

Who Owns California's Cropland?

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Analyses of cropland ownership patterns and planted crop mixes can help researchers prioritize outreach efforts and tailor research to stakeholders' needs.

Information about the property-size distribution and use of agricultural land at the property level is useful in assessing technology adoption, fragmentation of land, pesticide applications, wildlife connectivity, and many other issues. Data on agricultural land-ownership patterns can also help answer a host of important questions such as the characteristics of properties planted with a particular crop; variation in ownership patterns across counties; and cropping combinations. Finally, ownership information also can be useful for organizations providing technical and conservation support on a landscape scale.

Improvements in satellite-based imagery (remote sensing) technologies have allowed for increasingly accurate

maps that specify where farmers plant crops. Advances in geographic information systems processing capacity allows for owner-level analysis of agricultural land use. This study presents a novel analysis to elucidate cropland ownership in California that draws on publicly available satellite-based cropland data and a spatially explicit land-ownership database.

The authors created an ownership map of California from compiling individual county parcel maps across multiple years, with 49 counties from 2011 to 2015 and nine counties from 2005 to 2010. For this analysis, cropland area less than 5 acres, or less than 5% of a property's area, was excluded from the analysis.

This analysis supplements existing data by providing information at the property level, which we define as all parcels owned by a given landowner. This method allows the generation of ownership summary statistics, measures of inequality by county and by crop, and new information on crop mixes by property.

California Cropland Ownership Characteristics

Approximately 96% of California cropland is privately owned, followed by 1.4% federal, 0.9% state, 0.8% local, and 0.6% special districts (e.g., irrigation districts). Of the government-owned land, 50% is fallow, 16% is alfalfa or hay, and 14% is grain crops, with all other crops making up less than 5% of the total.

In 2013 there were approximately 7.87 million acres of private cropland in California greater than 5 acres or 5% of an owner's property, made up by approximately 68,699 owners. The largest 1% of cropland properties (the 687 properties larger than 1,277 acres) accounted for 26.5% of California's cropland. The largest 5% of properties (3,435 properties that are larger than 477 acres) accounted for just over half (50.6%) of California's cropland (Table 1).

The remaining 95% of properties (65,370 properties) comprised the remainder (49.4%) of the state's cropland. The 25% of California cropland

Table 1. Frequency Table of Ownership of California Cropland Based on Size Class

Size Category (in acres)	Total Acres	Percent of Total Acres	Cumulative Sum of Acres	Number of Owners	Percent of Total Owners	Cumulative Sum of Owners
5-10	97,056	1.2%	97,056	13,327	19.4%	13,327
10-25	301,931	3.6%	398,988	18,413	26.8%	31,740
25-50	423,983	5.1%	822,970	11,853	17.3%	43,593
50-75	347,432	4.2%	1,170,402	5,573	8.1%	49,166
75-100	305,583	3.7%	1,475,985	3,572	5.2%	52,738
100-250	1,391,963	16.8%	2,867,948	8,875	12.9%	61,613
250-500	1,367,857	16.5%	4,235,805	3,934	5.7%	65,547
1,000	1,459,906	17.6%	5,695,711	2,106	3.1%	67,653
5,000	1,695,154	20.4%	7,390,865	975	1.4%	68,628
10,000	348,303	4.2%	7,739,168	51	0.1%	68,679
> 10,000	558,856	6.7%	8,298,024	20	0.03%	68,699

