fruit. This last season, the work finished two weeks earlier, with no work it becomes harder to pay rent and buy food” –Listening session participant

In many instances, harvest schedules have shifted earlier to prevent workers picking fruit during the hottest hours of the day. For example, work that used to begin at 6 a.m. now begins at 3 a.m. to mitigate the effects of extreme heat. Seventy-eight percent of workers reported needing to adjust their work schedules, and 82 percent reported a reduction in the total number of hours they are assigned to work. Although shifts may begin earlier, workers are still required to conclude their workday earlier due to extreme heat, with peak temperatures often reached by 10 a.m.

Health

Farmworkers also highlighted health concerns linked to extreme weather events in the workplace, including but not limited to:

- Heat-related illnesses including exhaustion, stress, and stroke
- Dermal health challenges due to prolonged sun exposure
- Respiratory issues from wildfire smoke
- Eye strain from working with minimum lighting at night and early mornings
- Joint pain and discomfort for those working in severe cold temperatures during winter

In these last few years, there has been excessive heat, and we work fewer hours. It doesn't only affect the fruit, but also the workers. I stay hydrated but I feel the excessive heat earlier, around 8 or 9 a.m. I start feeling dizzy because of the heat" – Listening session participant

For example, earlier work schedules often require workers to harvest using headlamps and flood lights. This makes harvest conditions more challenging and can reduce earnings, but it also can create eye strain from working long hours under moving lights that oscillate between too high and too low to perform technical work. Participants also recognized the importance of sun protection, sharing that they now must opt for larger hats to shield their face and shoulders. In tree fruit systems, however, these hats hinder movement, reduce efficiency, and pose a safety risk by blocking visibility and increasing the chance of injuries from branches. Therefore, farmworkers must choose between the risk of sun exposure and these other dangers.

Health impacts contribute to the rising costs of medical expenses and medications. Farmworkers already experience some challenges at higher rates, including allergies, asthma, high blood pressure, and physical exhaustion. The drivers of many of these challenges, such as poor air quality or extreme weather, are exacerbated by climate change. These conditions not only affect their ability to perform at work but also influence their capacity to engage with their families and loved ones when they return home.

Home life

Farmworkers also discussed the trickle-down effects of climate change on their personal lives (See Figure 5 in *Section 2: Agricultural Climate Risks and Adaptation Opportunities*). As previously described, reduced farmworker earnings has led to challenges in making ends meet, especially as climate change results in increased costs. For example, extreme weather conditions follow farmworkers from the fields to their homes, where 77 percent reported a sharp increase in electricity bills due to the need to run air conditioning in the summer and heating in the winter. These respondents also noted a rise in their water bills, as they must use more water during the hot seasons and take precautions to prevent pipes from freezing in the winter. Forty-eight percent of farmworkers reported increased expenses related to climate change, such as the need to purchase new fans or heaters.

Surveys and listening sessions revealed that, for many families, the change in work hours can create significant tension at home. While working in the dark can offer relief from the heat, it presents a challenge for farmworkers with children, particularly in finding childcare. Many families rely on older children to care for younger siblings, but this often forces parents to make difficult decisions: either wake the older children or locate childcare at late or early hours which comes at a higher cost. Farmworker families typically depend on

dual incomes, thus having one parent stay home to provide childcare can directly impact their ability to provide for the basic needs of their families. Climate change-related shifts in work schedules also impact the ability of farmworkers to be present with their children for activities like taking them to school in the morning or reading them a bedtime story.

Strategies adopted

Listening sessions and surveys revealed that farmworkers are actively taking steps to mitigate the impacts of climate change (Figure 21). Seventy percent of farmworkers reported they have made changes in how they work. The most common adaptations described by workers include increased water intake (27 percent) and changes to their work attire (58 percent).

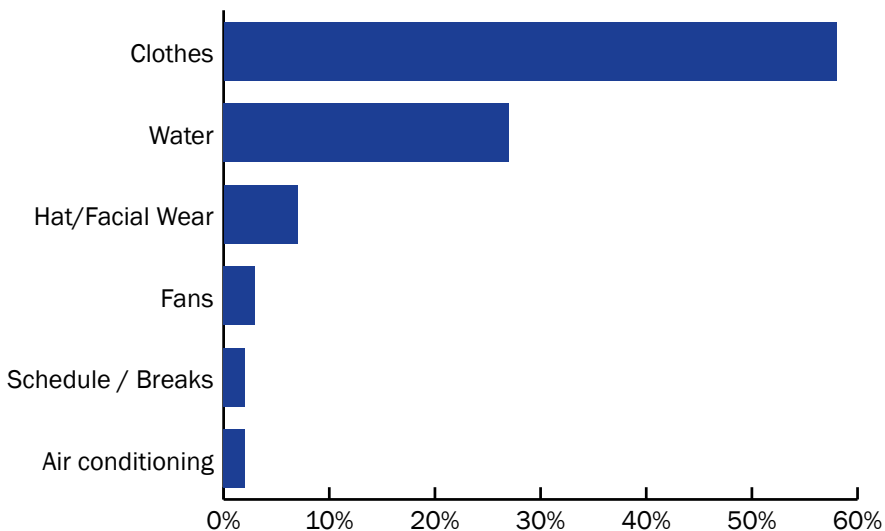


Figure 21. Farmworker survey responses to the question, "What kind of changes have you made in the way you work?" (n = 124)

