Chapter 3. California's Evolving Landscape

Kevin Novan

Abstract

California's footprint covers 101.5 million acres, approximately 26 million of which are classified as farmland by the U.S. Department of Agriculture. Farmland values vary substantially across the state, with some of the most valuable land concentrated in the state's fertile Central Valley. While the Central Valley has served as the engine driving the state's agricultural sector for much of the last century, farmland in the region is facing a number of threats. In particular, population growth, soil salinity, and water scarcity are spurring the conversion of farmland to non-agricultural uses.

About the Author

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Aerial view of farmland and waterways in the Sacramento-San Joaquin Delta, which includes five counties in Northern California.
Photo Credit: California Department of Water Resources

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Introduction

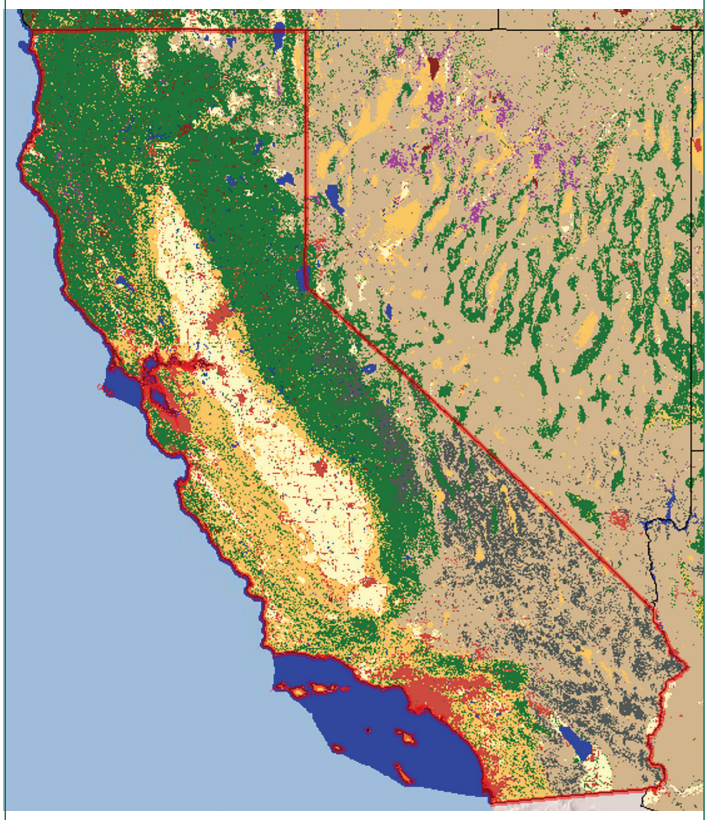
California's 101.5 million-acre footprint covers an incredibly diverse landscape (Figure 3.1). The Mojave Desert in the barren southeast is home to Death Valley, the hottest and lowest location in the United States. Roughly 80 miles away in the Sierra Nevada Range sits Mount Whitney, the highest point in the contiguous United States. The far northern reaches of the state are dominated by woodlands, while the south coast alternates between grasslands and heavily developed urban space.

Running through the middle of the state lies the state's key agricultural region, the 11 million-acre Central Valley. The valley's natural endowments—e.g., fertile soil and excellent growing conditions—combined with past human interventions—e.g., the construction of a vast irrigation infrastructure—have made the land one of the most productive agricultural regions the world has ever seen. By itself, output from the Central Valley accounted for 84 percent of the $47 billion in annual sales generated by the state's agricultural sector in 2015 (CDFA, 2016).

While the Central Valley has been the dependable engine driving the state's agricultural sector for much of the last century, farmland in the valley is facing a variety of threats. As California's population grows, some of the state's most productive farmland is being converted to non-agricultural uses (e.g., suburban developments). Past irrigation investments and practices have caused soil quality problems throughout large swathes of the Central Valley, resulting in productivity declines and, in many cases, abandonment of farmland. Moreover, prolonged droughts, environmental regulations, and looming groundwater restrictions will continue to affect water availability, potentially resulting in a variety of land-use changes.

This chapter provides an overview of land use in California. It begins with a summary of the data characterizing the current state of land use and land values in California. Next, looking back over the last century and a half, the patterns in land use and land values are explored. We pay particular attention to understanding how the footprint of California's agricultural sector changed over time in response to two key factors—the movement of people and the movement of water.

Figure 3.1. California Land Cover, 2011



- Forest & Woodland
- Shrub & Herb Vegetation
- Desert & Semi-Desert
- Polar & High Montane Scrub, Grassland & Barrens
- Aquatic Vegetation
- Open Rock Vegetation
- Nonvascular & Sparse Vascular Rock Vegetation
- Agricultural & Developed Vegetation
- Introduced & Semi Natural Vegetation
- Recently Disturbed or Modified
- Open Water
- Developed & Other Human Use

Source: United States Geological Survey, National GAP Analysis Project

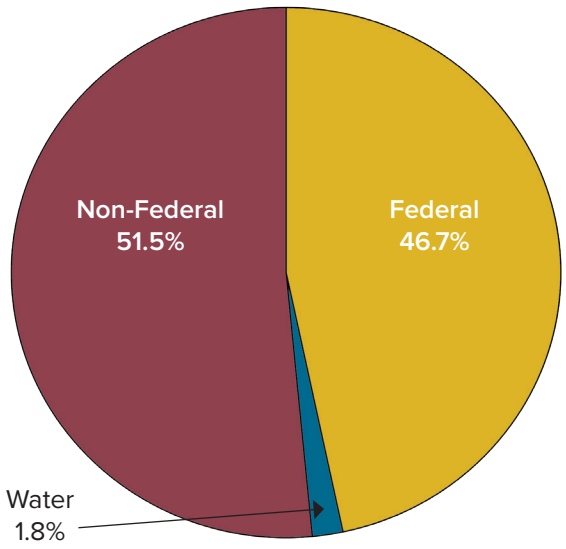
A Snapshot of Land Use in California

Federal Lands

To understand land use, it is important first to consider who owns the land. Across the entire U.S., 21 percent of the surface area is publicly owned land managed by the federal government. Like many states in the Western U.S., this share is much larger in California. Data from the United States Department of Agriculture's (USDA) National Resources Inventory (NRI) reveals that the federal government manages nearly 47 percent of California land (Figure 3.2). Federal land within California falls almost exclusively under the management of three agencies—the U.S. Forest Service (USFS), the U.S. National Park Service, and the U.S. Bureau of Land Management (BLM).

As of 2017, the USFS oversaw 20.76 million acres within California (CPAD, 2017). This ranges in size from the 2.2 million-acre Shasta-Trinity National Forest to the 150,000 acres of the Lake Tahoe Basin Management Unit inside California. Within the National Forests and Management Units, the USFS actively management of watersheds and forests (e.g., fire management). The U.S. National Park Service oversees an additional 7.6 million acres of national parks, monuments, and other areas (e.g., recreational areas) within California.

Figure 3.2. Share of Surface Area by Land Management, California, 2012



Source: United States Department of Agriculture, National Resources Inventory

As of 2017, the BLM oversaw 15 million acres within California, a large share of which is located in the arid southeast. Ultimately, the BLM is responsible for protecting and managing a wide array of natural resources and services provided by the land. For example, BLM land is used for recreation—e.g., trails, campgrounds, and off-road open areas. In addition, livestock uses approximately 6.1 million acres of BLM land in the state for grazing. As of March 2017, individuals can pay $1.87 to allow a cow and her calf, a horse, or five sheep or goats to graze on the public land for a month. In addition, the BLM manages the rights to extract timber, minerals, oil, and gas from the land it manages.

Often, the extraction or use of valuable resources (e.g., timber) found on the public lands directly reduces the ability of the land to provide important non-market services (e.g., habitat preservation). As a result, management of federal land is often quite contentious. For example, through the early 1980s, thriving mill towns (e.g., Happy Camp, CA) throughout Northern California were heavily dependent on timber harvested from federal lands. However, several species protected by the federal Endangered Species Act, including the spotted owl, are also dependent on the old-growth forests that were being logged as their habitat. Beginning in 1991, legal battles resulted in dramatic reductions in the amount of timber available for harvest from the USFS lands. Mill towns throughout the state are still reeling economically as a result of these logging restrictions.

Ongoing political debates involve proposed increases in wind and solar electricity generation capacity on BLM land in southeastern California. This region has some of the best solar potential in the state and numerous locations with excellent wind resources. However, the desert also serves as a vital ecosystem safeguarding several at-risk species, including the golden eagle and the desert tortoise. In 2016, conservationists scored a key victory at the expense of energy firms with the passage of the Desert Renewable Energy Conservation Plan. The plan set aside 6.5 million desert acres for conservation and 3.6 million acres for recreation, restricting potential future desert renewable energy sites to less than 400,000 acres.

