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Whither California Agriculture: Up, Down or Out? Some Thoughts about the Future

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DEDICATION

We wish to dedicate this report to our late fathers, farmers from places far apart but with a common bond to the land—Henry Johnston of Winters, California and Fred McCalla of Bremner, Alberta, Canada. They instilled in us the basic values of honesty and hard work. From them came our lifelong interest in agriculture and the rural countryside. They were of a generation of farmers who witnessed incredible technical change in agriculture and experienced the ups and downs of farming from the 1910s to the 1970s. Both survived the Depression on small family farms while raising young families. In meeting these challenges, they exhibited patience, good humor, and an unwavering dedication to family from which both of us have benefited immensely. We hope this joint venture, undertaken because of our common interests in agriculture, in a small way expresses our gratitude to them.

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I. INTRODUCTION

California agriculture in 2004 is a very different industry than it was in 1950, 1850, or, for that matter, at its beginning in the late 18th Century. California, until well into the 18th century, was one of the few remaining "hunter-gatherer" societies left in the world (Adams; Diamond; Smith). The origins of sedentary California agriculture began with the development of Spanish missions over the period 1769–1823. Over its brief history of 250 years, the character of California agriculture has been in a perpetual state of transition and adjustment: from early mission attempts to raise livestock, grow grains, and develop horticulture; to the era of ruminants (i.e., cattle and sheep); to the development of large-scale, extensive wheat and barley production; to the beginnings of intensive fruit, nut, and vegetable agriculture based on ditch irrigation and groundwater; to pioneering large-scale beef feedlot and dairy production; to the intensified and expanded production of an increasingly diverse portfolio of crops resulting from massive public irrigation schemes; to today's highly sophisticated, technologically advanced, management-intensive agricultural industry, which is embedded in a rich, urban state of 35 million people. It is a history of perpetual, profound, and often painful change.

The turn of the millennium was marked by hard times in California agriculture: low prices seemingly across the board, water-supply woes, contracting growth in export markets, more stringent environmental regulations, and declining farm income. What does the future hold for California agriculture? Is it as bleak as it sounds? California agriculture has experienced recurrent challenges over its history and has survived. Can it do so again?

This report is a modest attempt to throw some light on these questions. In this introduction we first review the situation in 2000–2002 to identify an assortment of "turn of the century" problems confronting California agriculture. In Chapter II we then place these symptoms/indicators in a historical context in a stylized, epochal history of California agriculture circa 1769 to the present. Chapter III is a more detailed examination of major structural shifts from 1950 to 2000, providing a look at internal performance indicators as well as comparisons to the performance of U.S. agriculture. In Chapter IV we develop a list of major factors that have driven California agriculture from the early mission agricultural period through the 20th Century and then make our qualitative assessment of the importance of these "drivers" in the early 21st Century. Chapter V contains our thoughts about the future of California agriculture.

Overall, California agriculture has always battled economic adversity. While blessing California with good weather and fertile soils, nature did not provide adequate rainfall in the right place or at the right time. The downside is that investments are needed to bring water to the soil to grow crops. The upside is that irrigation potentially allows watering crops at the precise time of need and in the correct amounts, greatly increasing the range of production options. Thus, water management is a critical additional dimension of complexity for California agriculture. California is a long distance from everywhere; therefore, importing and exporting have always been expensive in terms of both money and time. Finally, California, because of its subtropical, Mediterranean climate, has different and more complex problems with pests and diseases than does the rest of mainland agriculture.

Yet, since the 1850s, California agriculture has grown and adjusted many times. Each time, the composition and character of agriculture have changed, but the state's overall industry, in terms of value and volume of output, has grown steadily and has always returned to profitability.

Will California agriculture be unable to adjust and grow in the 21st Century? We cannot find evidence to support this proposition. In what follows we try to justify that conclusion.

Direct and Indirect Indicators of a "Turn of the Century" Problem?

The 21st Century began with great uncertainty in the minds of many California farmers and ranchers. There appeared to be many harbingers of a dismal future for the industry. In the two sections that follow, and in no particular order of significance, we list some suggested indicators compiled from a variety of media.

Some Frequently Heard Direct Indicators

Pervasive low commodity prices across the board. California has a highly diversified agriculture. Historically, when some prices have been low (e.g., field-crop prices), fruit, nut, vegetable, or livestock prices were high, but this was not generally true in 2000–2001. Hence, the widespread concern following recognition that the last time everything was down was during the Great Depression of the 1930s.

Ever-growing pressures on water available to California agriculture. The Central Valley Project Improvement Act (CVPIA); the CalFed Bay-Delta Program negotiations; falling water tables; permanent deficits in some districts (e.g., Westlands Water District); rancorous legal battles; and relentless growth in urban, industrial, and environmental demands have eliminated "surplus" water availability and greatly increased uncertainty about annual and long-term availability of water for agriculture. The Colorado River water-sharing compact established in 1922 is to be enforced 80 years later, potentially depriving California agriculture of at least 700,000 acre-feet of water.

Land loss to urban and industrial growth, salinization, and urban fringe issues. Irrigated land available to agriculture is declining because of the continued spill of urban growth onto prime agricultural areas. Urban sprawl, after consuming the Los Angeles basin, coastal San Diego County, and the Santa Clara Valley, is rapidly consuming prime land in Ventura County and the Livermore and Sonoma Valleys and is now spilling over into the Central Valley (Carter and Nuckton). Growth along the I–80, I–580, and I–205 corridors between the San Francisco Bay Area and the Central Valley as well as along the Sacramento-Stockton-Modesto axis (I–5 and Highway 99 corridors) has rapidly increased the Central Valley population in the last ten years. That growth is expected to continue, doubling the 1990 Central Valley population to eight million in 2020. Urban fringe issues restrict agricultural uses and/or increase costs of production (Johnston 1990). Reduced water supply also has implications for increased salinization of irrigated lands, resulting in the removal of marginalized land from production unless there are large investments for improved drainage.

The threat of reduced availability of farm labor. Labor uncertainties arise from the threats of immigration reform, better job alternatives, and border-tightening measures after 9/11.

New pests and loss of effective weapons. The glassy-winged sharpshooter is renewing and expanding the threat of Pierce's disease to grape vineyards. Infestations of Mediterranean and other fruit flies of various types periodically appear. Methyl bromide is being phased out as environmental regulations tighten. The cost of development and registration of chemicals continues to rise, making pesticide development for many specialty crops unprofitable.

Rising, increasingly unstable energy costs. Electricity deregulation, rising petroleum and natural gas prices, and the threat of rolling blackouts pose critical threats to the many energy-intensive segments of the agricultural industry, e.g., production, processing, and transportation.

Changing markets. Fewer opportunities exist for open and immediate sale of products and commodities in open or spot markets. Fresh vegetable sales are more concentrated with fewer and larger retail buyers demanding volume, quality, and services (e.g., Wal-Mart, Costco, Safeway, Kroger, etc.). Secondary processing and juice-concentrate markets have been reduced with the shift in consumer preferences toward fresh fruits and vegetables and with lower-cost foreign competitors gaining U.S. market share.

Changes in the structure of the processing industry. The role of processing cooperatives continues to decline. The closing of a large number of obsolete plants has both reduced total capacity and significantly altered the geographic distribution of capacity. The collapse of Tri Valley Growers (processed fruits and vegetables) is the most recent example in a long list of now defunct processing and marketing cooperatives that include the Rice Growers Association (RGA), CalCan (processed fruit), and Blue Anchor (fresh fruit). Declining market shares as well as financial stress continued for other processors, such as Diamond of California (nut crops), Sunsweet Growers (prunes), Blue Diamond Growers (nut crops), and Sunkist Growers (citrus) (*Sacramento Business Journal*). Other changes in the processing industry include growth in grower-owned processing, reductions in the number of brand-label processors, and an increase in private-label processors.

Slower demand growth and global competition for domestic markets. The slowdown in global economic growth and the domestic recession are leading to reduced

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demand for exports and stagnant domestic markets while global competition from alternative foreign suppliers is rising (e.g., Central and South American fresh fruit, flowers, and ornamentals; processed fruits and vegetables from Asia; juice concentrate from China and the southern hemisphere; and premium wine from Chile, New Zealand, Australia, and South Africa).

Change in demand patterns. Increasingly, there are specific designer demands involving health/diet issues and the rise in demand for organics and specialized or designer niche products. While highly differentiated demand is the antithesis of large-scale agriculture producing homogenous products, it may create niche opportunities for some, including smaller-sized firms.

These are but some of the perceived problems that potentially have a direct impact on California agriculture.

External/Indirect Factors

In addition, there is a frequently identified set of potential causes of significant change in the environment in which California agriculture operates. California agriculture has become more and more dependent on national and international markets even though instate demand has grown rapidly. External "events" or "factors" are of growing significance to the agricultural economy. Following are some examples.

Trade liberalization and regional trading agreements. The inclusion of agriculture under the general rules of General Agreement on Tariffs and Trade and that organization's subsequent transformation into the World Trade Organization significantly impacted the trading environments for agricultural products. This, plus the North American Free Trade Agreement, expansion of the European Union (EU), and numerous other proposed regional trade agreements have forever altered the global trading environment. These are seen to increase uncertainty and cloud the future, but they also may offer future opportunities not yet fully known.

Global financial instability. The East Asian meltdown and continuing problems in Argentina, Brazil, and Russia, plus volatility in capital movements, exchange rates, and interest rates, have contributed to increased uncertainty and instability in global money markets.

Global recession and macroeconomic interdependence. Closer linkages among nations in product and financial markets mean recessions spread rapidly and recovery requires multicountry policy consistency rather than unilateral policy action (e.g., Japan, EU, etc., dragging the United States into recession in 2000). The United States no longer controls its own destiny with inward-looking domestic monetary and fiscal policy.

Global warming and climatic instability. Global warming appears to be a reality, and its potential impact on agriculture is beginning to be understood. In addition, evidence continues to mount that extreme climatic events are becoming more frequent and are of larger amplitude. For California agriculture, it may mean greater variability in rainfall amounts and less stable patterns of rainfall distribution.

Global urbanization, population growth, and competition for resources. Global population will continue to grow, and most of the growth will be urban growth in developing countries. By 2050, more than 86 percent of the world's population will be in developing countries, and four billion people will live in developing-country cities (United Nations Population Fund). All of this portends increased competition for nonrenewable global resources and, with it, rising input prices. The flip side is that global demand for food will continue to grow.

Domestic resource competition, reduced supplies, rising prices, and increased regulation. Growth, urbanization, and affluence will only intensify the strong pressure already being exerted by the availability of land, water, and other natural resources. The inevitable impact on agriculture will be reduced availability of resources, rising costs, and increased regulation.

Deteriorating infrastructure. Competition for fiscal resources, coupled with a growing unwillingness to be taxed more, is leading to inadequate investment in new infrastructure (roads, mass transit, ports, and airports) and maintenance of existing infrastructure (freeways, levees, canals, and water infrastructure).

Declining public investment in knowledge generation and transmission. Not only, as noted previously, is necessary investment in public infrastructure not forthcoming, but there are also declining investments in agricultural research, extension, and education—expenditures that have, in the past, been critical to California agriculture.

II. A STYLIZED HISTORY OF CALIFORNIA AGRICULTURE FROM 1769 TO 2000

California agriculture has been repeatedly buffeted by rapid and often fundamental changes over its approximate 200-year history. Given the industry's rich history of continuous transformation, it is surprising that Jelinek could argue in 1982 that a comprehensive history had yet to be written. We could not find one either; therefore, drawing on multiple sources, we compiled our own stylized version. In doing so, we have drawn extensively on three works. The first is the rich but ponderous collection of essays prepared by University of California College of Agriculture faculty entitled *California Agriculture*, edited by the legendary Claude B. Hutchison, and published in 1946 on the occasion (three years late) of the university's 75th anniversary. The second is Jelinek's 1982 book, *Harvest Empire: A History of California Agriculture*. The third, which is the shortest, most recent, and most readable, is the lead chapter in the book *California Agriculture: Issues and Challenges*, "An Overview of the History of California Agriculture" by Alan Olmstead and Paul Rhode (1997).[1]

Since its beginning, everything about California agriculture seems to have changed: the mix of crops (annual and perennial); types of animals (beef to sheep to dairy); nature of technology (horse and mule power to global-positioning-satellite-guided Challenger tractors); and sources of water and markets served, as well as the magnitude and sources of capital, scale, and ownership patterns and the industry's interface with a rapidly growing urban state. The growing population of California generates increasingly severe constraints on the availability of good land, water, inputs, and management options.

Despite constant change, however, at least seven constants have driven California agriculture. *First*, California agriculture has always been "demand driven." It was never subsistence, family-farm agriculture like that which characterized much of early U.S. agriculture (Cochrane 1993); rather, it was driven by entrepreneurs seeking riches by serving high-value and/or newly emerging markets. These markets were generally distant and often foreign: hides and tallow to the United Kingdom and Boston; wheat to Europe and beyond; fruits, nuts, and vegetables to the East Coast, Europe, and, more recently, Asia; and wine to the world. *Second*, California agriculture is resource-dependent (land and water). Its history includes aggressive development of new land and water resources along with cases of soil and groundwater exploitation—the nature and severity of which has changed over its history. *Third*, California agriculture has been shaped by the absence of water in the right place. It has always been in search of more water and has been an aggressive participant in water debates (wars?) with both internal and external competing interests. *Fourth*, California agriculture has always depended on a large supply of agricultural labor for cultivating and harvesting its abundant produce from both relatively large-scale operations and specialty-crop farms. The source of a stable supply of field labor has varied over time with immigrants from Asia and the Americas. *Fifth*, California agriculture has grown rapidly and almost continuously, although it has been periodically buffeted by natural catastrophes (e.g., floods, droughts) and adverse economic shocks (e.g., the Great Depression, various recessions). *Sixth*, California agriculture, at least since the Gold Rush, has required very high levels of management skills—both technical and economic. It has always been dominated by large-scale operations that have grown in complexity and sophistication. *Seventh*, it has always been on the technological frontier in developing, modifying, or stealing new technologies, such as large-scale mechanical technology, irrigation equipment, horticulture/plant varieties, pest control, food processing, and wine making.

If we are to understand where California agriculture might go in the 21st Century, we must understand the forces that have shaped California agriculture to date. Therefore, we trace that evolution in more detail in terms of eight epochs or historical vignettes grouped in three clusters—pre-20th Century and the first and the second halves of the 20th Century:

[1] A more recently revised chapter by Olmstead and Rhode (2004), "The Evolution of California Agriculture: 1850–2000," is contained in Siebert.

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Pre-20th Century Epochs

- Epoch 1: The Spanish Mission Period (1769–1821)
- Epoch 2: The Mexican Period (1821–1848)
- Epoch 3: Gold, Statehood, Cattle, and Growth (1848–1860s)
- Epoch 4: Sheep, Wheat, and Early Horticulture (1860s–1890s)

Epochs of the First Half of the 20th Century

- Epoch 5: Fundamental Transformation: Extensive to Intensive Agriculture (1890–1930)
- Epoch 6: External Shocks: Depression and War (1930–1949)

Epochs of the Second Half of the 20th Century

- Epoch 7: Big Water, Growth, Relocation, and Diversification (1950–1970)
- Epoch 8: Ups and Downs, Intensification, Internationalization, and More Ups and Downs (1970–2000)

Pre-20th Century Epochs

Epoch 1: The Spanish Mission Period (1769–1821)

The Franciscan Order extended its missionary activities to Alta California in the 1760s. Led by the pioneering efforts of Fathers Portola, Serra, and others, the order developed a string of 21 Spanish missions from San Diego to Sonoma over the 54-year period 1769–1823. The Spanish Church missionary strategy included, in addition to its missions (spiritual), the presidio (military) and the pueblo (commercial) as components of early development. Livestock, field crops, and horticulture were introduced to feed the settlers and to provide economic activity for the converted natives. Efforts also included building some small gravity-irrigation schemes and developing primitive processing capacity (e.g., wine). Yet, despite all these efforts, Alta California was never much more than self-sufficient as total acreage of all cultivated field crops in all missions never exceeded 5,000 to 10,000 acres. The highest recorded production of grains was about 180,000 bushels in 1821—two-thirds wheat and one-fifth maize (Adams, p. 10). Livestock numbers varied between 285,000 and 400,000 head in the period 1807–1834 (Adams, p. 8), and the horticulture/garden area never exceeded 700 acres (Adams, p. 12). Mission agriculture was small and much of it disappeared in the subsequent Mexican period.

Epoch 2: The Mexican Period (1821–1848)

Until Mexican independence in 1821, land was vested in the church and few land grants were given out in the Spanish-California period. Mexican independence was followed by a period of uncertainty as to the role of the Church in secular affairs, and this was not settled until the secularization of all missions in 1834. This secularization led to stripping the church of land ownership and establishing the principle (unrealized) of the division of land between settlers and natives. Prior to 1822, there had been some 30 large "Rancho" land grants, and that number had risen to 50 by 1834. But after secularization (1834) and before the Bear Flag Rebellion (1846), 813 additional land grants were issued, totaling between 13 and 14 million acres (Jelinek, p. 18).

The years 1821–1847 were the period of the California Rancho—large spreads of land acquired by grants to Mexican citizens (regardless of their ethnic origin and thus including John A. Sutter, John Bidwell, James Wolfskill, and others) where cattle ranged largely untended (Jelinek). Periodically, cattle were slaughtered on the range to meet an East Coast and international demand for tallow and hides. In the same period, most of the mission pueblos declined or disappeared and California became largely a one-commodity state—cattle—surviving by exploiting large tracts of unimproved rangeland. The only exceptions were the beginnings of grape and tree-fruit production in the 1830s to 1840s in the Los Angeles pueblo associated with the names of Jean Louis Vignes (grapes) and William Wolfskill (citrus) (Muscatine).

Epoch 3: Gold, Statehood, Cattle, and Growth (1848–1860s)

The discovery of gold in 1848 and the Gold Rush of 1849 not only shaped the new state of California (which entered the Union in 1850) but fundamentally altered California agriculture. The nonnative (European) population of California was estimated to be 7,000 in 1845. In January 1849 it was estimated to be 26,000. By December 1849 it was 92,000 and it multiplied to

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255,000 by 1852 and 380,000 by 1860 (Jelinek). This was explosive growth by any measure with population increasing tenfold between early 1849 and 1860. The numerous gold miners and an even larger number of people who came to profit by serving the miners needed to eat, and a strong demand for food (especially meat) emerged.

> *Rancheros reaped first advantage from the population surge . . . hides gave way to beef as the price of cattle rose from under $4 a head before the rush to $500 a head at one point in 1849, leveling off at $50–$150 a head during the 1850's.* (Jelinek, pp. 23–24)

Southern herds were driven up the Central Valley or along the coast and sold to Americans who drove them into northern and Mother Lode towns for processing.

> *The initial monopoly of the rancheros, however, rapidly disappeared because of the poor quality of the beef and the inability of their 300,000 head to meet mine and town 'demand.'* (Jelinek, p. 24)

Competition came from cattlemen from the Midwest and Texas who, starting in 1850, drove herds west to California. By mid-decade, "up to 40,000 head entered annually" (Jelinek, p. 24). Large numbers of sheep were also driven in from the Southwest to augment the 17,500 sheep that were in California in 1850. In the peak year of 1856, 200,000 head of sheep entered California.

But the rancheros quickly lost out to American entrepreneurs who understood far better the nature of the demand for beef and the need for improved cattle. By the end of the decade, there was a flourishing American-owned cattle and sheep business in California. Estimates of the number of cattle vary from 1,234,000 head recorded in the 1860 census (Hart et al., p. 52) to three million head estimated by Jelinek (p. 27). However, weather, the ever-threatening wild card of California agriculture, dealt a near death blow to the cattle industry in the first half of the 1860s. In 1861–62, a huge flood in the Central Valley created a lake 250–300 miles long and 20 to 60 miles wide and drowned perhaps 200,000 head of cattle (Jelinek, p. 27; McClurg, p. 41). Immediately following the flood was a two-year drought in 1863–64 during which "many hundreds of thousands of cattle perished" (Jelinek, p. 27). Durrenberger claimed that droughts of the 1860s "resulted in the death of millions of head of cattle." Thus, even with some recovery in population, there were only 630,000 head of cattle left in California in 1870. As Jelinek noted:

> *By 1872 most rancheros had been displaced, wheat had overtaken livestock as the dominant branch of agriculture, and fruit cultivation had secured a new foothold.* (p. 23)

Epoch 4: Sheep, Wheat, and Early Horticulture (1860s–1890s)

The cattle industry was briefly overtaken by the sheep industry as California's major agricultural enterprise. The first census in 1850 identified 17,514 head of sheep. By 1860 it was a million head, and the industry peaked in 1876 at 6,406,465 head (Hart et al., p. 53). But, even before the sheep population peaked, wheat acreage was growing rapidly on large, extensive ranches, some of which approached one million acres in size (Jelinek, p. 29). California already had significant wheat production in 1859 and had begun to export wheat. The combined acreage of wheat and barley soared in the 1860s, exceeding one million acres in 1867 and peaking at nearly four million acres in the late 1880s (Olmstead and Rhode 1997, p. 3). The combined production of wheat and barley was reported on three to three and a half million acres for most of the 1880s and 1890s (Olmstead and Rhode 1997, p. 3). Tufts et al. (p. 114) reported that "by 1889 the state ranked second for wheat, producing more than 40,000,000 bushels on 2,750,000 acres."

But, as quickly as wheat (and barley) had grown to dominate valley agriculture, it crashed to the point where "by the end [of the first decade] of the 1900's only about 0.5 million acres of wheat were cut and the state became a net importer of wheat" (Olmstead and Rhode 1997, p. 2). Three causes are often postulated to explain the demise of the wheat industry, though there is some disagreement on the third. The first was soil exhaustion. Yields were declining as large-scale wheat growers simply mined natural soil fertility and moved on (Stoll). To some extent, barley replaced wheat as it was better suited to dry conditions. Second, there was a severe depression in agricultural prices in the 1880s and it was acute in wheat. California's distance from European markets resulted in very low farm prices. Third, development of a small but diversified fruit, nut, and vegetable industry provided an alternative land use. In the same period (the 1890s),

irrigated acreage was increasing rapidly. It is tempting to argue that horticulture replaced, if not displaced, wheat. But some scholars argue that wheat declined and fell on its own and that considerable wheat land lay idle for a number of years (Stoll). It is safe to say that the expansion of horticulture occurred simultaneously with the decline of wheat, thus staving off a severe depression in California agriculture.

