8. Agriculture

8. Agriculture

Washington's agriculture industry is important to the nation and the world. The combination of diverse climate, soils, and topography creates opportunities for growing a wide variety of crops. Agriculture is practiced in almost every region of the state, and it is the key economic driver and employer in most counties of the state. Washington's agriculture is highly diversified, with more than 300 commodities produced commercially. Washington is the ninth largest grower of crops in the U.S. and first in the production of nine commodities.[128] Further, Washington is the nation's third largest exporter of food and agricultural products.

Total farmland was about 15 million acres in 2007, with more than 1.8 million acres under irrigation. Washington's 39,500 farms and ranches produced crops and livestock valued at $7.9 billion in 2010, up from $7.1 billion in 2009. Field crops, livestock, and fruits accounted for most of the state's farm production value. Moreover, farming supports a wide range of economic activities, including a large food processing and distribution industry. The food and agriculture industry contributes 12 percent to the state's economy and employs 160,000 people.[129]

Biofuels such as ethanol and biodiesel are increasingly produced as alternative liquid fuels to replace petroleum-based gasoline and diesel and reduce greenhouse gas emissions. The resulting increase in wheat and other grain prices has benefited some farmers. However, biofuel production has contributed to increased costs and feed shortages for cattle, hogs, and other livestock industries, reducing profitability and increasing consumer prices.

[128] See agr.wa.gov/Marketing/International/Statistics.aspx; OFM (2011).
[129] See agr.wa.gov/AgInWA/Crop_Maps.aspx

Agriculture is sensitive to changing climate conditions and weather extremes, such as droughts, floods, and severe storms. Understanding the implications of climate change on agriculture is important for policymakers, governmental agencies, and agriculture producers. This information will help them to plan and make decisions that sustain productivity and ensure the economic viability of the sector in a changing environment.

The following sections describe the scientific understanding of the impacts of climate change on Washington's agriculture and outline key strategies to support state and local efforts to protect the agricultural sector.

Impacts of Climate Change on Agriculture

Climate change will affect agriculture in a number of ways, depending on the sensitivity of specific crops to the interaction of rising temperatures, changes in water availability, increasing carbon dioxide levels, and more frequent and severe events. Longer growing seasons, warmer temperatures, and higher carbon dioxide concentrations may increase productivity for some crops. But limited water availability along with more weeds, pests and diseases, extreme heat, drought, and flooding will likely negatively affect some crops and livestock.

Different crop zones across Washington support different commodities and agricultural practices, and these zones are likely to have different responses to climate changes. Changes in climate may affect which crops can grow efficiently in the state. For example, some cooler parts of Washington could see an increase in premium grape-growing acreage due to warming.[130] Climate impacts in other regions of the world may also affect Washington's agriculture sector and our global competitiveness.

Some of the key impacts of climate change on agriculture are:

- Changes in crop productivity.
- Decreases in water availability.
- Increased stress from extreme events.
- Reduced livestock productivity.
- Increased stress from invasive weeds, diseases, and pests.
- Global economic impacts from climate change.

1 Changes in crop productivity

Changing climate conditions is expected to alter the geographic regions in which specific crops can be grown. Crop productivity will be affected by several factors, including changes in average temperature and extremes, elevated carbon dioxide levels, availability of water, and stress from weeds, pests, and invasive species. Research on selected crops in Eastern Washington indicates that climate impacts will generally be mild over the next couple decades. Elevated carbon dioxide levels will likely offset some of the negative effects of climate change and result in yield gains for some crops. However, climate impacts will likely be increasingly harmful over time.[131]

[130] See *news.stanford.edu/news/2011/june/wines-global-warming-063011.html*
[131] Stöckle *et al*. (2010)

The vulnerability of cropping production systems in Washington is highest for crops that have very small windows for optimum performance, for perennial crops, and for farming systems currently on the margin of climatic production zones.

The decrease in snowpack and changes in streamflow patterns will limit the availability of water for irrigated crops. For example:

- The Yakima Basin reservoir system will be less able to supply water to all users, especially those with junior (newer) water rights.
- Average apple and cherry yields are likely to decline by 20 to 25 percent by the 2020s for junior water rights holders, due to lack of irrigation water. The value of apple and cherry production in the Yakima Basin is likely to decline by about $23 million, or 5 percent by the 2020s.[132]

2 Increased stress from extreme events, such as extreme heat, drought, and flooding

Extreme events, such as droughts and heavy downpours, are likely to reduce crop yields and affect livestock productivity. Excessive rainfall can flood cropland, delay spring planting, affect crop quality and quantity, and increase susceptibility to root diseases. It can also cause erosion and increase runoff of agricultural chemicals to surface and groundwater. Low-lying agricultural areas such as the Skagit River delta could be at higher risk of flooding as sea levels rise.[133]

More frequent and severe droughts will limit the water available for crops at the same time that warmer temperatures will increase water demand.