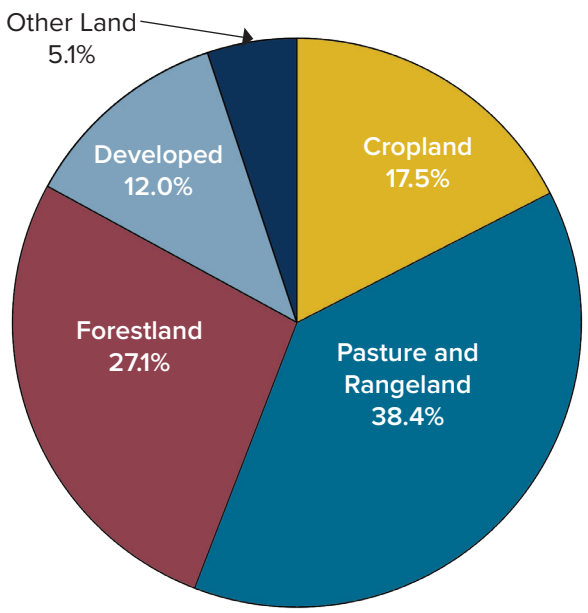
Non-Federal Land

The remaining half of the state—approximately 52 million acres of non-federally managed lands—includes privately owned land, tribal and trust land, and land controlled by the state and local governments. This non-federal land is divided across a variety of land types and uses. The USDA National Resources Inventory data from 2012 (Figure 3.3) reveals that pasture and rangeland (38.4 percent) and forestland (27.1 percent) accounted for nearly two-thirds of the non-federal land. The "Other" land category, which made up 5.1 percent of the non-federal land in California in 2012, includes farmsteads, barren land, marshland, and land in the Conservation Reserve Program (CRP).

The CRP is a federal program that offers landowners an annual payment for voluntarily removing environmentally sensitive land from agricultural production and planting native species that improve environmental quality. The CRP has had a substantial impact on land use across the country. As of January 2017, landowners enrolled 23.5 million U.S. acres in the CRP (Farm Service Agency, 2018). However, in California, only 74,338 acres were in the CRP.

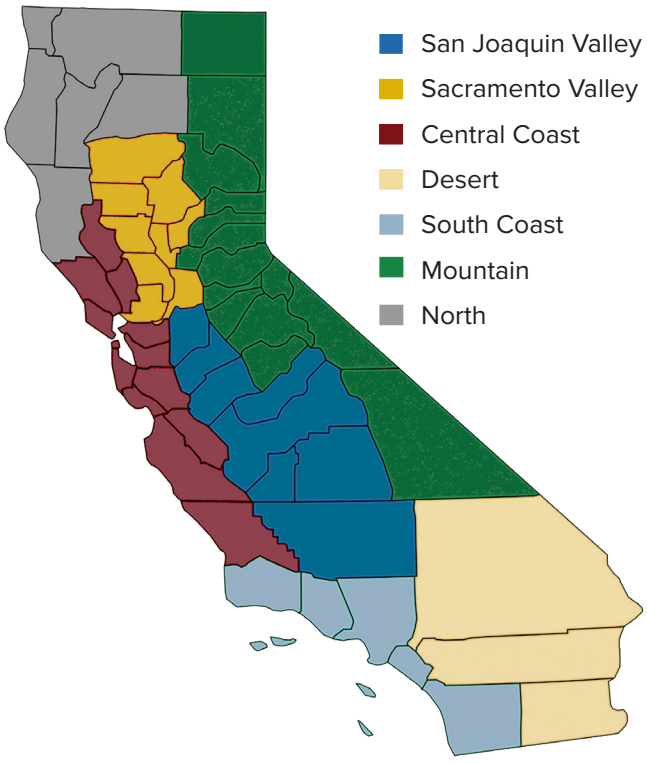
Ultimately, the CRP has not had a dramatic impact within California. Instead, California policymakers have focused on preventing the conversion of the state's productive cropland into developed, built-up space. The USDA's National Resources Inventory data show that 30 percent of the non-federal land in California in 2012 was split between cropland (9.14 million acres) and developed land (6.26 million acres). The NRI's definition of cropland includes land used for cultivated crops (e.g., row crops) as well as non-cultivated crops (e.g., horticultural crops). Developed land includes urban and rural tracts of land that have been built up, as well as land outside of built-up tracts in rural transportation corridors (e.g., roads, railroads). Cropland and developed land account for a relatively small share of the state's total area (approximately 15 percent), but are tightly linked. As developed land has grown since the 1950s, cropland has steadily shrunk.

Figure 3.3. Non-Federal Area by Land Cover/Use, 2012



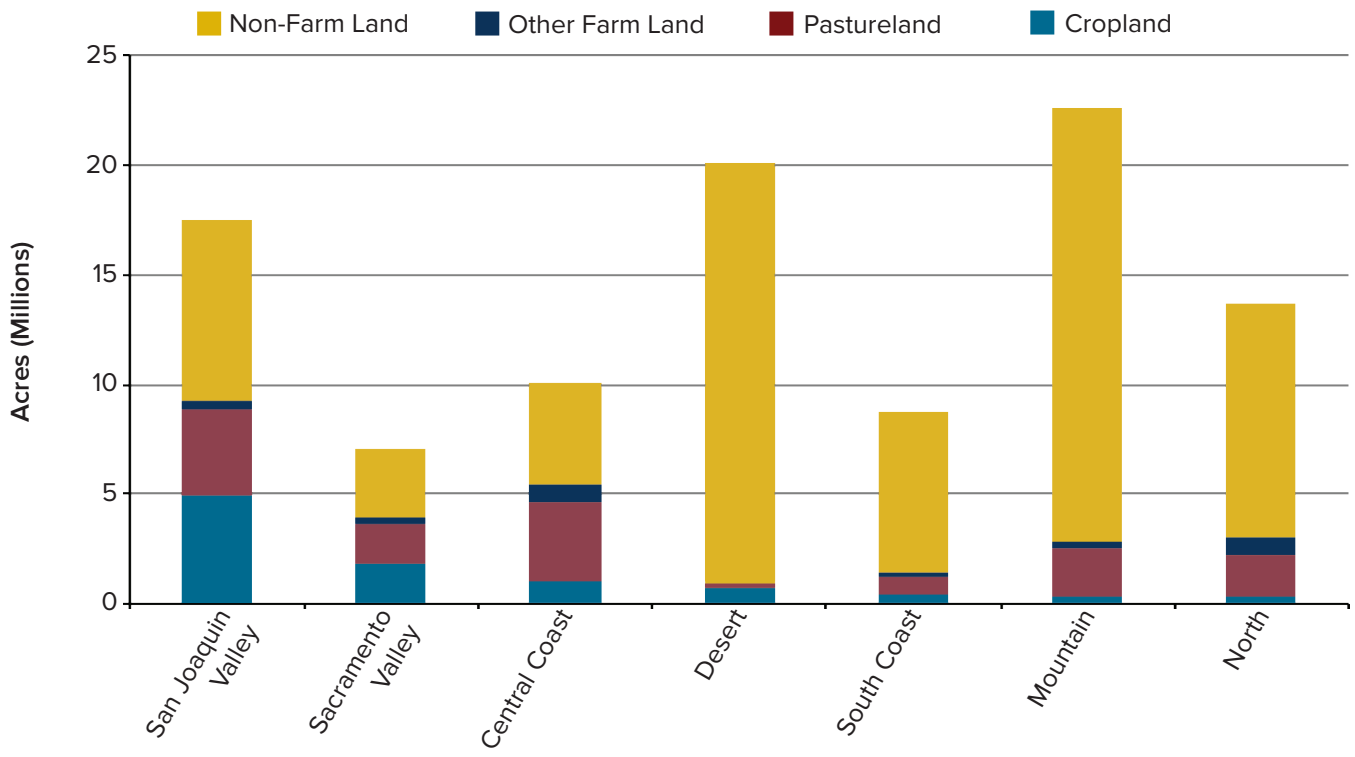
Source: United States Department of Agriculture, National Resources Inventory

Figure 3.4. California Regions



Source: Created by author

Figure 3.5. Land Use by Region, 2012



Source: USDA, National Agricultural Statistics Service

Variation in Land Use Across California

To explore how land use varies throughout California, the state's 58 counties have been broken up into seven regions with similar climates and geologies. The regions displayed in Figure 3.4 include the San Joaquin and Sacramento valleys; the Central and South coasts; and finally, the North, Mountain, and Desert regions.

The USDA's National Agricultural Statistics Service (NASS) quantifies the amount of farmland and non-farm land by county. As of 2012, 26.8 million acres of California were classified by the NASS data as farmland. Of this, 17.2 million acres were in pastureland, rangeland, and other farmed forestland—which includes wooded grazing land. Figure 3.5 highlights a fairly even distribution of these 17.2 million acres across each region in the state.

In total, 2012 NASS data classified 9.6 million acres of California farmland as cropland. Figure 3.5 highlights that, combined, the counties in the San Joaquin and Sacramento valleys—which together, make up the Central Valley—account for over 70 percent of the state's cropland. In contrast, in the heavily populated South Coast counties, agriculture has very little presence. Only 16 percent of the South Coast region's 8.73 million acres were classified as land in farms in 2012—with only 371,000 acres in cropland (4 percent of the state's total cropland). However, this was not always the case. Data from the 1950 USDA Census of Agriculture reveals that, in 1949, agricultural production in Los Angeles County generated nearly $157 million in revenue, more than any other county in the nation.