> *The passing of the wheat era at the turn of the century could have caused serious retrenchment in California agriculture. Constriction did not occur because three decades of heavy investment and tedious experimentation in fruit and vegetable cultivation had moved intensive agriculture to the threshold of prominence by 1900.* (Jelinek, p. 27)

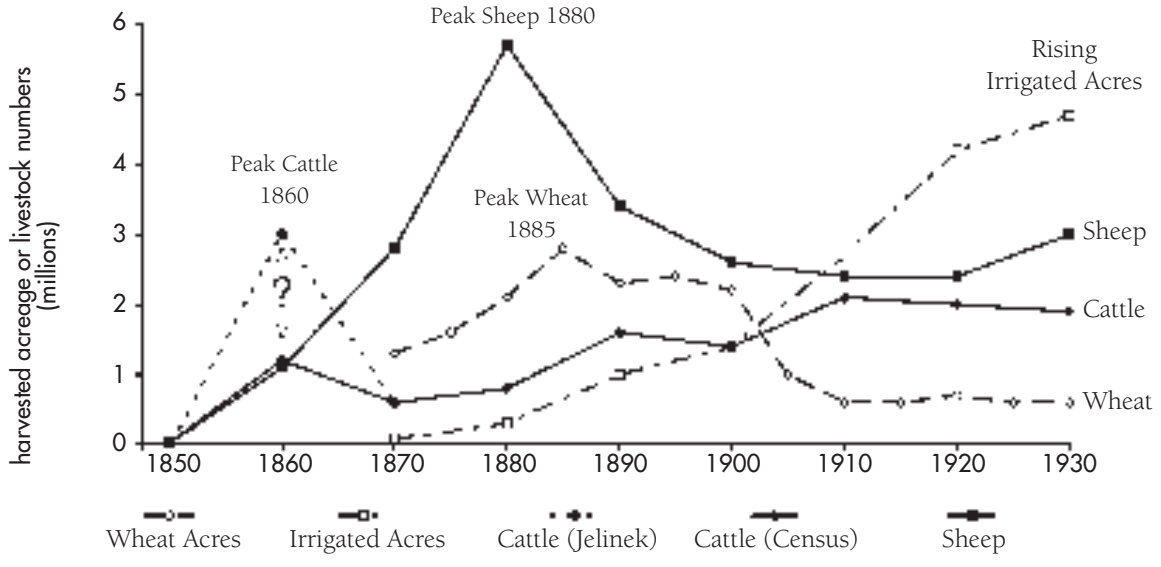
California Agriculture at the Turn of the Century

California agriculture at the end of the 19th Century had already experienced several transformations, from mission agriculture to cattle, to sheep, to wheat. Another transformation was under way that would forever shift California agriculture from extensive-dryland agriculture to intensive-irrigated agriculture. The magnitude and speed of each transformation was phenomenal, as is shown in Figure 1.

The cattle boom lasted less than 20 years, rising from 300,000 head in 1850 to perhaps three million head in 1860 and then falling back to 600,000 in 1870. Similarly, the sheep population grew rapidly from 1860 to 1880 and then dropped just as rapidly. Wheat (and barley) acreage likewise went from nothing in the 1850s to three million acres in the 1880s and then crashed to around a half million acres before 1910. Finally, as Figure 1 shows, the rapid growth of irrigated acres started in 1880 and tripled between 1900 and 1930. This is a proxy for the growth of irrigated horticulture and vegetable production.

> *During the successive periods when cattle, sheep and wheat held in turn the center of the stage, other kinds of agriculture destined to be of far greater importance were making slow but steady growth.* (Benedict, p. 397)
>
> *Major outlines of the state's agriculture were fairly well established by the beginning of the present century (20th). (Benedict, p. 398)*

Figure 1. **Selected Waves of Agricultural Development in California, Stylized Representation, 1860–1930**



Sources: Livestock numbers from U.S. Department of Commerce, Bureau of the Census 1961b. Cattle alternative estimates for 1860 are from Jelinek. Irrigated land numbers from Olmstead and Rhode 1997. Wheat Acreage from U.S. Department of Agriculture, Agricultural Marketing Service.

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Epochs of the First Half of the 20th Century

Epoch 5: Fundamental Transformation: Extensive to Intensive Agriculture (1890–1930)

The fourth transformation occurred very rapidly, as reported by Olmstead and Rhode.

> *The share of intensive crops in the value of total output climbed from less than 4 percent in 1879 to over 20 percent in 1889. By 1909 the intensive share reached nearly one-half, and by 1929, it was almost four-fifths of the total.* (1997, p. 5)

The growth in fruit shipments was rapid, increasing fivefold between 1890 and 1910 (Olmstead and Rhode 1997, p. 6). Jelinek (pp. 49–51) cites data to show spectacular growth in the number of fruit trees. He estimated that in 1880 there was a total of four million plum, peach, apricot, apple, and pear trees in California. In 1900 the total was more than 27 million. The most phenomenal growth was in oranges, from two navel orange trees planted in 1873 to 5.5 million orange-bearing trees in 1900.

California, aided by the transcontinental railroad and new cooling technology, soon expanded from servicing local needs to shipping product to Eastern U.S. markets. Overseas producers also were challenged.

> *The spectacular growth in California production had important international consequences as traditional Mediterranean exporters of many crops were first driven from the lucrative U.S. market and then faced stiff competition from upstart Californians in their own backyard of northern Europe.* (Olmstead and Rhode 1997, p. 6)

Most authors who analyzed the phenomenal transformation of California agriculture between 1890 and 1930 postulated a particular set of drivers. For Jelinek, the process was stimulated by prominent individuals but success really depended on four critical factors:

- Available agricultural labor from a succession of international sources—China, Japan, the Philippines, India, Mexico.
- Irrigation development—about one million irrigated acres in 1890 and almost five million by 1930.
- Improved transportation services—refrigerated rail shipping, trucking and rural roads, and improved handling, storage, and transportation technology.
- The development of marketing cooperatives that provided innovation in selling rapidly increasing production outside of California and to the world.

Rhode argues that the two dominant factors, though not usually discussed, were (1) rapid decreases in credit costs (interest rates declined significantly around 1890), and (2) horticultural productivity that was substantially improved by "biological learning." Rhode also identified four other drivers of importance, three of which are the same as Jelinek's:

- Mechanization (California was always a leader) – First commercial combine harvester, track-laying tractor, orchard sprayers, mechanical fruit and nut harvesters, etc.
- Irrigation – Small ditch irrigation schemes and newly formed irrigation districts, under the Wright Act of 1897, fostered expansion of surface-water irrigated acreage, and the 1890 invention of the centrifugal pump allowed greatly expanded groundwater use in the early 1900s.
- Labor – Large supplies of quality labor at low cost.
- Cooperatives – Innovative forms of collective grower action.

The major point is that the transformation from extensive grain growing and livestock grazing occurred relatively quickly and resulted from a complex interaction of many factors. From 1890 to 1930, the population of California increased fivefold (1 million to 5 million). Incomes rose rapidly from 1910 to 1929, which drove consumer demand toward fruits, vegetables, and livestock products and away from grains and field crops. A world-class agricultural research and extension system was established. Californians continued to import biological technology and test it, continuing in the spirit of Agostin Haraszthy and Luther Burbank. Finally, while inadequate rainfall at the wrong time of year limited rain-fed extensive agriculture, irrigation provided the final building block for producing a wide variety of products that thrive in California's hot climate and excellent soils laid down by millions of years of periodic flooding.

The 1920s, according to Benedict, was a period of relative optimism and rapid development. In the period 1919 to 1929, grape acreage expanded 94 percent; subtropical fruit and nut acreage, 82 percent; vegetable acreage, 91 percent; and temperate-zone fruit acreage, 63 percent. In contrast, acreage of cereals, hay, and other

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field crops fell (Benedict, p. 409). In part, this transition was responsive to changes in relative agricultural prices in the 1920s. All agricultural prices fell sharply in 1919 at the end of World War I (WWI), and grain prices stayed relatively low throughout the 1920s before plunging again in 1930. Prices of fruits, vegetables, nuts, and cotton, however, recovered substantially in the 1920s, fueled, no doubt, by rising incomes and a growing California population. Immigration in the 1920s amounted to 1.25 million people who came for well-paying jobs in growing cities.

Another indicator that California's agriculture did relatively better than U.S. agriculture in the 1920s is land prices. In 1920 the Index of Farm Land Value (1912–1914 = 100 percent) for the United States was 170 while the index of California land values was 167. By 1930, the U.S. index had fallen to 115 while California's remained at 160 (Benedict, p. 10). This probably reflects California agriculture's diminishing dependence on traditional grain and livestock products and rapidly improving productivity in horticultural products.

Thus, by 1930, California seemed on the way to agricultural riches, but ominous things were beginning to cause worry. Much of the expansion of irrigation in the period 1900–1930 came from groundwater sources; in 1902 less than 10 percent of irrigation water came from groundwater sources. The fastest expansion in groundwater exploitation occurred in the period 1910–1930, driven, in part, by widespread adoption of the centrifugal pump. The number of pumping units increased from approximately 10,000 in 1910 to almost 50,000 in 1930. Groundwater use again expanded in the 1940s, rising to 75,000 units in 1950 (Olmstead and Rhode 1997, p. 20). Groundwater had been perceived as an unlimited resource, but by 1930 problems with falling water tables, subsidence, and salinization were steadily approaching what Riesner called an ecological time bomb. The most promising source of water (groundwater) for further expansion of California agriculture was thus not only open to question but supplies were in danger of being reduced by continued overdrafting of underground water basins.

Epoch 6: External Shocks: Depression and War (1930–1949)

The threat of water shortages was only one of the pending shocks facing California agriculture. Let us begin this epoch with two telling quotes:

> *Thus California came to the beginning of the decade of the great depression with a vastly expanded and as yet unadjusted producing plant, with little experience in meeting depression conditions and with a comparatively heavy load of debt.* (Benedict, pp. 410–411)
>
> *The Depression had hit hard and late in California.* (Bradley, p. 148)

As we have seen, the 1920s was a period of rapid expansion in many perennial crops, where perennial-crop prices had fared better than grain prices. Therefore, the crash into the Depression was even more precipitous and shocking. Failing prices, exacerbated by significant droughts in 1929, 1931, 1933, and 1934, led to sharp contractions of farm income. Irrigated acreage dropped by one million acres between 1929 and 1935. The index of farm land values, which had been at 160 in 1930, plunged to 109 in 1933 (Benedict).

In the general economy, unemployment rose rapidly and job-induced in-migration virtually stopped by the early 1930s. But it was soon replaced by a further influx of poor farmers displaced by the Dust Bowl and the Depression. These new migrants, poor and unemployed, settled mainly in rural California, adding to an already volatile and sometimes violent labor situation. Contractions in demand hammered farm prices, drought reduced farm production (and income), surplus labor put downward pressure on wages, and poverty rates soared among both farmers and farm workers.

Agricultural prices showed some signs of recovery in the period 1933–1936, partly because of drought-induced crop failures and partly because of major federal efforts to reduce field-crop production under the Agricultural Adjustment Act (AAA) of 1933. However, the good years of 1937–1939 caused grain, livestock, and cotton prices to sink again. Financial stress became particularly acute. Export markets for specialty crops also contracted sharply and almost disappeared with the outbreak of war in Europe in 1939. California's agricultural exports basically ceased for three years before experiencing regrowth after the United States entered the war.

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The crisis of the 1930s fundamentally altered the policy environment in which California agriculture operated. Prior to 1930, California farmers opposed federal participation in agricultural affairs. According to Benedict,

> *The impact of the depression, with its debacle in farm prices, considerably modified the attitude toward federal action. . . . By 1933 the agriculture of California, like that in other areas, was in desperate straits. The magnitude of the problem was such that local action would obviously be inadequate.* (p. 422)

Federal intervention came on several fronts, including new forms of credit under the Farm Credit Administration. The AAA was a comprehensive program designed to reduce production and provide floor prices. The AAA instituted support (floor) prices for "basic commodities," including wheat, barley, rice, cotton, and milk. Though proposed as temporary, the measures became permanent parts of U.S. farm policy that remain today. Relatively generous support prices, coupled with California's efficiency in producing rice, cotton, and milk, no doubt contributed to rapid expansion of production of these commodities in the post-World-War-II (WWII) period.

The 1930s also saw major efforts by California agriculture to enlist state assistance in constructing a major water scheme to capture and transport northern Sierra water to southern Central Valley agriculture. The original Central Valley Water Project, proposed as a state operation that was to be financed by a voluntary bond sale, quickly received legislative approval. However, due to the deepening Depression, the bond sale was never initiated. Attention turned to the federal government, where the idea of spending to help agriculture while creating public works employment appealed to New Dealers in the early 1930s. In 1935 the Central Valley Project (CVP) became a Bureau of Reclamation project and, after 1937, a massive dam and conveyance system began to be constructed. The major impact on California agriculture would not, however, occur until after WWII.

Prior to the 1930s, irrigation development in California was almost exclusively financed privately. Less than 1 percent of irrigated acreage in California had been developed through federal action (Benedict, p. 421). The takeover of the CVP by the Bureau of Reclamation in 1935 and the state's subsequent development of the California Water Project in the 1960s meant that a large share of all subsequent surface-water development was publicly financed.

Just as the 1930s for California agriculture contrasted sharply with the growth and prosperity of the 1920s, the 1940s saw a return to prosperity and growth. The value of California agricultural output "grew tremendously . . . throughout the war years" (Bradley, p. 220). Acreage devoted to farming increased "an astounding 16.4 percent between 1940–1945" (Bradley, p. 220). Agricultural income was $452 million in 1940 and rose to $1.4 billion in 1945 (Bradley, p. 271).

This recovery was mainly a product of developments in the California and U.S. economies that were driven by the war effort. Durrenberger argues that WWII transformed California from a rural, natural-resource-based economy to a leading industrial and military state in just five years. The population in California almost doubled, from 5.6 million in 1930 to 10.6 million in 1950—with nearly four million of the increase occurring in the 1940s. In-migration resumed and, at its peak in the early 1940s, amounted to about a half-million people per year. California led all states in receipt of federal wartime expenditures. The state was a major contributor to the building of ships and airplanes, and the war spawned supporting industries, such as steel and construction, and caused massive increases in housing. "Over 90% of federal expenditure to promulgate the war in the Southwest Pacific was allocated to California" (Durrenberger, p. 101).

Even after hostilities ceased, higher levels of military spending persisted in California and growth in commercial air services sustained much of the employment in the aircraft business. As the economy boomed, the impact on the demand for agricultural products was obvious and substantial. Any likelihood of a postwar depression was put to rest by the beginning of the Korean War in 1950.

Unlike after WWI, there was not a sharp fall in agricultural prices and incomes after WWII. California agriculture continued to grow and diversify due to a combination of federal policy and an economy that was also growing rapidly, which prevented major price drops. Instead, the value of farm output in California grew by 24 percent in the period 1945–1950. To quote Bradley (p. 90),

> *In the space of ten years between 1937 and 1947 California agriculture moved from the crisis of the Depression, through an immensely profitable war, to a period of postwar expansion.*

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Expansion and its labor requirements made labor the dominant issue in California agriculture in the postwar 1940s and 1950s. The wartime boom had siphoned excess labor out of agriculture. California agriculture, facing rising wage rates, pressed for and received a program that allowed importing of Mexican labor. The federal Bracero Program, initiated in 1942, supplied significant quantities of farm labor through the boom years of the war and the postwar expansion of California agriculture.[2]

Water then replaced labor as the dominant issue in California agriculture. Expansion of agricultural production caused groundwater overdrafts to resume in the 1940s. However, construction on the CVP was suspended during the war years (1942–1944), delaying the availability of new surface-water supplies to production areas with overdrafted groundwater supplies.

In 1948, California permanently took over as the largest agricultural state in the Union in terms of value of production (Bradley, p. 96).

California Agriculture at Mid-Century

California agriculture arrived at the end of the first half of the 20th Century alive and well and ready to face new challenges. Credit constraints had been removed; machinery shortages of the war years were gone, and productivity was poised to soar. Substantial quantities of new water would soon arrive under the CVP. Henry Beckman, in a review of the first 100 years of California agriculture as printed in *California Cultivator*, made the following conclusion in 1947 (which could just as easily have been penned in 2000).

> *Those [preceding] years have brought their problems, variable, vexatious and challenging. No sooner has one problem been solved than another appears. . . .*
> *It is scarcely to be expected that new and equally trying problems will not continue to confront us. Our new proximity to all parts of the world; our increasing foreign trade and our wide spread airplane travel will continually expose us to the danger of importing pests and diseases. . . . Our markets . . . will become increasingly sensitive to our social, political and economic relationship to other countries. The increasing drain on our water supply will call for engineering and scientific exploration in areas yet untouched.* (p.43)

Epochs of the Second Half of the 20th Century

California emerged from the first half of the 20th Century as the leading state in the U.S. military/industrial complex. Its agriculture had weathered the Depression, had regained health during WWII, and was poised to expand as the CVP came online. At mid-century, the future must have been seen as a time of great promise for the state.

The second half of the century, at least until the 1990s, met that promise. California's population grew in the next 50 years from 10 to 35 million people. California gross domestic product (GDP) generally grew faster than that of the United States, meaning per-capita California GDP exceeded the U.S. GDP in most years. In fact, by the end of the century, California was being touted as either the fifth or sixth largest economy in the world, exceeding Canada in both population and GDP and Italy (both members of the so-called G–7) in GDP. The growth was fueled by rapid expansion, first in the aerospace industry and then in electronics and computers. California led the nation in both fields. Also, military expenditures remained high through the 1980s. For example, in the 1960s California received 20 percent of all U.S. defense contracts (Durrenberger, p. 102).

Of course, when defense cutbacks came in the 1990s, California suffered a disproportionately high share of defense reduction. Immigration slowed substantially, a severe recession struck the state in the early 1990s, and the state continued to suffer through a prolonged and severe drought. A rapid recovery in the second half of the 1990s, fueled in part by the "dot com" boom, quickly collapsed into a recession in the first years of the 21st Century, bringing with it severe financial difficulties for the state.

We now proceed with the last two vignettes in our epochal history. It goes without saying that it becomes more difficult to describe California agriculture in simple or brief terms. Still, despite the increased complexity, the need for brevity persists. Therefore, what follows in Epoch 7 (1950–1970) and Epoch 8 (1970–2000) are at best highlights and more likely are selective illustrative anecdotes.

[2] The Bracero Program was terminated in 1964.

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Epoch 7: Big Water, Growth, Relocation, and Diversification (1950–1970)

The decades of the 1950s and 1960s were boom periods in California. The population nearly doubled from a little more than ten million in 1950 to almost 20 million in 1970. The 1950s were particularly explosive; population increased by 5.1 million—a more than 50 percent increase within one decade. Incomes grew quickly as the Cold War spurred rapid economic growth, particularly in the new aircraft and electronics industries as well as in older line industries such as agriculture and motion pictures. Massive investments in infrastructure continued in water projects, highways, airports, ports, higher education, and urban development. Virtually all of the increase in population was in burgeoning urban areas on the south coast, particularly in the Los Angeles basin and the San Francisco Bay Area to the north.

With rapidly expanding housing growth, mostly in sprawling single-home subdivisions, urbanization accelerated the takeover of agricultural land. In just 20 years, Los Angeles County went from producing the highest value of agricultural production in the state—and in the nation—to being out of the "top ten" California counties in 1970. Vast stretches of Orange and San Diego Counties, longtime major producers of citrus and subtropical fruits and vegetables, were developed quickly, beginning in the 1960s with the Irvine Ranch and continuing through the 1970s and 1980s. In the north rapid urbanization quickly consumed much of Santa Clara County's agriculture, pushing fresh- and dried-fruit production into the Sacramento and northern San Joaquin Valleys.

The rapid relocation of production was able to occur, in part, because the state's stock of irrigated land increased from less than five million acres in 1945 to more than seven million acres in 1970, peaking at around 8.5 million acres in the 1980s. Virtually all of the expansion came from publicly funded large-scale projects. Water in the Delta-Mendota Canal in 1953 signaled completion of the CVP, which "brought over a million additional acres of San Joaquin Valley land into production by the mid 1950s" (Bradley, p. 199). The SWP was nearing completion at the end of the 1960s, bringing in excess of a half-million new acres into production in the southern San Joaquin Valley.

The cumulative impacts of population and income growth, urbanization, and new production opportunities opened by water transfer led to rapid and significant changes in California agriculture. The changes involved expansion both in the suite of crops produced and in alterations in the location of production. We identify three examples.

First, Southern California's dairy industry moved from southern Los Angeles and northern Orange Counties to eastern Los Angeles County (Chino and Pomona) and then to western San Bernardino and Riverside Counties in the 1950s and 1960s. The dairy industry eventually migrated north into the southern San Joaquin Valley, where it is now concentrated in Tulare and Merced Counties.

Second, the citrus industry experienced a similar migration, first east to Riverside and San Bernardino, then north. Today, more than 50 percent of the state's production is in Tulare County, compared to nearly 45 percent of production in Los Angeles and Orange Counties in 1950.

Third, rapid urban development in the south San Francisco Bay Area pushed deciduous fruit production out of the Santa Clara Valley into the Sacramento and Northern San Joaquin Valleys. Using prunes as an example (we could use apricots or peaches as well), in 1950 nearly 80 percent of the 100,000 bearing acres of prunes were on the central coast. The ratio of nonbearing to bearing acreage was "0.09".[3] By 1960, the nonbearing to bearing ratio for the state had tripled to 0.34, but in the Sacramento Valley it was an astounding 0.82. In those two decades, prune acreage in the Sacramento Valley increased from 20,000 to 50,000 bearing acres. By the end of the century, virtually all prunes would be grown in the upper Sacramento Valley. And with this massive relocation came substantial increases in yields because of new trees, better varieties, higher planting densities, and new cultural practices. Prune yield in 1950 was 1.46 tons per acre, in 1970 it was 2.08, and in 1987 it topped 3.0 tons.

Crops also moved as new water became available. One significant example is almonds. In 1950 half of the

[3] Permanent plantings vary in the length of their economic life once they begin to bear an economic crop. If the normal economic life of an orchard was 20 years, for example, orderly replacement (nonbearing acreage) of a stable bearing average would be 5 percent (0.05) of bearing acreage. Ratios of nonbearing-to-bearing acreage greater than 0.05 would signal future expansion of bearing acreage.

