# Development of a Statewide Spatial Database for Almonds, Walnuts and Pistachios

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## Background & Purpose

There is currently no accurate and timely spatial nut crop database for the Central Valley. The purpose of this project is to produce a field by field spatial database using remote sensing analysis. This will represent about 1.5M of the (approximately) 8.0M irrigated acres in the Central Valley. This work is important and timely because nut commodity organizations currently purchase annual crop acreage data no earlier than April/May of the year following the data year. These data historically underestimate acreage, are mostly non-spatial and can be <75% accurate.

Never in California's history has spatial crop data been as important as it is now; it impacts agricultural decisions for managing a fragile water supply, environmental stressors such as climate change, increasing regulatory requirements at the state and federal levels, and expanding global markets. All of these factors converge and demand decisions made with comprehensive and current information.

An accurate database that can be easily updated annually is needed to inform the broad range of crop and resource management and regulatory compliance challenges that face the agricultural industry today.

These data are relevant to:

- New standards in air and water quality regulatory compliance
- Sensitive species risk assessments
- Spatial pest and disease management
- Climate change impacts and predictions
- Water and nutrient resource management
- Market supply impacts from rapid growth in nut crop acreage
- Production challenges including transportation and processing

The results from this work are needed to inform current research, help facilitate regulatory compliance, enhance resource management, and enable commodity organizations with accurate, current information. The ultimate purpose of this project is to provide a crop database that will fulfill multiple needs for growers, researchers, commodity organizations, and water planners and resource agencies.

## Project Goals & Objectives

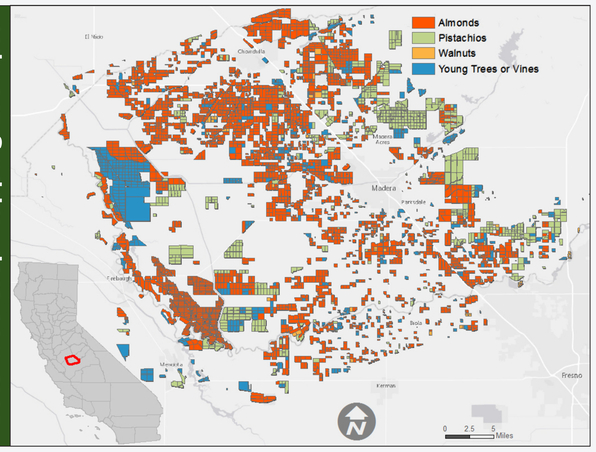
The primary goal of this project is to implement, on a statewide scale, a current method for an accurate spatial database of nut crops that can be efficiently updated annually. Additionally, goals of this project include:

- Improve the accuracy and timeliness of spatial nut crop data.
- Provide a single source of data that is not based on assumption or extrapolation, and that is usable by growers, commodity organizations, related industry, and management of multi-agency and regulatory requirements.
- Expand the successful crop mapping pilot work at the county scale to a statewide scale.

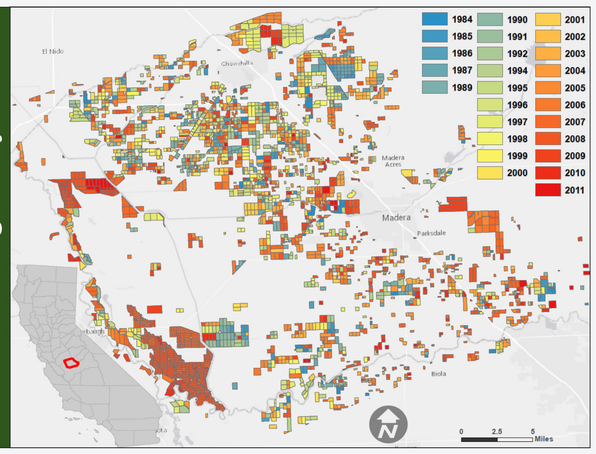
The specific objectives of this project include:

- Use remotely sensed imagery, remote sensing analytical techniques, and ground truthing methods to locate and quantify almond, walnut and pistachio acreage throughout California with an accuracy of at least 95%.
- Develop a GIS-based map that can be used to tell how much acreage of each nut crop there is, and where it is.
- Demonstrate efficient and timely updating (annually) using change analysis.

**Land IQ 2013 Tree Crop Mapping Example**




**Land IQ Almond Age Analysis**




## Methods

The method described to the right has been used successfully in selected California Counties. Unlike many previously used methods to acquire crop data, this method does not rely on surveys or extrapolation. Instead, every field is analyzed to determine crop type and age. Other methods that use remote sensing technology for crop mapping have been developed in the Midwest where large acreages of relatively few types of crops are grown, but these methods do not accommodate specialty crops such as nut crops. The remote sensing method includes the following steps:

### Imagery Acquisition

Evaluate and acquire imagery from various sources based on cost and spectral, spatial and temporal resolution suitability.

### Field Boundary Delineation

Use imagery and other resources to delineate individual fields defined as a homogenous crop.

### Ground Truthing

Identify and geo-reference crops by survey so that each crop can be associated with remotely sensed data.

### Analysis

Perform analysis on imagery to determine crop type. Assess accuracy using statistical probability.

### Change Analysis and Update

Use change analysis to determine which orchards have been removed or added and to classify these new or changed fields.

## Forecasted Timeline


### Change Analysis

Into the future, the baseline crop maps can be updated annually using change analysis which is lower cost and faster than the initial analysis year.

## Expected Outcome and Impacts

- Location and extent of approximately 1.5M acres of almonds, walnuts and pistachios in the Central Valley
- Total acreage of each crop (currently variations of up to 40% exist in multiple sources of available data), summed by regional areas
- Age of each orchard from 1984 forward
- Select data for biomass estimation in ongoing collaboration with UC Davis
- Outreach through development of spatial databases, GIS products, maps, and publications

## Project Cooperators

California Almonds, Almond Board of California — Environmental Stewardship/ Crop Protection Committee and Marketing Committee

CA.GOV — California Department of Food and Agriculture

California Walnuts

California Pistachios — California Pistachio Research Board

UC Davis Department of Plant Sciences, College of Agricultural and Environmental Sciences

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