Ultimately, market forces and changes in the value of land across competing uses (i.e., agriculture vs. development) drove the dramatic land-use transition in locations like Los Angeles County. To understand how these land-use transitions occur, it is important first to consider how the value of land is determined.

Agricultural Land Value

The value of California's farmland varies considerably across the state. Figure 3.6 displays the average value of an acre of agricultural land during 2012 within each county. The spatial variation in agricultural land value is driven in part by differences in how profitable agricultural production is expected to be in different locations. All else equal, land that generates greater profits will be in higher demand and have a higher market value.

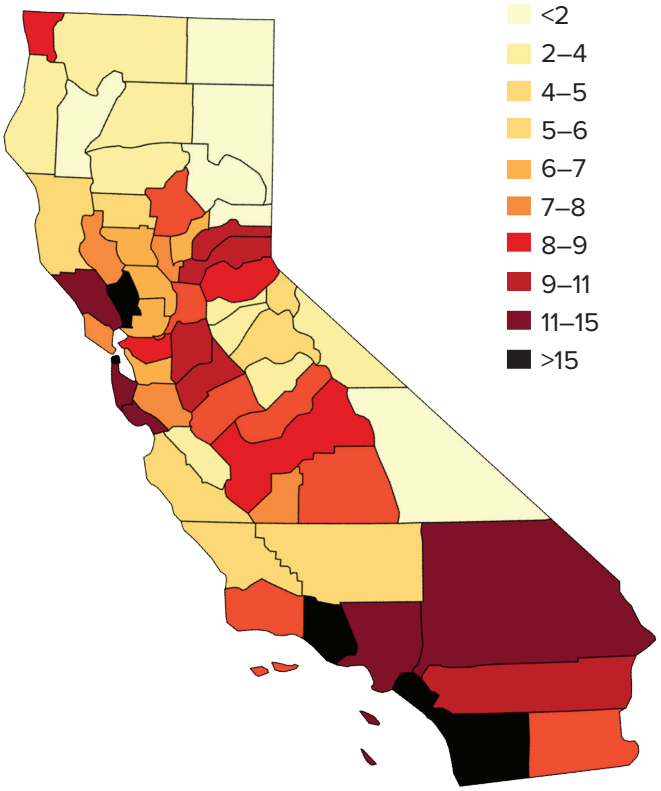
The profitability of agricultural production on a given piece of land depends on the combination of several factors. For one, the natural endowments of the land—e.g., the soil quality and the climate—will dramatically affect not only the productivity of the land, but also what crops will grow. For example, agricultural land in Napa County, which has a climate that is uniquely well suited for growing very high-value wine grapes, had an average value of $21,801 per acre in 2012—the third highest across the state's 58 counties.

The productivity of agricultural land, and therefore its profitability, also depends heavily on whether the land is irrigated or not. Precipitation in California occurs almost entirely during the late fall and winter months (October through March). In contrast, agricultural demand for water typically peaks during the spring and summer months (April through September). Without access to irrigation, the types of crops that will grow, and the productivity of agricultural land in California, would be dramatically reduced.

Figure 3.7 shows the average value of an acre of California cropland from 1997 through 2017 (inflated to 2017 dollars using the Consumer Price Index), and the average values of an acre of irrigated cropland and an acre of non-irrigated cropland. Over the past 20 years, the average value of irrigated cropland was approximately three times higher than the average value of non-irrigated cropland.

It is important to note, however, that a simple comparison of the average value of irrigated land to non-irrigated land fails to accurately uncover the impact of access to irrigation on land values. In particular, irrigated land can differ from non-irrigated land in a variety of ways that also affect land values. For example, low-value land with poor soil quality may be less likely to be irrigated, resulting in a larger average gap between the value of irrigated and non-irrigated land.

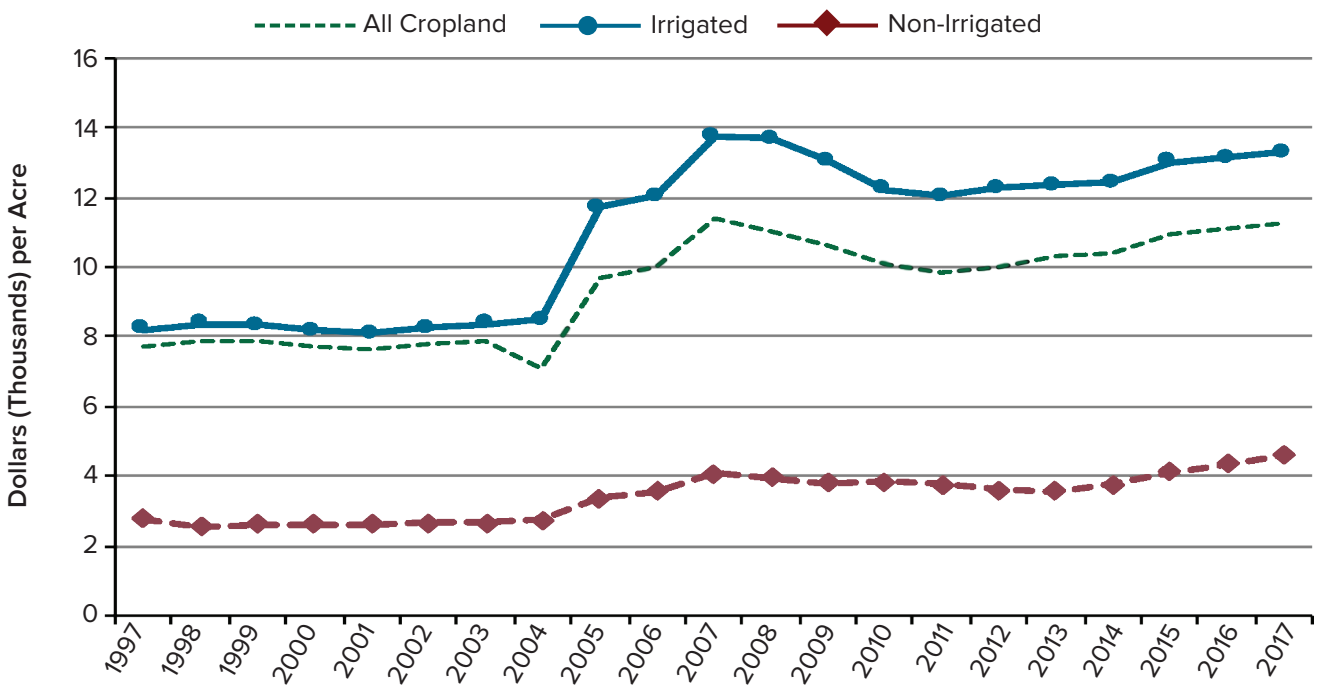
Figure 3.6. Average Agricultural Land Value by County, $1,000 per Acre, 2012



Source: USDA, National Agricultural Statistics Service

Previous research examines how land values at the farm-level vary across space (Schlenker et al., 2007) and across time (Buck et al., 2014) as a function of the average surface water delivered (acre-feet/acre) to each regional irrigation district. Importantly, the studies also control for differences across space and time that could also affect farmland values (e.g., climate, soil quality) and may be correlated with surface water deliveries. These studies estimate that access to an additional acre-foot of surface water increases the value of California farmland by $880/acre to $3,723/acre (in 2012 dollars). To get a sense of the magnitude of this impact, from 2001–2008, an estimated average of 0.47 acre-feet/acre of surface water was delivered to California counties (Buck et al., 2014), so an additional acre-foot of surface water increases the value of an acre of California farmland by roughly $414 to $1,750 (in 2012 dollars).

Figure 3.7. Average Value of California Cropland, 2017 Dollars, 1997–2017



Source: USDA National Agricultural Statistics Service

Notes: Nominal values were inflated to 2017 dollars using the Consumer Price Index.

Importantly, the value of agricultural land is also heavily influenced by non-agricultural factors. In particular, if, at some point in the future a given piece of farmland would be more valuable when used for something other than agricultural production (e.g., residential or commercial space, part of a transportation corridor), then this non-agricultural value will be capitalized into the present value of the land.

Figure 3.6 highlights a couple of extreme cases where urban influences have driven up agricultural land values. According to NASS data, San Francisco County, which encompasses 30,011 acres, had only 12 acres of farmland in 2012. The estimated value of this farmland was $126,111 per acre—dramatically above California's 2012 average value of $6,880 per acre of farmland. Similarly, heavily developed Orange County encompasses 505,994 acres, of which 55,775 acres were in farmland in 2012. This farmland had an average value of $21,854 per acre. Ultimately, San Francisco County and Orange County were the only two counties with higher average farmland values than Napa in 2012. This does not imply that agricultural production from an acre of farmland in San Francisco or Orange County generates a greater profit than an acre of wine grapes grown in Napa. Instead, the inflated land values reflect urban pressure driving up land values.