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state's almonds were grown in the Sacramento Valley, 25 percent in the San Joaquin Valley, and the remainder in coastal counties. There were 90,000 bearing acres and about 18,000 nonbearing acres (ratio 0.20) geographically distributed in the same ratio as production. Yields averaged 0.42 tons per acre. Statewide in 1970 there were 148,000 bearing acres and nearly 90,000 nonbearing acres (a very high ratio of 0.6). Of these, 74,000 bearing acres and 70,000 nonbearing acres were in the San Joaquin Valley. In 20 years, yields doubled to 0.84 tons per acre. By 2000, 80 percent of production was in the San Joaquin Valley, 20 percent in the Sacramento Valley, and virtually none on the coast. Yields now average well over a ton per acre.

The expanded availability of both federal (CVP) and state (SWP) water, coupled with relatively high federal commodity price supports, also led to rapid expansions in cotton and rice production despite generally low and declining field-crop prices in the 1950s and 1960s. Along with an increase in production, a significant change in U.S. commodity policy in 1965 rapidly increased exports of basic commodities (e.g., corn, wheat, cotton, rice) because these exports were now priced competitively in world markets.

The bottom line is that the 1950s and 1960s saw the beginning of a second fundamental transformation of California crop agriculture in terms of expansion, changing composition, relocation, and greatly enhanced yields. The dominant driver of this transformation was productivity growth. Traditional field crops, as a share of production, declined steadily, to be replaced by higher-valued, income-sensitive crops. Higher incomes plus urbanization accounted for the rising importance of fresh vegetables and horticulture products in California agriculture.

Rising incomes after WWII also fueled a rapid expansion in consumer demand for beef. U.S. consumption rose from somewhat more than 50 pounds per capita in 1950 to almost 95 pounds in the mid-1970s. California's livestock sector responded to that demand expansion in a big way. One of the most phenomenal growth patterns observed was the practice of fattening slaughter beef in confined feedlots. Cattle numbers in California had been flat from 1900 to 1940, at approximately 1.4 million head. Numbers increased to 3.9 million head in 1969—a 250 percent increase (Olmstead and Rhode 1997, p. 12). Overall, the state's feedlot industry exploded after WWII, increasing from 125,000 head in 1945 to one million head in 1965 (Scheuring, p. 190).

> *More than a million beef cattle are currently* [*middle 1960s*] *being fattened in the state—a number 8 times as great as the number under feed in 1940.* (Durrenberger, p. 107)
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> *Between 1953 and 1963, the number of cattle on feed in California and the capacity of the state's feed lots tripled.* (Olmstead and Rhode 1997, p. 12)

Again, California led the nation in new approaches to large-scale agricultural production. However, by the 1970s, large-scale feedlots were established in Arizona, Colorado, Texas, and the Midwest, areas generally more proximate to Great Plains and Midwestern feed supplies. Also, per-capita beef consumption steadily declined after the 1970s, stabilizing around 66 pounds per capita in the 1990s and early 2000s.

California's second beef boom was replaced by the significant expansion of the dairy industry. In 1950 there were 780,000 dairy cows in California—19,428 farms with an average of 40 cows per farm. Average production per cow was 7,700 pounds of milk per year. In 1970 there were slightly less than 5,000 farms, nearly a 400 percent reduction, but the average number of cows per farm had nearly quadrupled to 150. Each cow now produced an average of almost 13,000 pounds per year—yields nearly doubling in 20 years.

The dairy transformation had begun. It would play out dramatically over the next 30 years so that in 2001 there were but 2,157 dairy farms with an average of 721 cows each and yielding more than 21,000 pounds of milk per cow. Production increased even more rapidly because the number of cows also increased from 700,000 to 800,000 in the 1950s and 1960s to 1,555,000 in 2001. The dairy industry emerged as the dominant commodity in the agricultural portfolio of California. In 1993 California overtook Wisconsin as the number one milk producer in the nation and now accounts for 48 percent of the U.S. nonfat dry milk production (number one), 28 percent of U.S. butter (number one), and 18 percent of U.S. cheese production (number two).

There are many other stories that could be told about the boom period of the 1950s and 1960s, but the picture that emerges is clear: a dynamic, demand-driven agriculture responding to each instance of production relocation (whether driven out by cities or moving to water) with

substantially increased productivity. Aided and abetted by a constant supply of new technology, agriculture in the 1950s and 1960s grew rapidly. It existed in a state that was growing very rapidly and getting rich fast. Despite this record of rapid growth, the next three decades were going to be even more explosive but also more unstable. Whereas the 1950s and 1960s were characterized by relatively stable prices, increased price volatility in the next three decades would lead to substantial swings in the profitability and economic sustainability of firms in California agriculture.

Epoch 8: Ups and Downs, Intensification, Internationalization, and More Ups and Downs (1970–2000)

As California agriculture entered the last three decades of the 20th Century, and despite ongoing growth in specialty-crop production, it maintained a predominant basic-commodity orientation. Field crops together with livestock and livestock products accounted for 56 percent of the value of agricultural sales in 1970. Basic (traditional) commodities were priced in national markets, and California producers responded to these national prices and transportation differentials. Government policy supported stable prices. By the end of the epoch, less government policy emphasis on domestic prices became the norm along with wider price swings induced by rapid changes in both consumer and export demand for California's agricultural produce.

Many vegetables, fruits, and nuts were exclusively produced in California. At the very least, if not exclusive to the entire U.S. production, they were definitely exclusive during certain production seasons. Specialty crops enjoyed multiple market options (fresh and/or processing), but those options would become less easily accessible over time.

European and Asian economies, which were growing markets throughout this period, gradually gained increased influence over agricultural prices, making the California producer more exposed to offshore economic conditions. While foreign economic conditions were not a significant factor at the start of this period, they emerged abruptly in the mid-1970s and added considerable turbulence to agricultural markets during the 1990s.

This epoch witnessed an eroding shift from a heavy reliance on production of undifferentiated commodities toward a more diverse, more specialized agriculture that responded more directly to consumer demands for food, fiber, and horticultural products. Beginning with an expanding production base in the San Joaquin Valley that was initially heavily devoted to field-crop production, California agriculture aggressively shifted over time toward higher-valued, more capital-intensive crops as markets permitted. The mass of production for many products shifted into the San Joaquin Valley from both the south and the north as markets expanded. Producers throughout the state scrambled to find opportunities that yielded acceptable economic returns to factors of production. The large shares marketed through cooperatives declined as producers apparently lost confidence that co-ops could make the transition to consumer-demand-driven marketing as efficiently as newer players focusing on more diversified market outlets for their products. Contractual arrangements and supply coordination increasingly replaced open or spot markets even for undifferentiated commodities. Producers observed an increasing concentration of off-farm processors and marketers. Some producers invested heavily to better integrate their operations vertically and horizontally to achieve economies of size and scope.

The introduction to the state's agricultural statistical summary for 1970 noted that "some 200 crops are grown in California, including seeds, flowers, and ornamentals" (California Crop and Livestock Reporting Service 1971b, p. 5). The statistical report for the 2000 crop year reported a significant numerical revision, noting that "some 350 crops are grown in California, including seeds, flowers, and ornamentals" (California Department of Food and Agriculture 2001, p. 35), nearly doubling crop numbers over the three decades. The crops currently on the market reflect a much wider array of processed forms to better satisfy consumer and food-service institution demands.

The increased number of commodities and product forms available reflected changes in the composition of both domestic and export demand. Domestic population increased substantially. Higher income, dual-income households demanded new product forms, and the growth of ethnic populations brought new crop demands, particularly from growing numbers of Hispanic and Asian consumers. Many consumers preferred and demanded convenience over even the most basic food preparation

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for many of their meals. Per-capita consumption shifts included changes in livestock demands (more chicken and fish relative to red meats) and in the demand for more fresh, rather than processed, forms of many vegetables and fruits. Export markets also required different product forms than did domestic markets.

By the end of the 20th Century, there were nearly 35 million people residing in California (up from 20 million in 1970). One out of eight persons in the United States now resided in California, making the state's diverse population an important, primary market for food and nursery products.

The epoch began and ended with two contrasting water-resource scenarios that were also greatly influenced by population growth. Agriculture, which foresaw prospective ample quantities in the 1970s, now, in the face of resource competition from urban and environmental demands, was confronted with increasing water-resource scarcity and uncertainty at the turn of the century. Increased surface-water deliveries occurred following completion of Oroville Dam and San Luis Reservoir in 1967 and 1968, respectively, and with extensions of the California Aqueduct serving west-side and southern San Joaquin agriculture in the early 1970s. The Kern County Intertie Canal, which connected the east side of the valley with the aqueduct, was completed in 1977, signaling the state's completion of major surface-water delivery systems. Even though there was a pronounced shift from field crops to higher-valued commodities in major areas of the San Joaquin Valley, the large increment in newly developed, better-irrigated lands served a total of 4.25 million acres of major field crops (cereals, cotton, sugar beets) in 1970—a level even higher than that reported for 1950. Later in the epoch, extensive crop acreage fell with the addition of more higher-valued crops. A second significant increment in surface-water availability was extension of the CVP's Tehama-Colusa Canal, enabling intensification of production on the west side of the Sacramento Valley (e.g., tomatoes, almonds, and vegetable seeds). Thus, California agriculture was flush with new surface-water supplies at the outset of this epoch.

However, two of the century's more severe droughts occurred during this period—the first in 1976–77 and the second over the period 1987–1992. The former was more severe, but the latter, longer drought had a far greater impact on agriculture. Both droughts sharply reduced water deliveries from the north to meet the growing needs of San Joaquin Valley agriculture. Average runoff in the Sacramento and San Joaquin hydrological areas fell to half of normal levels in the 1987–1992 drought. As a consequence, groundwater extractions in the San Joaquin Valley exceeded recharge by 11 million acre-feet during the 1987–1992 drought (Department of Water Resources).

At the end of the epoch, agricultural water supplies were reduced by new CVPIA requirements on CVP deliveries plus an inability to transfer supplies through the Delta due to environmental and physical system concerns even if surface water was available. The imminent reduction of Colorado River water supplies to the Metropolitan Water District of Los Angeles could also reduce surplus water supplies and create additional competition for moveable water. Water markets were developed during this period to facilitate the transfer of water among individuals and agencies in both annual and longer-term arrangements. But surplus water to serve future agricultural uses had evaporated from the system. Astute water management, including water transfers and water banking, was required in most agricultural regions by the end of the epoch.

The 1970s

The early 1970s can be characterized as a period of aggressive expansion fueled by improving world markets and concern about "feeding a hungry world." Product prices were strong for food commodities. U.S. producers were cheered on by Secretary of Agriculture Butz "to plant fence row to fence row," promising the end of supply controls, long an integral piece of U.S. farm policy. With strong prices came a rapid run-up in U.S. farm asset values. The resulting increase in the value of farm assets fulfilled lenders' security requirements for an increasingly capital-intensive, expanding California agriculture.

Worldwide market demands collapsed later in the 1970s, but U.S. farmland values continued to rise into the early 1980s, in part due to negative real interest rates. Farmland appreciation, adjusted for inflation, over the period 1958–1978 was nearly 80 percent while common stocks lost 20 percent and cash lost nearly 50 percent (*Business Week*). Such information spurred substantial investments in U.S. and California farmlands by individuals, institutional investors, and even foreign investors, creating a price bubble that would collapse in the mid-1980s.

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Nationwide, the index of farm real estate values was 245 percent more in 1980 than in 1970. Because California agriculture had not benefited as greatly from rising basic commodity (cereals and oilseed) demands worldwide, the 1980 farm real estate value for California was only 110 percent higher than the 1970 value. Irrigated land increased more than nonirrigated land, and there were relatively larger increases in value in the San Joaquin Valley than in the Sacramento Valley.

Some permanent plantings exhibited excessive land-price escalation. Almonds and grapes were two permanent crops that attracted significant investment during the 1970s.

Commodity Example – Almonds. Almonds were aggressively planted in the San Joaquin Valley beginning in the late 1960s. Nonbearing acreage amounted to more than 60,000 acres for all but two years from 1968 to 1982, and bearing acreage quadrupled from about 100,000 acres in the mid-1960s to 400,000 by the mid-1980s. Yields increased from three-quarters of a ton per acre to one ton and more. Exports expanded rapidly as supplies increased, accounting for about two-thirds of the crop by the end of the 1970s. The per-acre value of San Joaquin Valley almond orchards increased from $2,250 in 1970 to a peak of $8,570 per acre in 1983 before the investment bubble burst. Within five years, the average value for almond-orchards would fall by 40 percent to $5,200 per acre. Older marginal plantings in northern areas became uneconomical and were removed, further accentuating the shift of production to the San Joaquin Valley. Total bearing acreage stabilized in the range of 400,000 to 430,000 acres from the mid-1980s to the mid-1990s.

Commodity Example – Grapes. Grapes also attracted significant investments with most of the expansion also taking place in the San Joaquin Valley. The bearing, producing acreage of wine grapes statewide was between 120,000 and 130,000 acres for a long period—from the mid-1950s through the decade of the 1960s. As consumers expressed increasing interest in California wines, nonbearing acreage skyrocketed, amounting to 25,700 acres in 1970, 54,000 in 1971, 104,200 in 1972, and 149,000 in 1973. Most of the new nonbearing acreage in 1973 was in the San Joaquin Valley (about 82,000 acres) and in the emerging central coast wine-growing region (about 38,000 acres). The statewide bearing acreage of wine grapes rose sharply from about 132,000 in 1970 to 318,000 by 1977. Another bubble arose. The per-acre value of San Joaquin Valley wine-grape vineyards increased from $1,475 in 1970 to a peak of $9,770 in 1982 before a precipitous drop to only $4,000 by 1986. The appearance of surplus wine grapes also affected the fortunes of producers of Thompson Seedless grapes (traditional raisin producers but also historical suppliers of grapes for lower-quality wine products). Raisin vineyards had increased in value from $1,550 in 1970 to $10,840 per acre in 1980, but by 1986 their decapitalized value was also only about $4,000 per acre.

Lesser-quality San Joaquin wine grapes proved to be of little interest to the wine industry given the increased supply of superior-quality grapes emanating mainly from coastal production regions. Central coast vineyards rose in value (to $16,640 per acre in 1984) and, after only a modest adjustment, rose further to more than $20,000 per acre by the 1990s. Prices also escalated in premium north coast production areas.

By the end of the 1970s, substantial investments in perennial crops pointed toward the first of the epoch's "ups and downs," concluding with a mid-1980s collapse of land prices. Readjustment would affect producers across the length and width of the state.

The 1980s

The decade of the 1980s began with the apparent overproductive capacity of U.S. and California agriculture. Both were unable to respond to the loss of newly gained export markets and general weakening of world economic conditions following the energy price run-up of the mid-1970s. Plus, some remaining groundswell from the 1970s continued in California as investment funds sought higher returns in agriculture, further contributing to unprecedented plantings of permanent crops. Commodity prices fell, input prices and interest rates rose, export demand turned down, and farm income declined. Even though it was evident that basic commodity prices were low, some apparently thought that California specialty-crop producers might be immune to agriculture's declining economic fortunes, but that obviously was not to be.

The farm financial crisis began in the Midwest but gradually affected all of U.S. agriculture, including California's, where the impact was delayed and of lesser magnitude. Farm incomes fell in the face of high debt loads incurred in the land-buying and investment binges of the 1970s. Highly leveraged farms and farm investments

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were particularly vulnerable to sharp changes in economic fortunes. Consequences included rapid and deep decapitalization of assets, bank foreclosures of farms and ranches, and secondary and social impacts that permeated much of the economy. From 1982 to 1987, land values fell by as much as 60 percent in Iowa and Minnesota and by at least 40 percent in most Midwest and Great Plains states. California land prices fell by a lesser amount—28 percent on average. They would later improve for specialty-crop land but not for widely available field-crop lands that lacked higher and better use potentials.

The mid-1980s was a period in which California agriculture sought to right itself from the fallout of the financial crisis. Lenders reevaluated behavior that had resulted in overextended lines of credit that had to be "worked out" following the crisis. Some producers maintained that credit was rationed, but lenders maintained that ample credit was available for applicants with portfolios reflecting appropriate credit risk. Cooperatives came under increasing pressure to yield economic returns commensurate with those of other outlets. Growers sought more immediate economic returns, in part to satisfy lenders' operating loan requirements. Rising environmental concerns provided additional challenges regarding rice straw burning, use of chemicals, endangered species, and more balanced water use among agricultural, municipal, industrial, and environmental-use claimants. Structural adjustment within the processing sector occurred as older plants, many of which were located in urban and urbanizing areas in Southern California, the San Francisco Bay Area, and the Sacramento region, closed.

Prices gradually rose and markets strengthened by mid-decade with rising domestic demand and expanded exports to Europe and Asia. Events were gradually righting a badly tossed sector when the 1987–1992 drought appeared on the horizon to ultimately affect all California agriculture. This was yet another severe shock to the system. In particular, the west side of the San Joaquin Valley was pummeled by a nexus of water issues, e.g., reduced water supplies, inadequate off-farm drainage, and rising water tables, extending through the decade of the 1990s. Selenium toxicity in the Kesterson Wildlife Refuge was a harbinger of future environmental challenges.

The 1990s

Two additional early-decade shocks would impact agriculture in the 1990s. A four-year recession (1990–1994) softened domestic demands and affected capital markets. The CVPIA in 1992 abruptly changed the political economy of federal water availabilities, curtailing water deliveries south of the Delta. Farms on the west side of the San Joaquin Valley were impacted financially as water became at once more expensive and scarcer because of both drought and regulatory change or, as some saw it, because of a combination of natural and regulatory droughts. Financially leveraged farms again faced foreclosure pressure. Lending institutions this time were quicker to secure and dispose of foreclosed assets. Quick disposal depressed the land market and the value of collateral assets to the chagrin of marginally solvent producers and firms.

Weakening of Japanese and Asian economies again affected U.S. commodity exports. However, California's specialty-crop exports were impacted to a lesser extent, and nut crops and grapes in particular enjoyed more favorable markets and prices. Large investments again appeared for perennial crops from investors and from growers seeking to broaden production portfolios to include higher-grossing crops. Ample farmland was still available for these higher and better uses relative to production of field crops, which was still plagued by the low prices of the early 1990s.

By mid-decade, export markets were again strong, including those for basic field-crop commodities. In the main, prices strengthened for the products of California's agricultural sector through 1996–97, with variations from commodity to commodity (generally strong for cotton, tree fruits and nuts, wine grapes, cereals, and milk products, for example; variable for fresh produce; and weaker for citrus and beef). Low interest rates continued to feed investments in permanent plantings.

Producers of basic commodities enjoyed high export demand when new federal farm legislation was put in place in 1996. In the first year of the farm program, producers enjoyed healthy market prices *and* decoupled farm-program payments, but shortly thereafter economic fortunes again reversed. Within a couple of years, world economies again softened and farm prices were low across a wide spectrum of both basic and specialty commodities—and the domestic economy also faltered. An *ex post* doubling of federal program payments sought to shore

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up basic commodity producers. Acreage remained in production despite low prices.

The ups and downs of the 1990s were also marked by significant structural change. Brand-name fruit and vegetable processors (Hunts, Del Monte, Heinz) closed processing facilities. Other processing outlets disappeared. The bankruptcy of Tri Valley Growers in 1999 had a disastrous effect on producers already at the margin. Consolidation reduced the number of input suppliers available to growers. Increased buyer concentration in fresh produce squeezed out many grower/shippers, placing more reliance on large firms capable of supplying customer needs on a year-round basis. With widespread and rapid changes in the competitive environment, product prices fell while production costs continued to rise, further squeezing production agriculture.

Contractual arrangements became increasingly critical to preserve shrinking margins. Some growers countered by integrating processing and marketing activities. Even though farm financial advisors had been more temperate regarding increasing debt loads, many growers and agribusiness firms experienced difficulty in continuing their farming operations.

At Century's End

At the century's end, California's agricultural producers once again were seeking to stay upright while searching to reright their economic fortunes. The industry had witnessed significant change over the preceding three decades.

The sector was more diverse in production and less dependent on field-crop and livestock (except for dairy) production than in 1970. Contractual marketing arrangements for agricultural production were now the norm in this new, higher-valued production system, changing marketing channels and risk exposures of producers and contracting firms. Field crops, livestock, and livestock products (other than milk and cream) contributed less than 20 percent to agricultural markets in 2000 whereas specialty crops now dominated—28 percent fruit and nut crops, 26 percent vegetables, and 11 percent nursery and greenhouse products. Dairy products alone contributed nearly 15 percent of the value of agricultural products sold in 2000.

The sector was also more export-oriented. Despite a drop of 5 percent below peak levels in 1997, the value of California agricultural exports amounted to $6.6 billion in 2000. Agricultural commodities with ratios of farm quantity exported to farm quantity produced of 20 percent or more in 2000 included cotton lint (78 percent); almonds (71 percent); walnuts (46 percent); prunes (40 percent); dry beans (36 percent); grapefruit (35 percent); plums and rice (34 percent); apples, apricots, and onions (28 percent); oranges (27 percent); broccoli and fresh tomatoes (26 percent); dates and pistachios (23 percent); asparagus and cherries (22 percent); and cauliflower (20 percent).[4]

Competitive pressures increased for water resources throughout the state and for land in some areas, particularly in the northern San Joaquin and southern Sacramento Valleys. Environmental issues continued to command attention with more emphasis on in-stream water use, dairy-waste management, new chemical standards, water quality, and particulate matter (air-pollution) concerns. With ample field-crop land and increased permanent plantings, values for open agricultural land for agricultural uses have remained relatively stable over the past decade. The major exceptions include varietal wine-grape vineyards in premium coastal areas, irrigated vegetable land on the south and central coast, and dependably watered, developable land in the San Joaquin Valley.

The two dominant underlying forces affecting regional shifts in the location of agricultural production have been population growth and water-supply conditions. Rapid postwar and continuing urban and suburban population expansions forced relocation to interior valleys, first from the Los Angeles basin and later from the Central Coast and San Francisco Bay Area.

[4] Comparable export shares are not available for earlier decades.

