Agricultural Production and Food Systems

A Discussion Paper about Community Resilience *November 2015*

Brief: *What is simultaneously one of the greatest contributors to climate change and one of its greatest potential solutions? It is how we farm and eat. Food and climate change are inextricably linked. The challenge for Washington State is to shift to climate smart agriculture and sustainable food systems - food systems that cool the planet, enhance biodiversity, and promote community food security and food sovereignty. Planners can play an important role in fostering the shift.*

Problem

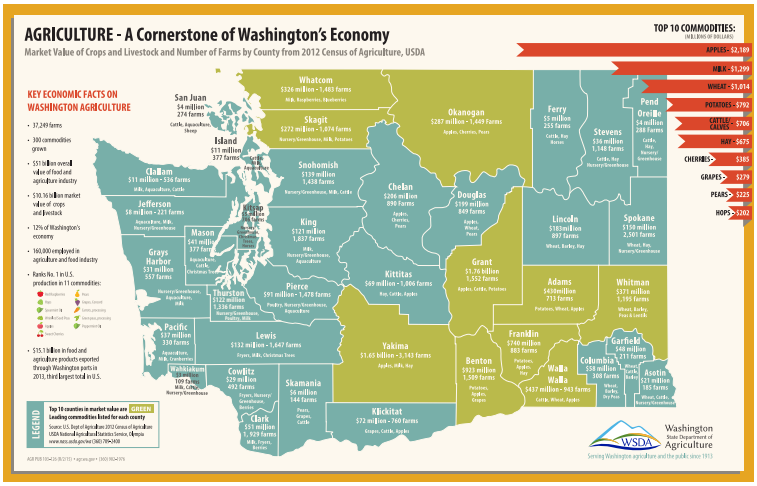
How we currently farm and eat produces greenhouse gases that contribute to climate change. Meanwhile, climate change will have major impacts on agriculture and food systems in Washington. Climate disruptions are already measurable, and are projected to become more severe in coming decades. Impacts include rising temperatures, changes in crop productivity, less reliable water supplies, increased stress on plants and animals, reduced livestock productivity, and increases in invasive weeds, diseases, and pests. The impacts will vary across the state.

Local government can help communities shift to **climate smart** agriculture and sustainable food systems. Key strategies include: promoting carbon sequestration, conserving farmland, ensuring access by small-scale farmers, conserving and reusing water, reducing food-related waste, supporting mid-sized food infrastructure[1], enabling urban agriculture, and developing diverse markets for local food.

Introduction

Washington's food and agriculture industry is a cornerstone of the economy. The overall value of the **food and agriculture industry is over $50 million, or 12% of the state's overall economy.** There are almost 38,000 farms across the state, and about 160,000 people are employed in the food and agriculture sector (See Figure 1).

Figure 1



How we farm and eat is a major contributor to climate change. At the same time, our food systems practices have great potential… to do what? Current agricultural and food systems practices are largely unsustainable. Globally, the food system—from how our food is produced, to how it is transported, to what we do with our food waste—accounts for **between one fifth and one-third of greenhouse gas**

[1] Mid-sized infrastructure refers to a size and scale that is appropriate for small and mid-sized farmers, rather than large agri-business.

emissions.[2] The majority of those emissions are related to the production of food, but the combined contribution of transport, refrigeration, preparation and waste management is growing. The largest source of food-related greenhouse gas emissions comes from methane from animal production.

Here in Washington, agricultural production is directly responsible for about 6% of the state's greenhouse gas emissions - mainly from the release of methane from cattle digestion, manure, the application of fertilizers, and other agricultural activities.[3] When combined with processing, transportation of food, electricity to refrigerate and prepare food, and food-related waste, Washington's food system is a major driver of climate change.[4]

Climate Change Impacts to Washington's Agricultural Production and Food Systems

Climate change will have significant impacts on agricultural yields and earnings, food prices, reliability of delivery, food quality, and food safety in Washington.

Climate disruptions to agricultural production are already measurable across the Pacific Northwest and are projected to become more severe over this century. The consequences will be different for different crops and locations, with some possible impacts shown below in Figure 2. Some impacts may be beneficial to certain locations and crops, but overall, climate change will pose great challenges to Washington food production.