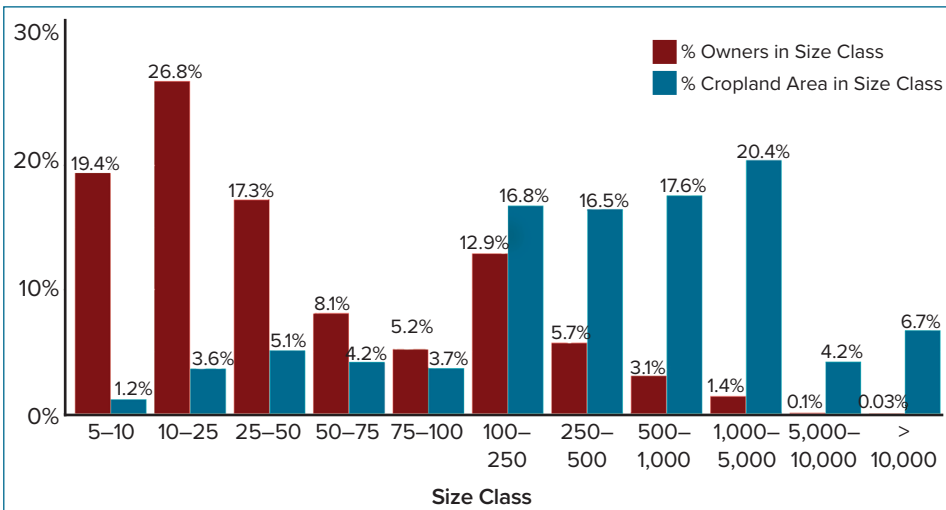


Figure 1. Distribution of Number of Owners and Percent of Private Cropland Ownership Greater than 5 Acres in Particular Size Classes of Ownership.

Source: Author's statewide ownership map

comprised of the smallest properties is made up of 57,490 properties, 84% of all owners, and these properties are smaller than 152 acres. This leads to a distribution of ownership where the bulk of land falls into larger size classes between 100 to 5,000 acres, while the bulk of the owners fall into categories of less than 50 acres (Figure 1). The median acreage of properties was 29.8 acres and mean acreage was 120.7 acres.

County Cropland Ownership

We calculated metrics of cropland ownership on a county basis, including an analysis of equality of ownership, represented by the Gini coefficient. The Gini coefficient is a measure of statistical dispersion that is commonly used as a measure of inequality, where a value of zero expresses perfect equality with all values the same and a value of one expresses maximal inequality among values.

Notably, private cropland dominated the land area of Sutter and Kings Counties, making up over 64% of their land area. Yolo and San Joaquin counties had the next highest amount at 46%. The rural corners of California generally had the largest median size of cropland property, with the highest values in Imperial and Modoc

counties (> 80 acres). More urban and tourism-focused counties (Los Angeles, Lake, and Sonoma counties) tended to have lower median property size.

Equality of cropland ownership, however, was not well-predicted by whether a county is rural or urban; rather, it tended to be most associated with the size and number of the largest landowners in the county or regulations implementing a minimum parcel size. Kings County had the most unequal cropland ownership, followed by Kern and Contra Costa counties. Santa Clara, Napa, and Mendocino counties had the most equal cropland ownership (of counties with > 5,000 acres of private cropland).

Crop Types

Many crops had similar ownership characteristics with a few exceptions. Rice and cotton had large average acreages planted, while fruit trees, walnut trees, and other tree crops had small average size plantings (Figure 2). Among properties growing rice, the average acres planted to rice were far larger (214 acres) than the average acreages grown in all other crop categories. There were also few properties that planted small areas of rice; the 25th percentile of rice acres

planted was 40 acres, more than six times larger than the equivalent measure for any other crop type.

Properties planted with cotton in 2013 had the second highest average (117 acres), but the median acreage of cotton properties was similar to other crops. The metric that tends to set cotton apart from rice is its much higher maximum acres grown on a single property (~56,600 acres). Rice and cotton had comparatively few properties planted, ranking 13th and 14th in number of owners across 14 crop categories, yet they ranked 6th and 10th in acres planted out of the crop categories.

The crop categories of fruit trees, walnuts, and other tree crops were notable for their comparatively small ownerships. Mean ownership was between 27 and 35 acres, and median values were below 8.45 acres. While two other crop types, almonds and fallow land, had median values around 8 acres, their average values were comparatively larger.

The year 2013 was the second year of the recent and ongoing drought in California, and approximately 25,265 owners had over 1 million acres left fallow, with 45 acres being the average area left fallow. Nearly 60,000 of those acres were left fallow by a single property owner in Kings, Kern, and Tulare counties, an area where crops are highly dependent on irrigation.

Land planted with rice, which had the highest-average acreage planted, also had the most equal distribution of land, in part because there were relatively few small properties. The most unequal ownership came in the other tree crops category, which is composed of 82% pistachios, 1% pecans, and 17% all other tree crops.

In the other tree crops category, a single ownership of pistachios acreage accounted for 7% of that crop category's area. This, combined with

an abundance of small owners (evidenced by the lowest median ownership size of all crop categories), led to a high inequality measure. This measure of 7% in the largest ownership allows for separate corporate owners that may be controlled by a single entity. Using a more inclusive measure of what constitutes a single owner, this category shows that a single entity likely accounts for approximately 11.4% of all ownership in the other tree crop category.