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III. THE CHANGING STRUCTURE OF CALIFORNIA AGRICULTURE, STATISTICS, AND FINANCIAL INDICATORS: 1950–2000

A fuller appreciation of changes of the recent half century is the immediate precursor to an examination of the state of California agriculture as the industry enters the 21st Century. We first review the changing character of California agriculture from 1950 to 2000, focusing on major shifts in the structure of production (crops versus livestock, intensive versus extensive products), commodity composition, and geographic distribution. We then document the increasing importance of exports, followed by statistical information and financial indicators comparing California and aggregate national (U.S.) agriculture with respect to farm numbers, land in farms, farm real estate values, farm income, and selected financial ratios.

The Changing Character of California Agriculture: 1950–2000

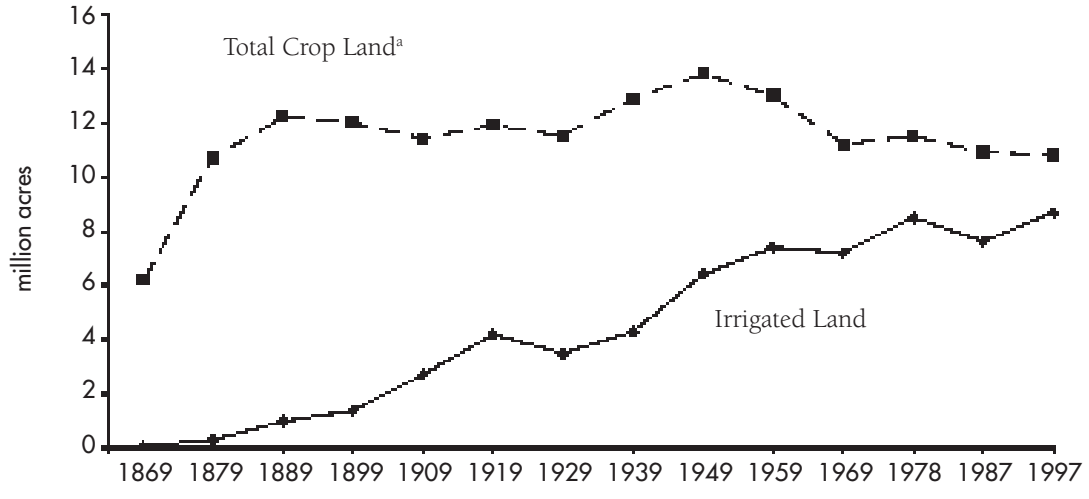
Irrigated Area

Without doubt, the most significant structural changes of the half century were those that followed the addition of two major water projects that came online in this period. Together, the federal CVP and the California SWPT brought more than three million additional acres under irrigation. As shown in Figure 2, irrigated acreage grew from 4.3 million acres prior to WWII to 6.4 million at the start of the 1950s. Expansion, mostly from CVP supplies, increased irrigated acreage to 7.4 million in 1959 and subsequent increases, mostly from SWP deliveries, yielded 8.5 million acres in 1978. The most recent census indicated that there were 8.7 million acres of irrigated land in 1997.

Value of Production

Expansion in irrigated production capacity plus rapid increases in productivity allowed California agriculture to experience very rapid growth in output at good prices (except for grains in the 1950s and 1960s) until the early 1990s. Demand growth fueled by rising incomes and population growth kept California agriculture on a steep growth path. In constant 1996 dollars, the market value of agricultural products sold grew from $400 million in 1950 to nearly $27 billion in 1997 (see Figure 3). The

Figure 2. **Total Crop Land and Irrigated Land in Farms in California, 1869–1997**



[a] Not fully comparable for the various census years.

Sources: 1869–1919 from Olmstead and Rhode 1997; 1929–1959 from U.S. Department of Commerce, Bureau of the Census 1967; 1969–1997 from U.S. Department of Agriculture, National Agricultural Statistical Service 1999.

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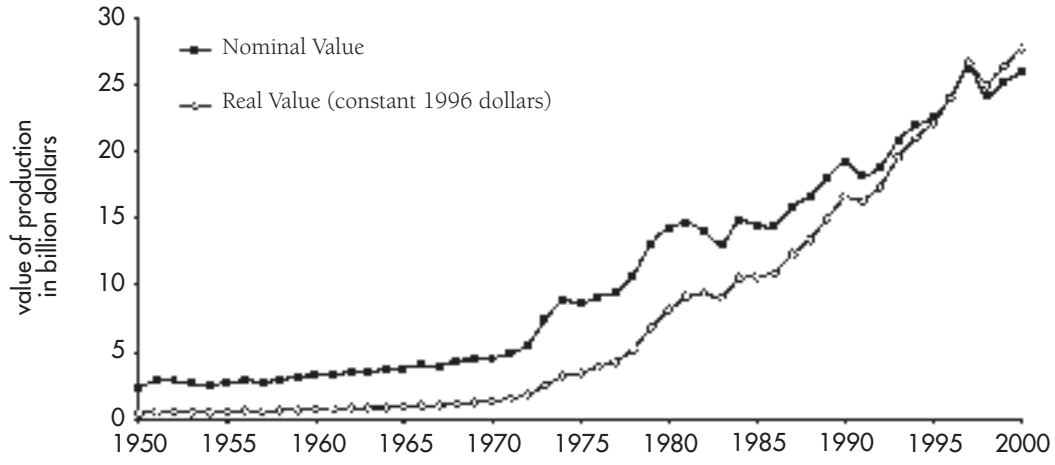
Figure 3. **Value of California Crop and Livestock Production in Nominal and Constant 1996 Dollars, 1950–2000**



Sources: U.S. Department of Agriculture, Economic Research Service 2003b. U.S. President 1960, 2001.

upward trend in the real value of agricultural production was tempered by short periods of decline—in the mid-1970s (weaker foreign markets) and early 1980s (weak markets in general) and by economic recessions in the early 1990s and again at the end of that decade. However, within that overall picture of growth, there were significant changes in the composition of output, the importance of particular commodities, and the geographic location of production.

Plant versus Animal Production

The shares of the value of agricultural product sales coming from plant and animal products changed persistently over the past 50 years. As shown in Figure 4, crops made up 61 percent of sales in 1950 while livestock accounted for 39 percent.[5] The shares remained relatively constant throughout the 1950s and 1960s with expansions both in crop production (acreage expansion) and livestock production (beef feedlots and dairy). However, livestock shares then fell steadily so that in 2000 three-quarters of the value of California production came from plant production (more intensive crops, i.e., perennials, vegetables, and nursery crops) and only one-quarter from livestock. The crop share in California was much higher than the U.S. average of roughly 50/50 and significantly different from European agriculture, where animal products generated approximately two-thirds of sales.

Additionally, these broad trends hide significant changes that occurred within both the plant and livestock production categories. Figure 5 shows the shares of crop production made up by major crop categories: field crops (cereals, cotton, hay, etc.); fruits, nuts, and berries; vegetables and melons; and nursery and greenhouse products. Over 50 years, the field-crop share of total crop production fell steadily, dropping from 33 percent of value in 1950 to less than 10 percent in 2000. The share of intensive agricultural crops (fruits, nuts and berries plus vegetable crops) rose from 63 percent in 1950 to 77 percent of total crop products by 2000. Growth was most pronounced in nursery products (rising from 4 percent to 15 percent). These latter trends no doubt reflected (1) the shift in the preference of consumers with rising incomes toward fresh products, and (2) phenomenal growth in urban populations.

Shares also shifted significantly within the livestock sector. In 1950 poultry and poultry products made up about 23 percent of the value of production, dairy products constituted 26 percent, and meat animals

[5] It is interesting to note that these are nearly the same shares that existed in 1910 (62 percent crops and 38 percent livestock).

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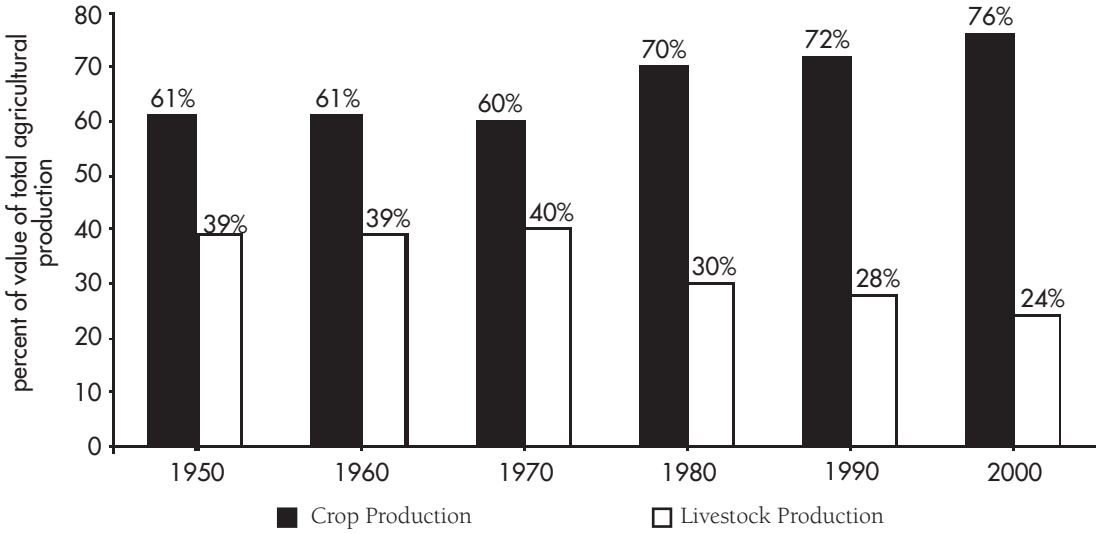
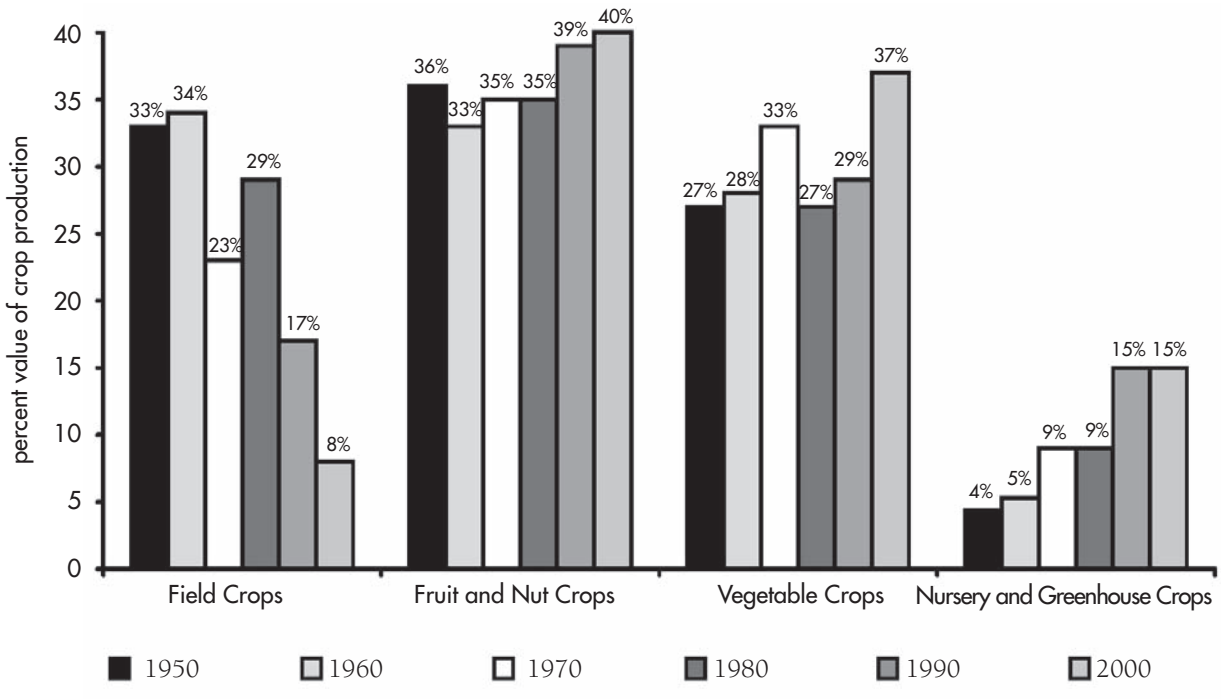
Figure 4. **Crop and Livestock Shares of Total Agricultural Production in California, 1950–2000**



Source: U.S. Department of Agriculture, Economic Research Service 2003b.

Figure 5. **Relative Shares of the Production of Major Crops in California, 1950–2000**



Sources: Field crops, fruits and nuts, and vegetables from U.S. Department of Agriculture, Economic Research Service 2003b. Nursery and Greenhouse Products from California Crop and Livestock Reporting Service 1971b; California Department of Food and Agriculture 1981, 1991, and 2001; and U.S. Department of Commerce, Bureau of the Census 1967.

represented 42 percent (Figure 6). Over the 50-year period, poultry's share declined gradually to 16 percent. Cattle and calves increased very rapidly in the 1950s and 1960s as the large-scale feedlot boom hit California, rising to 49 percent of livestock value in 1970. Thereafter, the share of the beef industry steadily declined, approaching 20 percent of value in 2000. The value of dairy production approached 60 percent of total livestock production in 2000, doubling in importance from shares of 30 percent or less in the period 1950 to 1970. We attempt to explain

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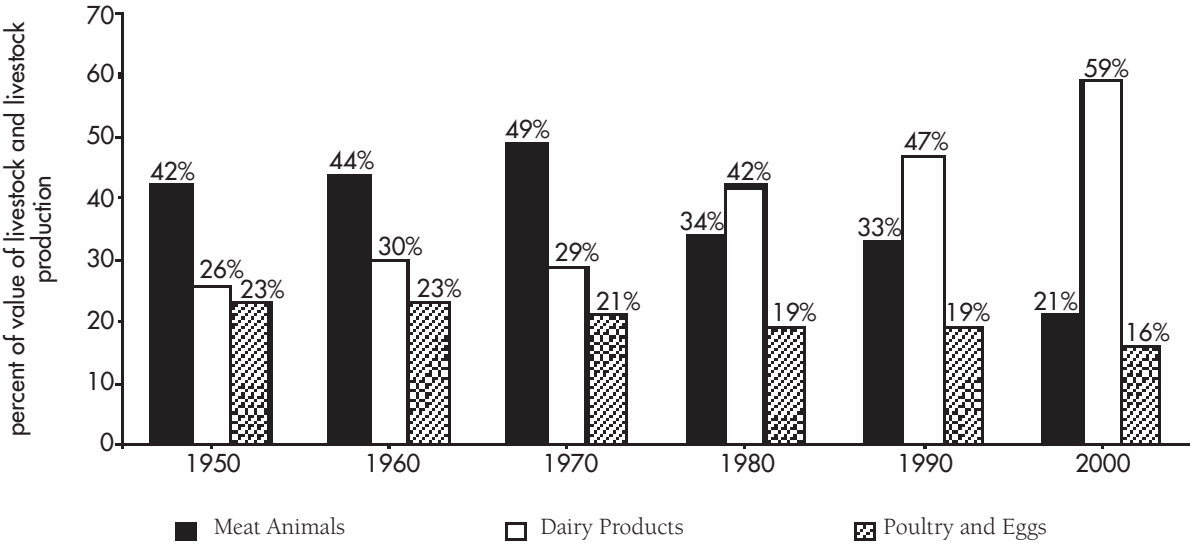
Figure 6. **Relative Shares of Livestock and Livestock Products in California, 1950–2000**



Source: U.S. Department of Agriculture, Economic Research Service 2003b.

some of the causes of these shifts in industry composition in the sections that follow.

Commodity Composition—Ranking and Value

At the aggregate level, California agriculture seems to be fairly stable and growing rapidly (Figure 3); but beneath the surface it is a caldron of perpetual change. Here, we look briefly at what commodities are important, followed in the next section by a discussion of where they are produced.

Table 1 attempts to capture the dynamics of an ever-changing commodity composition. Part A presents the top ten commodities in 1950 and what happened to their rankings over the next 50 years, and Part B presents the top ten commodities in 2000 and how their rankings changed over the past 50 years.

Several trends stand out in Part B. Dairy has clearly supplanted beef as the number-one commodity and now holds a commanding lead over the second-ranked commodity, grapes. Cattle and calves, ranked first from 1950 to 1970, were ranked fifth in 2000. Field crops' role in the top ten declined in relative importance. In 1950 four of the top ten were field crops (Part A)—cotton (number three), hay (number five), barley (number eight), and potatoes (number ten). In 2000 only two field crops remained in the top ten (Part B)—cotton (number six) and hay (number nine). Nursery products and flowers and foliage have come from relative insignificance to number three and number seven, respectively. Overall, products sensitive to rising incomes have grown in importance—grapes (wine), nursery products, flowers, lettuce, strawberries, and almonds make up six of the top ten.[6]

The share of the total value of production accounted for by the top ten commodities has fallen, reflecting a much wider spectrum of high-valued commodities produced on California farms and ranches. The top ten commodities accounted for 66 percent of the total value of agricultural production in 1950 but only 61 percent in 2000.[7]

[6] Appendix Table A1 amplifies the changing commodity composition over recent decades by showing the ranking of the top 20 commodities for each decade, 1950 to 2000.

[7] Appendix Table A3 lists commodities that accounted for 1 percent or more of the value of production and shows in more detail the shift from extensive to more intensive production over the past half century.

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Table 1. **California's Top Ten Agricultural Commodities, Where They Went, and Where They Came From, 1950–2000**

Part A. Top Ten Commodities in the 1950 Annual Report and their Rankings in Subsequent Decades

Commodity	1950 Value of Production (million dollars)	1950	1960	1970	1980	1990	2000	Trend
Cattle and Calves	321	1	1	1	2	2	5	▼
Dairy Products	238	2	2	2	2	1	1	▲
Cotton	202	3	3	6	3	4	6	▼
Grapes	158	4	6	3	4	3	2	▲
Hay	121	5	4	4	5	6	9	▼
Eggs, Chicken	105	6	5	5	11	12	24	▼
Oranges	92	7	7	10	15	11	16	▼
Barley	73	8	11	18	24	48	70	▼
Lettuce	59	9	9	7	10	8	4	▲
Potatoes	52	10	8	13	22	22	29	▼
Total Value of State Production in Million Dollars		**2,321**						
Top Ten as Percent of Total Value		**66%**						

Part B. Top Ten Commodities in the 2000 Annual Report and their Rankings in Previous Decades

Trend	1950	1960	1970	1980	1990	2000	Commodity	2000 Value of Production (million dollars)
▲	2	2	2	1	1	1	Milk and Cream	3,704
▲	4	6	3	4	3	2	Grapes	2,836
▲	n/a	n/a	9	6	5	3	Nursery Products	2,247
▲	9	9	8	10	8	4	Lettuce	1,484
▼	1	1	1	2	2	5	Cattle and Calves	1,267
▼	3	3	6	3	4	6	Cotton	898
▲	n/a	n/a	14	9	7	7	Flowers and Foliage	842
▲	25	18	19	14	13	8	Strawberries	767
▼	5	4	4	5	6	9	Hay	730
▲	23	19	17	7	10	10	Almonds	682
n/a – not available							**Total Value of State Production in Million Dollars**	**25,509**
							Top Ten as Percent of Total Value	**61%**

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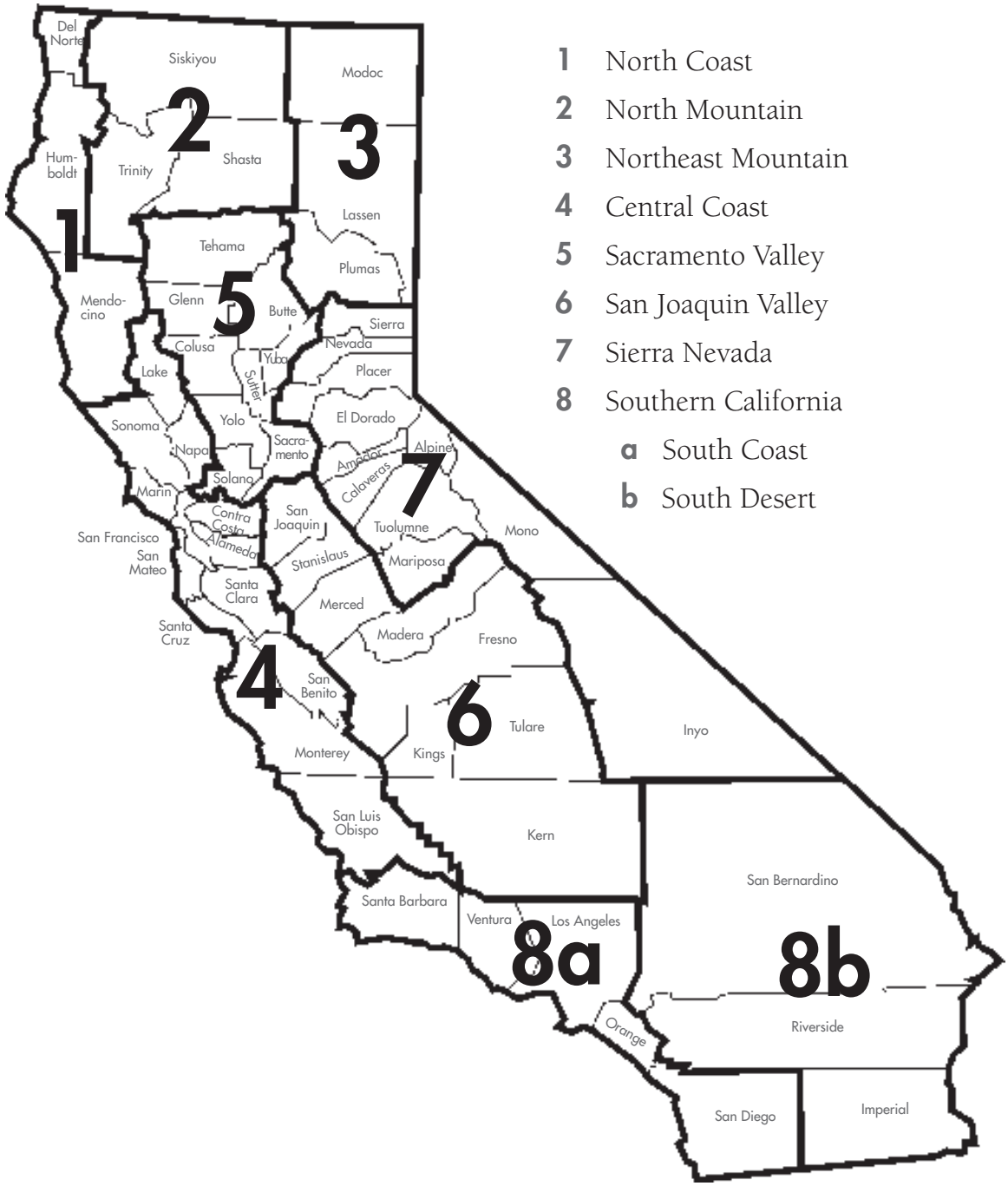
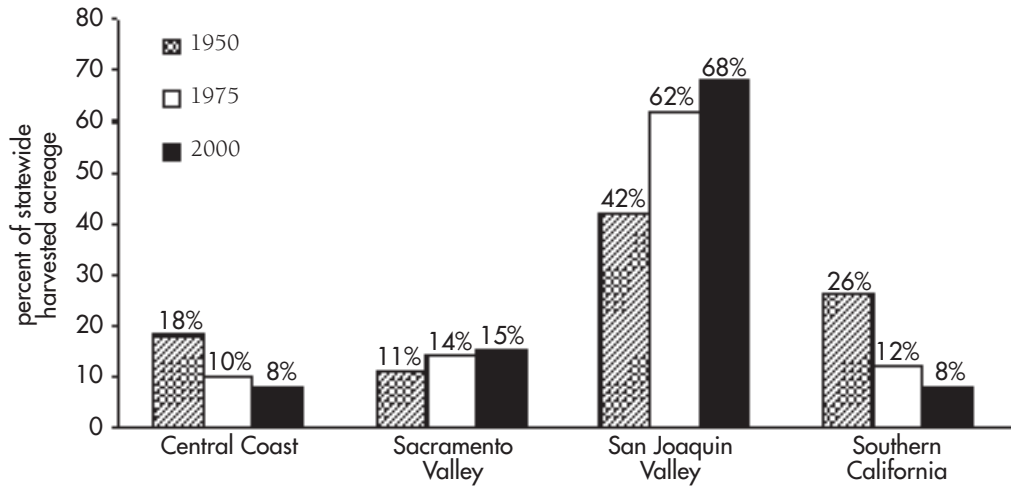
Figure 7. **The Agricultural Production Regions of California**



Source: Johnston 2004.