[132] Vano *et al*. (2010).
[133] U.S. Global Change Research Program (2009).

3 Reduction in livestock productivity

Heat and humidity stress pose a significant threat to livestock well-being, especially in confined conditions such as dairy, beef, pig, and poultry operations. A large number of animal mortalities have been reported in recent heat waves, with some states reporting losses of 5,000 head of cattle in a single heat wave in one summer. Heat stress and mortality will likely increase as temperatures rise in Washington. [134]

Warmer temperatures will also affect production efficiency and result in:

- Decreases in voluntary feed intake, leading to reduced weight gains and lower milk production.
- Increases in the energy requirements to maintain healthy livestock.
- Allowing greater proliferation and survival of parasites and disease pathogens.[135]

Studies show that the negative effects of hotter summers will outweigh the positive effects of warmer winters for agricultural production.

Climate change has already disrupted western U.S. rangelands and livestock populations, and the effects are expected to be more severe in the future.[136] Production of animal feed will likely be extended into late fall and early spring. However, quality of animal feed will be negatively affected, water will be limited, species of plants will shift, and plant productivity will decline.[137]

[134] U.S. Global Change Research Program (2009).
[135] U.S. Global Change Research Program (2009).
[136] U.S. Climate Change Science Program and U.S. Dept. of Agriculture (2008).
[137] U.S. Global Change Research Program (2009).

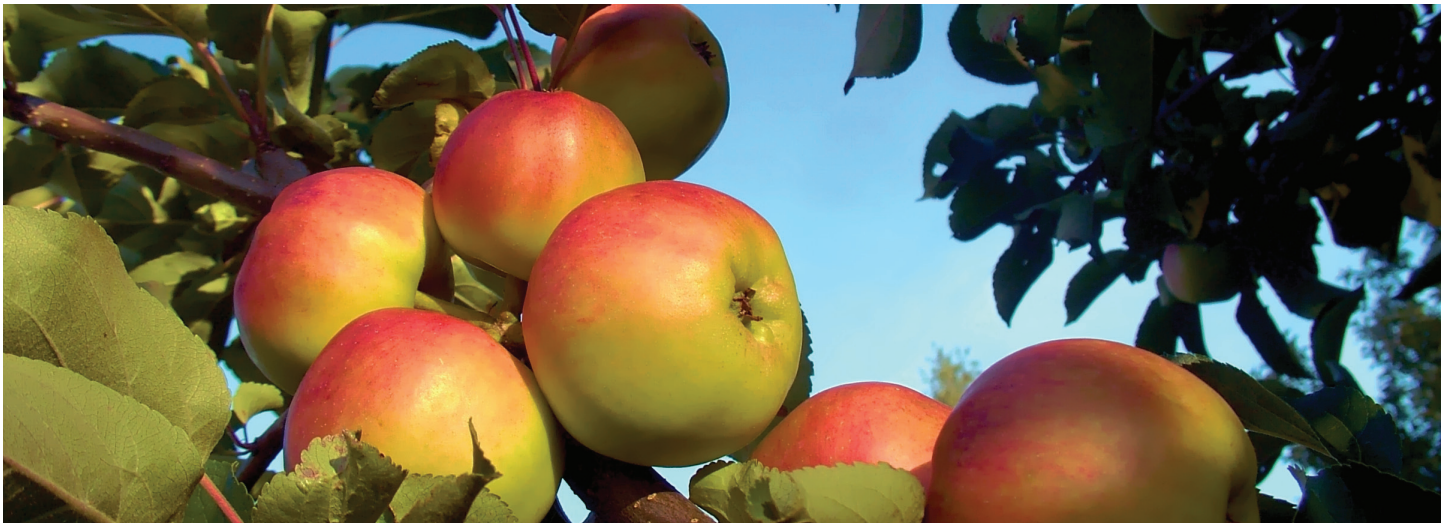
4 Increased stress from invasive weeds, diseases and pests

With higher temperatures and changing precipitation patterns, Washington will likely become increasingly susceptible to invasion by new agriculture pests, invasive weeds, and carriers of human and livestock disease. Warmer temperatures will allow invasive weeds and pests to expand their ranges northward, spreading weeds and pests not previously seen in Washington. These new insects will be able to survive the winter and complete additional life cycles in the longer growing season. [138]

Increases in weeds, insects, and diseases will most likely:

- Increase the cost of crop production.
- Decrease yields and crop quality.
- Increase the costs of controlling weeds.
- Increase risks to food safety, human exposure, and the environment.

