IMPACT

Agriculture and Ranching

"Increased temperatures are expected to increase the variability of precipitation. Thus, a challenge for ranchers will be to manage this variability."

Yolo County agriculture fields. Photo by Susan Ellsworth, courtesy of the University of California, Davis.

Key Messages

1

Many important costs of climate change to agriculture will be adjustment costs especially in tree-crop production, which requires large up-front capital investments and many years between the time trees are planted and when they produce sellable output.

2

Public and private entities can more effectively deliver web-based information decision-making tools for climate-change adaptation if they consider constraints faced by the intended users. Access to high-speed Internet service is particularly low in regions with relatively large populations of Native American farmers and ranchers.

3

The reduction of agricultural water demand will be a key strategy for adapting to climate change through strategies such as addressing water pricing and markets, providing incentives to adopt water-saving irrigation technology, reusing tailwater, or shifting to less water-intensive crops.

The eleventh chapter of the *Assessment of Climate Change in the Southwest United States* reviews the climate factors that influence crop production and agricultural water use. "Agriculture and Ranching" discusses modeling studies that use climate-change model projections to examine effects on agricultural water allocation and scenario studies that investigate economic impacts and the potential for using adaptation strategies to accommodate changing water supplies, crop yields, and pricing. The chapter concludes with sections on ranching and drought, and on disaster-relief programs.

Agricultural uses account for 79 percent of water withdrawals in the Southwest and more than 92 percent of the crops are irrigated. The region produces more than half of the nation's high-value specialty crops (fruits, vegetables, and nuts), which are especially vulnerable to possible effects of climate change. The region's other major outputs—ranching and crops such as cotton, wheat, corn, and grazing forage—are also sensitive to fluctuations in precipitation. Region irrigators are largely dependent on either groundwater or extensive surface infrastructure that captures, stores, and transports water. Therefore, better precipitation projections will be crucial for agricultural adaptation to climate change.

For more information about *Assessment of Climate Change in the Southwest United States*, see: www.swcarr.arizona.edu, www.cakex.org, www.islandpress.org/NCAreports.
This fact sheet developed by Institute of the Environment, University of Arizona.

Irrigation Management

Irrigators could adapt better to climate variability through the use of existing water-management information from public and private entities such as: the California Irrigation Management Information System (CIMIS), the Arizona Meteorological Network (AZMET), and the Colorado Agricultural Meteorological Network (CoAgMet). CIMIS generated an estimated $64.7 million in benefits from higher yields and lower water costs, at an annual cost of less than $1 million.

Water Transfers

Water transfers could reduce the costs of adjusting to water shortages. If today's institutional restrictions were lifted and investments in infrastructure made, agriculture-to-urban transfers would increase income for agricultural areas, partially compensating for losses from reduced water use.

Many riparian systems like the Bernardo Wildlife Area in New Mexico depend on return flows from agricultural water use which could be altered as a result of conservation measures.

Shifts in Water & Land Use

Models predict that the agricultural sector will make significant adjustments in water use, land use, and cropping patterns, and as a result urban and industrial water users will remain largely unaffected. Other models suggest that the sector will bear the increased costs for water transfers and storage. The sector will incur adjustment costs as a result of changes to infrastructure, switching to different crops, and new management practices.

For many growers, the ideal location for growing specific crops will change as a result of climate change. Established infrastructure may need to be relocated and growers may be inexperienced with the crops suitable for the new climate. Adjustment costs can be substantial for tree crops: If growers reduce the number of trees as a response to drought, it will reduce the region's ability to produce tree crops for many years thereafter. Relocating where trees are grown would be a costly adjustment.

Ranching

Cattle ranching and dairies are also economically important in the region. Many grazing lands are rain-fed and irrigation water is devoted to alfalfa and other hay, which provide forage for dairy operations and supplemental cattle feed.

In the case of multi-year drought, (a) the length and severity of the drought and (b) the timing of drought in the cattle price cycle are important considerations for livestock ranchers. Two adaptation strategies are to provide supplemental feed to cattle and to reduce herd sizes. Supplemental feeding appears to be a viable long-term strategy. It allows more animals to be sold after the drought (when prices are higher) and avoids aggressive herd reduction during drought, which has a higher replacement cost. However there is no single "right" strategy and the advantages of supplemental feeding depend on drought and price cycle timing.

One way to adapt to climate-change-induced water shortages is to shift the mix of crops grown. Ranges of water application rates (acre-feet of water applied per acre) by state and irrigation technology for different crops grown in southwestern states.

	Minimum	Median	Maximum
Orchards, Vineyards, Nuts	**0.3** *Colorado/Drip*	**2.7** *California/Sprinkler*	**6.5** *Arizona/Gravity*
Alfalfa	**1.6** *Colorado/Sprinkler*	**3.1** *Nevada/Sprinkler*	**6.4** *Arizona/Gravity*
Cotton	**2.2** *New Mexico/Sprinkler*	**3.1** *California/Gravity*	**4.8** *Arizona/Gravity*
Corn/silage	**1.4** *Colorado/Sprinkler*	**2.7** *Utah/Sprinkler*	**4.7** *Arizona/Gravity*
Corn/grain	**1.5** *New Mexico/Gravity*	**2.1** *California/Gravity*	**4.2** *Arizona/Gravity*
Rice	**4.1** *California/Gravity*	**4.1** *California/Gravity*	**4.1** *California/Gravity*
Wheat	**1.3** *Colorado/Sprinkler*	**2.3** *California/Gravity*	**3.6** *Arizona/Gravity*
Barley	**1.2** *Utah/Sprinkler*	**1.7** *Colorado/Sprinkler*	**3.6** *Arizona/Gravity*
Vegetables	**1.7** *Colorado/Sprinkler*	**2.8** *Nevada/Gravity*	**3.5** *Arizona/Sprinkler*
Sorghum	**0.6** *Colorado/Sprinkler*	**1.7** *California/Sprinkler*	**3.5** *Arizona/Gravity*

Information from: Frisvold, G. B., L. E. Jackson, J. G. Pritchett, and J. P. Ritten. 2013. "Agriculture and Ranching." In *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*, edited by G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, 218–239. A report by the Southwest Climate Alliance. Washington, DC: Island Press.