

Table 2. Further explanation of each recommendation by category.

These Consortium recommendations were made for CDFA as the principal agency, but given the overlap of agriculture with other sectors (e.g., water), the importance of collaborating with other state, federal, and research agencies are noted. The following ranges have been adopted for “Timeframes”: short = 0-6 months, medium = 6-18 months, long = > 18 months. The following expense distributions have been approximated for “Potential Cost”: Low = \$ 0-1,000, Medium = \$ 1,001-10,000, High => \$10,000. UC ANR is the University of California Agricultural and Natural Resources which includes agricultural Extension Services (e.g., farm advisors).

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
Outreach & Education				
<p>Grower Technical Assistance</p> <p>CDFA should facilitate an increase in grower technical assistance and trainings specific to climate change adaptation, such as for water, soil, and pest management, by doing the following:</p> <ol style="list-style-type: none"> 1. Advocate for <i>public</i> (e.g. CA Public Utilities Commission, California Energy Commission, etc.) and <i>private</i> (e.g. commodity groups) re-investment in grower technical assistance such Resource Conservation Districts and UC Cooperative Extension; 2. Increase grower awareness of existing technical assistance and training programs; 3. Act as a clearinghouse for climate change adaptation-specific best management practices (BMPs) and coordinate with other groups to disseminate this information to growers; 4. Coordinate with agencies and education institutions to develop new trainings, (optional) certification programs, and continued education units (CEUs), for pest, soil, and water management practices that help growers adapt to climate change. CDFA should: <ul style="list-style-type: none"> • Coordinate trainings through existing training funding programs carried out by agencies and groups like DWR and Irrigation districts; • Tailor climate change outreach programs to pest control advisors and nutrient managers. 	<ul style="list-style-type: none"> • Resource Conservation Districts • UC ANR Cooperative Extension • California State Universities • Regional Water Boards • Ag Associations & Commodity Groups • Agricultural Commissioners • Growers • Department of Water Resources (DWR) • Irrigation Districts • Natural Resource Conservation Service • California Certified Crop Advisors • California Association of Pest Control Advisors • Association of Applied IPM Ecologists • Xerces Society • Audubon California 	Primary	Medium	Low

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p><i>Interagency Cooperation</i> CDFA should ensure that staff are present and advocating for growers during agency and cross-agency discussions (e.g., Strategic Growth Council, California Energy Commission, Public Utilities Commission) regarding energy and water use efficiency and other matters relevant to climate change adaptation. CDFA should ensure cross-agency efforts support the adaptation needs identified by the Consortium.</p>	<ul style="list-style-type: none"> • California Strategic Growth Council • Governor’s Office and Planning and Research • State Board of Food and Agriculture • Climate Action Team • Local Agency Formation Commissions (LAFCOs) • California Public Utilities Commission (PUC) • California Energy Commission (CEC) • California Department of Water Resources (DWR) • Regional Water Boards 	<p>Primary</p>	<p>Short</p>	<p>Low</p>

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p><i>Recognition for Innovative Growers</i> CDFA should recognize growers who adopt climate change adaptation and resilience practices. The CDFA should acknowledge growers in a publically accessible, <i>food-focused</i> context, using:</p> <ul style="list-style-type: none"> • Grower case studies posted to the CDFA website; • A food-focused media campaign that includes farmers markets, events with celebrity chefs, California grower “branding”; • A CDFA “Climate Change Adaptation” award. 	<ul style="list-style-type: none"> • CDFA Environmental Farming Act Science Advisory Panel • UC ANR • Resources Conservation Districts • Ag Associations & Commodity Groups • Agricultural Commissioners • Non-governmental organizations • Media outlets • California Farm Bureau Federation 	Secondary	Medium	Low
<p><i>International Information Sharing and Grower-to-Grower Exchange</i> CDFA should fund and coordinate the development of an international grower-to grower information-sharing exchange that will help California growers:</p> <ul style="list-style-type: none"> • Identify low chill and heat tolerant varieties used in locations outside California (nationally and internationally); • Identify alternative crops that may be grown successfully in the various regions of California under future conditions; • Investigate management practices that can counter the weather impacts of climate change such as heat stress, drought, and flooding; • Identify management practices for pests that may be helpful with increased pest pressures, and that support beneficial pests and pollinators. 	<ul style="list-style-type: none"> • International Embassies • International Consulate General offices • International Universities • California Farm Bureau Federation • University of California System • Ag Associations & Commodity Groups • Growers • Agricultural Coalitions • Agricultural Commissioners • UC ANR 	Tertiary	Short	Low