Figure 8. **Fruit and Nut Crops' Share of Harvested Acreage by Major Agricultural Production Region for 1950, 1975, and 2000**



Sources: California Crop and Livestock Reporting Service 1951a, 1976a; California Agricultural Statistics Service 2001a.

Changing Location of Production—Agricultural Production Regions

The majority of agricultural production takes place in just four of the eight agricultural production regions of California (see Figure 7): Region 4 (Central Coast), Region 5 (Sacramento Valley), Region 6 (San Joaquin Valley), and Region 8 (Southern California).[8]

Major shifts of production among regions reflect progressively increasing demands for California products for both domestic and export markets, withdrawal of land from agricultural production because of population growth in temperate coastal areas (especially the Los Angeles basin), growth in higher-valued perennial and vegetable production displacing field-crop acreage in interior areas, and shifts within the Central Valley induced by surface-water deliveries. We examine the half-century of changes in regional shares of production for the major commodity groupings—fruit and nut crops, vegetable crops, and dairy products.

Fruit and Nut Crops

Statewide acreage of fruit and nut crops increased throughout the last half a century from about 1.5 million acres in 1950 to nearly 2 million in 1975 and 2.5 million in 2000. Yields per acre also increased, resulting in production increases far above that of just acreage alone. Figure 8 shows that the share of the state's acreage fell in the Central Coast region from 18 to 8 percent and in the Southern California region from 26 to 8 percent. There were significant increases in the San Joaquin Valley (from 42 to 68 percent of state acreage); many of the additional acres are located in newly developed areas supported by federal and state water-delivery systems.

Commodity Example – Almonds. The shifting location of almond acreage reflects the shift of production southward in the Central Valley from the Sacramento to the San Joaquin Valley toward productive irrigated lands with newer cultural and management systems in the southern region. Urbanization displaced a large portion of the acreage in the Central Coast region.

Eighty percent of almond plantings are now located in the San Joaquin Valley (Figure 9). In 1950 three of the "top five" almond producing counties were located in the Sacramento Valley. In 2000 the top five counties accounted for more than two-thirds of statewide acreage, and all were located in the San Joaquin Valley (Appendix Table A2, Part A).

Commodity Example – Oranges. In 1950 four out of every five acres of oranges were in Southern California (Figure 10). The early dominance of Southern California counties (Orange, Los Angeles, San Bernardino, Ventura) waned within the next two decades, and acreage was

[8] California's agricultural production regions are described in Johnston (2004).

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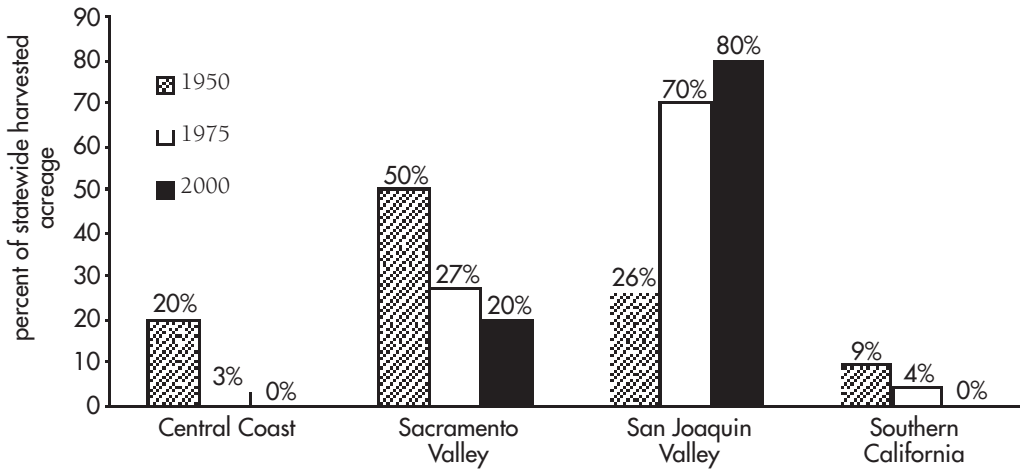
Figure 9. **Almonds' Share of Harvested Acreage by Major Agricultural Production Region for 1950, 1975, and 2000**



Sources: California Crop and Livestock Reporting Service 1951a, 1976a; California Agricultural Statistics Service 2001a.

progressively displaced northward to the east side of the San Joaquin Valley as CVP water deliveries began in the 1950s. San Joaquin Valley acreage rose by 85,000 acres between 1950 and 1975. Tulare County alone now accounts for more than half of the state's 207,000 acres of oranges, and 82 percent of the harvested acreage is now located in the San Joaquin Valley production region. Orange County, which had 60,109 acres of oranges in 1950, retained only 115 acres in 2000.

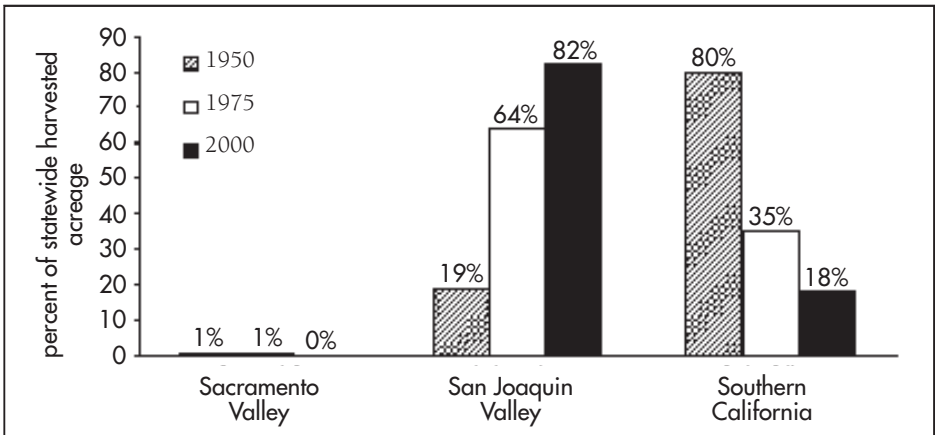
Appendix Table A2, Part B, identifies harvested acreages of oranges for the top five counties from 1950 to 2000. In 1950 the top five counties accounted for 85 percent of orange acreage. Concentration in the top five counties is now 93 percent of statewide acreage.

Vegetable Crops

High-valued production has persisted in the Central Coast and Southern California agricultural production regions (Figure 11). Statewide, acreage increased from about 700,000 acres in 1950 to nearly 900,000 in 1975 and to 1.5 million in 2000. Nearly 20 percent of all vegetable acreage is devoted to processing tomatoes grown in the Central Valley. Without processing tomatoes, 2000's shares of harvested vegetable acreage are nearly equally distributed among the Central Coast, the San Joaquin Valley, and Southern California—34, 33, and 27 percent, respectively.

Commodity Example – Processing Tomatoes. Processing tomatoes had several shifts in production as acreage grew from only about 75,000 acres in 1950 to 250,000 in 1975 and nearly 300,000 in 2000. In the 1950s production was concentrated in the northern San Joaquin and southern Sacramento Valleys (Figure 12). By 1975, harvested acreage and share increased in the Sacramento Valley, but it has since shifted to central and

Figure 10. **Oranges' Share of Harvested Acreage by Major Agricultural Production Region for 1950, 1975, and 2000**



Sources: California Crop and Livestock Reporting Service 1951a, 1976a; California Agricultural Statistics Service 2001a.

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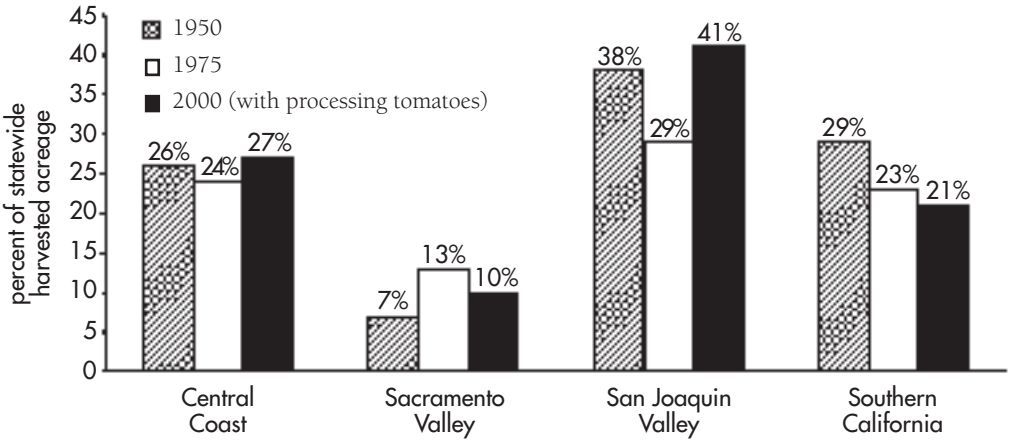
Figure 11. **Vegetable Crops' Share of Harvested Acreage by Major Agricultural Production Region for 1950, 1975, and 2000**



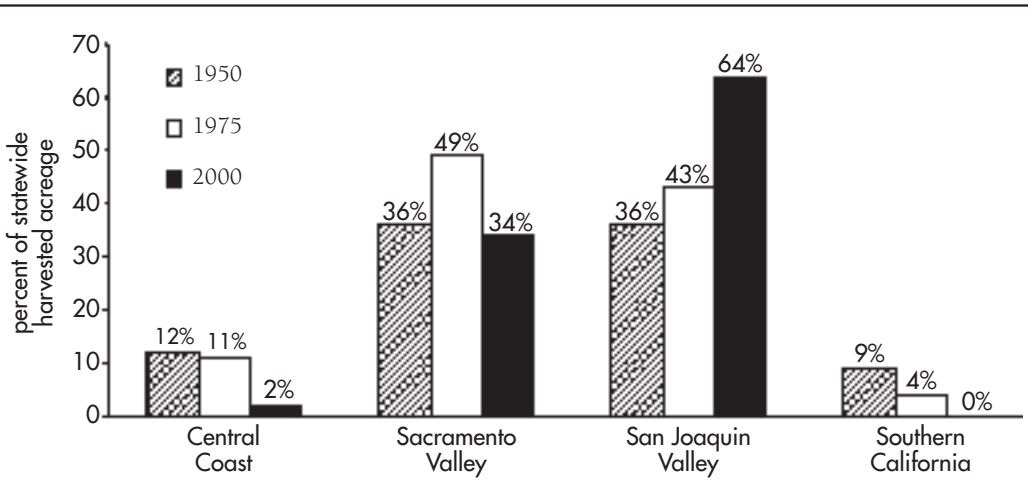
Sources: California Crop and Livestock Reporting Service 1951d, 1977; California Agricultural Statistics Service 2001a.

southern areas of the San Joaquin Valley, drawn by better growing seasons, higher solids for paste production, and improved water availability. San Joaquin County was the top county in 1950, Yolo County was number one in 1975, and Fresno, with nearly 40 percent of the state's harvested acreage, was the number one county in 2000 (Appendix Table A2, Part C).

Dairy Products

Dairy products now constitute about 15 percent of the total value of California agricultural production. In 1950 dairy production was located primarily in proximate areas serving the Los Angeles and San Francisco fresh-milk markets. Los Angeles County ranked number one in dairy production in 1950, and its production was nearly twice the volume of Stanislaus', the number two ranked county. Stanislaus, Merced, and San Joaquin County each served the state's other metropolitan area—the San Francisco Bay Area. By 1970, Los Angeles' production was displaced from the top five due to the growth in dairying in adjacent San Bernardino and Riverside Counties (Appendix Table

Figure 12. **Processing Tomatoes' Share of Harvested Acreage by Major Agricultural Production Region for 1950, 1975, and 2000**



Sources: California Crop and Livestock Reporting Service 1951d, 1977; California Agricultural Statistics Service 2001a.

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A2, Part D).

Total production has now grown manyfold with an increased variety of manufactured milk products. The chief shift in production has been from the Los Angeles basin into the southern San Joaquin Valley (Figure 13). Tulare County increased production continuously throughout the last 50 years and became the state's number one producer by 1970. The San Joaquin Valley now accounts for three-quarters of statewide production of dairy products, and Tulare County alone accounts for nearly a quarter of statewide milk production.

Changing Location of Production—Top Counties

Data presented in Table 2 confirms two fundamental trends in California agriculture. The first is the decline in importance of Southern California in overall value. Los Angeles produced the highest value of production in 1949 (highest also of any county in the United States) but had disappeared from California's top five by the 1960s.

The second trend is the rising importance of the southern San Joaquin Valley; Fresno, Kern, and Tulare County accounted for 21 percent of California production in 1949 and 32 percent in 2000. This reflects two things: (1) the shifts of high-value commodities (citrus and dairy) from Southern California, and (2) the enormous productive potential of both east-side agriculture and the newly irrigated agricultural land on the west side of the valley. The share of total value coming from the top five counties increased sharply, from 35 percent to 49 percent, over the 50-year period.

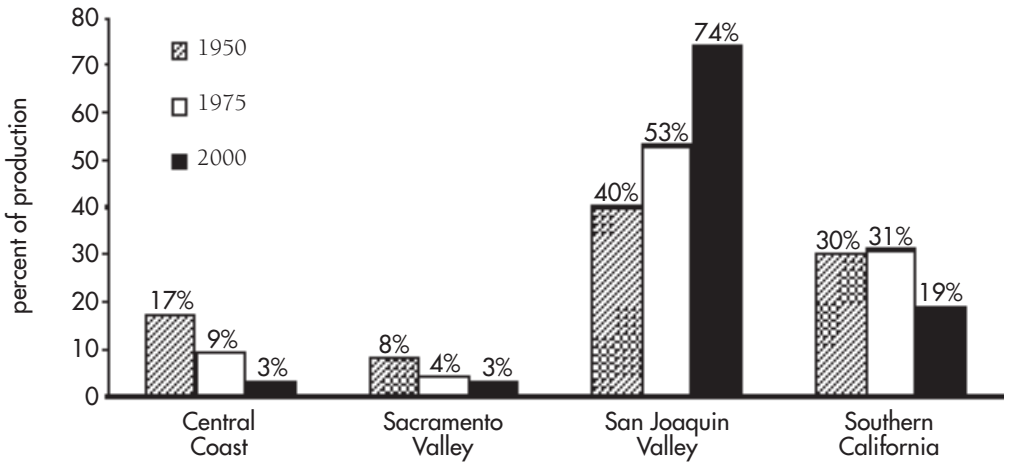
A few other points of note: California Department of Food and Agriculture (CDFA) preliminary data for 2001 put Tulare County in the number one spot, confirming the rising importance of dairy production to California. Monterey County has steadily increased its share of production, which rose from 3 percent in 1949 to 11 percent in 2000, reflecting a rapid increase in demand for fresh vegetables.

Table 3 lists the top ten California counties by value of crop and animal production. In 1950 Los Angeles County was number one but was shortly thereafter overtaken by Fresno County, which dominated throughout the last four decades of the 20th Century (until 2001). The same six San Joaquin Valley counties are included in the 1950 and 2000 rankings (Fresno, Tulare, Kings, Merced, San Joaquin, and Stanislaus), but their relative rankings changed from decade to decade. There are three Southern California counties on both the 1950 ranking and the 2000 ranking, but they are entirely different counties. In 1950 Southern California counties included were Los Angeles, Imperial, and Orange; in 2000, they were San Diego, Riverside, and Ventura.

Increased concentration of statewide agricultural production occurred over the past half decade. The top five counties accounted for about a third (35 percent) of the value of production in 1950 and nearly half (49 percent) in 2000. The top ten counties accounted for slightly more than half (53 percent) of statewide production in 1950 and 70 percent in 2000.

In summary, population growth and water availability have been the two dominant underlying forces affecting regional shifts in the location of agricultural production within the state. Rapid postwar and continuing urban and suburban population expansions forced relocation to interior valleys—first from the Los Angeles basin and later from the central coast and San Francisco Bay Area. Only high-valued vegetables, nursery, and specialty crops persist because of climatic and location advantages in the remaining Central Coast and Southern California areas of production. Trees and vines have, when possible, moved from Southern California and Central Coast regions to those interior areas with more favorable soils and water supplies and less population pressures. The most favored area for increased intensive production, including dairies, is the San Joaquin production region. In general, the Sacramento Valley has had fewer opportunities to change the mix of commodities produced. In some cases, commodities traditionally grown in the Sacramento Valley have also found more productive locales in the newer crop areas of the San Joaquin Valley. Now, at the start of the 21st Century, urban development is placing pressure on agricultural production in the northern San Joaquin and southern Sacramento Valleys, setting in motion further dynamics affecting the future location of the state's agricultural production.

Figure 13. **Dairy Products' Share of Production by Major Agricultural Production Region for 1950, 1975, and 2000**



Sources: California Crop and Livestock Reporting Service 1951c, 1976b; California Agricultural Statistics Service 2001a.

Table 2. **California's Top Five Agricultural Counties, Where They Went, and Where They Came From, 1949–2000**

Part A. Top Ten Commodities in 1949 and Where They Went

		Rank						
Percent of Production in 1949	**County**	**1949**	**1959**	**1969**	**1982**	**1992**	**2000**	**2001**
9%	Los Angeles	1	5	15	16	21	28	27
8%	Fresno	2	1	1	1	1	1	2
7%	Kern	3	2	2	2	3	4	4
6%	Tulare	4	3	4	3	2	2	1
5%	San Joaquin	5	7	8	8	8	6	6
35%	**Top Five**							

Part B. Top Five Counties in 2000 and Where They Came From

Rank							
1949	**1959**	**1969**	**1982**	**1992**	**2000**	**County**	**Percent of Production in 2000**
2	1	1	1	1	1	Fresno	13%
4	3	4	3	2	2	Tulare	11%
8	12	8	5	4	3	Monterey	11%
3	2	2	2	3	4	Kern	8%
10	9	9	6	5	5	Merced	6%
						Top Five	**49%**

Sources: California Department of Food and Agriculture 2001; U.S. Department of Commerce, Bureau of the Census 1952, 1961a, 1972, 1984, 1994.

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Table 3. California's Top Ten Agricultural Counties Ranked by Value of Agricultural Sales, 1949–2000

Rank	County	Value of Sales (millions)	Percent of State Sales
1949 Census of Agriculture			
	California	1,742.0	
1	Los Angeles	157.0	9%
2	Fresno	144.0	8%
3	Kern	122.1	7%
4	Tulare	105.4	6%
5	San Joaquin	86.9	5%
6	Imperial	75.2	4%
7	Stanislaus	65.6	4%
8	Monterey	57.8	3%
9	Orange	56.5	3%
10	Merced	54.8	3%
	Top Five Counties		**35%**
	Top Ten Counties		**53%**
1959 Census of Agriculture			
	California	2,824.5	
1	Fresno	276.0	10%
2	Kern	220.2	8%
3	Tulare	199.0	7%
4	Imperial	170.4	6%
5	Los Angeles	156.0	6%
6	Riverside	144.8	5%
7	San Joaquin	137.8	5%
8	Stanislaus	115.0	4%
9	Merced	94.5	3%
10	Ventura	92.3	3%
	Top Five Counties		**36%**
	Top Ten Counties		**57%**
1969 Census of Agriculture			
	California	3,875.2	
1	Fresno	379.2	10%
2	Kern	304.9	8%
3	Imperial	293.2	8%
4	Tulare	258.2	7%
5	Riverside	223.6	6%
6	Stanislaus	222.3	5%
7	San Joaquin	188.9	5%
8	Monterey	185.3	5%
9	Merced	145.8	4%
10	Ventura	135.6	3%
	Top Five Counties		**38%**
	Top Ten Counties		**60%**
1982 Census of Agriculture			
	California	12,491.4	
1	Fresno	1,495.6	12%
2	Kern	1,074.1	9%
3	Tulare	963.0	8%
4	Imperial	741.8	6%
5	Monterey	737.8	6%
6	Merced	655.4	5%
7	Riverside	619.2	5%
8	San Joaquin	593.2	5%
9	Stanislaus	555.4	4%
10	San Bernardino	479.1	4%
	Top Five Counties		**40%**
	Top Ten Counties		**63%**
1992 Census of Agriculture			
	California	17,052.0	
1	Fresno	2,081.5	12%
2	Tulare	1,386.7	8%
3	Kern	1,336.9	8%
4	Monterey	1,212.7	7%
5	Merced	907.6	5%
6	Stanislaus	897.1	5%
7	Riverside	846.9	5%
8	Imperial	753.0	4%
9	Ventura	667.8	4%
10	Kings	581.8	3%
	Top Five Counties		**41%**
	Top Ten Counties		**63%**
2000 CDFA			
	California	27,162.1	
1	Fresno	3,418.6	13%
2	Tulare	3,067.0	11%
3	Monterey	2,923.3	11%
4	Kern	2,208.5	8%
5	Merced	1,538.5	6%
6	San Joaquin	1,348.7	5%
7	San Diego	1,253.8	5%
8	Stanislaus	1,197.3	4%
9	Riverside	1,048.6	4%
10	Ventura	1,047.1	4%
	Top Five Counties		**48%**
	Top Ten Counties		**70%**

Sources: California Department of Food and Agriculture 2001; U.S. Department of Commerce, Bureau of the Census 1952, 1961a, 1972, 1984, 1994.

