



ISSUE BRIEF

CLIMATE-READY SOIL: HOW COVER CROPS CAN MAKE FARMS MORE RESILIENT TO EXTREME WEATHER RISKS

California

California is not only the most populous state in the nation but also the highest grossing state in farm income. In fact, many crops grown in the United States, including almonds, grapes, olives, and pistachios, are produced solely in California.¹ Yet the state's high-value agricultural sector is also highly vulnerable to extreme weather and climate impacts, such as the drought, now four years long, that has caused billions of dollars' worth of agricultural losses.² Additional increases in temperature and impacts to water resources from climate change will only further threaten agriculture in the state. However, more widespread adoption of soil stewardship practices can help to increase the resilience of crops to these growing threats.

IMPORTANCE OF THE AGRICULTURAL SECTOR

California produces more than 400 commodities and nearly half of all fruits, nuts, and vegetables grown in the country. The state's nearly 77,900 farms and ranches produced almost \$49 billion in agricultural products in 2013, making California the nation's leading agricultural state.³ Many of these products are used around the world. The state exported more than \$21 billion in agricultural commodities in 2013, with almonds, dairy products, and wine being the top three exports. Other major commodities include cattle, strawberries, walnuts, and lettuce.⁴

Table I. California's Top 5 Crop Commodities by Value in 2014⁵

Commodity	Value
Almonds	\$5.9 billion
Grapes	\$5.2 billion
Strawberries	\$2.5 billion
Walnuts	\$1.8 billion
Hay	\$1.7 billion

Half of total field crop acres planted with cover crops

540,000 METRIC TONS
OF GHGs CAPTURED ANNUALLY



BILLION
GALLONS OF
WATER STORED

More than 1.3 million jobs in California are directly or indirectly supported by the agricultural production and processing industry.⁶ Even though agriculture represents only about 2 percent of the state's gross domestic product, a wide swath of the state's land is devoted to farming.⁷ California's Central Valley, stretching from Redding in the north all the way to Bakersfield in the south and comprising the Sacramento Valley and San Joaquin Valley, receives more than 60 percent of the state's total farm-related income.⁸ Nearly one-quarter of all jobs in this region are directly or indirectly supported by the agriculture industry.⁹

EXTREME WEATHER AND CLIMATE CHANGE IMPACTS ON AGRICULTURE

Agriculture in California is especially vulnerable to extreme weather events. From 2012 to 2014, the state had 504 USDA disaster declarations for drought, flooding, or excessive heat.¹⁰ From 2010 to 2014, insured crop losses due to these causes, along with hot wind and extreme precipitation, exceeded \$551 million.¹¹

Multiple years of below-normal precipitation and record high temperatures have resulted in widespread and extreme drought conditions that have affected farms and cities alike. In 2014 alone, the agriculture sector lost access to an estimated 6.6 million acre-feet of surface water due to reduced snowpack and in-stream flow.¹² These surface water losses were partially offset by groundwater pumping; however, groundwater depletion in some areas is leading to reduction of storage capacity, infrastructure damage, and land subsidence.¹³ Overall, drought conditions in 2014 led to an estimated \$2.2 billion in total agricultural economic losses and the elimination of approximately 17,100 jobs.¹⁴ These losses were due to cropland fallowing, increased groundwater pumping costs, livestock and dairy impacts from pasture depletion and increased feed prices, and

Additional information on this topic is available for download at www.nrdc.org/water/climate-ready-soil.asp

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indirect impacts in sectors associated with crop production. Continued drought conditions in 2015 will cause an estimated additional \$2.74 billion in economic losses and the elimination of 21,000 jobs in California’s agricultural sector.¹⁵

Hotter temperatures and impacts to water availability from climate change pose additional risks to California’s agriculture. In the San Joaquin Valley (the portion of the Central Valley south of the Sacramento–San Joaquin River Delta), temperatures are projected to get much warmer in the future with the number of days above 95°F doubling by mid-century.¹⁶ Across the Southwest U.S. region, annual average temperatures are projected to increase by 2.5°F to 5.5°F by mid-century and 5.5°F to 9.5°F by the end of the century, with the greatest increases in summer and fall if emissions continue to rise.¹⁷