Crop Mixes

Many landowners or their tenants plant multiple crops, either in rotation or as market demands shift. We used our database to calculate typologies of properties based on the similarities of crops planted together. The analysis identified seven crop clusters that yield interesting insights into how farmers specialize or mix crops. Three clusters tended to mix crops or orchards, with no single category composing more than half of the property area, while four clusters tended to specialize in a particular crop type, with more than 79% planted in a single crop type (Table 2).

Many grape, rice, almond, and alfalfa/hay producers tended to focus the majority of their plantings in their primary crop. Of the three clusters that mixed crops, one was mixtures of fruit trees, almonds, and walnuts; the second was dominated by fallow land and a mixture of other crops; the third group was very diverse, and tended towards a comparatively even mixture of grain crops, tomatoes, alfalfa/hay, and fallow land. Of the farmers who specialized in single crops, those who grew grapes had the strongest specialization, followed by rice, alfalfa/hay, and almonds.

Implications for Research and Extension

Agricultural statistics are crucial to decision-making, improving

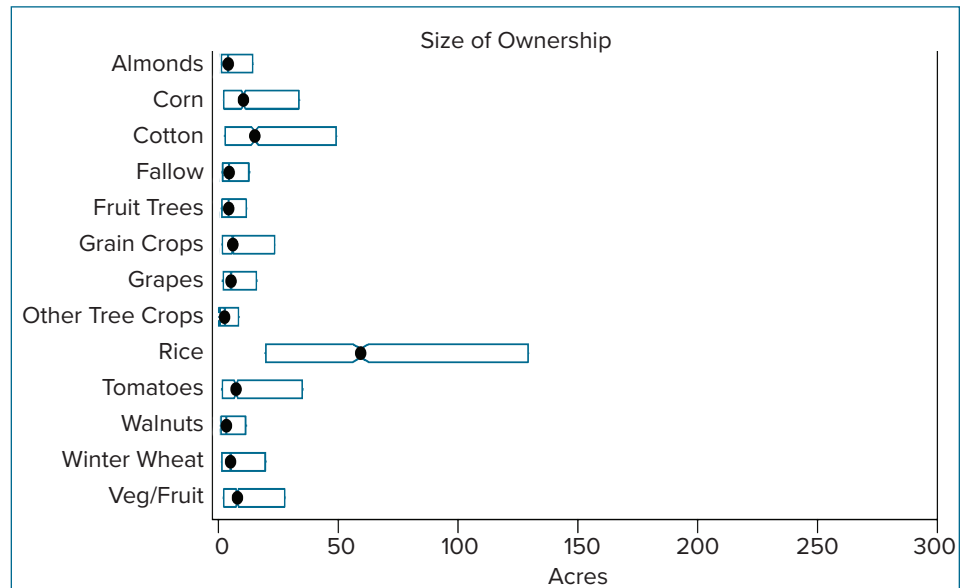


Figure 2. Measures of Acres Planted by Individual Owners by Crop Type.

Median represented by black dot, first and third quartile value at outer edge of boxes.

agricultural efficiency, and protecting the environment. Improvements in remote-sensing technologies, along with the availability of parcel data, allow researchers to present agricultural statistics in new ways. We do that here and show, to our knowledge for the first time, how land ownership is distributed for multiple crops throughout the state. We do not comment here on whether this ownership arrangement is efficient, just, or fair.

From the perspective of resource agencies and Cooperative Extension, these ownership patterns present opportunities for tailoring research and extension programs to their desired audience. For example, knowledge of the average size and distribution of cropland ownership in a particular type of crop can assist researchers developing more efficient harvest methods geared towards a particular-sized parcel, or in prioritizing outreach activities and methods of communication.

