Science Societies

Impact of 2021 drought in the Pacific Northwest

By Emmanuella Owusu Ansah, Olga S. Walsh

November 3, 2021

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Drought causes tremendous losses to agriculture and impacts water supply, energy production, and public health. This year's drought in Idaho is extreme due to a very dry spring followed by an extreme, prolonged summer heat wave. This article will provide an overview of the current drought in the Pacific Northwest, how crops have been impacted, and look at ways farmers can adapt.

Drought causes tremendous losses to agriculture and impacts water supply, energy production, and public health. Drought directly affects wildlife and increases the risk of wildfires. This year's drought in Idaho is extreme due to a very dry spring followed by an extreme, prolonged summer heat wave. Idahoans have experienced the hottest June and July on record this year. In fact, Idaho is facing unprecedented drought conditions despite typical snow levels during the 2020–2021. Moreover, some water managers are warning that the state of Idaho may be entering a multi-year drought, if significantly greater-than-normal snowpack is accumulated next winter. Often a drought takes a long time (years or even decades) to fully develop, and thus is very difficult to predict.

Depending on the perspective, drought can be classified into three types:

1. *Meteorological drought.* This occurs when dry weather patterns dominate an area. As the humidity increases, rainfall becomes low, and temperature rises. Meteorological

drought is characterized by water shortage and dry winds. The meteorological drought is always specific to a region: the atmospheric conditions that result in deficiencies of precipitation vary substantially from region to region.

2. *Hydrological drought.* Prolonged meteorological drought results in hydrological drought. This type of drought is characterized by a considerable decrease in the level of water in lakes, ponds, and rivers due to less rainfall and an increase in temperature. This occurs when inadequate surface or subsurface water supply becomes evident, especially in reservoirs usually after many months of meteorological drought. Precipitation deficiency results in a rapid depletion of soil moisture immediately apparent to agriculturalists.
3. *Agricultural drought* links characteristics of meteorological and/or hydrological drought, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil water deficits, and reduced water levels. The relative susceptibility of various crops during different stages of crop development, from emergence to maturity, is considered. Inadequate soil moisture at seeding time may impact germination, reducing crop yield potential. If the soil moisture is replenished as the growing season progresses, crop yields may not be reduced even with early-season below-normal topsoil moisture (but adequate for crop establishment).

Pacific Northwest Drought

Most of the Pacific Northwest (PNW) is experiencing abnormally dry or drought conditions (Table 1). According to the Aug. 17, 2021 U.S. Drought Monitor, more than 94% of the region is in drought, up from just under 41% at the start of 2021.

Table 1. Precipitation data for selected Idaho locations from Oct. 1, 2020 through Sept. 30, 2021. Source: Drought.gov.

Location	Total precip.	Normal value	Departure from normal	Last year
	———————— inches ————————			
BOISE	10.43	11.51	–1.08	13.29
MCCALL	19.03	23.06	–4.03	23.16
TWIN FALLS	6.14	10.28	–4.14	7.59
POCATELLO	8.14	11.82	–3.68	10.16
IDAHO FALLS	9.34	10.07	–0.73	10.98
CHALLIS	4.65	6.93	–2.28	7.22
STANLEY	12.99	17.86	–4.87	14.36
LEWISTON	7.59	12.87	–5.28	14

For the region, 2021 is considered the fifth severe drought with 1924 being the first followed by 1931, 1977, and 1994, respectively. The drought in the PNW can be described as a spring drought (National Integrated Drought Information System, **2021**). The dry spring followed by a heat wave in the PNW has led to drought conditions in most PNW states. The minimal springtime precipitation has failed to boost high-elevation snowpack and supplement snowmelt runoff, resulting in extremely dry conditions across the region. This spring drought caused the reservoirs to be drained rapidly to meet water demands (even higher than in non-drought years) due to the severe early and mid-summer heat waves.

The exceptional precipitation deficits across the Northwest can be illustrated by the record low precipitation from March 1 to July 25 at approximately 90% of SNOTEL[1] sites. Currently, almost all counties in Idaho, Oregon, Washington, and California have been declared as in a state of severe drought (D2 in Figure 1; Market Intel, 2021) with other counties in extreme and exceptional drought. With severe drought, agriculture has really been hit with farmers harvesting less of the normal.1