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p><i>Establish an Online Research Needs Forum</i> CDFA should fund and establish an online research needs forum to match grower adaptation needs with researchers in the field.</p>	<ul style="list-style-type: none"> • Growers • Agricultural Coalitions • Ag Associations & Commodity Groups • UC ANR and Other Universities • Agricultural Commissioners 	Tertiary	Short	Low
<p><i>Pest and Beneficial Species Outreach</i> CDFA should inform the public about pest and plant disease threats as well as beneficial plants, insects, and pollinators, relevant to climate change adaptation. Outreach could be conducted through:</p> <ul style="list-style-type: none"> • Events such as school Ag Days, fairs and media outlets; • A newly created database of pest and damage records available to growers and farm advisors; • Distribute educational materials to growers about the benefits, costs, management and maintenance of hedgerows and flower strips. 	<ul style="list-style-type: none"> • CDFA Plant Health Division • CDFA Environmental Farming Act Science Advisory Panel • California Department of Pesticide Regulations • California State Association of Counties • Agricultural Commissioners • UC ANR • California Invasive Species Council 	Tertiary	Short/Medium	Low/Medium
<p><i>Flood Risk Outreach</i> CDFA should inform growers of the increased flooding risk due to climate change and:</p> <ul style="list-style-type: none"> • Compile an online list of existing resources and programs that deal with flooding; • Distribute parcel-specific maps that predict movement or growth of flood plains to help growers make decisions about planting in those areas. 	<ul style="list-style-type: none"> • California Department of Water Resources (DWR) • Resource Conservation Districts • Agricultural Commissioners • Municipal Water Districts • Ag Associations & Commodity Groups • Agricultural Coalitions 	Tertiary	Medium	Low

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p><i>Interagency Habitat Restoration Projects</i> The CDFA should work with Key Partners to identify opportunities to create habitat for beneficial native pollinators. CDFA should provide outreach to Key Partners regarding the value of native pollinators to agricultural systems.</p>	<ul style="list-style-type: none"> • Caltrans • Local (City, County) Governments • Utility companies and California Public Utilities Commission (PUC) • Irrigation districts • Resource Conservation Districts • CDFA Environmental Farming Act Science Advisory Panel 	Tertiary	Long	Low/Medium
<p><i>Climate Change Adaptation Conference</i> The CDFA should host a winter (annual or bi-annual) statewide conference on climate change adaptation for all agricultural stakeholders: agencies, growers, agricultural groups, and researchers. Information about the conference would be shared on a website including research abstracts.</p>	<ul style="list-style-type: none"> • Multiple State Agencies • Growers • Ag Associations & Commodity Groups • Agricultural Commissioners • UC ANR and other Universities 	Tertiary	Medium	Medium

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
Planning and Resource Optimization				
<p><i>Participation of Agricultural Interests in Integrated Regional Water Management Process</i></p> <p>CDFA should advocate for inclusion of grower interests in the Integrated Regional Water Management (IRWM) process (beyond Irrigation district representation) and any future <i>regional</i> water planning processes coordinated by the Department of Water Resources (DWR). Grower needs to be addressed in these efforts including:</p> <ul style="list-style-type: none"> Identifying locations for flood control (e.g. floodplain), groundwater recharge, and multi-benefit habitat restoration (e.g. wetlands); Options for utilizing excess (flood) waters for reuse, storage, or groundwater recharge; Utilizing pressurized water systems where appropriate; Re-evaluating reservoir capacity and reservoir operations to manage water availability with a changing climate; Appropriate regulation, management, and use of recycled/reused water; Existing or emerging conflicts between urban and agricultural water use (expected to increase with climate change); Water quality (expected to decrease with climate change); Promotion of water conservation and efficiency at field, district, and regional scales; Low impact development to improve urban-impacted infiltration to groundwater aquifers. 	<ul style="list-style-type: none"> Department of Water Resources (DWR) Regional Water Boards Irrigation Districts Growers Ag Associations & Commodity Groups Agricultural Commissioners Caltrans Department of Fish and Wildlife Resource Conservation Districts California Farm Bureau Federation Other local stakeholders 	Primary	Long	Low