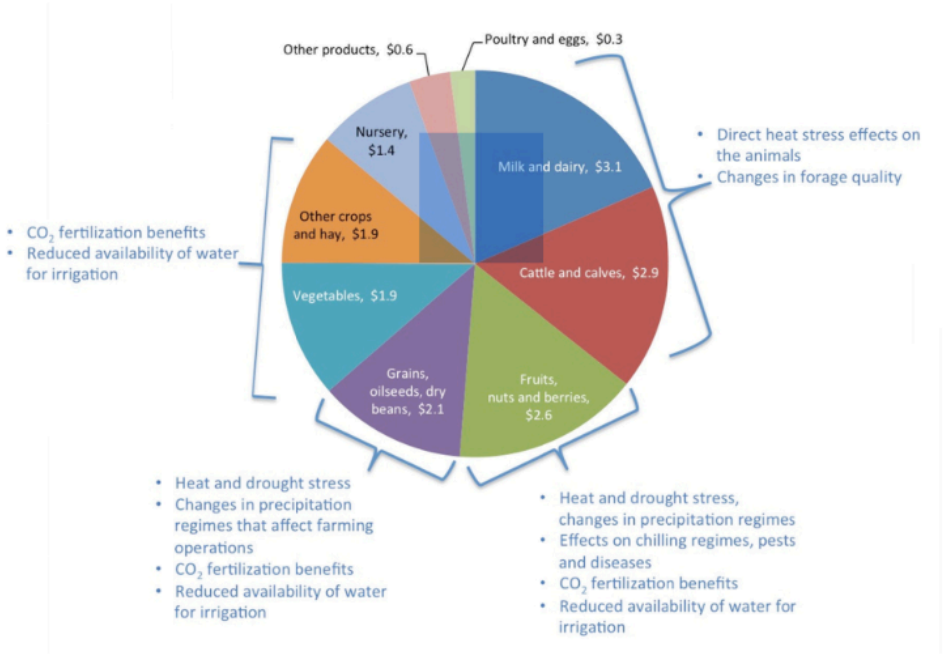


Figure 2: Pacific Northwest agricultural commodities (for Washington, Oregon, and Idaho), with potential climate change impacts listed for each sector. Market values are shown in $ (billion), with a total value of $16.8 billion.
Figure source: *Eigenbrode et al., 2013*

The top three expected changes to climate include the following[5]:

1. **Rising temperatures**. The number of frost-free days per year is expected to increase by 40 days by 2080, as

[2] Vermeulen, S. J., Campbell, B. M., & Ingram, J. S. (2012). Climate change and food systems. *Annual Review of Environment and Resources*, *37*(1), 195.

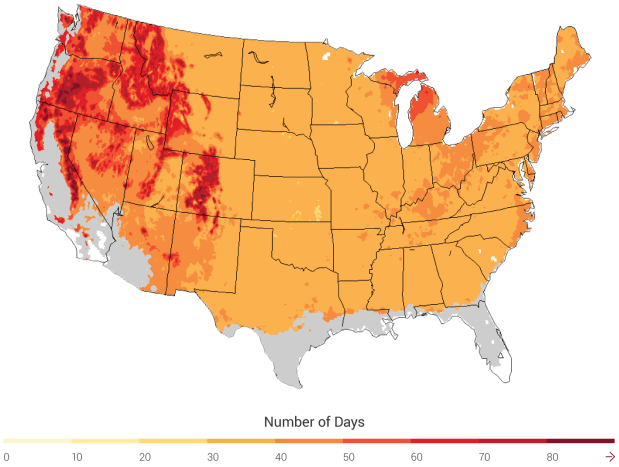
[3] Washington State Department of Ecology. (2012). Agriculture. Chapter 8 in Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy.

[4] Exact data regarding total greenhouse gas emissions form all food systems activities not available, but may be similar to global averages of about 1/5 to 1/3 of greenhouse gasses.

[5] Washington State Department of Ecology. (2012). Agriculture. Chapter 8 in Preparing for a Changing Climate: Washington State's Integrated Climate Response Strategy.

shown in Figure 3. Meanwhile, summer temperatures are expected to increase. These changes may be beneficial for certain crops (e.g. grapes), and create challenges for other cool-weather crops (e.g. potatoes, leafy greens, and winter wheat). They may also help extend the growing season, but lower productivity in summer.

Figure 3: Change in Frost-Free Days Projected by 2080.



2. **Changing precipitation**. Traditionally, much of Washington's summer water supply comes from melting snowpack, but global warming will cause more precipitation to fall as rain. With less snowpack, summer water supplies will likely be reduced. This may be exacerbated by projected warmer summer temperatures and more severe and frequent droughts. Irrigated crops such as apples and cherries will especially be affected.

3. **More extreme weather events and fires.** Projected increases in the frequency of heat waves and heavy rainfall events and the areas burned by wildfire may have negative effects on crops, livestock, and facilities and cause financial hardship for farmers.