Land Use Over Time

Land use is constantly evolving. The USDA performs a comprehensive survey of the nation's agricultural sector—the Census of Agriculture. Figure 3.8, which displays data from the USDA's Census of Agriculture for California from 1850 through 2012, shows the number of acres devoted to some type of farmland during each census. In addition, from 1925 and on, the plot displays the acreage of farmland that was cropland, pasture and rangeland, and wooded farmland.

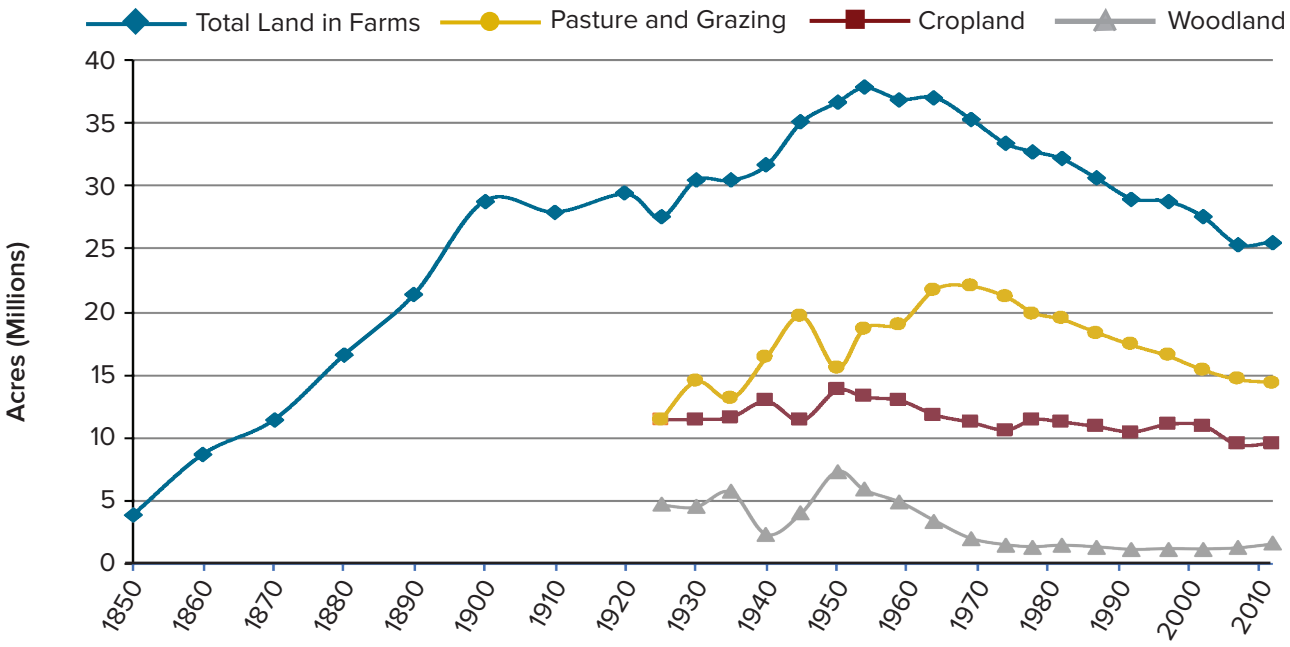
There are two clear patterns displayed in Figure 3.8. First, from 1850 until the 1950s, the total area in farmland steadily increased from approximately 4 million acres to nearly 38 million acres. Beginning in the 1950s, the trend reversed—the total area in farmland has consistently fallen. In 2012, there were approximately 26 million acres of farmland in the state, a 32 percent decline from the peak observed in the 1950s. Figure 3.8 illustrates the decline in farmland over the 50-plus years within each category. In particular, cropland declined by 30 percent from 1950 to 2012. This section highlights the key factors that spurred the initial growth in agriculture's footprint and the subsequent decline in agricultural land.

Early Settlement (Pre-1850)

Western settlement of California began in earnest in 1769. Spain's effort to colonize present-day California focused not only on establishing forts (presidios) in the region, but also on supporting the establishment of a chain of 21 religious outposts (missions) stretching from modern-day San Diego (San Diego de Acala) to Sonoma (San Francisco de Solano). During the period of Spanish control, there was effectively no private ownership of land (Robinson, 1948). The missionaries were simply caretakers of the land. In some cases, individuals were granted concessions to use land for grazing or agriculture. However, these concessions were simply use rights—the Spanish government owned the land.

This changed when Mexico gained independence from Spain in 1821 and took control of Alta California. To encourage settlement, the Mexican government began granting land rights to individuals. By 1846, over 500 ranchos were scattered throughout Mexican-controlled Alta California (Robinson, 1948). Located on lands along the coast and coastal rivers, these ranchos were originally

Figure 3.8. Total Farmland and Farmland by Use, 1850–2012



Source: USDA, Census of Agriculture

overseen by the Spanish missions. In addition, ranchos were found throughout the San Joaquin and Sacramento valleys. Ultimately, the privately held ranchos encompassed most of the best grazing and agricultural land in Alta California.

Early Statehood

With the signing of the Treaty of Guadalupe Hidalgo in 1848, the Mexican-American War ended. With the U.S. assuming control of California, the new government honored the pre-existing rights to the majority of rancho land grants. As a result, when California officially became the 31st state in the nation in 1850, approximately 9 million acres of large (15,000 plus-acres per grant) tracts of rancho land—which included much of the best grazing land along the coast—were already privately "owned."

Ultimately, proving ownership of lands granted by the Spanish and Mexican governments was challenging. With the 1848 discovery of gold and the subsequent Gold Rush, the population in California increased. Homesteaders and squatters inundated the regions surrounding cities like San Francisco and Sacramento—often residing on the prime rancho lands. The U.S. Federal Government established the Public Land Commission in 1851 to determine the validity of the original rancho land grants. Ultimately, the commission reviewed 813 cases, and upheld 604 of the original rancho land claims (Robinson, 1948). However, the legal process was so long and costly that the majority of Spanish Californian landowners were forced to sell their claims to speculators prior to the resolution of the cases.

While private ownership disputes over the highly desirable rancho lands were being settled, the vast majority of the new state of California (nearly 90 percent) was newly owned federal land. Much of the federal land was transferred from public to private ownership in the early decades of statehood via a variety of federal land-disposal policies.

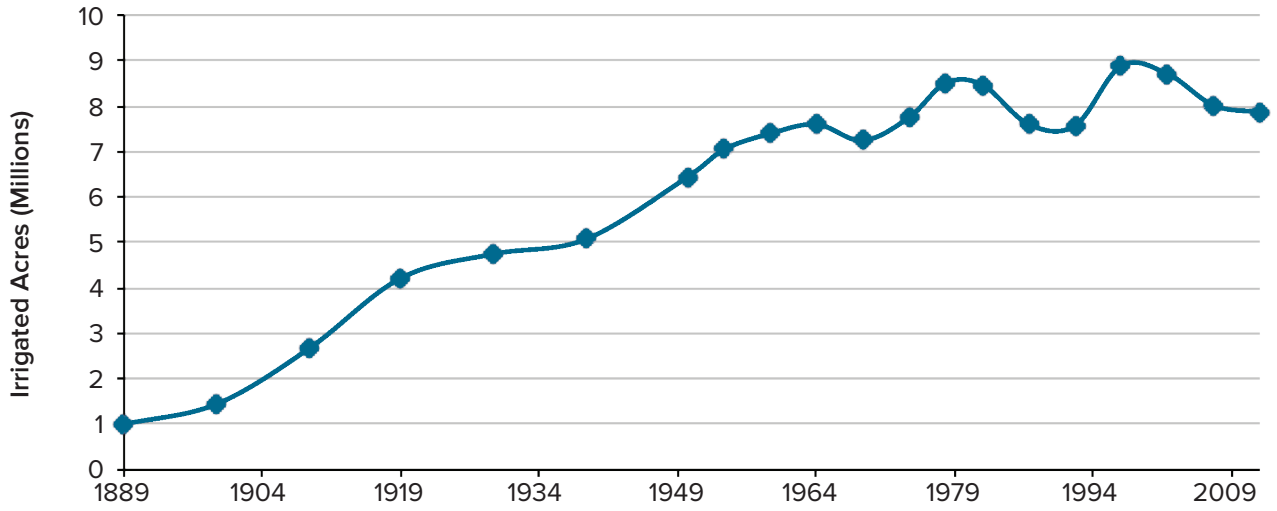
One of the most well-known policies was the 1862 Homestead Act. The act offered any head of household 160 acres of public land for $1.25 per acre after six months of continuous residence, or free after five years of residence. Overall, 10,476,665 acres of California, approximately 10 percent of the surface area, were distributed through the Homestead Act (National Park Service, 2018). Other important land-disposal policies included the 1877 Desert Land Act, which allowed individuals to purchase 640 acres of dry land at 25 cents per acre under the condition that the land was irrigated within three years. In addition, the 1878 Timber and Stone Act provided public timber and stone lands that were unfit for cultivation to individuals for $2.50 per acre.