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p>Review Regulatory Barriers</p> <p>The CDFA should perform or fund a review of regulatory barriers to climate change adaptation including food safety. Safe and sustainable revisions of the following should be considered:</p> <ul style="list-style-type: none"> • EPA and DPR registration of pesticides relative to climate change threats; • Section 18 and Section 24(c) of FIFRA • Water rights, and water trading rules; • Federal crop insurance program for specialty crops to address California conditions. • Food safety regulations 	<ul style="list-style-type: none"> • California Department of Pesticide Regulations • Pesticide/Chemical Manufacturers • California Department of Public Health • Ag Associations & Commodity Groups • Agricultural Commissioners • Food and Drug Administration • Leafy Green Products Handler Marketing Agreement (LGMA) • State Water Resources Control Board • California Department of Water Resources (DWR) 	Primary	Medium/Long	Low
<p>Farmland Conservation</p> <p>The CDFA should promote farmland conservation through Key Partners to increase agriculture’s economic resilience to decreased revenue and increased costs associated with climate change. Also ensure adequate time for agricultural land transition to alternative crops in the long-term instead of to urban development in the short-term.</p>	<ul style="list-style-type: none"> • California Department of Conservation • Local (City, County) governments • Land trusts • Local Agency Formation Commission • USDA Natural Resource Conservation Service (NRCS) 	Secondary	Medium/Long	Low

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p><i>Improve Growers' Ability to Adapt to Climate Change</i> CDFA should support USDA Natural Resources Conservation Service in a review and/or creation of policies to improve growers' ability to adapt to climate change. These policies should:</p> <ul style="list-style-type: none"> • Promote new technologies for climate change relevant to water, soil, and pest management; • Incentivize grower adoption of technologies and practices for improved water management, which includes use of: water meters, soil moisture sensors, on-farm water storage, and groundwater recharge where possible; • Suggest ways to scale best management practices (BMPs) to all sizes of farms. 	<ul style="list-style-type: none"> • USDA Natural Resources Conservation Service (NRCS) • Ag Associations & Commodity Groups • Growers • Resource Conservation Districts • UC ANR Cooperative Extension • Irrigation districts • California Department of Water Resources (DWR) 	Secondary	Medium	Low
<p><i>Secure Funding for Pest Programs</i> CDFA should maintain and secure additional funding for pest exclusion and detection programs.</p>	<ul style="list-style-type: none"> • Legislature • Ag Associations & Commodity Groups • State Board of Food and Agriculture • Agricultural Commissioners • USDA Animal and Plant Health Inspection Service (APHIS) • California Department of Fish and Wildlife 	Tertiary	Ongoing	Medium
<p><i>Marketing Efforts</i> CDFA should coordinate with USDA to promote and market California brands to offset expected economic losses and/or increased expenses due to climate change.</p>	<ul style="list-style-type: none"> • USDA • Grower Associations • Commodity groups 	Tertiary	Medium/Long	Low

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Research Needs				
<p><i>Economic and Environmental Studies of the Costs, Benefits, and Risks of:</i></p> <ul style="list-style-type: none"> • Crop relocation, including infrastructure considerations, and climate analogues; define where crops will be best suited under future climate conditions considering soil type, topography, water availability, and potential hazards; • Crop-specific sustainability of hothouse/greenhouse production and the development of BMP's for individual crops; • Water Management, in terms of: <ul style="list-style-type: none"> - Increasing above and below ground water storage capacity; - Groundwater recharge; - Use of recycled/reused or desalinated water; - Efficient irrigation technology implementation; - Reduction of evaporation from irrigation canals using solar panels or chemicals; - Sustainable forest management practices to enhance water resource availability for agricultural systems downstream. • Maintaining wild or restored habitat areas in agricultural, urban and non-urban areas (including road sides and utilities' right-of-ways), while ensuring food safety components of agricultural operations. 	<ul style="list-style-type: none"> • University of California • Ag Associations & Commodity Groups • California Department of Water Resources (DWR) • Xerces Society • Audubon California • Resource Conservation Districts • US Bureau of Reclamation • Regional Water Boards • Irrigation Districts • California Department of Public Health • Food and Drug Administration • Produce Marketing Association • United Fresh • Local Governments • Caltrans • Utilities (PG&E) • California Public Utilities Commission 	Primary	Long	High