Figure 5: The Chelan Fruit Company experienced $50-80 million in damages during fires in the summer of 2015. (Photo source: Sy Bean / The Seattle Times, 2015)

These and other climate-related changes are expected to have other impacts on agricultural production, including the following three impacts:

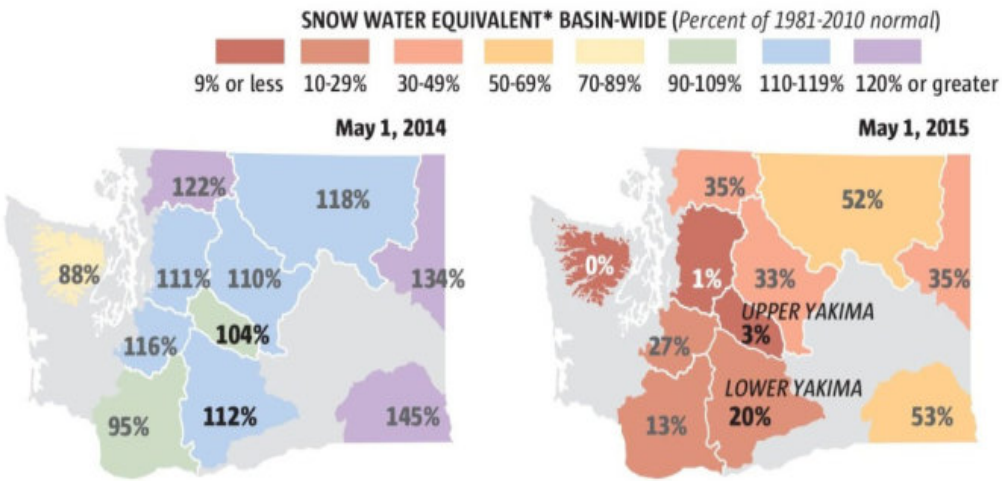


Figure 4: The snow pack (or so-called "no pack) in 2015 may be a harbinger of future snow packs. Figure source: Bernton, 2015

4. **Changes in crop productivity.** Combined warming and the "fertilization" effect of increased CO2 could increase

yields for some crop varieties, particularly winter wheat and apples. However these gains would be limited by shortages of irrigation water. Potato and cool climate grape yields are expected to decrease. Changes in climate may affect which crops can grow where.

5. **Reduced livestock productivity.** 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 of livestock will likely increase as temperatures rise in Washington. Specifically for dairy cows, warmer temperatures may result in decreases in voluntary feed intake, leading to reduced weight gains and lower milk production.

6. **Increases in invasive weeds, diseases, and pests.** Warmer winters are likely to enable more weeds, diseases, and pests to survive. For example, in recent years the potato tuber moth has become a major pest in eastern Washington. Its invasion is likely related to warmer winter temperatures that enhance moth survival during the winters and enable earlier emergence (5 to 10 days) of adults in the spring. This in turn causes an increase in control costs, and the potential that moths will develop resistance to insecticides. Like the potato tuber moth, the stink bug, codling moth, and cereal leaf beetle, among other pests, are also expected to increase.

Figure 6: The stink bug, an invading insect from Asia, is a threat to berry, fruit and vegetable production in the state. The mild winter of 2015 resulted in a sharp increase in the stink bug population.[6] (Photo source: Steve Ringman/The Seattle Times, 2015)

Other impacts are also expected to affect the food system more broadly, beyond just production. The impact of climate change on the hydropower system will affect the food processing industry. The freezing of fruits and vegetables is energy-intensive, and will be affected by any major changes to the hydropower system that come from changes in precipitation and stream flows. Potential impacts of climate change on the state's transportation infrastructure and the cost of fuels will also likely impact Washington agricultural exports. Washington currently ships about 70 percent of its harvest out of the state to other parts of the U.S. and to countries like Japan and China. The viability of this export model will be impacted.

Low-income producers and consumers of food will be more vulnerable to climate change Low-income producers, for example, may be less able to adopt new technologies under increasing climatic risks. Low-income consumers may be hit harder by expected increases in food prices.