Perhaps the most important land-disposal policies were the railroad land grants that began with the Pacific Railway Acts of 1862 and 1864. From a military and economic standpoint, it was viewed as absolutely vital to create a transcontinental railway linking the newly acquired Pacific Coast to the eastern half of the country. To achieve this objective, the federal government incentivized railroad companies to construct the railways using two forms of payment. First, direct payments were made for each mile of track laid. Second, the railroad companies were given land. Extending out 10 miles on either side of the newly constructed track, the railroad companies were given every other 640-acre (1 square mile) section of land. Therefore, for every mile of track laid, the railroad company received 6,400 acres of public land (10 square miles). By receiving the rights to the land, the railroad companies had access to resources required to construct the railways (e.g., timber) and they could sell the land to raise additional funds to pay for the construction. If the granted lands were not subsequently sold within three years, the land was to be made open to settlement at the regular $1.25 per acre.

In 1869 the Central Pacific railway, which began in Sacramento, was linked with the Union Pacific track in Promontory Point, Utah, completing construction of the transcontinental railroad. Subsequent land grants funded the construction of additional railways throughout California—e.g., Los Angeles towards Texas, Sacramento to San Francisco, Sacramento to Oregon, and Sacramento to Los Angeles. In total, the federal government granted 11,585,534 acres of California to the railroads (Robinson, 1948).

The railroad land grants had a substantial impact on the state's agricultural sector. First, as the granted lands were sold off to settlers pouring into the region, the amount of privately held acreage in farmland steadily increased. Recognizing that transporting produce would be an

Figure 3.9. Total Number of Irrigated Acres of Farmland, 1889–2012



Source: USDA Census of Agriculture; Olmstead and Rhode, 2003

integral part of their business, the railroads encouraged farming by constructing shops, warehouses, loading docks, etc. in market towns up and down the Central Valley. The railroads put up capital to finance the construction of local irrigation projects. The railroads also ran special refrigerated fruit trains to move the specialty produce grown in the valley to eastern markets.

Data from the U.S. Census of Agriculture reveals that, in 1870, there were 35,934 farms in California. By 1900, this number was up to 72,542 farms, including 28,000 growing specialty crops like fruits and vegetables.

Irrigating the Valley

While much of the initial growth in California's farmland was driven by population growth and the redistribution of land from public to private ownership, the dramatic expansion in agriculture's footprint into the Central Valley from the early 1900s through the 1950s would not have been possible without substantial investment in flood control and irrigation.

Prior to human intervention, runoff from the Sierra Nevada made its way to the San Francisco Delta and the Tulare Basin and inundated the Sacramento and San Joaquin valleys, resulting in vast, flooded wetlands. During the 1850s, approximately 4 million acres of the valley floor were seasonal wetlands (Frayer et al., 1989). At the same time, vast amounts of arable land in the Central Valley that were not adjacent to reliable sources of surface water relied on spring flooding or scarce rainfall.

As demand for farmland grew, farmers in some areas began to pool their resources to purchase the rights to surface water and fund the construction of small-scale dams and irrigation ditches (Hanak et al., 2011). This strategy was formalized with the 1887 passage of the Wright Act, which allowed for the formation of local irrigation districts with two-thirds support from the local landowners. The irrigation districts could raise funds through taxes and bonds to acquire water rights and construct water-distribution infrastructure (Pincet, 1999). By the early 1900s, irrigation districts had been established throughout much of the state (Pisani, 1984).

While irrigation districts made headway in irrigating the valley's fertile land, the localized strategy was ultimately insufficient given the huge demand for irrigation. Simply put, there was not enough local surface water to go around. Initially, farmers went underground for extra water. With improvements in drilling and pumping technology, the early 1900s saw a dramatic increase in groundwater extraction from aquifers. In 1910, there were around 10,000 pumping units (Olmstead and Rhode, 2003). By 1930, there were nearly 50,000 units, and 75,000 units by 1950.

Figure 3.9 displays the number of acres of irrigated farmland in California by year. At the turn of the century, there were 1 million acres of irrigated farmland. With the growth in local irrigation districts and groundwater extraction, this number reached 4.7 million acres by 1930. Interestingly, total farmland increased by only 2 million acres over the same 30-year window (Figure 3.8). Perhaps the most dramatic impact this initial wave of irrigation had on the agriculture sector came in terms of what was grown, rather than on how much land was in production. Comparing the 1900 and 1930 agricultural censuses reveals a shift away from low-value crops—e.g., wheat acreage fell from 2,683,405 acres in 1899 to 632,779 acres in 1929—in favor of much higher-value, specialty crops (Olmstead and Rhode, 2003). For example, California lettuce crops, which only covered 46 acres in 1899, grew to cover 60,564 acres in 1929 and had a total value of over $11 million. Cantaloupes and melons, valued at over $9 million in 1929, increased from 764 acres in 1899 to 46,365 acres in 1929.

In Southern California and the southern San Joaquin Basin, the regions with the greatest reliance on groundwater extraction, groundwater withdrawals dramatically exceeded the amount of surface water that replenished the aquifers (Hanak et al., 2011). Instead of managing groundwater withdrawals, farmers and policymakers simply sought to increase the amount of surface water being diverted to the region, both for irrigation and to supply the growing urban demand in the booming coastal cities. This required going beyond small-scale, local irrigation districts and instead required large infrastructure investments that could store and move water over vast distances.

Initially, very contentious inter-basin water projects supplied urban demand centers in San Francisco (via Hetch Hetchy) and Los Angeles (via Owens Valley). In the 1940s, the Boulder Canyon Project began delivering water from the Colorado River to the Coachella Valley in Southern California, driving an expansion in agriculture in the region. The first steps of the Central Valley Project (CVP) began in 1937, with the construction of the Shasta Dam on the Sacramento River. The CVP would ultimately include a series of dams, reservoirs, and canals that would store and divert waters from the Sacramento, Trinity, American, Stanislaus, and San Joaquin rivers as well as pump water from the San Francisco Delta. The CVP ultimately provided roughly 7 million acre-feet of water annually, with approximately 90 percent used for irrigation in the Central Valley (Hanak et al., 2011).

However, 7 million acre-feet was not enough to meet the state's growing agricultural and urban water demand. In 1961, construction on the State Water Project (SWP) began with the massive Oroville Dam on the Feather River, northeast of Sacramento. Water stored behind the dam would be released throughout the year and allowed to flow towards the Delta. Ultimately, it would be pumped from the Delta and delivered south via the California Aqueduct to farmers in the San Joaquin Valley and, finally, lifted over the Tehachapi Mountains and delivered to Southern California.

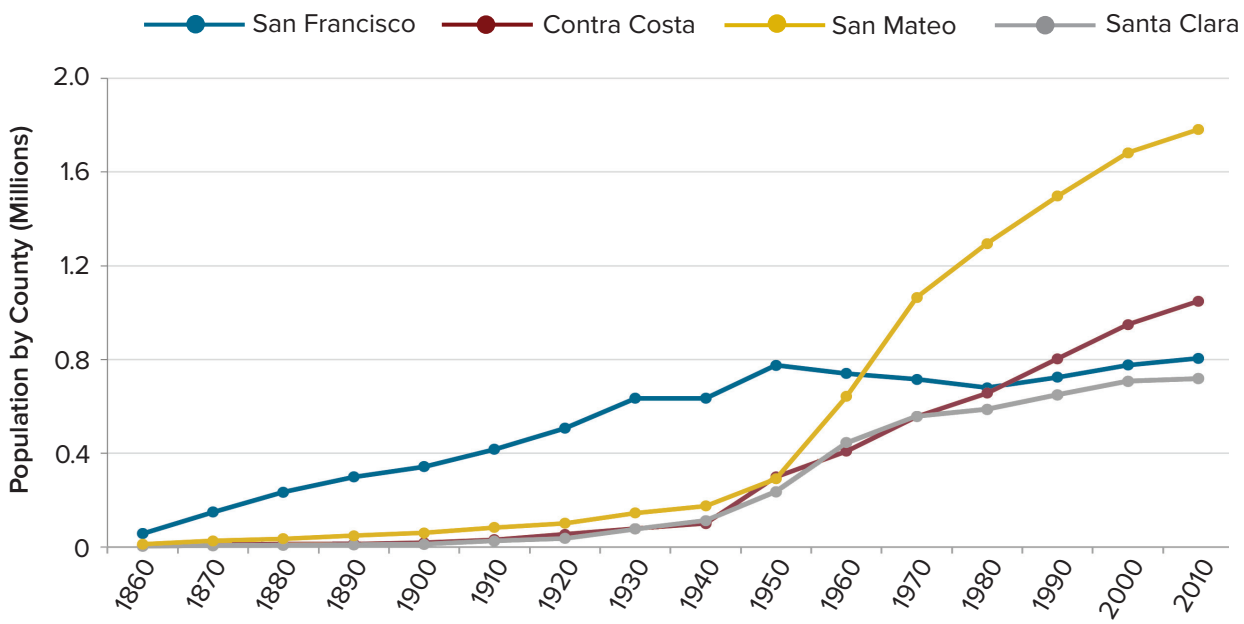
The investment in irrigation and flood control over the last century and a half has dramatically reshaped the Central Valley. Most notably, the valley's wetlands have largely been erased by the construction of over 100 dams, an extensive network of levees, and thousands of miles of water-delivery canals. By the 1980s, the valley's 4 million-plus acres of wetlands had been reduced to less than 400,000 acres (Frayer et al., 1989). Not only did the water projects dry up the wetlands, they transformed the center of California from a dry valley to the agricultural engine of the state. By the 1950s, the number of irrigated acres of farmland eclipsed 7 million acres. Ultimately, the increased access to irrigation made it possible for California's farmland to steadily increase to its peak acreage in the 1950s (see Figure 3.8).