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p>Research Plots for Experimental Study: Locate research plot space for the study of:</p> <ul style="list-style-type: none"> • Structural, mechanical, or biological methods to reduce crop heat stress; • Crop training systems for perennial crops to protect them from heat stress and sunburn; • Climate-controlled cultivation of certain crops; • Cover cropping and crop rotations that can efficiently utilize irrigation systems and prevent runoff; • Water conservation and/or efficiency outcomes of grower use of soil moisture monitoring, on-farm water storage, and improved irrigation uniformity; • Benefits of habitat restoration in large-scale agricultural systems. • Methods or inputs to increase winter chill quantity and quality. 	<ul style="list-style-type: none"> • University of California • Ag Associations & Commodity Groups • UC ANR • USDA Natural Resource Conservation Service (NRCS) • Xerces Society • Audubon California • Resource Conservation Districts 	Secondary	Long	High
<p>Crop Breeding: Coordinate with key partners to promote research on:</p> <ul style="list-style-type: none"> • Crop heat and cold tolerance; • Low chill varieties; • Self-fertile varieties of almonds and other pollinator-dependent crops; • Maintain public crop breeding programs (e.g., secure funding for maintenance of germplasm information). 	<ul style="list-style-type: none"> • University of California • Plant Breeding Companies • Growers • USDA 	Tertiary	Long	High
<p>Improve Honey Bee Health Identify new methods and products to improve honey bee health, in terms of:</p> <ul style="list-style-type: none"> • Disease • Breeding • Pesticides • Nutrition 	<ul style="list-style-type: none"> • University of California and California State University • Ag Associations & Commodity Groups • UC ANR Cooperative Extension • USDA 	Tertiary	Long	High

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
<p><i>Study Impacts of Saltwater Intrusion</i> Study saltwater intrusion on agricultural lands, asking the following questions:</p> <ul style="list-style-type: none"> • Where are the greatest threats? • Will sea level rise add to the problem - in coastal areas or elsewhere? • What are the adaptation solutions available to growers? 	<ul style="list-style-type: none"> • Coastal Conservancy • Army Corps of Engineers • Resource Conservation Districts • California Department of Water Resources (DWR) • University of California and California State University Researchers 	Tertiary		
<p><i>Pest Forecasting</i> CDFA and other agencies should develop and adopt pest forecasting tools that account for the effects of climate change</p>	<ul style="list-style-type: none"> • USDA Animal and Plant Health Inspection Service (APHIS) • University of California • National Aeronautics and Space Administration (NASA) 	Tertiary	Medium/Long	Medium/High
<p><i>Augmentative Biological control</i> Study opportunities in augmentative biological control, the release of large numbers of native natural enemies, for emerging pest threats (e.g., assess the ability of California’s beneficial generalist species to provide control for new invasives).</p>	<ul style="list-style-type: none"> • University of California • Other Universities 	Tertiary	Long	High
<p><i>Crop Fertility</i> Research to describe and determine the effects of climate change on fertilization and pollination of California crops.</p>	<ul style="list-style-type: none"> • University of California • Other Universities 	Tertiary	Medium	Low

Recommendation	Key Partners	Level of Priority	Timeframe	Potential Cost to CDFA
Technology and Innovation				
<p><i>Weather Information</i></p> <p>CDFA should compile a list for NOAA of grower needs for weather data and forecast products for up to 21 day forecasts including improved:</p> <ul style="list-style-type: none"> • Accuracy and spatial resolution; • Grower-specific data products such as heat- or chill-hours, fog presence, soil moisture, evapotranspiration (ET), drought and flood prediction indicators; • Access to data (the historical record) through accessible data interfaces and/or list of providers of relevant data products; • Warning systems. 	<ul style="list-style-type: none"> • National Aeronautics and Space Administration (NASA) • National Oceanic and Atmospheric Administration (NOAA) • National Weather Service • Ag Associations &Commodity Groups • Agriculture Coalitions • California State University • University of California • Cal Emergency Management Agency 	Secondary	Long	High
<p><i>Field Level Monitoring Tools</i></p> <p>CDFA should develop a list specific to grower needs for vegetation and pest information from new/emerging technologies (e.g., remote sensing, mobile sensors) for field level monitoring of environmental variables and farm management.</p>	<ul style="list-style-type: none"> • National Aeronautics and Space Administration (NASA) • Private Companies • California State University • University of California • Ag Associations &Commodity Groups • Agriculture Coalitions 	Tertiary	Medium/Long	Medium/High