Warmer temperatures increase moisture loss from soils and also raise crop water demand.¹⁸ Warmer winter temperatures also have negative implications for perennial crops, particularly those sensitive to temperature such as almonds, citrus, and stone fruit.¹⁹ During dormancy before springtime growth, these high-value crops require a certain number of winter chill hours below a specific temperature threshold.²⁰ Warmer temperatures during this critical stage of development for these crops are expected to reduce quality and yield.²¹ Further, projected reductions in snowpack, earlier snowmelt, and changes in precipitation due to climate change are predicted to alter runoff patterns and reduce water availability, disproportionately impacting agriculture, which uses 80 percent of the state’s water.²² Increases in extreme heat days will also reduce labor productivity in “high risk” sectors like agriculture, where workers spend significant time outdoors.²³

COVER CROPS CAN HELP COMBAT THE PRESSURES OF CLIMATE CHANGE ON CALIFORNIA AGRICULTURE

California’s farmers can build resilience to these growing climate risks by improving soil health through practices like cover cropping. Cover crops are planted to protect and improve soil health and may be planted in between growing seasons or alongside more permanent crops. They increase the water-holding capacity of soil, allowing farmers to capture more water from heavy rainfall events and to store water for increasingly hot and dry summers.²⁴ (Using other soil stewardship practices like no-till farming and applying compost to increase soil organic matter also help to store more water in the soil.) California’s existing cover crop acres help store 6.8 billion gallons of water—enough to provide more than 210,000 people with water for one year.²⁵

Cover crops can also help farmers cope with the increased weed pressures associated with the shifting growing season and changing climate by suppressing weed growth and breaking weed cycles.²⁶ Further, cover crops have been shown to increase primary crop yields. During the 2012 drought that affected much of the central United States, cover crops demonstrated their ability to build agricultural resiliency by providing the greatest yield benefit in areas that were hardest hit by extremely dry weather.^{27,28}

Cover crops can also help to reduce emissions of greenhouse gases that contribute to climate change by sequestering carbon and reducing the need for synthetic fertilizers, whose production and transport result in increased greenhouse gas emissions.^{29,30} California’s existing cover crop acres capture nearly 89,000 metric tons of greenhouse gas emissions each year—the equivalent of taking more than 18,600 cars off the road.³¹

Across California, less than 4 percent of cropland is planted with cover crops, leaving great potential for cover crop expansion.³² In fact, if half of the total field crop acreage in California were planted with cover crops, farmers could sequester more than half a million metric tons of greenhouse gas emissions—the equivalent of taking over 114,000 cars off the road.³³ On farms where permanent crops are grown, like vineyards and orchards, cover crops can be used between planted rows as well. Using cover crops and other practices to increase soil organic matter on half of the total field crop acres in California could help store 10.9 billion gallons of water—enough to meet the annual needs of nearly 340,000 people. By using cover crops and other soil stewardship practices to improve the health of their soils, California farmers can help to mitigate existing water challenges from the drought and better prepare for future extreme weather risks.

CALIFORNIA FARMERS SEE FIRSTHAND THE BENEFITS OF HEALTHY SOILS

Farmers in California’s Sonoma and Napa Counties, to name just a few, are increasingly turning to soil stewardship to become more resilient to drought and other extreme weather impacts.³⁴ These practices in many cases also help reduce the release of greenhouse gases into the atmosphere. In addition to cover cropping, farmers are adding nutrient-rich compost instead of synthetic fertilizers to their soil.³⁵ Together, these management practices build healthy soils that are high in organic matter, which helps to capture and store carbon dioxide—a major greenhouse gas pollutant and contributor to climate change—and retain soil moisture. For every 1 percent increase in soil organic matter, an additional 20,000 gallons of water can be stored in the top six inches of soil on an acre of farmland.³⁶ These healthy soil management practices help farmers to better cope with the severe and extensive drought conditions plaguing the state.

ENDNOTES

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