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[6] Bernton, H. (June 24, 2015). Farmers worry about harvest as stink bugs make a mess in NW region. Seattle Times. http://www.seattletimes.com/business/agriculture/stink-bugs-leave-their-messy-trail-across-nw-region/

Impacts Across the State and Nation

Climate change impacts will be variable across the state. Western Washington agriculture is likely less vulnerable than the interior. Greater water availability, access to urban markets, and the milder climate of coastal Washington will likely make it easier for agriculture to adapt in this region. Some cooler parts of Washington could even see increases in productivity for certain crops for example in premium grape-growing acreage. However, cool-weather crops may be less productive. Low-lying agricultural areas such as the Skagit River delta could be at higher risk of flooding as sea levels rise. Areas in the interior, especially semi-arid regions with limited access to irrigation water, have much less capacity for adaptation. Areas like the Yakima Basin will likely experience water shortages in the spring and summer. These shortages are projected to result in irrigated crop losses in the Yakima River basin of $46 million per year by 2040[7]. Other parts of Eastern Washington may experience extremely hot and dry summers and increased fires.

Future projections around climate change have some uncertainty. Notably, there is some uncertainty about the future frequency and persistence of extreme temperature and precipitation events, as well as the beneficial effects of elevated carbon dioxide concentrations on future crop productivity.

Nationwide, climate change effects are expected to push crop-productive areas further north while decreasing the overall yield of a number of basic food crops, such as corn and wheat. This nationwide northern shift for agriculture and the decreased productivity of a number of crops will put increased pressure on Washington's agriculture. Some predict that Washington will replace California as a leading agricultural producer.[8] Such a shift would put strain on Washington's water supplies, roadways, and land prices.

Strategies to Adapt to Climate Change and Promote Climate-Friendly Agriculture and Sustainable Food Systems Practices[9]

1. ***Address the intersection of agriculture, food systems and climate change in long-range plans.***
   a. incorporate policies about about the whole food system, from production through distribution, access and consumption, in comprehensive plans- in a stand-

[7] Washington State Department of Ecology. Climate Change and Agriculture. http://www.ecy.wa.gov/climatechange/2012ccrs/agriculture.htm

[8] Mass, C. (2015). Reversing William Shatner's idea: Moving California agriculture to the northwest. Cliff Mass Weather Blog. Accessed at http://cliffmass.blogspot.com/2015/06/reversing-william-shatners-idea-moving.html).

[9] Some of the strategies come from: Regional Approaches to Climate Change for Pacific Northwest Agriculture. www.reacchpna.org & Sustainable Washington 2009: Planning for Climate Change. American Planning Association, Washington Chapter. 3.7 Food Security & Agriculture, Agriculture and Planning. http://www.washington-apa.org/3-7-food-security---agriculture

alone section and/or integrated into other sections
   b. include a food section in sustainability plans.

2. ***Promote or require the adoption of carbon-sequestering and other sustainable agricultural production methods***
   a. Encourage carbon sequestration on agricultural lands through cover cropping, conservation tillage, residue management, optimizing crop rotations, and avoiding or reducing unplanted lands.
   b. Encourage integrated pest management and restrictions on the use of agricultural chemicals.
   c. Encourage the implementation of renewable energy (e.g. solar, wind) and discourage the use of fossil fuels on farms.
   d. Foster improved management and reutilization of livestock wastes, especially from concentrated dairy and poultry operations.
   e. Support agroforestry and tree-plantings on surplus croplands, croplands of marginal productivity.

3. ***Promote water conservation, storage, re-use, and planning.***
   a. Obtain up-to-date forecasts of droughts and extreme events, and share that information with farming communities.
   b. Allow and incentivize on-farm and urban water conservation, (e.g. via soil management), storage (e.g. cisterns), and re-use (e.g. greywater).
   c. Incorporate watershed planning into comprehensive plans, capital facilities plans, and development regulations.

4. ***Conserve farmland and ensure that diverse, small-scale farmers can access it.***
   a. Incorporate a 'no-net-loss' policy for productive agricultural land into local comprehensive plans. Specify programs (Purchase of Development Rights, Transfer of Development Rights) and techniques (including agricultural zoning and minimum lot size) for protecting farmland.
   b. Minimize sprawling development patterns and encourage further growth in already developed areas to reduce pressure to develop agricultural lands.
   c. Develop programs to ensure access to farmland by small-scale farmers (e.g. public leasing, loan programs).
   d. Identify barriers to farming and farmland ownership by new, young, minority, and women farmers and address those barriers.

5. ***Reduce and reuse food waste***
   a. Support on-farm bio-gas production from anaerobic digesters.
   b. Implement municipal composting programs, for potential use by farmers.
   c. Restrict food waste from garbage pick-up and encourage at-home composting.

6. ***Fund research, training and technical assistance for climate-friendly farming.***
   a. Fund and support agricultural pilot programs, at the state and local levels, to evaluate innovative agricultural practices that might increase crop yield, decrease

water use, and/or sequester carbon.
b. Create or enhance existing networks to facilitate rapid transfer and adoption of new knowledge and climate smart technologies among farming communities.