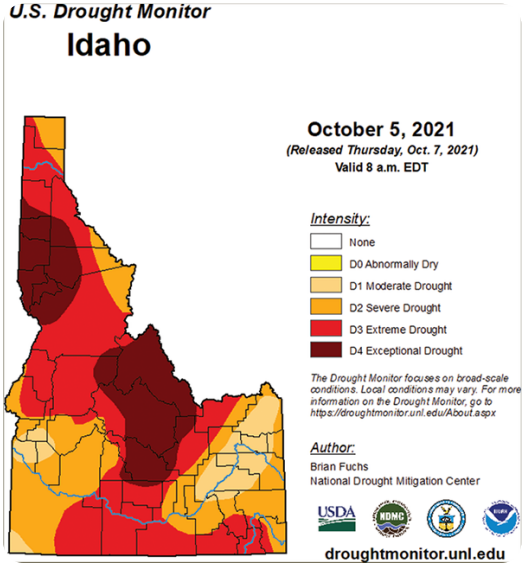

Figure 1, *Idaho drought conditions, Oct. 5, 2021. Source:* ***Drought.gov****.*

Crops Impacted

Drought severely impacts crop production, and this is largely due to low soil moisture. According to the **USDA National Agricultural Statistics Service** (USDA-NASS), most crops have shown some heat stress even under irrigation. Currently, more than 75% of all soils (top 6 inches) are classified as "very dry" with less than 50% of typical moisture available (U.S. Drought Monitor, **2021**). Inadequate soil moisture and heat cause crops to desiccate, resulting in stunted growth of crops and hence a decline in the quantity and quality of produce. When it comes to crop production, both short- and long-term drought have significant effects on crops.

The 2021 drought destroyed most crops; spring and winter wheat, potatoes, barley, and canola are notable among the most affected. According to the **USDA-NASS**, winter wheat harvest is down by 21% in Idaho, 31% in Oregon, and 44% in Washington compared with last year. Barley harvest is projected to be down by 36% in Idaho and

52% in Washington from last year. Spring canola growers who normally harvest 2,000 lb/ac are estimated to harvest just 800 lb/ac.

Aside from crops, livestock producers have also been adversely impacted. Cattle operators have been forced to sell their cattle because of lack of grass to feed their animals. Idaho's topsoil rated 73% short to very short on water with 58% of rangeland and pastures rated poor to very poor. Extremely hot and dry conditions persisted in northern Idaho: much of the grain crops were cut for hay due to anticipated impact of grain fill. Hay yields were also negatively affected because of the continued hot and dry conditions.

In southern Idaho, several irrigation districts have run out of storage water early in the season. Idaho water managers are a predicting substantial decline in aquifer levels and expect to enter winter with very little carryover. Dryland crops and rangeland across the state of Idaho have been severely impacted by the exceptionally dry conditions (**Drought.gov**).

The drought specialists are estimating that the impacts on agricultural crops, rangeland, surface and groundwater, freshwater ecosystems, and wildfire risk are likely to continue and/or worsen in the next several months. Re-charge of groundwater systems is typically a two-year process even with normal to above-normal precipitation. Considering the severity of the impacts on reservoir levels, reliance on aquifers, and lack of natural recharge, the negative effects of drought will be long-term and could last several seasons (National Integrated Drought Information System, **2021**).

Way Forward

Figure 2, *Idaho state-specific drought impacts compiled by the National Drought Mitigation Center, Sept. 10, 2021. Source:* ***Drought.gov****.*

Since drought is partly a result of a changing climate, there is the need to find ways to mitigate it in the coming years. The National Drought Mitigation Center has compiled U.S. drought maps showing the intensity and location of drought that can help growers identify severe drought areas. This map uses a five-category system shown in Figure 2.

The sustainability of agriculture in the PNW, and Idaho specifically, depends on the capacity of farmers to adapt to water resource constraints. Beginning in 2016, many southern Idaho crop producers have been required to cut their annual groundwater withdrawals by up to 20%. A survey conducted by Idaho State University and the University of Idaho has found that the adaptations most commonly used by growers to mitigate the lower irrigation water availability were (1) reducing water spending, (2) installing more efficient irrigation systems, (3) watering less frequently, and (4) changing crop rotations (Running et al., 2019). Growers should be encouraged to incorporate drought-resistant and water-use-efficient crops such as sorghum, quinoa, and teff that can be grown with limited water availability. Also, to combat drought, growers could incorporate trees on their farmlands. These trees would help reduce evaporation due to the shade provided as well as help draw water from the ground for crop uptake due to their fibrous root system.

Further reading

University of Idaho—Water Conservation Publications and Resources: **https://bit.ly/3IzG0W5**

University of Idaho Extension—Drought Resources: **www.uidaho.edu/extension/drought**

NOAA.gov—Definition of Drought: **https://bit.ly/3BBXIOe**

Drought.gov—Idaho: **https://www.drought.gov/states/idaho**

Natural Energy Hub—What is Drought, Its Types, Causes and Effects: **https://bit.ly/3oWGHus**

National Geographic Society—Drought: **www.nationalgeographic.org/encyclopedia/drought**

References

Farm Bureau. (2021). Assessing Western drought conditions—Idaho farmers report reduced yields under dire conditions. **https://bit.ly/3iVum6h**

National Integrated Drought Information System. (2021). Drought status update for the Pacific Northwest. **https://bit.ly/3mKl12g**

Running, K., Burnham, M., Wardropper, C., Ma, Z., Hawes, J., & du Bray, M.V. (2019). Farmer adaptation to reduced groundwater availability. *Environmental Research Letters*, **14** (2019), 115010. **https://doi.org/10.1088/1748-9326/ab4ccc**

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