

Review

Climate Change Trends and Impacts on California Agriculture: A Detailed Review

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Abstract: California is a global leader in the agricultural sector and produces more than 400 types of commodities. The state produces over a third of the country's vegetables and two-thirds of its fruits and nuts. Despite being highly productive, current and future climate change poses many challenges to the agricultural sector. This paper provides a summary of the current state of knowledge on historical and future trends in climate and their impacts on California agriculture. We present a synthesis of climate change impacts on California agriculture in the context of: (1) historic trends and projected changes in temperature, precipitation, snowpack, heat waves, drought, and flood events; and (2) consequent impacts on crop yields, chill hours, pests and diseases, and agricultural vulnerability to climate risks. Finally, we highlight important findings and directions for future research and implementation. The detailed review presented in this paper provides sufficient evidence that the climate in California has changed significantly and is expected to continue changing in the future, and justifies the urgency and importance of enhancing the adaptive capacity of agriculture and reducing vulnerability to climate change. Since agriculture in California is very diverse and each crop responds to climate differently, climate adaptation research should be locally focused along with effective stakeholder engagement and systematic outreach efforts for effective adoption and implementation. The expected readership of this paper includes local stakeholders, researchers, state and national agencies, and international communities interested in learning about climate change and California's agriculture.

Keywords: climate change; agriculture; California; chill hours; drought; vulnerability

1. Introduction

California is the largest and most diverse agricultural state in the United States of America, with 77,500 farms comprising 5.7 million ha of pasture and rangeland and 3.8 million ha of irrigated cropland that generate an overall agricultural production value of \$50.5 billion [1]. The state produces over a third of the country's vegetables and two-thirds of its fruits and nuts on nearly 1.2% of the nation's farmland. California grows over 400 different commodities, some of which are produced nowhere else in the nation. About 50% of the nuts and fruits consumed in the United States are grown in California, including almonds, pistachios, walnuts, grapes, citrus, apricots, dates, figs, kiwi fruit, nectarines, prunes, and olives [2]. In addition, California leads in the production of avocados, grapes,