7. Enable urban agriculture

a. Remove regulatory barriers to urban agriculture on private land (e.g. allow food production in front and back yards, enable animal-raising, allow onsite sales).
b. Encourage new development to include community gardens or resident gardens, including rooftop gardens.
c. Support community gardens with jurisdictional resources.
d. Inventory publicly owned lands (e.g. park lands, portions of school property) for suitability as community gardens or for use by urban farmers.
e. Develop consistent policies across city agencies about rights-of-way and other open land use for community garden or urban agricultural purposes.

8. Support energy efficient mid-sized food infrastructure.

a. Support small and medium-scale food processing infrastructure located near farming communities and population centers.
b. Incentivize food infrastructure (e.g. processing facilities, refrigeration, transportation) to adopt energy-efficient and water conserving practices.

9. Develop the demand and market for local, sustainable, and just food

a. Develop Farm-to-Institution programs to increase consumption of locally and regionally produced food in schools, child cares, hospitals, jails, and group housing with central cafeterias.
b. Prioritize sustainable and just production practices in local procurement practices.
c. Develop permanent spaces throughout urban regions to be used as farmers markets or food hubs, for affordable use by farmers.

10. Increase access to local, healthy foods by low-income people

a. Increase acceptance of electronic benefits transfer (EBT—food stamps) and WIC payments (Women, Infants, and Children Program) at farmers markets.
b. Implement programs to "double dollars" for Supplemental Nutrition Assistance Program (SNAP, formerly known as "food stamps") shoppers at farmers markets.

Examples

(organized by the Strategies above)

#1, Comprehensive plan policy examples

King County shall collaborate with the Washington State University Extension, the University of Washington, and King Conservation District to develop information on the likely impacts of climate change on agriculture in King County, and to develop mitigation and adaptation strategies that are appropriate for King County's soils and farm economy. Research should address soil management, water storage, irrigation, alternative crops, integrated pest

management, and nutrient management. The information should be made available to farmers through technical assistance programs and farm planning. (King County, Rural-669)

The county shall work with federal, state, local, and private agencies to ensure and maintain adequate water for the needs of agriculture. Assessments of future surface and groundwater availability for agriculture should consider projected impacts of climate change. (King County, Rural-668)

#3, Promote water conservation and reuse
This report describes a position vision, along with specific strategies, for water-conserving and draught-tolerant agriculture in California.
http://pacinst.org/wp-content/uploads/sites/21/2014/04/sustaining-california-agriculture-pacinst-full-report.pdf

#5 and #8, Biomass to fuel project
Qualco Energy, a nonprofit partnership in Snohomish County, operates an anaerobic digester and has a vision to help start a national movement to turn animal waste and other pollutants into a fuel source. The gas production comes from manure from 1,300 cows and off site feedstocks. At maximum gas output, Qualco could generate 1.2 MW's of power

#8, Promoting urban agriculture
Cities across the United States have or are changing their zoning codes to further support urban agriculture. In Washington, the city of Tacoma has established comprehensive plan policies to support urban agriculture and is an active partner of Harvest Pierce County, the Urban Agriculture wing of Pierce Conservation District (founded in 2010).

#9, Support food hubs
Snohomish County partnered with Snohomish County Growers Alliance,, the City of Everett, and private developers to construct a 60,000 square-feet, year-round Farmers' Market and Food Hub in downtown Everett. The facility will include a large commercial kitchen and processing facility where farmers can make products to sell at the market or deliver across the nation.
http://ofp.scc.wa.gov/snohomish-couty-food-hub-groundbreaking/

#10, Increasing access to healthy food
Many farmers markets throughout the state have Electronic Benefit Transfer matching programs, which increase the purchasing power of low income shoppers. For a list of markets, see the WSFMA Member Market Directory. In the Payment Options dropdown, select "SNAP EBT," and look for "EBT matching is available" in the market information.

Resources

Food Systems Planning and Healthy Communities Lab
http://foodsystemsplanning.ap.buffalo.edu/

International Government Panel on Climate Change. Climate Change 2014: Impacts, Adaptation and Vulnerability. (Particularly Chapters 7, 14, 15, and 16).
http://www.ipcc.ch/report/ar5/wg2/

Regional Approaches to Climate Change for Pacific Northwest Agriculture.
www.reacchpna.org

Sustainable Washington 2009: Planning for Climate Change. American Planning Association, Washington Chapter. 3.7 Food Security & Agriculture, Agriculture and Planning. http://www.washington-apa.org/3-7-food-security---agriculture