In terms of outreach, natural resource professionals seeking to increase adoption of best practices in particular counties or for certain crop types can benefit from this knowledge. For example, in crop types dominated by a few large properties, individual

Table 2. Average Percentage of Crop Category Grown for Each Owner, by Cluster

Crop Cluster/ % of Cropland	Crop Type	Percent
1/ 9.5%	Grapes	85.2%
	Almonds	5.2%
	Other (12 types)	9.6%
2/ 24.5%	Grain Crops	30.0%
	Winter Wheat	20.4%
	Alfalfa & Hay	10.1%
	Fallow	9.5%
	Tomatoes	8.6%
	Corn	8.5%
	Other (8 types)	12.8%
3/ 10.9%	Fruit Trees	43.8%
	Walnuts	27.2%
	Almonds	11.2%
4/ 29.3%	Other (11 types)	17.7%
	Fallow	48.7%
	Vegs & Fruits	9.2%
5/ 7.5%	Other Tree Crops	8.3%
	Alfalfa & Hay	6.5%
	Almonds	6.4%
	Other (9 types)	21.0%
6/ 10.4%	Almonds	87.5%
	Other (13 types)	12.5%
7/ 7.9%	Alfalfa & Hay	79.1%
	Almonds	6.4%
	Other (12 types)	14.5%
8/ 7.9%	Rice	83.0%
	Fallow	6.8%
	Other (12 types)	10.3%

outreach may be an appropriate method of extension given the disproportionate area of cropland affected. Alternatively, crops dominated by many small properties like fruit trees or walnuts will likely require efforts utilizing mass communication tools that can reach thousands of owners.

The largest 1% of cropland properties accounted for 26.5% of California's cropland. The largest 5% of properties account for just over half of California's cropland.

For crops with comparatively low variation in ownership size (rice and tomatoes), outreach agencies may be able to reach a broad audience by focusing on challenges facing an average-sized farm. Crops with wide variation in property size (e.g., almonds, other tree crops, and properties with fallow land) may require an approach that reaches owners of small, medium, and large properties. While the vegetables/fruit category exhibits low variation in property size owned, it contains the widest variation of crop types, requiring a large diversity of subject-matter experts who can be devoted to relatively similar-sized properties.

The analysis of crop mixes yields insights into guiding research and extension approaches, as well as information for equipment or seed sellers. Knowing that grapes, rice, alfalfa/hay, and almonds all tended towards specialization suggests that specialized outreach may be most effective. Conversely, researchers and advisors working on crop categories that are commonly mixed may benefit by collaborating with others to uncover potential synergies in mixed-planting systems. The characteristics of the clusters can also help these collaborators to know their audience; for example, properties with mixed crops from clusters 2 and 4 were larger than the

average farm, while the tree crop mix (cluster 3) was composed of smaller properties than average.

Many factors such as the suitability of land for particular crops, historical settlement patterns, whether economies of scale are present for particular crops, and local land-use ordinances likely influence the differences in distribution of ownership by different crop types and in different counties. Walnuts had small median and mean area planted, which is likely driven by their requirements for high-quality alluvial soils that occur along rivers flowing out of the Sierra Nevada. These lands have generally coincided with historic small towns that have been farmed for longer periods of time, leading to greater fragmentation as generations turn over and land holdings are split among family members.

Much of the state's rice is grown on soils that have such a high clay content that no other crops can be productively grown on them, possibly reducing small-farm demand and subdivision for this type of land. The consolidation of cotton plantings occurred historically and likely is impacted by a variety of factors, including the relative difficulty in growing cotton, its greater ability to grow in saline soils, and economies of scale in producing sufficient cotton to sustain a ginning operation.

Historical settlement and homesteading patterns, where the farm size was limited by the amount of labor available (usually the immediate family), may have made aggregations of land more difficult in some places, potentially driving the relative equality of ownership in Santa Clara, Mendocino, and Napa County. Additionally, Napa County enacted the Agricultural Preserve Act and Measure P, which implement minimum-parcel-size regulations and zones agricultural use as the best use in many areas of Napa County.

These factors have led to comparatively few dominant landowners in these coastal agricultural areas, and in the case of Napa, fewer smallholders, which limits the measure of inequality.

These results provide useful information for Cooperative Extension efforts seeking to target growers by particular crop varieties or by various localities. This assessment can provide help in prioritizing outreach activities and methods of communication, as well as in tailoring research efforts to stakeholders' needs. They may also prove useful in allocating resources regionally, depending on the area of cropland, type of crop, and number of people served. Continuing to track the relationship between ownership patterns and crop patterns in the future will be a valuable way to analyze the ever-changing landscape of agriculture in California.

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