Agricultural Exports

California's farms and ranches have always relied on exporting a significant share of total production to foreign markets, which recently amounted to a fifth or more of the total value of production. The value of California agricultural exports ranged from $6.5 to $7 billion over the five-year period 1997–2001.

Table 4 shows export values and rankings for California's most important agricultural export commodities for 1997 and 2001.[9] The rankings of most important exported commodities did not change much between 1997 and 2001. Almonds and cotton, the top two export commodities, each with exports exceeding $600 million, had exports valued significantly less in 2001 than in 1997. The largest percentage of increase in export values was for carrots (+69.2 percent) and dairy (+57.5 percent);

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Table 4. California Agricultural Export Values and Rankings for 1997 and 2001

Commodity	Ranking 2001	Ranking 1997	Export Value (Million Dollars) 2001	Export Value (Million Dollars) 1997	Percent Change 1997–2001
Almonds	1	2	685.6	$818.3	–14.3
Cotton	2	1	604.5	918.3	–33.4
Wine	3	3	470.9	375.9	+25.3
Table Grapes	4	4	394.5	330.3	+19.4
Dairy	5	8	338.4	214.8	+51.5
Oranges	6	5	297.5	308.4	–3.5
Tomatoes, Processing	7	7	211.7	226.3	–6.5
Walnuts	8	10	179.1	153.0	+17.0
Rice	9	11	166.4	144.4	+15.2
Beef and Products	10	6	154.8	262.0	–40.9
Prunes	11	13	149.5	139.2	+7.3
Raisins	12	9	144.1	199.8	–27.9
Lettuce	13	14	142.6	120.8	+18.0
Strawberries	14	15	136.1	116.5	+16.8
Peaches and Nectarines	15	18	118.7	102.1	–16.3
Pistachios	16	16	108.9	113.4	–4.0
Broccoli	17	19	89.2	87.7	+1.7
Hay	18	12	86.3	141.2	–38.9
Lemons	19	17	75.7	119.9	–36.9
Carrots	20	27	68.0	40.2	+69.2
Total of 50 Principal Animal and Plant Commodities			**5,348.6**	**5,673.2**	**–5.7**
Total of All Agricultural Exports			**6,521.9**	**6,995.5**	**–6.8**

Sources: Bervejillo and Sumner; Kuminoff et al.

decreases of 30 percent or more occurred for beef and products, hay, lemons, and cotton. An improvement in commodity prices from lower price levels could significantly increase the value of agricultural exports in the 21st Century.

Exports have always been important to California's farmers and ranchers. Over time, changes in the character of California agriculture have changed the kinds of animal and plant commodities significantly entering export markets. Table 5 compares the most recent list (2001) of the top 20 export commodities with that of two decades earlier (1980). Comparable export values do not exist for these two periods, but the two lists of rankings do reflect the agricultural sector's shift toward production (and exports) of higher-valued dairy, fruits, tree nuts, and vegetables.

Export outlets are crucial for many of California's commodities. It is estimated that in 2001 the quantities exported were nearly half or more for rice, pistachios, almonds, prunes, and cotton produced on California's farms and ranches (Table 6). Note that the export of grapes and grape products appears as the first commod-

[9] Changes in the value of exports reflect changes in export quantities as well as export prices. Prices for many commodities were low in 2001 so a decline in export value could occur even with larger export quantities over the period.

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Table 5. **Changes in the Composition of the Top 20 California Agricultural Exports between 2001 and 1980**

Rank	2001	1980
1	Almonds	Cotton
2	Cotton	Almonds
3	Wine	Rice
4	Table Grapes	Wheat
5	Dairy	Grapes, All Uses
6	Oranges	Oranges
7	Tomatoes, Processing	Lemons
8	Walnuts	Cattle and Products
9	Rice	Walnuts
10	Beef and Products	Peaches
11	Prunes	Prunes
12	Raisins	Tomatoes, All Uses
13	Lettuce	Cottonseed
14	Strawberries	Dairy Cattle and Products
15	Peaches/Nectarines	Alfalfa
16	Pistachios	Dry Beans
17	Broccoli	Chickens and Products
18	Hay	Lettuce
19	Lemons	Onions
20	Carrots	Pears

Sources: Bervejillo and Sumner; California Department of Food and Agriculture 1981.

ity in this table as the most important agricultural export. The aggregate of fresh grape, wine, raisin, and grape juice exports was more than $1 billion, easily topping the value of almonds or cotton alone (Bervejillo and Sumner). In 2001 17 percent of the quantity of production of the top 50 export commodities was exported.

Economic conditions in East Asia and Europe are important to exporters (Table 7). Shares of exports have not changed much over the recent past. Roughly a fifth is exported to each of the following markets: Japan, other East Asian nations, the European Union, Canada, and the rest of the world, including Mexico and Latin America. Changes in foreign economic conditions, trading relationships, and exchange rates significantly affect the bottom line for California producers.

Table 6. **Ratio of Farm Quantity Exported to Farm Quantity Produced (Top 14 Export Commodities in 2001 Compared to 1997)**

Commodity	2001 Percentage	1997 Percentage
Grapes, All Uses[a]	22	21
Almonds	67	55
Cotton	87	82
Dairy	6	5
Oranges	27	32
Tomatoes, Processing	13	15
Walnuts	33	27
Rice	49	27
Beef and Products	6	9
Prunes	69	36
Lettuce	8	8
Strawberries	13	12
Peaches and Nectarines	11	20
Pistachios	50	32

[a] Includes export values of fresh grapes, raisins, wine, and grape juice.
Sources: Bervejillo and Sumner; Kuminoff et al.

Selected Farm Statistics: 1950–2000

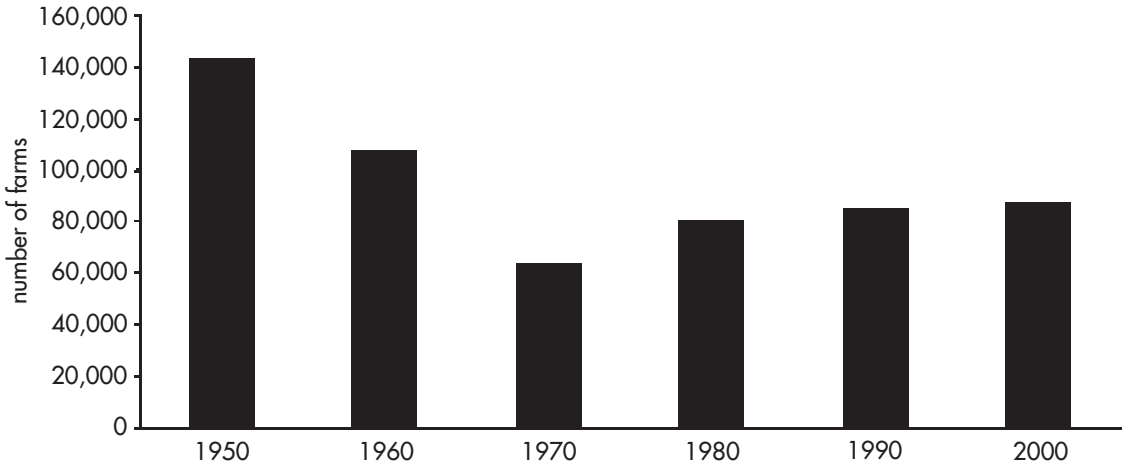
This final section contains additional information to enhance understanding of the changing character of California agriculture. Specifically, we now assess structural dimensions of California agriculture—farm numbers and the value of agricultural production.[10]

Table 7. **Percent of California Agricultural Export Value Shipped to Major Markets in 2001 and 1998**

Export Market	Percentage of Top 50 Commodity Exports 2001	1998
East Asia	40	41
(Japan)	(18)	(22)
European Union	21	22
Canada	22	20
Rest of the World	17	17

Sources: Bervejillo and Sumner; Kuminoff et al.

Figure 14. **Number of California Farms for Selected Years, 1950–2000**



Source: U.S. Department of Agriculture, Economic Research Service 2004.

Farm Numbers

The number of farms in California fell sharply from 144,000 to 64,000 over the period 1950–1970. Farm numbers subsequently rose from 81,000 farms in 1980 to 85,000 farms in 1990 and peaked at 89,000 in 1998 and 1999.[11] There were an estimated 87,500 farms in California in 2000 (Figure 14).

The U-shaped pattern of farm numbers in California differs from the pattern observed for the United States over the same time period. The number of U.S. farms fell continuously from 5.6 million in 1950 to 4.0 million in 1960, 2.9 million in 1970, and 2.4 million in 1980 and has ranged between 2.1 and 2.2 million from 1986 to the present.

What is a Farm?

A farm for statistical purposes is any "place" from which $1,000 or more of agricultural products were or normally would have been sold. This Census of Agriculture definition has been used in a consistent manner since 1974.[12] While there were an estimated 87,000 farms in California in 1997 (CDFA, National Agricultural Statistical Service), the *1997 Census of Agriculture* contained detailed information only for the 74,126 farms for which responses to its mail census survey were received.[13]

The following description of the structure of California agriculture is based on *1997 Census of Agriculture* information. Respondents ranged from very small retirement, residential, and lifestyle farms to operations with sales in the millions of dollars. While average farm size was 374 acres, 28 percent of the enumerated farms were less than nine acres in size and 60 percent were less than 50 acres in size. The average market value of agricultural

[10] More detailed information about the structure and performance of California agriculture, land in farms, farm real estate values, farm incomes, and financial ratios may be found in the University of California Agricultural Issues Center publication *The Measure of California Agriculture, 2000* (Kuminoff and Sumner).

[11] Because the definition farm is based on the value of agricultural sales in nominal terms and has not changed since 1974, rising farm numbers over the past three decades is due, in part, to the effect of inflation over the time period.

[12] For the 1969 and previous censuses, the definition of a farm was $250 or more sold on establishments less than ten acres in size; alternatively, places of ten acres or more were counted as farms if sales amounted to at least $50.

[13] The difference between the census enumeration of 74,126 farms in 1997 and the U.S. Department of Agriculture (USDA), National Agricultural Statistics Service (NASS) (1999) estimate of 87,000 farms in 1997 is the subsequent adjustment for four components of error in the census farm count. Undercounts were due to farms not being on the mail list and to farms incorrectly classified as nonfarms. Overcounts were due to farms duplicated or enumerated more than once and to nonfarms incorrectly classified as farms (see USDA, NASS, *1997 Census of Agriculture: California, State and County Data*, Volume 1, Geographic Series, Part 5, Appendix C.) For the most part, the additional 13,847 farms identified in the coverage overview and revision were low value producers. Only 3,580 farms produced $10,000 or more of agricultural product (Appendix C, Table G).

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Table 8. **Distribution of "Smaller" and "Larger" Farms in California and the United States, 1997**

	Proportion of All Farms	Proportion of Total Sales
Smaller Farms (Sales <$250,000)		
California	84%	9%
United States	91%	33%
Larger Farms (Sales >$250,000)		
California	16%	91%
United States	9%	67%

Source: U.S. Department of Agriculture, National Agricultural Statistics Service 1999.

products sold was $310,718 per farm, but 35 percent of the farms sold less than $5,000 and 65 percent sold less than $50,000 per farm. An occupation other than farming was the principal occupation of 47 percent of "farm" operators.

Farm Numbers and Agricultural Production

The U.S. Department of Agriculture's (USDA's) Economic Research Service (ERS) recently developed a farm typology based primarily on annual sales of farms and the occupation of owners (USDA ERS 2001). Specific data for California farms were not included in the ERS study, but some parallel inferences can be identified.

Smaller Farms

Farms with annual sales of less than $100,000 likely capture the majority of the many "limited resource/retirement/residential/lifestyle" farms in California. Such farms account for 74 percent of all farms (90 percent of farms with operators having a principal occupation other than farming) but produce only 4 percent of the total value of agricultural sales. Farms with annual sales between $100,000 and $250,000 may be operated by someone who identifies principal occupation as farming. Farms in this sales grouping make up 10 percent of all farms and contribute 5 percent of total sales.

Smaller California farms, those with less than $250,000 in agricultural sales, make up 84 percent of all farms. They account for 73 percent of farming-occupation farms and almost all (96 percent) of the other-occupation farms. Given the intensive nature and frequently high cost of production, unenviable standards of living (low net farm incomes) might still be associated with even the larger farms in this group. These farms reflect smaller proportions of total farms and total sales in California than are estimated for the United States with ERS typology groupings (Table 8). In contrast, 91 percent of U.S. farms sold less than $250,000 of agricultural products and accounted for 33 percent of total agricultural sales.

Larger Farms

The remaining 12,147 California farms, those with more than $250,000 in sales, made up one of every six farms (16 percent) in 1997 and accounted for 91 percent of sales. Extreme skewness is noted within this grouping. The largest group, consisting of 4,775 farms (6 percent of California farms), had sales exceeding a million dollars and accounted for 75 percent of total sales. In contrast, only 9 percent of U.S. farms had sales of $250,000 or more. They accounted for 67 percent of total U.S. sales of agricultural products.

Is the Concentration of Agricultural Production Increasing?

It is generally asserted that farming in the United States has become more concentrated as farm numbers have declined and more complex as farm operators have adjusted to change. Has the concentration of agricultural production in California become more pronounced over time? The census data show little change over the past two decades in the number of larger farms producing approximately three-quarters of the value of agricultural products sold (Table 9).

Land in Farms

Land being used for agricultural production in California decreased by 26 percent over the period 1950–2000. There were nearly ten million fewer acres (about 15,500 square miles) of land in California being farmed in 2000 than in 1950. Acreage increased from 37.5 million acres in 1950 to 39 million acres in the late 1950s, but since then there has been a continual decline in area throughout the remainder of the 20th Century (Table 10).

The relative reduction in the state's agricultural land

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Table 9. **Proportion of Large Farms Producing about 75 Percent of Sales for 1978, 1987, and 1997**

Census Year	Proportion of Farms	Proportion of Sales
1997	6.4%	74.8%
1987	6.8%	74.0%
1978a	4.4%	65.3%
1978b	10.2%	80.8%

Sources: U.S. Department of Agriculture, National Agricultural Statistics Service 1999; U.S. Department of Commerce, Bureau of the Census 1981, 1989.

Table 10. **Land in Farms in California and the United States in Millions of Acres for 1950–2000**

Year	California	United States
1950	37.5	1,202
1960	38.8	1,171
1970	36.6	1,088
1980	33.8	1,035
1990	30.8	987
2000	27.8	943

Source: U.S. Department of Agriculture, Economic Research Service 2003b.

area is greater than that for the United States; land area in U.S. farms decreased by only 22 percent over the same period (1950–2000).

Farm Real Estate Values

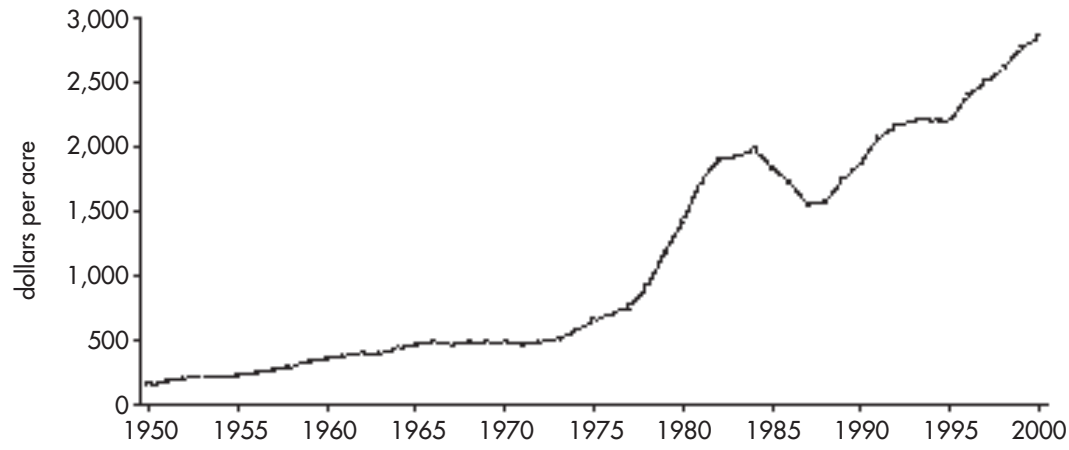
Land is an important farm asset for farmers and ranchers. Farm real estate values include land and buildings plus permanent appurtenances (trees, vines, permanent irrigation systems, etc.). USDA statistics show substantial appreciation over time in the value of land and buildings (Figure 15). The average value in California in 1950 was $154 per acre. The nominal value of $2,850 per acre in 2000 is 18.5 times larger than that for 1950. Real appreciation is about 250 percent when adjusted for inflation.

There is, of course, wide variation in per-acre values depending on the location and the highest and best use of California's agricultural land. Select vineyard and vegetable lands are considerably higher in value and have displayed greater appreciation than statewide averages. Table 11 shows USDA-estimated values for several broadly defined statewide types of California agricultural land in 2000.

Statewide averages are of limited use in reflecting the large variation in values of land in various areas of the state even if they had similar highest and best uses. For example, the California Chapter of the American Society of Farm Managers and Rural Appraisers (CALASFMRA) reported wine-grape values ranging from $3,500 to $180,000 per acre in 2000, along with considerable variation in opinions about market activity and price trends depending on location within the state. Vineyards in the North Coast region ranged in value from $12,000 to $180,000 per acre depending on other factors, such as location or rootstock.[14]

Sales information for irrigated crop land reveals a range from $600 to $49,000 per acre depending on location, highest and best use, and water source. Central Valley

Figure 15. **Average Value of Land and Buildings in Farms in California, 1950–2000**



Source: U.S. Department of Agriculture, Economic Research Service 2003a.

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sales values range from a low for Kings County lake-bottom irrigated crop land ($660 to $1,600 per acre) to a high for choice irrigated crop land in San Joaquin County ($5,500 to $9,000 per acre). Coastal irrigated land values were substantially greater. In Monterey County values ranged from a low of $9,000 per acre in the King City area to a range of $20,000 to $39,000 per acre in the prime vegetable production area of the lower Salinas Valley (CALASFMRA).

Farm Incomes

Gross Farm Income

California's share of U.S. gross farm income (GFI) has increased over the past 50 years. It was about 9 percent of the U.S. GFI in 1960 and 1970 and in the low teens in 1990 and 2000 (Table 12). Net farm incomes (with direct government payments) also show a similar relative performance, amounting to 9 percent of the U.S. gross in 1960 and 11 percent in 2000.

Net incomes to farmers and growers are influenced by changes in prices, productivity, factor costs, and net government transactions, including direct government payments, licenses, and property taxes. Producers of basic commodities (cotton, rice, cereals) are the primary recipients of direct payments. However, because a large share of California's farmers and ranchers do not receive direct government payments, its share of net income amounted to 20 percent of the U.S. net farm income without direct government payments.

Table 11. **Average Value of California's Agricultural Land on January 1, 2000**

Type of Land	Value of Land and Buildings Dollars per Acre
Pasture Land	$1,000
Crop Land	$5,870
Nonirrigated	$1,400
Irrigated	$6,400

Source: U.S. Department of Agriculture, National Agricultural Statistics Service 2001.

Net Farm Income

Net farm incomes to California farmers and ranchers were constant (about $1 billion) and without much variation during the 1960s (Figure 16). For most of the 1990s, incomes ranged from $5 to $6 billion with considerable year-to-year variation, presenting a difficult financial environment for agricultural producers. California farmers experienced reduced levels of net farm incomes beginning in 1997, which was also true for the net farm incomes of all U.S. farmers. The two interim decades (from 1970 to 1990) were expansive years, showing growth in production capacity statewide and cyclical variations that were mostly associated with offshore market opportunities gained and lost. California's share of U.S. net farm income increased from 9 to 11 percent over the period 1960–2000.

In contrast, U.S. net farm income growth was more gradual through the 1980s, except for a spurt in the early 1970s, due again to export market opportunities that were attractive to all U.S. crop and livestock producers. The

Table 12. **Gross and Net Farm Income for California and the United States for Selected Years, 1960–2000**

	Gross Farm Income (in Billion Dollars)			Net Farm Income with Direct Government Payments			Net Farm Income without Direct Government Payments		
Year	U.S.	CA	% Total U.S.	U.S.	CA	% Total U.S.	U.S.	CA	% Total U.S.
1960	37.9	3.4	9	11.2	1.0	9	10.5	1.0	10
1970	55.1	4.7	9	14.4	1.0	7	10.7	0.9	8
1990	188.8	20.2	11	44.6	5.7	13	35.3	5.3	15
2000	218.6	27.2	12	46.4	5.3	11	23.5	4.8	20

Source: U.S. Department of Agriculture, Economic Research Service 2003a.

[14] Napa and Sonoma Counties reflected vineyard values ranging from $55,000 to $180,000 per acre. The range in values for Lake and Mendocino County vineyards ranged from $12,000 to $65,000 per acre (CALASFMRA).

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Figure 16. **Net Farm Income (Billion Dollars) in California, 1960–2000**

Source: U.S. Department of Agriculture, Economic Research Service 2003a.