Post-War Suburbanization

From 1920 through 1940, California's population steadily grew from 3.4 million to 6.9 million—roughly adding 174,000 people per year. After the end of WWII, the population exploded. In 1950, there were 10.6 million residents, and by 1960, there were over 15.7 million.

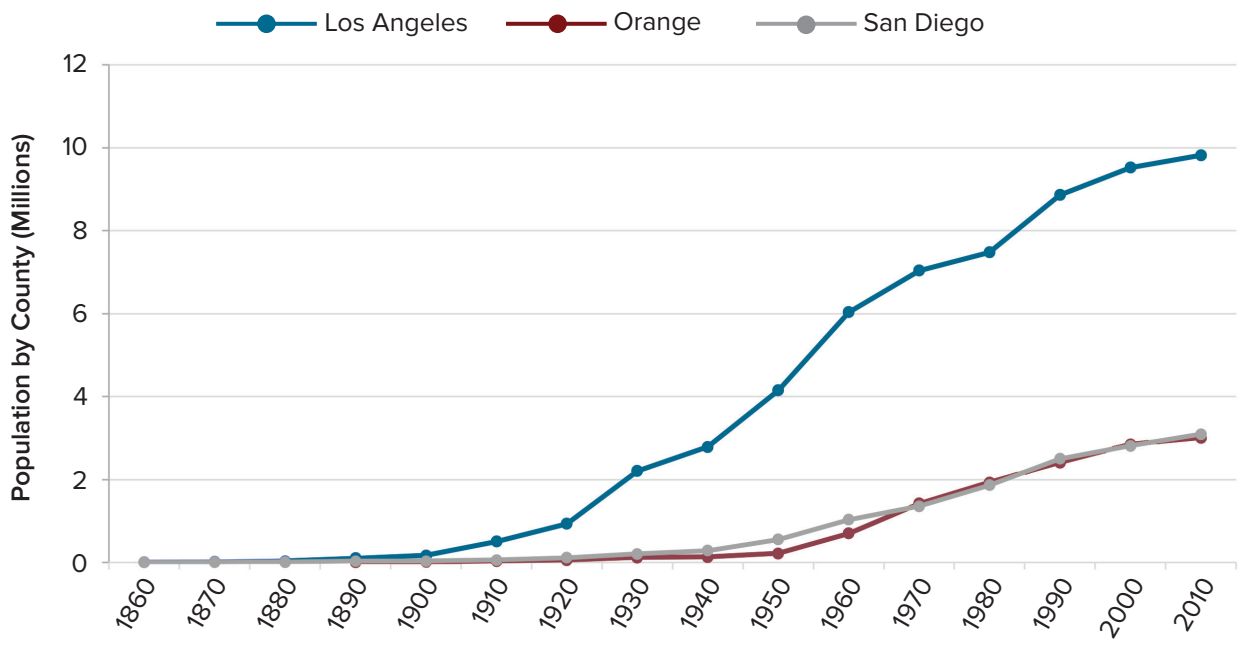
To understand how this growth affected land in California, it is crucial to observe where the population expanded. Figure 3.10a displays the population in San Francisco County and several of the neighboring counties from 1860 through 2010. In 1940, the population of San Francisco County had reached 634,536—nearly twice as much as the sum of the populations of Contra Costa, San Mateo, and Santa Clara counties, all neighboring San Francisco. By 1950, the population of the three neighboring counties

Figure 3.10a. Population by County, 1860–2010



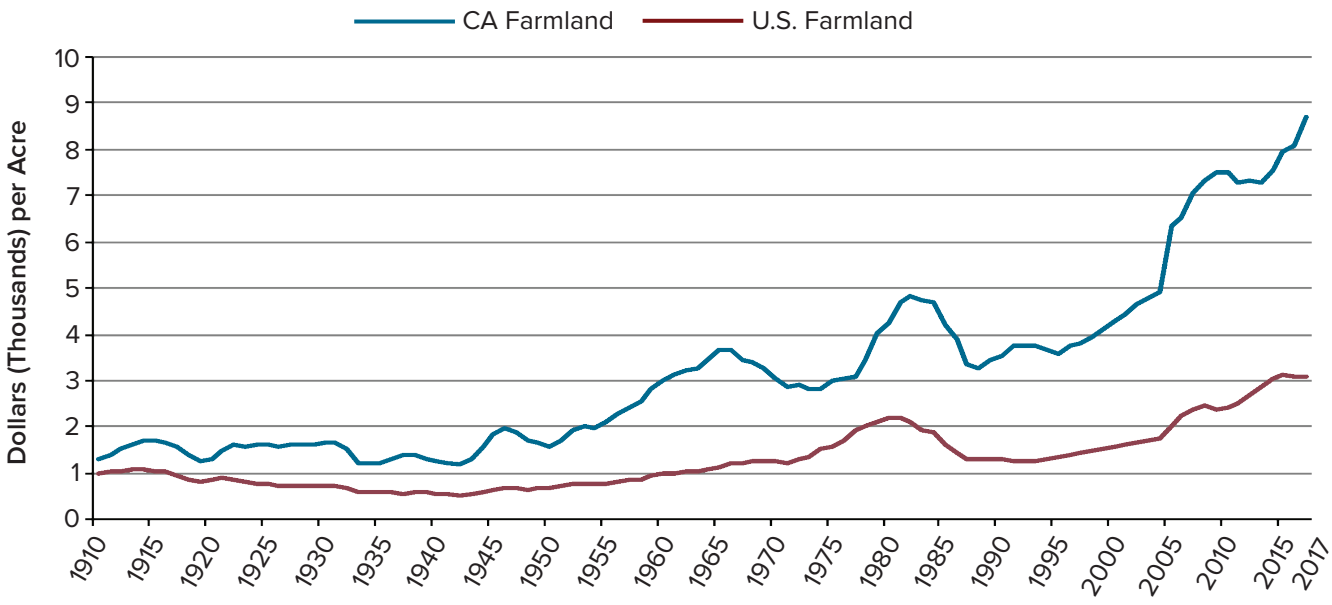
Source: U.S. Census Bureau

Figure 3.10b. Population by County, 1860–2010



Source: U.S. Census Bureau

Figure 3.11. Real Farmland Values by Acre, 2017 Dollars, 1910–2017



Source: USDA National Agricultural Statistics Service

exceeded San Francisco's population by nearly 50,000 residents. Even more striking, from 1950 through 1980, San Francisco's population shrunk while the surrounding counties continued to see rapid growth.

Figure 3.10b paints a similar picture of growth in Southern California. While Los Angeles County continued to rapidly grow from 1900 and onwards, the other southern counties (Orange and San Diego) began to experience rapid growth beginning in the post-War period.

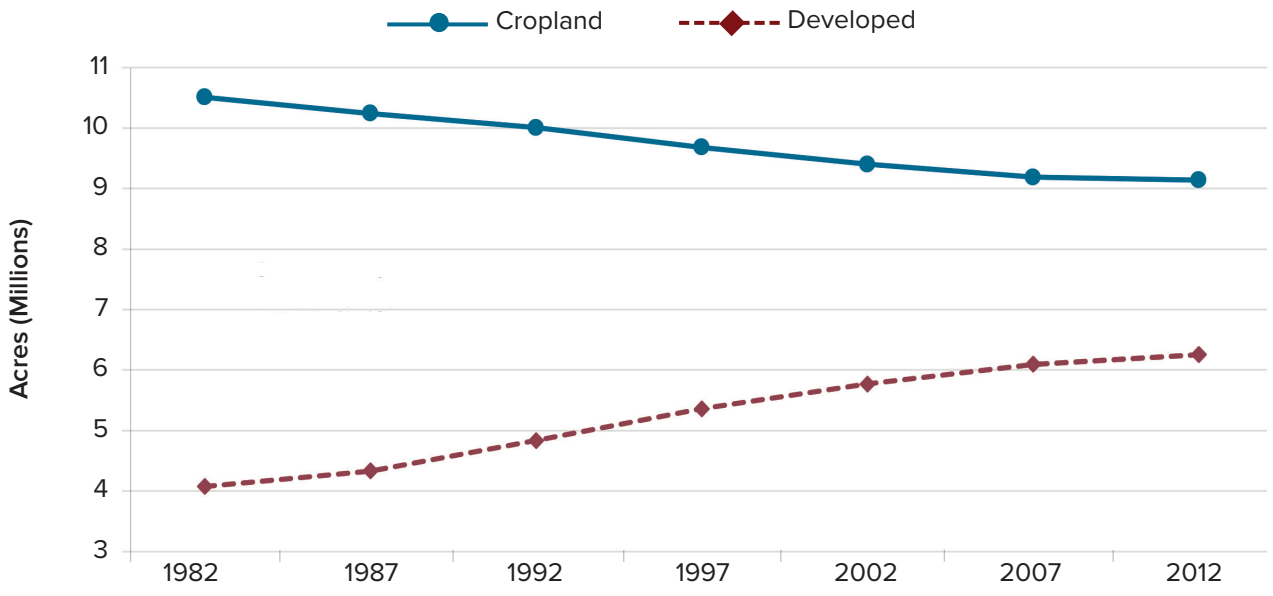
This suburban expansion had a dramatic impact on the value of farmland. Figure 3.11 displays the average real value (in 2017 dollars) of an acre of farmland in California and the U.S. as a whole from 1910 through 2017. From 1910 through 1940, the real value of California farmland hovered around $700 per acre more than the national average. We attribute this difference to the fact that California farmland was very productive and amenable to producing high-value crops. Coinciding with the substantial growth in suburbanization, California farmland values exceeded the national average by nearly $2,000 per acre from 1955 through 1965.