For example, in recent years the potato tuber moth has become a major pest in eastern Washington. This invasion is believed to be due to warmer winter temperatures that increase moth survival during the winters, with fewer dying off. Warmer temperatures result in earlier emergence (5 to 10 days) of adults in the spring, an increase in the percent of additional generation that growers would have to control, an increase in control costs, and the potential that moth would develop resistance faster to insecticides.



[138] U.S. Global Change Research Program (2009).

Economic impacts on Washington agriculture

Washington's agriculture industry will likely experience both economic benefits and disruptions from global climate change and global markets. For example, several staple crops consumed in developing counties, such as cereal grains, are major commodities grown in Washington State.

If global climate predictions are realized, the Pacific Northwest will likely be looked upon to provide food to other parts of the world experiencing crop failures due to rising sea levels, heat waves, droughts, floods, and increased pests.

Also, as the purchasing power of people in the most populous countries increases, demand for high-value food crops grown in Washington will also increase.

While these global changes may increase demand for Washington's commodity exports, rising costs of energy and transportation may reduce this opportunity.

5 Economic impacts from global climate change

Other global and local factors will affect Washington's agriculture sector and how it responds to climate change. For example:

- The Pacific Northwest may be called upon to provide food to other parts of the world that are more vulnerable, have food shortages, and are less able to adapt to changes in climate.
- The impact of climate change on the hydropower system will affect the food processing industry. The freezing of fruits and vegetables is Washington's primary food processing industry. This industry is energy-intensive and has depended on the relatively low cost of hydropower in the region.
- Potential impacts of climate change on the state's transportation infrastructure and the cost of fuels will very likely affect Washington agricultural exports. Washington ships about 70 percent of its harvest out of the state, with the nearest major markets over 1,000 miles away. The current global distribution of goods depends on well-developed infrastructure that provides fast, low-cost transportation.

Recommended Adaptation Strategies and Actions—Agriculture

Washington's farmers and ranchers have been successful in increasing agricultural productivity. This success is due in large part to their ability to adapt to changing growing conditions through changes in management practices and in crops or animal selection. However, projected changes in temperature and precipitation and an increase in extreme events (such as drought, heat waves, and heavy downpours) are likely to challenge the effectiveness of current farming practices—affecting crop growth, yields, and livestock productivity.

How the agriculture sector responds to climate change will likely not only affect food production and livestock products but also may impact ecosystems and fish, wildlife and native plants. The four strategies recommended here focus on a number of economically profitable and socially and environmentally acceptable practices. The strategies aim to help farmers anticipate and respond to opportunities and challenges of climate change and extreme weather events. The strategies are grouped according to the following separate but related areas of concern:

- Protection of productive agricultural land.
- Reduction of impacts of severe droughts and floods.
- Prevention and control of invasive species.
- Engagement of agricultural communities in research, data sharing, and adaptation policies and actions.

Strategy E-1. Maintain and enhance agriculture productivity by helping farmers and ranchers transition toward sustainable agriculture.

Actions:

1. Conserve and protect productive and adaptable farmlands by supporting county and city policies and programs that limit sprawl and conversion of agricultural lands to development and facilitate locally-grown food and community garden plots.

2. Maintain agricultural land in production and compensate farmers for the environmental benefits of conservation projects implemented on their lands. Examples of projects include ones that:
   - *Preserve and restore wetlands, riparian corridors, and wildlife habitat.*
   - *Improve water quality.*
   - *Sequester carbon (keep carbon in the soil)*

3. Compensate farmers using mechanisms such as purchases, leases, and establishment of conservation markets. Support the agricultural community in accessing funding programs within various state, federal, and local agencies and conservation organizations.

Conservation markets give economic values to environmental benefits and are sold to purchasers, typically land developers required to mitigate impacts of their development projects.

