In 2014 the USDA formed seven regional climate hubs across the United States to support climate-smart decision-making. This is a multiagency effort among the Agriculture Research Service, US Forest Service, and Natural Resource Conservation Service intended to deliver science-based knowledge and practical information to farmers, ranchers and forest landowners that will help them adapt to climate change and weather variability. Each Hub will provide technical support for land managers to respond to drought, heat stress, floods, pests, and changes in growing seasons. The hubs will also provide regional assessments and forecasts for hazards and adaptation planning as well as education and outreach for land managers on ways to mitigate risks and thrive despite change.

Hawai‘i and the US-affiliated Pacific Islands are included in the Southwestern Regional Climate Hub (SWRCH), which also covers Arizona, California, Nevada, New Mexico and Utah. The Southwestern region produce highly diverse agricultural crops, that include lettuce, taro, tree fruits, nuts, grapes, onions and citrus. This region relies more heavily on irrigation than any other region in the US. Whereas the water supply for Arizona, California, Nevada, New Mexico and Utah relies on snowmelt from the Sierra Nevada and the Rocky Mountains, Hawai‘i depends on ground water from aquifers. Without adequate supply from these water sources production in this region will decline.

How does the climate and weather change affect Hawai‘i’s producers?

Climate change will certainly affect agricultural production in Hawai‘i, along with nearly every other aspect of our lives. In most of the state increased temperatures combined with decreased rainfall (especially in leeward areas) will reduce the amount of available freshwater for drinking and crop irrigation. All islands will experience challenges with fresh water resources. However the severity of impacts will vary depending on water storage capability, susceptibility to coastal flooding, as well as island size and topography. Low-lying islands will be particularly vulnerable due to their small landmass, geographic isolation, limited potable water resources, and limited agriculture resources. Excessive drought also increases the incidence of wildfire in Hawai‘i, especially as abandoned agricultural fields revert to unmanaged grasslands. Wildfires...
have direct negative impacts on human safety, infrastructure, agricultural production, cultural resources, and native forests, and reduce the ability of watersheds to recharge aquifers and prevent sedimentation delivery to coral reefs.

Sea level rise will cause saltwater intrusion from the ocean into ground water resources during storm events. Rising sea levels will also escalate the threat to coastal structures and property, harbor operations, airports, wastewater systems, shallow coral reefs, and other natural resources (Figure 2). Coastal infrastructure and agriculture activity will also be affected as rising sea levels reduce the available land for agriculture and periodic flooding increases the salinity of groundwater. Due to Hawai‘i’s dependence on imported food, fuel and material, the vulnerability of shipping ports and airports to extreme events, sea level rise, and increasing wave heights are of great concern. Climate change is also expected to affect human health by increasing incidences of diseases related to flooding, increases in heat-related illnesses and impacts on sewer systems and public health.

**How can we respond to climate and weather change in Hawai‘i?**

Climate change response falls into two basic categories: mitigation and adaptation. Mitigation simply means taking preventative action. The primary contributor to climate change is increased emissions of carbon dioxide and other greenhouse gases into the atmosphere due to human activities. The transportation and energy sector are the primary sources of greenhouse gas emissions. Although these industries are slowly shifting towards ‘green technologies,’ such as electric vehicles, most of Hawai‘i’s electricity is still pro-
duced by burning petroleum (Figure 3). This is why efforts to switch to ‘green energy’ such as solar and wind and reduce our dependency on imported fossil fuels are critical climate mitigation goals for society as a whole. We can also contribute to this effort as individuals, by increasing the efficiency of household energy use and limiting vehicle use and air travel.

With much of climate change mitigation dependent on large scale economic shifts, climate change response at the producer level is often focused on adaptation or preparedness. Developing effective adaptation strategies for agricultural production ultimately depends on producers understanding and anticipating the coming changes. Although the availability and quality of climate change information is increasing each year, one of the primary goals of the Climate Hubs is to improve the accessibility and relevance of climate science for agricultural producers. Better climate information allows producers to identify and anticipate their needs and vulnerabilities, which, through effective, two-way communication, can then provide research priorities for scientists to improve preparedness. For example, we are anticipating increased drought over the coming decades in Hawai‘i (Figure 4), but what sort of timescales can producers use for planning and what strategies, such as increased irrigation efficiency or drought tolerant

Figure 4. Predicted changes in wet and dry season rainfall under a scenario of moderate greenhouse gas emissions (RCP 4.5) and under high (current) emissions scenario (RCP 8.5).
crops, would producers be willing to adopt? Clearly, climate adaptation needs to be a collaborative process, which is why Cooperative Extension is such an important partner in the overall Climate Hub effort.

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