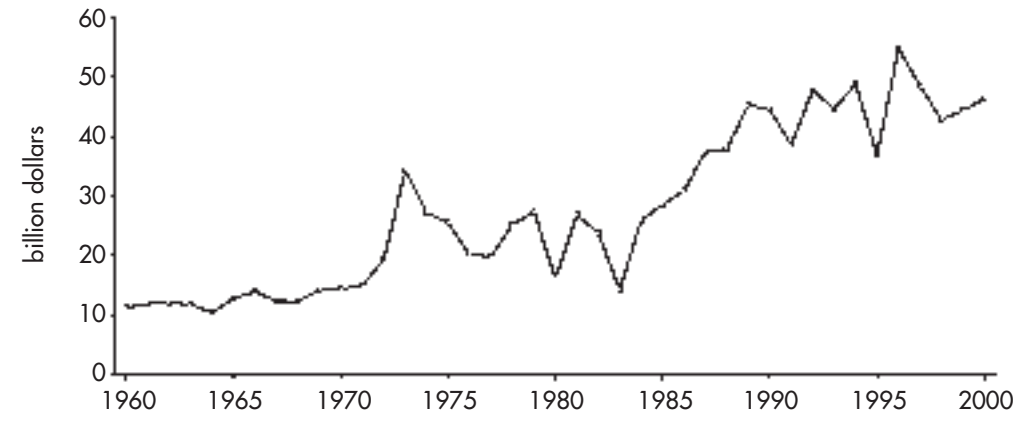
more significant growth in net incomes occurred from the 1980s through the mid-1990s (Figure 17).

Ratios of Farm Debt to Net Farm Income

California's share of U.S. farm debt increased from 9.7 to 10.1 percent over the period 1960–2000, reflecting the more capital-intensive nature of California's agriculture. U.S. and California ratios of debt to net farm income were very comparable through the 1960s to 1973 (Figure 18).

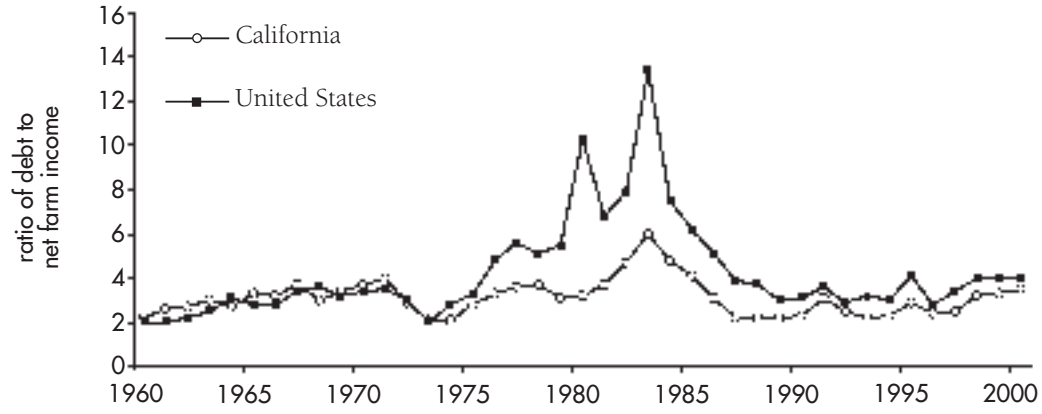
Since 1973, the U.S. ratio has been higher than that of California and considerably higher during the remainder of the 1970s to the mid-1980s, leading up to the farm financial crisis of the mid-1980s. U.S. farm debt ranged from 5 to 13.4 times net farm income throughout the period 1976–1986, considerably higher than ratios for California farms. (Interest payments, ranging from $16.3 to $21.8 billion over the period 1980–1986, were greater than net farm income in several years.) U.S. ratios of debt to net farm income since 1987 continue to exceed the California ratio, ranging from three to four times net farm income.

Figure 17. **Net Farm Income (Billion Dollars) in the United States, 1960–2000**



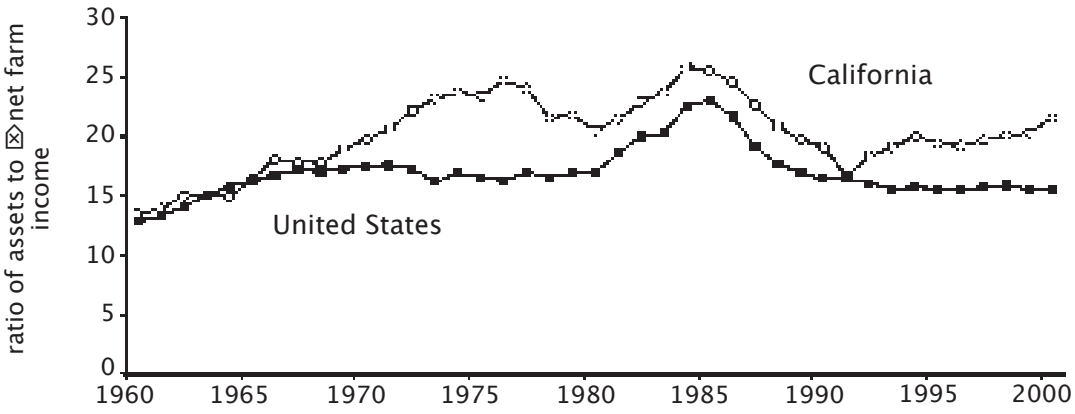
Source: U.S. Department of Agriculture, Economic Research Service 2003a.

Figure 18. **Ratios of Debt to Net Farm Income for California and the United States, 1960–2000**



Source: U.S. Department of Agriculture, Economic Research Service 2003a.

Figure 19. **Ratios of Assets to Net Farm Income for California and the United States, 1960–2000**



Source: U.S. Department of Agriculture, Economic Research Service 2003a.

Farm Debt to Asset Ratios

The capital-intensive nature of California agriculture is reflected in the debt-asset ratio, which was persistently higher than the U.S. ratio over the period 1960–2000 (Figure 19). In general, the change in U.S. and California ratios was similar over time with one notable exception. Whereas the U.S. ratio remained relatively unchanged from the mid-1960s through the 1970s (between 16 and 18 percent), the California ratio reflected the sharply increased indebtedness required to develop new lands and perennial plantings.

Summary

The last half of the 20th Century witnessed dramatic change in the character of California agriculture—from a sectored economy dominated by extensive livestock and field-crop production to the premier specialty-crop producer of the nation and the world. Changes included a reconfiguration of production within the state in response to rising population, increased domestic and foreign demands, and available resources. Farm numbers fell, though not as dramatically as U.S. farm numbers, and have been relatively stable for the past several decades. A diverse mixture of limited-resource/retirement/residential/lifestyle farms exist along with larger farms that provide a large share of total agricultural production. Despite perceptions of increased concentration of production among a few larger-sized farm units, U.S. census data do not reveal strong evidence of increased concentration over the past several decades. Land in farms has declined over the half-century, and farm real estate values have demonstrated substantial appreciation, increasing by 250 percent in real terms. There is, of course, wide variation in per-acre values depending on natural-resource endowments, location, and highest and best use of lands currently in agricultural production. California's share of national gross farm income exceeds 10 percent, and the share of national net farm income without inclusion of direct government payments is 20 percent. Both reflect the preeminence of California's agriculture and the weak association of much of its production with direct government payments for basic commodities. Financial ratios are also different from those for the U.S. industry, reflecting higher net incomes and higher capital investments required for specialty crops vis-à-vis field crops.

IV. DRIVERS OF CALIFORNIA AGRICULTURE

Responding to market forces, the state has witnessed numerous transformations in cropping patterns, labor sources, and technologies. Among these changes, however, many fundamental characteristics have endured: many of the institutional and structural features found today have deep roots in the state's past. (Olmstead and Rhode 1997, p. 25)

Undertaking a prognosis of the future is an exercise fraught with danger. Surely the future is unpredictable in absolute terms, but we believe that one may learn a great deal about what forces may shape the future by understanding the importance of past and enduring features (drivers) that have influenced the growth and development of California agriculture.

Our stylized history suggests a set of historical factors (drivers) that have influenced development of California agriculture over most of its history. We identify six general categories of drivers of importance—biophysical, technology and inputs, access to capital and labor inputs, human capital, demand factors, and public investment—and within these categories an even more specific total of 18 historical drivers.

First, this chapter establishes a baseline for appreciating the historical influence of these identified drivers against which we can speculate on their future influences. Then, we give our evaluation of how important they were in each of the three historical periods—pre-20th Century, 1900–1950, and 1950–2000. Table 13 lists five major categories and 18 historical drivers.

Our evaluation of California agriculture in the 21st Century is based on these past, historical drivers and our perception of what their importance will be in the future. But prior to our discussion of the importance of future drivers in the 21st Century, we identify five significant "future threats" and also find "future opportunities" embedded in many of these. We then identify two additional drivers that have increasingly come into play in the more recent past. The two new entrants arise from the regulatory revolution of the late 20th Century and increased competition for resources (water and land), both with roots fed by the two powerful forces of population growth and urbanization.

Factors (Drivers) Influencing Evolution of California Agriculture—Past

First, we discuss past historical drivers, indicating their role and relative contribution through the end of the 20th Century.

Biophysical Factors: Climate, Soils, Water, and Production Opportunities

California is blessed in the major crop production regions with a subtropical, Mediterranean climate that is characterized by cool, wet winters and hot, dry summers. Substantial precipitation as both rain and snow washes sediments into the valleys, which, because of millenniums of flooding, are deeply layered with fertile alluvial soils.

There are hundreds of geomorphologically differentiated soil series in California (at least 700) existent over a very large landmass (100.2 million acres), a result of significant, often extreme variations in geology, topography, native vegetation, temperature, and rainfall. When sufficient water is available, the valleys of California provide a biological environment hospitable to an incredibly wide variety (suite) of possible products.

Relatively warm, wet winters allow subtropical perennials to survive and permit production of temperate products during the winter season. Further, the combination of mountains and valleys provides year-round feed for livestock in various areas of the state. Thus, California's major production regions inherited the possibility of a very diverse, year-round agriculture adapted to a subtropical temperature endowment in summer and a temperate climate in winter.

In its natural state, California's one disability was that rain and snowfall generally occurred in abundance where and when they could not be effectively used for

Table 13. **Historical Drivers of California Agriculture**

Drivers		Historical Period Pre-1900	1900–1950	1950–2000
A. Biophysical				
1. Climate: Mediterranean and Subtropical		+	+++	+++
2. Soils: Alluvial—rich and deep		+++	+++	+++
3. Water Development: private and public+		+++	+++	
4. Widening Suite of Possible Products		+	++	+++
B. Technology and Inputs				
5. Biological Technology: borrowed, adapted, invented		+	+++	+++
6. Mechanical Technology: adapted, invented		++	+++	++
7. Adaptive Pest Management: imported and invented		++	+++	+++
8. Transportation: development and innovation		++	+++	+++
9. Processing and Storage Technology		+	+++	+++
C. Access to Capital and Labor Inputs				
10. Access to Capital		+	+++	+++
11. Access to Labor: cheap and reliable seasonal supply		++	+++	+++
D. Human Capital				
12. Superior Production Management		+	++	+++
13. Superior Adaptive and Risk Management		+	++	+++
14. Marketing and Institutional Innovation: co-ops, marketing boards		+	+++	++
E. Demand Factors				
15. Population Growth:	a. California	+	++	+++
	b. U.S.	+	+++	++
	c. World	+++	++	+++
16. Economic Growth/Rising Incomes:	a. California	+	++	+++
	b. U.S.	++	+++	+++
	c. World	+	++	+++
F. Public Investments				
17. Investments in Public Infrastructure: water, transportation		++	+++	+++
18. Public Investment in Research, Education, and Extension		+	+++	++
G. New Entrants				
19. Regulation: environmental, safety		0	0	–
20. Urban and Resource Management Competition		0	–	––

Legend: Importance to Agricultural Development in this Period

+++ Very Important (positive impact) ++ Important + Somewhat Important

– Negative Impact –– More Negative ––– Very Negative 0 Not a Factor

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agriculture. Water development initiatives tried to solve this deficiency—first by early private investment in ditch and gravity flow systems that were followed later by investment in wells that allowed exploitation of a vast groundwater resource. Finally, massive public investments (starting with the Federal Reclamation Act of 1902—Colorado River and many other developments; large federal investments, especially in the 1930s and 1940s for initiation of the CVP; and significant SWP investments in the later 1960s) combined to bring almost nine million acres under irrigation by the end of the 20th Century.

With irrigation development, the suite of possible products expanded enormously. Many new crops introduced into California agriculture were imported from elsewhere and adapted to California's ecology. Of course, with the new plants came their own followings of pests and diseases introduced into areas that lacked their natural predators. Despite new biological challenges, production possibilities grew in the form of an expanding portfolio of new commercial commodities.

Thus, these four drivers—climate, soils, water development, and a wide suite of possible products—came together in the 20th Century to produce the California agriculture we know today. Will these drivers continue to be equally important in the future? Undoubtedly, but some suggest that clouds are appearing on the horizon with respect to water availability, land loss, and soil degradation. We will return to these issues later.

Technology and Inputs: Biological Technology, Mechanical Technology, Adaptive Pest Management, Transportation, Processing, and Storage

The four drivers just discussed provided the platform for a potentially diverse and highly productive agriculture. Technology and inputs were additional requirements for an expanded agricultural-production payoff. With its early history as a rain-fed, hunter-gatherer society, there initially was limited capacity to produce technology. California agriculture would become a voracious borrower, importer, and adapter of technology. For example, expansion of dryland agriculture required seeds and mechanical technology. Large-scale wheat production depended on importing and adapting technology—the combine harvester, for example. Further mechanization was fostered by development and adoption of large track-layers and wheeled tractors, plus a wide variety of specialized and self-propelled machinery. With the transformation from extensive to intensive agriculture (1890–1930), biological technology became increasingly critical, remains so today, and will be in the future. With imports of plants and animals came diseases and pests never previously experienced in California. No natural predators were present to serve as a form of checks and balances. Therefore, pest management was critical. The relative importance of this combination of factors changed over time as mechanical technology became relatively less important and biological and pest-management technologies gained importance.

The success of California agriculture in responding to changing state, national, and international demands has been because of technical innovation in transport, processing, distribution, and storage. These, coupled with an efficient production system and innovative marketing skills, enabled delivery of commodities and products meeting market-driven demands of consumers in increasingly distant markets. Early development of the fruit industry was based on dried fruit sales to U.S. and foreign markets. Fresh market sales to eastern U.S. markets increased with iced, refrigerated rail cars on expanded transcontinental rail-line systems. Processed fruits and vegetables, consumer-ready value-added products, improved postharvest technologies (arresting product deterioration), and improved transportation technologies are other types of improvements made during the 20th Century, facilitating the delivery of California products to higher-income consumer markets worldwide.

Access to Capital and Labor Inputs

California agriculture is critically dependent on the availability of capital and labor inputs. Intensive plant and animal production systems are heavy users of short-term financing for operations and intermediate-term financing for development expenses. Widespread mechanization, the transformation to perennial crops, development of irrigation, and establishment of large-scale confined livestock operations increasingly required access to large capital flows. Specialization in agricultural finance also emerged to support growth and change on California's farms and ranches in the form of large commercial and institutional financiers. A banking system of small-scale,

local banks common to other areas of the United States would not suffice. In its stead a quite different system of alternative, often cooperative commercial and institutional lenders provided the capital input increasingly required by 20th Century California agriculture.

Almost from the beginning of California agriculture, the labor requirements of most farms and ranches exceeded availability from family labor sources alone. Extensive wheat farms required labor for planting and cultural operations plus provision for large numbers of horses and mules used for tillage and harvest. Irrigated agriculture obviously required higher labor inputs per acre than dryland farming. Consequently, labor requirements grew explosively as land was converted from dryland to irrigated production. Conversion to intensive crops required a great deal more labor, especially to meet large peak-labor demands for seasonal planting, cultural, and harvest operations. Thus, access to a stable supply of affordable labor was critical. Most of the labor came from an ever-changing set of international sources—Chinese, Japanese, East Indian, Filipino, Mexican, and Central American.

Access to capital and labor has always been important to development of California's agriculture and critical to sustainability in the 20th Century of highly intensive productive systems.

Human Capital: Production Management, Institutional Innovation, and Adaptive Risk Management

A complex suite of possible crops, numerous climatic niches, ever-active pressure from pests, and irrigation, together with the challenges of effective use of large, off-farm sources of capital and labor inputs, greatly increased the demands for superior production management. California agriculture is complex and unforgiving to those who make mistakes in production management. Thus, over time, those who survived learned how to be effective and efficient managers. This asset has not only been preserved but also improved generation after generation.

Successful production of perishable products—fruits, vegetables, and livestock products—must be accompanied by well-organized, efficient, and innovative marketing skills and accompanying institutional innovation. California agriculture has an incredible record of institutional innovation and marketing successes: the irrigation district authorized by the Wright Act, marketing/bargaining cooperatives, marketing boards, producer check-offs to support research, and ramping up of exports for perishable fruits, vegetables, and nut crops (1970s and 1980s) are but a few examples.

Finally, putting all of the pieces together—finance, technology, multiple crops, irrigation, marketing increased production while maintaining high-quality, and surviving in a rapidly changing external environment—required substantial *adaptive* management skills. Droughts, floods, pest invasions, and unanticipated regulation required effective *risk* management. The record of California agriculture's constant, and sometimes wrenching, adjustment to a risky and changing world while continuing to grow attests to the quality of human capital engaged. This strength has clearly grown over the past half-century.

Demand Factors

From the beginning, California agriculture has, of necessity, been demand-driven. Population numbers and income levels drive demand. In 1850 there was little "local in-state demand" and transportation barriers cut off the great middle of the United States. International markets for hides, tallow, wheat, wool, and, later, nuts, fruits, and wine were driving forces. Markets are only developed when they can be accessed within a reasonable period of time with products that retain desirable quality characteristics.

California agriculture has benefited by constantly shifting its production toward products where demand increases as incomes grow—livestock products, nuts, fruits, fresh vegetables, and wine for example. California's agricultural development in the 20th Century benefited from rapidly growing populations in California and North America, as well as in selected European and Asian markets, who were simultaneously becoming richer. It was an explosive formula for demand-driven growth.

Public Investments

Finally, we must note that a diverse set of public investments were important in at least two critical ways, both of which involved investment in public goods. First, there were substantial investments in transportation (rail-

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roads, highways, ports, and airports) and water-supply infrastructures. Without these, a market-oriented, perishable-crop agriculture in a hot desert climate simply would not have developed. Second, California as a state invested heavily in agricultural education, research, and extension, which have clearly had major impacts (Scheuring et al.; Scheuring). The land-grant model of public education, research, and cooperative extension used throughout the United States proved especially beneficial in giving impetus to the rapid development and continuous adjustments identified in this stylized history of California agriculture. Widespread and available education for both youth and farmers improved managerial skills and enabled quick and effective dissemination of the biological and technological innovations that underpin 20th Century performance.

However, recent developments are potentially troublesome. Public infrastructure has basically ceased expanding, and its condition—some argue—is deteriorating. The cost of education has increased even while access has become more difficult. Investments in agricultural research and extension have suffered several rounds of reductions, e.g., in the early 1970s and early 1990s, and is being pummeled at present in the extreme budget crisis of 2002–2004.

Conclusion

Clear patterns among drivers are discernible from this discussion. In the early 19th Century history of California agriculture, the sector developed chiefly from activities supported by the inherent inventory of rich, alluvial soil resources; progressive employment of mechanical and pest-management technologies; and access to cheap and reliable labor. With limited California demand for expanding levels of production, U.S. and worldwide markets were important and made accessible by improvements in transportation. Improvements in public infrastructure also supported production and marketing achievements in the pre-1900s.

The 20th Century evolution of California agriculture followed from the full slate of drivers identified in Table 13. Of these, several have had diminishing roles. The dominant importance of mechanical technology has fallen relative to the rising importance of biological and adaptive pest-management technologies over the past century. And several drivers, we believe, have diminished in importance to California agriculture since 1950. Among them are access to capital, particularly for small- and medium-sized farm units; issues affecting the once strong and considerable contributions of cooperatives and marketing-order provisions; comparative advantages in transportation; and the overriding contributions of public investments in agricultural and agriculturally related education, research, and extension programs. Following the next section, we will continue with our discussion of drivers, hazarding even to make our subjective judgments of changes that might affect California's agriculture in the 21st Century.

Future Threats and/or Future Opportunities

Our stylized history suggests that 18 historical drivers influenced the development of California agriculture over most of its history. Some say that the future will be sharply different than the past—that there are both bigger and more ominous threats ahead. In this section we comment briefly on some of the ones frequently heard before moving to our fuller assessment of changes in the importance of historical and newer drivers in the future.

Future Threat Number One

Water Shortages and Global Warming

The Sacramento Bee recently (December 22, 2002) ran a story in which the title telegraphed its content: "Future Shock: Epic Drought Could Strike Again, Scientists Warn."

> *Since its last drought, from 1987 to 1992, California has added 6 million people and tens of thousands of yards, orchards, golf courses and other businesses dependent on water. By all accounts, its developed water supply hasn't kept pace, and soon it may shrink drastically.* (p. 1)

The article goes on to cite the loss of Colorado River water, net losses of between one and two million acre-feet of water to environmental uses, and expanded municipal and industrial demand, coupled with no supply expansion, as reasons for making the state and its agriculture increasingly vulnerable with each passing year. It is only a matter of time before, says the article, the arrival of the next inevitable drought.

Emerging research on the potential impact of global warming on California agriculture suggests that the pat-

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tern and timing of precipitation will change, bringing earlier and more uncertain rainfall that will result in lesser snow packs and less ability to store water over winter (Lund et al.). Further climate variability is predicted to increase—a magnification of the El Niño effect.

All of these factors clearly portend a more constrained and variable water supply for California agriculture. Is this the end, as some would suggest? The realistic answer is "no," but better management will be critical. California agriculture uses more than 78 percent of California's available water, down from 85 percent half a century ago. This adjustment was possible because there was, and still is, room for improvement in technical and economic efficiency of water management. Today, more than 60 percent of the state's irrigated acreage is watered with flood/furrow irrigation, a significantly less efficient technology than sprinkler or drip irrigation. Second, shifts in cropping patterns from heavy water-using, low-value crops, to higher-value, lower water-using crops would show significant savings. Finally, economic efficiency could be improved with market-driven transfers among uses and regions. The bottom line: Even if municipal or industrial water use doubled in the next 50 years, California agriculture would lose a smaller proportion of its water (less than 20 percent), the transfer of which could be mitigated by shifting cropping patterns, more efficient application, and better functioning water markets. High-value agriculture can be competitive for water, but it will require adjustment and superior management.