As demand for land grew throughout Southern California and around the Bay Area, much of early rancho land—the earliest land in agricultural production, and some of the most productive farmland—was steadily sold off to large developers. This process was also accelerated by the system of property taxes. Landowners paid taxes based on the assessed market value of their property. As farmland values increased, so did farmers' property tax bills. Financial pressure from growing tax bills, combined with lucrative offers from developers, lead to large reductions in farmland. From 1945 through 1968, over 1 million acres of prime agricultural land was developed (Pincetl, 1999).

To mitigate the loss of farmland to urban and suburban development, the state passed the Williamson Act in 1965. Agricultural land owners could voluntarily sign 10- to 20-year contracts with their local government guaranteeing that their land would remain undeveloped during the contract period. In exchange, the landowners paid property taxes based on an estimate of their land's value that only reflected the income that would be earned through agricultural production, not based on the market value of their land, which was being driven up in many regions by demand for non-agricultural uses.

Participating in the program was not only voluntary on the part of the landowners, but also the local governments. To incentivize counties and cities to participate in the program, and to compensate them for the reduction in

Figure 3.12. Cropland and Developed Acreage, 1982–2012



Source: USDA National Resources Inventory

their stream of property tax revenues, the state government would make payments to the local governments based on the acres of land enrolled in the program and the type of land (e.g., prime farmland, prime farmland bordering urban land, and non-prime farmland).

The Williamson Act has been very successful in enrolling acreage. By 1968, 23 counties were participating in the program with over 2 million acres of farmland contracted to remain out of development (Sokolow, 1990). By 1978, 48 counties were participating and over 16 million acres of farmland were under contract. As of 2015, an estimated 16.1 million acres remain under contract (California Department of Conservation, 2016). However, it is not clear whether the Williamson Act meaningfully slowed the rate of farmland conversion to developed land. Ultimately, very little farmland in the immediate path of development was enrolled in the program (Sokolow, 1990). Research from the 1970s suggests that landowners expecting lucrative and imminent development opportunities were unlikely to participate (Hansen and Schwartz, 1975; Carman, 1977).

Ultimately, suburban growth and development through the second half of the 1900s resulted in the loss of a substantial amount of farmland in Southern California and throughout the Bay Area. This land included much of the Spanish and Mexican rancho land grants and represented some of the most productive farmland in the state. Over the most recent decades, the trend of urban development and farmland conversion has continued. Figure 3.12 reveals that, from 1982 to 2012, the number of acres in built-up land in California increased from 4.1 million acres to 6.3 million acres. Over the same period, total cropland in the state fell from 10.5 million acres to 9.1 million acres.

Ongoing Issues Facing California's Farmland

Paving Over the Valley?

While much of the initial urbanization occurred in the coastal regions of California, the Central Valley has not been immune to the issue of development and farmland conversion. The California Department of Conservation's Farmland Mapping and Monitoring Program (FMMP) began tracking changes in land usage throughout California's key agricultural regions. Every two years, the FMMP quantified the amount of land that changed between uses—for example, farmland to grazing land or farmland to developed land.

The agricultural land surveyed by the FMMP is classified into different categories based on the USDA Natural Resource Conservation Service's (NRCS) evaluation of the land's suitability for agricultural production (e.g., physical and chemical properties of the soil and climate). The best agricultural land is classified as Prime Farmland. Land with minor shortcomings (e.g., not perfectly flat terrain) is classified as Statewide Important Farmland. Both Prime and Statewide Important Farmland are restricted to land that was used to grow irrigated crops at some point during the four years preceding the survey year. Unique Farmland contains lower-quality soil but is still largely irrigated cropland or used for non-irrigated orchards or vineyards. The definition of Local Important Farmland varies by county but largely includes farmland that does not meet the standards of Prime, Statewide Important, or Unique Land. Finally, the FMMP includes Grazing Land, Urban or Built-up Land (e.g., residential, industrial, commercial, landfills, golf courses), and Other Land. The Other category importantly includes vacant, non-agricultural land that is bordered by developed land—a point which will be discussed in more detail below.

By 1994, 44.1 million acres—roughly 90 percent of the privately held land in the state—was being surveyed by the FMMP. The top panel of Table 3.1 displays the total acreage of FMMP-surveyed land that was converted to urban or built-up space between 1992 and 2012. In total, 893,930 surveyed acres were converted to urban space. Of this total, 512,007 acres came from agricultural land—223,984 being Prime, Statewide Important, and Unique Farmland acres.

The bottom panel of Table 3.1 focuses on the FMMP-surveyed land specifically in the counties that make up the Central Valley—the Sacramento and San Joaquin Valley regions displayed in Figure 3.4. Over the 20-year period, 243,665 acres of valley's land was converted to urban space. From 1992–2002, 45 percent of the state's Prime, Statewide Important, and Unique Farmland converted to Built-up Land came from the Central Valley. From 2002–2012, this share had increased to 60 percent.

Table 3.1. Acres Converted to Urban and Built-up Land by Source

California					
	Prime Farmland	Statewide Important & Unique Farmland	Grazing & Local Important	Other Land	Total
1992–2002	85,961	37,123	158,737	219,385	501,206
2002–2012	67,763	33,137	129,286	162,538	392,724
Total Acres	153,724	70,260	288,023	381,923	893,930
Central Valley					
	Prime Farmland	Statewide Important & Unique Farmland	Grazing & Local Important	Other Land	Total
1992–2002	37,500	18,432	31,181	25,332	112,445
2002–2012	41,671	18,004	39,669	31,876	131,220
Total Acres	79,171	36,436	70,850	57,208	243,665

Source: Farmland Monitoring and Mapping Program

Table 3.2. Actual and Projected Population by Region, 1970–2060

		Population By Region						
	Total California Population	Central Coast	Desert	Mountain	North	Sacramento Valley	San Joaquin Valley	South Coast
U.S. Census								
1970	19,971,069	4,973,291	1,213,641	259,809	283,853	1,146,258	1,630,329	10,463,888
1980	23,667,764	5,639,947	1,650,325	418,017	360,683	1,450,817	2,048,102	12,099,873
1990	29,760,021	6,573,040	2,698,096	591,779	426,553	1,918,193	2,742,000	14,810,360
2000	33,871,653	7,404,808	3,397,182	743,681	460,869	2,230,317	3,302,792	16,332,004
2010	37,253,956	7,804,405	4,399,379	887,290	486,983	2,532,877	3,971,659	17,171,363
Projected								
2020	40,748,172	8,659,967	4,938,561	936,655	493,711	2,856,369	4,410,489	18,452,420
2030	44,031,155	9,433,021	5,567,287	1,022,005	509,577	3,154,574	4,972,092	19,372,599
2040	46,873,884	10,115,513	6,144,984	1,100,396	519,806	3,436,193	5,528,504	20,028,488
2050	49,118,640	10,670,040	6,655,039	1,160,209	525,726	3,681,988	6,026,361	20,399,277
2060	50,985,273	11,147,001	7,129,550	1,229,036	535,519	3,919,560	6,494,076	20,530,531
Share of Growth								
Observed: 1970–2010		16.4%	18.4%	3.6%	1.2%	8.0%	13.5%	38.8%
Projected: 2020–2060		24.3%	21.4%	2.9%	0.4%	10.4%	20.4%	20.3%

Source: U.S. Census Bureau and California Department of Finance

Previous research also notes that the FMMP farmland-to-urban conversion statistics could understate the true amount of farmland being developed (Kuminoff et al., 2001). In particular, the Other Land category can mask important dynamics in land use. While Other Land includes a variety of undeveloped land types (e.g., brush, timber, and wetlands), not all Other Land is truly undeveloped. For example, Other Land includes low-density, rural developments—e.g., large rural residences, or "ranchettes," that are likely not used for commercial agriculture. In addition, Other Land includes farmland that has been idled for at least four years. In many cases, this land may simply be awaiting development.