Listening session participants reported that sufficient quantities of quality drinking water is not always available at work sites, with rising temperatures rendering available water undrinkable. This condition, referred to as "*agua muerta*" or "dead water," results as water sits in the heat and becomes prone to bacterial growth. Several farmworkers shared that the contaminated water could cause severe illness, sometimes leading to missed work the following day. As a result, workers shared that they take extra measures to stay hydrated, such as freezing their water overnight, so it stays cool throughout the day. They also mentioned needing to drink water strategically to avoid retrieving it from their car during shifts, resulting in lost time and reduced wages. Additionally, workers noted the challenges in appropriately managing water bottle waste during rushed field days, leading to trash and negative environmental impacts.

More than half of participants (58 percent) reported making adjustments to the type of clothing they wear to work due to changing climate conditions. Farmworkers indicated that they now choose lighter fabrics that still provide protection from the sun, and many opt for larger sun hats to shield their faces. However, it was noted that wearing a larger hat is not always feasible depending on which crop farmworkers support, as described in the section *Health*. Many farmworkers also mentioned wearing reusable face coverings similar to ski masks or bandanas to protect them from wildfire smoke, dust, and pesticide residue.

“To stay fresh, I freeze gel packs overnight and I put them in my cooler, so they stay cold, once I’m at work I wrap them in a t-shirt and I place around my neck. This helps keep me cool.” – Survey respondent

“I bought these mini portable fans at the store, I clip to my bag when I’m picking cherries and use them to keep me cool” – Survey respondent

Farmworkers described the challenges of finding shade during their breaks. While the provision of rest areas is required by state regulation, they are not always available during fieldwork. Farmworkers reported walking back to their cars to seek shade, though it can often be even hotter inside the vehicle, posing a health risk. If they choose to turn on the air conditioning, they face the added cost of fuel, along with the environmental downside of idling, which results in the emission of harmful pollutants. In the winter during extreme cold conditions, farmworkers reported using heat packs in the toe box of their work boots and gloves to keep warm.

Interestingly, the survey and listening session highlighted farmworkers’ desire to personally contribute to environmental well-being at work and in their communities. Several participants described practices aimed at keeping work, home, and community areas free of waste, with active efforts to reuse and recycle. Farmworkers expressed the hope that their cities initiate recycling programs, increased vegetation, and tree-planting efforts, to provide communities and homes with natural shade and cooler environments.

Recommendations for a more climate-resilient future

Surveys and listening sessions revealed that farmworkers are significantly affected by climate change, with impacts on their earnings, working hours, and health. These challenges extend beyond the workplace, affecting their home lives and communities as well. While farmworkers are deeply impacted by climate change, they are also eager to engage and contribute to potential solutions.

“It’s important to involve farmworkers in making changes” – Survey respondent

The following recommendations were produced collectively with farmworkers following an analysis of survey and listening session results. The intent of these recommendations is to foster collaboration across all sectors of the agriculture industry, and to unite efforts to tackle climate change and build a sustainable future.

Recommendations for farmworker engagement:

- Collaborate with labor advocacy groups, Semillero de Ideas, unions, and NGOs that specialize in farmworker rights and health to ensure inclusive policy recommendations.
- Integrate HEAL (Healthy Environment for All) Act principles with ongoing farmworker engagement.
- Establish transparent communication channels between government agencies, farmers, and workers.
- Develop simplified, multilingual guides for environmental regulations to build trust, understanding, and to ensure compliance.

Recommendations for policymakers and industry:

- Integrate farmworker voices into decision-making bodies to ensure that laws and regulations reflect their needs. For example, establish a farmworker advisory board to collaborate with producers and policymakers.
- Create accountability mechanisms to monitor compliance with worker protection regulations, ensuring employers are held responsible for implementing safety measures.

Recommendations for economic resilience:

- Propose funding for programs that support farmworkers economically during periods of reduced agricultural activity caused by climate impacts.
- Fund solar panels and insulation for worker housing, reducing energy costs and improving living conditions.

Recommendations for farmworker inclusion in research and technology:

- Encourage collaborative research that involves farmworkers in identifying proactive climate-resilient strategies and tools, ensuring the solutions developed are practical and worker-centered.
- Evaluate the social and economic implications of introducing climate-resilient technologies, with a focus on minimizing negative impacts on rural workers.
- Introduce mobile technology platforms for workers to report real-time observations of climate impacts, pests, and plant diseases. These could include photo and video submissions to a centralized research database while ensuring that farmworkers are fairly compensated for doing so.
- Improve access to reliable and real-time meteorological tools tailored to workers' needs.

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