4. Protect the productivity of agricultural soils from water runoff, erosion, wind storms, and excessive heat through such management practices as:
   - *Direct-seeding.*
   - *No-till farming.*
   - *Reduced-volume irrigation systems.*
   - *On-farm water conservation and storage.*
   - *Biological and organic soil amendments, such as manure and compost.*
   - *Integrated pest management practices.*
   - *Cover-crops and fall-planted crops.*

5. Facilitate access by farmers and growers to technical and financial assistance to implement the practices.

6. Help growers select more economically and ecologically resilient crops, such as:
   - *Pest-resistant crops.*
   - *Drought-tolerant crops.*
   - *Diversified variety of crops.*
   - *Soil and water holding crops, such as alfalfa seed.*

7. Safeguard livestock against the impacts of climate change, and protect livestock by:
   - *Modifying facilities to reduce heat stress.*
   - *Limit the enclosure of livestock during hot weather and allow livestock access to pastures.*
   - *Ensuring properly managed grazing.*
   - *Improving herd performance through good genetic stock.*
   - *Adapting the reproduction season to fit the climate and sources of feed and forage.*
   - *Establishing a herd health program in impacted areas.*
8. Ranchers can be provided with assistance from conservation districts, Washington State University's cooperative extension service, and other agricultural organizations.

Dryland Farming and Climate Change

To address questions related to climate change and dryland agriculture, the region's land-grant universities—Washington State University, Oregon State University, and the University of Idaho—recently received a $20 million grant from the U.S. Department of Agriculture.

Known as Regional Approaches to Climate Change in Pacific Northwest Agriculture (REACCH PNA), this grant will support 20 scientists at the three universities and the USDA's Agricultural Research Service to begin a comprehensive evaluation of the impacts of predicted climate change on the region's cereal grain production.

reacchpna.uidaho.edu/reacchpna

Strategy E-2. Reduce impacts of severe droughts and extreme weather events on irrigated agriculture.

Actions:

1. Increase the ability of the state, local governments, irrigation districts, and other entities to obtain the most up-to-date forecasts of droughts and extreme events. Integrate these forecasts into drought planning and decision-making by policymakers, water users, and water managers. Improve and update existing data provided through federal agencies such as the National Oceanic and Atmospheric Administration, Natural Resources Conservation Service, and National Weather Service as well as universities including the WSU AgWeatherNet Program.

2. Prepare for and respond more effectively to droughts. This may require revising the statutory authority for drought emergency declarations by the Governor**.** The declaration triggers several drought response activities.

3. Identify highly drought-vulnerable basins, provide advance warning of drought and extreme events, develop drought plans, and enable decision makers to reduce risks and damages from droughts.

4. Enhance water conservation and efficiency activities at the farm and district levels in highly drought-vulnerable basins by expanding technical and financial cost-share assistance programs. These programs help growers reduce irrigation needs and runoff, such as improving water conveyance, improving groundwater infiltration and soil retention/capture, and planting drought-tolerant crops.

5. Improve water reliability and increase water supplies through continued support for integrated basin water management planning and by fostering voluntary transfer of water. (Changes to current statutes may be needed to provide incentives to increase participation of existing water right holders in water transfer programs.)

6. Expand and improve the effectiveness of the state's water right transfer program by seeking statutory changes that provide flexibility and incentives to current water right holders interested in transferring their water to other users.

Strategy E-3. Prevent, eradicate, and control pests, diseases, and weeds potentially harmful to public health, the environment, and agriculture production.

Actions:

1. Implement tracking and monitoring, pest and weed control, and eradication actions. State and federal agencies, county noxious weed boards, and county pest and disease boards should conduct these efforts collaboratively.

2. Provide information to the agricultural community to enable farmers and growers to modify agricultural practices and to adapt to new pests and diseases.

3. Increase awareness and protect pollinator (bees) habitat by incorporating conservation of bee habitat into land management and farm practices that minimize land use impacts on pollinators—including tillage, pesticide use, burning, grazing, cover-cropping, and roadside management.

4. Develop and enhance emergency response plans to manage significant pest outbreaks that harm human health, the environment, and the economic viability of the agriculture sector. These plans should include streamlined approval mechanisms of new biological and chemical tools as well as monitoring.

Strategy E-4. Promote opportunities to engage the agricultural sector and rural communities in developing and implementing new policies, technologies, and practices addressing the impacts of climate change.

Actions:

1. Increase participation of farmers, producers, farm organizations, industry leaders, and rural communities in research, changes to public policies, and implementation of new policies and programs that promote:
   - *Ecosystem services.*
   - *Environmental health.*
   - *Economic profitability.*
   - *Social and economic equity.*
2. Create or enhance existing networks to facilitate rapid transfer and adoption of new knowledge and technologies to help farmers adapt to changing climate, promote sustainability, and benefit the environment, rural communities, and farmers.
3. Engage the agricultural community in research to assess vulnerability of various annual (e.g., cereal grains) and perennial crops, and select crop varieties capable of adapting to expected climate changes.