FMMP statistics reveal that, from 1992–2012, 611,848 acres of California's Prime, Statewide Important, Unique, and Local Important land was converted to Other Land. Much of this represents cropland being taken out of agricultural production. Over the same 20-year period, Table 3.1 highlights that 43 percent of the FMMP-surveyed land converted to urban built-up space came from the Other Land category. Combined, this suggests that the impact of urban expansion on farmland acreage is larger than the FMMP statistics initially revealed.

The Challenge of Slowing Development

Looking forward, the conversion of Central Valley farmland to built-up space will continue to be an important issue. Table 3.2 shows the historical population by region during each census from 1970 through 2010. In addition, the table includes projected population to 2060 from the California Department of Finance. From 1970 through 2010, the South Coast region accounted for 38.3 percent of the growth in the state's population, more than any other region. From 2020 through 2060, however, the San Joaquin Valley's population is expected to grow by nearly 2.1 million residents—an absolute increase that exceeds the expected growth in the South Coast.

This population growth will continue to exert development pressure on the valley's farmland, and particularly the farmland located on the urban fringe of the main

population centers up and down the Highway 99 corridor in the Central Valley. A prime example is Fresno, CA—the state's fifth-most-populated city. Between the 2000 and 2010 censuses, Fresno's population grew by 15 percent. Over the same period of time, the area encompassed by the city grew by 7 percent.

Reducing the conversion of farmland to developed land is a major focus of policymakers, but is difficult to accomplish. Aside from the Williamson Act, which differentially assessed agricultural and non-agricultural land values, a number of other strategies are being actively used in an attempt to conserve farmland (e.g., land trusts, development rights purchase or transfer programs). Perhaps the most impactful policy tools are zoning regulations. Local governments use zoning restrictions to prevent agricultural land from being used for other purposes. Of course, the fact that zoning can be changed over time reduces the efficacy of the policy.

Moreover, local land-use policies can often work at odds with one another. For example, local governments often simultaneously impose growth (zoning) restrictions—which prevent a city's footprint from expanding into neighboring agricultural land or open-space—along with building restrictions preventing densification (e.g., height limits on new structures). Other examples of land-use policies with competing effects include transportation projects. For example, as part of the 2005 SAFETEA-LU federal transportation legislation, funding was approved for the California Farm-to-Market Corridor, which aimed at converting Highway 99 into a four-lane expressway running from the southern end of the Central Valley all the way to Sacramento. While this investment in infrastructure was, in part, motivated by the benefits that would accrue to the agricultural sector from the more efficient movement of products, the highway improvements—which were completed in 2014—will also inevitably speed the rate of urban expansion and sprawl along the Highway 99 corridor.

Environmental and Water Issues

While population growth in key agricultural regions will continue to increase the revenue that can be earned by converting farmland to non-agricultural uses, other factors are simultaneously affecting the profits that can be earned by continuing to use the land for agricultural production. One particularly acute threat affecting the productivity of agricultural land in the western San Joaquin Valley is the issue of soil salinity (Schoups, 2005).

Throughout much of the San Joaquin Valley, groundwater was the chief source of irrigation water from the 1920s up through 1950. The reliance on pumping was reduced substantially by 1951 as the CVP began delivering surface water to the northern San Joaquin Valley and farther south through the San Luis Unit by 1968. However, more than just water has been delivered to the region. While the surface water has relatively low salt content, given the sheer volume of water delivered to the San Joaquin Valley, an estimated 1.6 million tons of salt are applied to the land annually (SJVDP, 1990). Ultimately, the salt from surface water and the soil, as well as other naturally occurring minerals and heavy metals, leach into the groundwater that is largely confined by a layer of clay.

It was always well understood that the water applied to the land would need to be drained from the region or else there would be serious issues with soil salinity as the water tables steadily rose (Letey, 2000). Initially, there were plans for the Bureau of Reclamation to construct a system of tile drains to return the water to the Delta (Hanak et al., 2011). However, the San Luis Drain was never completed. Instead, drainage water was diverted to the northwest portion of the San Joaquin Valley where it pooled at the Kesterson National Wildlife Refuge. Once the drainwater evaporated, high levels of salt, selenium, and a range of other heavy metals from the soil steadily accumulated and, by the early 1980s, large numbers of fish and waterfowl were dying or being found with severe deformities. Similar levels of contamination and wildlife deformities and deaths also were observed in the Tulare Basin, in the southern half of the San Joaquin Valley (SJVDP, 1990).

In 1986, drainage into Kesterson was halted and no drainage infrastructure has been constructed. As the water table has risen, high levels of salt have been drawn up into the top layer of soil, resulting in severe productivity issues for large swathes of farmland. Estimates from the San Joaquin Valley Drainage Report suggest that 460,000 acres of San Joaquin farmland will be abandoned by 2040 at the current rate of salt accumulation (SJVDP, 1990). These impacts are already being observed in the Westlands Water District, where over 100,000 acres of drainage-impacted land has been abandoned or is being converted to alternative uses—e.g., the Westlands Solar Park, a 2.4-GW solar farm to be in operation in 2025.

Drainage issues are not unique to the Central Valley. To the south, cropland in the Coachella and Imperial Valleys receive surface water diverted from the Colorado River, which has relatively high saline levels. This water, along with salt and minerals (e.g., selenium), ultimately drains into the Salton Sea—a 350-square mile lake southeast of Palm Springs. Over time, the saline levels in the Salton Sea have been steadily climbing, resulting in the collapse of the wildlife ecosystem. Moreover, the Salton Sea is steadily drying up. As a result, the surrounding farming communities face serious health threats posed by the toxic dust from the dry lakebed being swept into the air.

Cropland along the coast also must also confront salinity issues. For example, farms in the Salinas Valley, located west of the San Joaquin Valley in Monterey County, rely heavily on groundwater for irrigation. Over time, as the rate of groundwater extraction has outstripped the rate of freshwater recharge, seawater has steadily been pulled under the coastal Salinas Valley. To become less reliant on the salt-tainted groundwater, and to slow the rate of seawater incursion into the underlying groundwater, there have been steady efforts to reduced groundwater extraction and to instead irrigate with recycled water as well as surface water stored during wet periods.

The profitability of agricultural production is also affected by growing scarcity of the chief complement to land—water for irrigation. A wide range of factors have and continue to impact water availability, including environmental regulations surrounding water flows required for habitat preservation in the San Francisco Bay-Delta; growth in urban-water demand; variability in snow and rainfall induced by climate change; and the looming regulation of groundwater withdrawals following the Sustainable Groundwater Management Act (SGMA). The steady growth in water scarcity has had a clear impact on the amount of irrigated acreage in California over recent decades. Data from the USDA National Resources Inventory reveals that irrigated cropland in California fell from 9 million acres in 1982 to 8 million acres in 2012.

Ultimately, water scarcity has dramatic impacts on how farmland is used in California. For one, a lack of access to water can alter whether land is even used for agricultural production. For example, USDA and NASA estimates based on satellite imagery suggest that in 2015, during the prolonged drought California faced, 1.03 million acres of Central Valley cropland were fallowed. In contrast, in 2011, prior to the drought, approximately 400,000 acres of cropland were fallowed (Melton et al., 2015). Of course, these represent short-run changes in response to extreme drought conditions. In response to longer-run changes in water supply, there can also be changes in the composition of crops being grown, with a movement away from water-intensive crops to less water-intensive crops.

There are important interactions between the set of issues facing farmland in the Central Valley. For example, population growth will continue to create a financial incentive for farmland to be converted to developed land. At the same time, as water becomes scarce and more expensive, the profitability of agricultural production will fall, potentially accelerating the rate of farmland conversion. In contrast, if water scarcity results in lower levels of surface water being applied to farmland in the San Joaquin Valley, the loss of productive farmland stemming from rising water tables and soil salinity will be mitigated.

Conclusion

In 1850, California's population was just over 90,000. By 2017, the population had risen to 40 million. In many regions in California, the landscape has been largely unaffected by the swelling population. Federally owned lands in the arid southeast, throughout the rugged Sierras, and scattered across the wooded northern reaches remain sparsely populated and relatively untouched. In contrast, the coastal regions and the Central Valley have undergone dramatic changes over the last decade and a half.

Following WWII, suburbanization swept through the Bay Area and Southern California. The state's oldest and most productive farmlands, the initial Spanish and Mexican ranchos, were largely paved over. The South Coast and Bay Area now account for a large share of the state's roughly 7 million acres of developed land. Moving inland from the coast, the construction of over 100 dams, an extensive network of levees, and thousands of miles of water-delivery canals have permanently reshaped the landscape in the Central Valley. Millions of acres of wetlands have been erased and the once dry Central Valley has been transformed into the most productive agricultural region in the country.

Looking forward, California's lands will continue to evolve. Much of the future growth in population is projected to occur in the Central Valley. As the population expands, there will be pressure to convert Central Valley farmland into developed land. As this chapter highlights, slowing this process is challenging, and even more so when the profitability of agricultural production is threatened by soil-quality problems and water scarcity. Ultimately, the state's very diverse agricultural sector will continue to evolve and adjust to the reality of a shrinking footprint on the land.

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