Future Threat Number Two

Population Pressure, Urbanization, and Relentless Resource Competition for Land, Water, and Air Resources in California

Significant quantities of prime agricultural land are lost each year to urban and infrastructure use. However, the numbers must be placed in perspective. There are 8.7 million acres of irrigated land and 10.8 million acres of nonirrigated (rain-fed) crop land in California. The annual loss represents 0.05 percent of the former and 0.04 percent of the latter. While water is the constraint to expanding irrigated acreage, not potentially suitable land, it remains true that the land that is most attractive to conversion to nonagricultural uses is generally also the most productive "prime" agricultural land. Thus, conservation of prime farmland is of growing interest to private groups and public agencies. A common acceptable system of land classification would do much to facilitate communication among participants involved in future agricultural land-use decisions, including that of conserving prime farmlands (Johnston 1990, pp. 83–85).

A longer-term concern may well be the increasing irritation between farming and urban life at the rural fringe of urban neighborhoods—"rururbia" (Johnston 1990)—in terms of air quality (dust, pollen, and odors), noise, and incompatible activities, such as crop dusting at 4:30 a.m. or 24-hour operation of a tractor. "Freedom to Farm" ordinances have increased community understanding of issues, and so far both sides have learned to adjust and will likely continue to do so. However, if, as projected, California's population approaches 60 million by 2040, resource competition can only increase and rural-urban conflicts may need to be further mediated by public policy.

Land-conversion pressures, once thought to apply only to lands in the two major urban areas, the Los Angeles basin and the San Francisco Bay Area, now confront Central Valley inhabitants in interior cities and smaller towns alike.

> *There are no more valleys over the hill, either to the west or to the east, to absorb losses in productivity if Central Valley lands are not conserved. . . . [C]itizens of the Central Valley and this state must work diligently to maintain the flexibility and to forestall irreversibilities not only of its land base, but also of all resources associated with agriculture. There are no more "valleys."* (Johnston 1990, p. 86).

Other forces that affect the overall availability and productivity of agricultural lands include the effects of salinization, reduced water supplies, air pollution, erosion, soil compaction, and soil pollution, all of which reduce per-acre productivity and, at their extreme, eliminate land from economic usage. Their effect on the land base is apparent. Further, the consequences of recent 2003 regulatory initiatives dealing with air pollution from farming operations and water discharges from farm properties will obviously impact how this state's farms and ranches operate, likely increasing production costs.

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Future Threat Number Three

Globalization, Freer Trade, and Low-Cost Overseas Competition

Some journalists argue (e.g., O'Connell) that the water issue will soon be moot because global competition will wipe out California agriculture, leaving the state swimming in water surpluses. There is no doubt that further liberalization of trade, coupled with free flows of capital and technology, will continue to change competitive conditions in markets where California agriculture competes. And yes, no doubt there will be commodities that California agriculture will no longer be able to afford to produce even though it once had a comparative advantage in their production.

But, as before, there will also be new, emerging market opportunities where California will out-compete and dominate. Much is heard of slogans like "prices are global, costs are local," "cheap labor will kill us," and "we can't compete with unregulated foreign agriculture." Surely our historical analysis strongly suggests that California has always faced "low-cost" competition in distant markets and has, in general, made appropriate adjustments to remain economically viable. Successful California producers have delivered quality and reliability of supply as well as quantity of product. These are additional arguments for production and marketing success, especially in markets where a few larger buyers dominate. Success is less achievable for producers of standardized, homogeneous commodities and more attainable for demand-driven production of specialized, designer, or niche products. Focusing on and isolating the cost of a particular factor of production (e.g., labor, water, land) is not particularly useful. Factor substitution, constantly improving productivity, differentiable products, product quality, and supply reliability also merit attention when discussing comparative market opportunity. Otherwise, this history would be that of a less profitable, land-based field crop and extensive livestock "commodity-oriented" agricultural industry more akin to that of the U.S. heartland.

While it is true that reducing trade barriers gives others better access to California markets, it also gives California better access to theirs, and some of those markets, such as China and India, are huge. Retreating behind U.S. and/or California trade barriers is an even worse alternative. In 2000 California exported more than a quarter of the value of its output, and the share has generally been growing. So far, at least, for every foreign market where we have lost share, there have been others where we have gained. The most powerful, positive argument in favor of the value of freely functioning global product and financial markets is that it levels the playing field and lets California agriculture compete in a rapidly growing global market. The potential magnitude of international markets is addressed in the next section.

Future Threat Number Four

Changing Patterns of Economic Growth: Stagnant Growth in Developed Countries' Markets

California agriculture prospered in the 1920s because California population and income were growing rapidly and California agriculture was shifting to produce commodities in which consumption increased as incomes rose. The same story, on a national scale, played out in the 1950s and 1960s as both California and U.S. populations and incomes grew. International demand resulting from rising incomes in developed industrialized countries (Japan, Europe, etc.) had positive impacts in the last third of the 20th Century. But, argue the doomsayers, population growth has slowed or is even reversing in some regions (Eastern Europe and the former Soviet Union), and this population stagnation has been paralleled by slower economic growth rates. Finally, increases in demand for fruit and vegetables begin to slow as incomes continue to rise. Thus, a gloomy scenario can be easily painted, describing a "sky is falling" fear of collapsing market growth for California's high-valued crops and animal products.

But every coin has a flip side. All of the above, of course, are true but only in regard to potentially diminishing parts of future global-market opportunities. Population growth in developing countries, while declining, is still substantial. The world's population, now slightly more than 6 billion, will approach 9 billion by 2050 (United Nations Population Fund). Virtually all of the growth will be urban populations in developing countries. Whereas in 1975, when 75 percent of the world's population lived in developing countries, it will have reached 86 percent by 2025. Further, in a significant sample of developing countries, economic growth rates consistently exceeded those of rich (developed) countries (World Bank). Finally, these emerging middle-income countries are just approaching

income levels where the demand for livestock products, fruit, nuts, and vegetables will increase rapidly.

The growth in demand for the products California agriculture produces could be spectacular. Think what the potential could be of just a small share of the food purchases of 1.3 billion Chinese and 1.6 billion Indians approaching middle-income levels. While we may see China as a competitive threat today, it is also likely that Chinese agriculture will not, simultaneously, be able to meet their growing demand for grains, livestock products, and horticultural products. It is even possible that, in another 50 years, Africa, with a population exceeding 1.2 billion, will be a commercial market. Thus, relative to U.S. agriculture, California agriculture is well placed and should be able to compete in growing markets in developing countries. On balance, the "threat" may well be an "opportunity."

Finally, we should note that, despite a pattern of slow growth in population in other developed countries, population in the United States is projected to increase 38 percent by 2040 and California is projected to grow by 70 percent. So, domestic demand growth will not die; one in six U.S. residents will be a nearby California resident.

Future Threat Number Five

Reduced Public Investment in Agricultural Research and Development

Many of the historical drivers for development of U.S. agriculture stemmed from early federal and state support of research, education, and cooperative extension through land-grant universities. Three times over the past 50 years there have been substantial reductions in state support for agricultural research and extension—the early 1970s, early 1990s, and early 2000s.

Agricultural technologies were relatively unencumbered by proprietary claim and freely available to all until the 1980s (Pardey and Beintema, p. 20). Public research and development (R&D) funding exceeded private R&D funding in the United States until 1980. From 1980 to 1998, public funding increased nominally by only 13 percent (and has actually declined since 1995) while private R&D funding increased at a significantly faster rate, by 43 percent. Shares of total U.S. funding in 1998 were 57 percent from private sources and 43 percent from public sources (Alston and Zilberman).

Despite the fact that nominal public expenditures in California for agricultural research and extension increased through the late 1990s, real total expenditures peaked a decade earlier (in 1990) and have since fallen (Alston and Zilberman). Recent state cuts to funding for research and extension may never be restored and certainly will not return in the near future.

The principle reason for increased total investments in agricultural research is developments in molecular biology (biotechnology) that, coupled with intellectual property protection for agricultural products, have given powerful incentives for increased private-sector investment in agricultural research. Thus, while we identified public-sector R&D as an important driver in the past, it is likely that private investment, plus the enormous potential of biotechnology to reduce costs, stabilize yields, and increase quality, will mitigate to a considerable extent the negative impact of declining public support.

The one dark cloud on the horizon is the strong public reaction against genetically modified organisms (GMOs) in important European and Japanese export markets. On the other hand, rapid adoption of GMOs in a growing number of countries, plus a lack of substantive evidence so far about increased risk resulting from their use, may render some of the negative concerns less important with the passage of time.

Drivers Influencing the Future of California Agriculture

We now speculate on how important the identified drivers might be in the 21st Century relative to their influence in the last half of the 20th Century (1950–2000). Post-WWII agricultural development was associated with the generally positive alignment of dominant drivers. Our assessment—our possible prognosis of 21st Century California agriculture—contains some deterioration in factors supporting the industry relative to the recent past.

Our evaluations are summarized in the "Future" (last) column of Table 14. We posit that the mix of drivers continues to be important to the future of the industry. But changes in the quantity or quality of ingredients (the drivers) in the mix will also be an important influence on future structure and performance. The overall mix determining 21st Century outcomes will trigger change and adjustment to emerging realities. We evaluate changes in the impact of most of the drivers in the first five major

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categories (A–E) to future outcomes, taken as a whole, to be relatively small. We indicate that most drivers will continue to make significant contributions to California agriculture similar to those most recently occurring in the late 20th Century.

However, we also regard seven of the 20 drivers as having critical, adverse impacts because of an expected deterioration in their contributions to California's agriculture. Four of the first 16 drivers in the major categories (A–E) were downgraded relative to our previous assessment through the 20th Century. Less favorable environments are likely due to an absence of water-development initiatives (3), heightened concerns about access to capital (10) and labor (11), and lessening importance of cooperatives and marketing boards (14). Adverse effects of changes in drivers are identified in the final two categories (F and G), reflecting likely changes in public investments. A decline in public investments in infrastructure (17) and in public research, education, and extension (18), expanding impacts of regulation (19), and intense competition for resources (20) will continue at currently heightened levels.

We next discuss each of the seven major categories of drivers in turn.

Category A: Biophysical Factors

Four drivers—climate, soils, water development, and a wide suite of possible products—came together in the 20th Century to produce the California agriculture that we know today. Will they be important in the future? Undoubtedly.

1. Climate—21st Century Impact: Remains High (maintain +++)

California agriculture utilizes a range of benevolent climatic regimes to underpin its bounty of production. Although some concerns exist regarding a threat of global climate change, significant climatic alterations do not appear likely to offer profound change over the next several decades.

2. Soils—21st Century Impact: Remains High (maintain +++)

In a similar manner, California's agricultural production benefits from large quantities of soils found to be productive in a range of uses—from extensive rangelands to acreages of land types suitable for higher-valued uses such as vegetables, perennial fruit, and nut crops. While there has been serious loss of productive lands from coastal valleys, both public and private concerns have developed programs that conserve prime agricultural lands and mitigate conversion of farmlands to nonagricultural uses. Some do suggest that there may be clouds on the horizon with respect to land loss and soil degradation (increasing salinization and drainage issues), but even so, California's agriculture is not likely to experience a shortage of farmland in the foreseeable future.

3. Water Development—21st Century Impact: Moves from Very Positive to Neutral (downgrade from +++ to 0)

Competition for a finite and often highly variable supply of water will increase from urban and environmental demands. The three historical periods were characterized by significant water developments—by gravity systems of surface-water irrigation after the Gold Rush (pre-1900), growing groundwater extraction made possible by the invention of the centrifugal irrigation pump (1900–1950), and public investments in multipurpose reservoirs and irrigation systems, including the CVP and the SVP (1950–2000).

We are unable to visualize water-supply developments of comparable significance in the 21st Century, save for the possibility of a breakthrough in ocean-water desalinization, which might contribute to meeting rising urban demands in southern coastal areas and thus lessen the degree of competition for water currently applied in agricultural uses. In the absence of such advances, water-market transfers, water banks, institutional sharing arrangements for variable water-supply conditions, and conjunctive management of groundwater basins will likely be the hallmarks of efficient management of the state's limited yield from existent ground and surface-water sources.

4. Suite of Products—21st Century Impact: Remains High (maintain +++)

The suite of possible products is likely to continue to expand in response to the changing ethnic composition of the state's and the nation's population by changing tastes of domestic consumers and by rising demands for specialty crops in favorable export markets. Agricultural

Table 14. **Future Drivers of California Agriculture**

Drivers		Historical Period: Pre-1900	1900–1950	1950–2000	Future
A. Biophysical					
1. Climate: Mediterranean and subtropical		+	+++	+++	+++
2. Soils: alluvial—rich and deep		+++	+++	+++	+++
3. Water Development: private and public+		+++	+++	0	
4. Widening Suite of Possible Products		+	++	+++	+++
B. Technology and Inputs					
5. Biological Technology: borrowed, adapted, invented		+	+++	+++	+++
6. Mechanical Technology: adapted, invented		++	+++	++	++
7. Adaptive Pest Management: imported and invented		++	+++	+++	+++
8. Transportation: development and innovation		++	+++	+++	+++
9. Processing and Storage Technology		+	+++	+++	+++
C. Access to Inputs					
10. Access to Capital		+	+++	+++	++
11. Access to Labor: cheap and reliable seasonal supply		++	+++	+++	++
D. Human Capital					
12. Superior Production Management		+	++	+++	+++
13. Superior Adaptive and Risk Management		+	++	+++	+++
14. Marketing and Institutional Innovation: co-ops, marketing boards		+	+++	++	+
E. Demand Factors					
15. Population Growth:	a. California	+	++	+++	+++
	b. U.S.	+	+++	++	++
	c. World	+++	++	+++	+++
16. Economic Growth/Rising Incomes:	a. California	+	++	+++	+++
	b. U.S.	++	+++	+++	+++
	c. World	+	++	+++	+++
F. Public Investments					
17. Investments in Public Infrastructure: water, transportation		++	+++	+++	+
18. Public Investment in Research, Education, and Extension		+	+++	++	–
G. New Entrants					
19. Regulation: environmental, safety		0	0	–	––
20. Urban and Resource Management Competition		0	–	––	–––

Legend: Importance to Agricultural Development in this Period

+++ Very Important (positive impact) ++ Important + Somewhat Important

– Negative Impact –– More Negative ––– Very Negative 0 Not a Factor

←···

producers will respond to meet growing and changing needs if markets can be developed and sustained to meet economic costs of production.

Overall, three of the four biophysical drivers are expected to maintain significance in the future. Only water development (3) is judged to be less positive for agriculture in coming years.

Category B: Technology and Input Factors

The relative importance of biological and pest-management technologies will continue to exert greater relative influence on the performance of California agriculture than mechanical technology. Transportation, processing, and storage technologies will maintain their important roles in moving the produce of California farms and ranches to consumers across North America and beyond to export markets.

5. Biological Technology—21st Century Impact: Remains High (maintain +++)

Early growth and development was fostered by adapting imported biological materials to California production conditions. Major industries developed throughout the 20th Century based on imported germ plasms and animals, augmented by varietal selection and genetic improvements, to match local growing environs. The flow of new products continues, meeting the many economic demands of growing ethnic populations in the United States and consumers worldwide. New biotechnological advances have already provided improvements for field crops, reducing chemical inputs and increasing custom characteristics of feed and industrial products. Coequal application to food products has not received strong approval by domestic and foreign consumers. Nonetheless, biological technological advance is seen as a continuing strong driver of California agriculture in the 21st Century, particularly if improvements move from the current focus on field crops to advances for specialty crops, where the introduction of bioengineered resistance could be important in offsetting the current lack of approved materials for smaller acreages of horticultural crops.

6. Mechanical Technology—21st Century Impact: Remains Positive (maintain ++)

California agriculture has a strong history of both adapting and developing new, innovative mechanical technologies to meet the requirements of Mediterranean-type agriculture (Olmstead and Rhode 1997, pp. 14–19). The list includes development of large-grain combines, crawler tractors, the centrifugal irrigation pump, mechanical fruit and nut harvesting systems, aerial application systems, etc. Unlike much of U.S. agriculture, which is dependent on machinery and equipment lines of large national manufacturers, California producers rely on mechanical technologies from several sources—from large machinery and equipment lines for general purpose tractors and combines, from foreign manufacturers for specialized, precision equipment for special production uses (e.g., for vegetable crop farms and dairies), and from local inventor-manufacturers who design and/or take over the manufacture of equipment that was first developed on farms and ranches for very specific needs. The industry will maintain its reliance on productivity-improving and/or cost-reducing mechanical technologies for continued economic success.

7. Adaptive Pest Management—21st Century Impact: Remains High (maintain +++)

An open border and a global economy bring the possibility of new pests that adversely affect the economic productivity of California agriculture. It is increasingly difficult to provide both effective monitoring of local production areas and thorough inspection of incoming plant and animal materials for potential threats to the state's agriculture. Some examples: the Mediterranean fruit fly threatened the state's fruit industry in the 1980s; foot and mouth disease, mad cow disease, and Newcastle's disease are of constant concern to the livestock and poultry industries; African bees could imperil the apiculture industry; the spread of Pierce's disease by the glassy-winged sharpshooter has already decimated southern grape-growing regions and has the potential to cause great economic damage if introduced into other major grape-growing regions; the spread of phylloxera required removal of grapevines and replanting on resistant rootstock, etc. Adaptive pest management, required to maintain the economic viability of agricultural production through variety selection, integrated pest-management programs, eradication programs, cultural practices, and the like, will continue to be critically important to 21st Century agriculture.

8. Transportation—21st Century Impact: Remains High (maintain +++)
9. Processing and Storage—21st Century Impact: Remains High (maintain +++)

Technology will be important in delivering quality products in larger quantities to diverse markets worldwide. Drivers 8 and 9 are listed separately in our table, but here they are discussed together as they are often of joint importance to market delivery of high quality products to both domestic and export buyers. In a demand-driven system, products must be quickly delivered to consumers in an assured form and quality.

The produce of California's farms and ranches has always greatly depended on national and international markets. Early on, international markets, which could be reached by sea, were more accessible than were interior domestic markets. That changed with completion of the transcontinental railroad in the late 19th Century. Ice cooling opened domestic markets for perishables in the early 20th Century. Post-WWII construction of the interstate highway system triggered another shift in the mode of transport—from rail to refrigerated trucks—for servicing domestic and nearby Canadian and Mexican markets. More recent innovations—refrigerated container shipments and air freight—permitted development of overseas export markets. Each major innovation led to structural changes in product mixes from extensive to increasingly intensive types of agricultural production. Efficient, timely transportation will continue to be of paramount importance to the economic viability of California agriculture.

Early expansions of commercial agriculture featured livestock products (tallow and hides) and nonperishable commodities (wheat and barley)—products that required minimal processing and, in a relative sense, did not require extraordinary storage skills to maintain market acceptability. Subsequent development of the fruit industry went through several major changes, first from dried fruit to development of markets for processed (canned) and frozen products and then to a major emphasis on fresh fruits. Simultaneously, the challenge also was to deliver products to markets located more distant from producing orchards and vineyards. Scientific understanding of the postharvest physiology of harvested crops grew to be of paramount importance in the 20th Century, leading to practices that include quick postharvest cooling and control of atmospheric conditions during packing, storage, and shipping. Parallel shifts are noted for the vegetable industry, which has also moved to a predominantly fresh-product form for domestic and foreign consumers.

In summary, the import of improved transportation technologies impacted the industry earlier than did a focus on processing and storage. Contributions to transportation technologies evolved throughout the past 150 years. In contrast, contributions to improved or new processing and storage technologies have been of growing significance, especially during the post-WWII period, underpinning the transformation of California agriculture from a majority dependence on extensive field and livestock products to one dominated by more intensive production of fruits, nuts, and dairy products that move to worldwide markets.

Category C: Access to Capital and Labor Inputs

Access to capital and to labor has always been important to agricultural firms and businesses. Structural changes in these input markets, plus concern about availability, lead to generally less positive outlooks for the future.

10. Access to Capital—21st Century Impact: Less Positive (from +++ to ++)

Financial problems in the last two decades of the 20th Century and the related wave of megamergers of regional banks into national banks have changed the lending environment. Agricultural firms no longer compete in segmented capital pools for agricultural-related loans. This has been a major structural change. Now, credit markets are mostly nationwide markets (some with considerable global reach) with little or no differentiation in the designated portions of loan portfolios dedicated to agricultural firms—farms and businesses. The result is that all firms compete in much larger markets, putting additional stress and uncertainty on many small- to medium-sized farms and agribusinesses. Smaller firms may be competitively disadvantaged unless they have an economically viable niche market for product or services or unless they have nonfarm sources of income.

The distribution of farms by size of farm has become increasingly bimodal as the industry has been exposed to the several financial challenges during the recent two decades. In California and the United States there are

growing shares of small-sized farms of minor commercial significance (large numbers of farms with a small share of production in the aggregate) and a relatively small number of large farms that produce the majority of agricultural production. In between there is a group of small-sized commercial farms with operators who are dependent on farm sales as the chief source of income.

Our assessment continues to acknowledge the realities of a capital-intensive industry facing significant structural changes in product markets that generally favor larger over smaller producers in meeting the quantity and quality specifications of supply contracts. Some will require capital not only to expand production but also to integrate production with processing and marketing activities (by vertical integration), involving themselves in production of a wider suite of products (by horizontal integration) or in other production regions (by spatial and/or temporal integration)—all efforts to maximize returns on internal and external sources of capital. Thus, for these firms, access to capital will continue to be important if they are to respond successfully to changing economic realities into the 21st Century.

Our assessment also recognizes the increasing scrutiny of the creditworthiness of small- and medium-sized firms, which require higher levels of internal funding for loan security. While changes in capital markets are of limited concern to small farms that are characterized by residential, retirement, or part-time farming interests, financial stress will likely persist for medium-sized operations attempting to remain commercially viable. Viability is challenged by the low return on small levels of production and the difficulty in competing for production contracts favorable enough to attract adequate levels of external financing. Without a successful adjustment outcome, they will be destined to either exit the industry or, at best, experience even lower levels of returns on management and internal capital and/or be increasingly dependent on nonfarm incomes.

11. Access to Labor—21st Century Impact: Less Positive (from +++ to ++)

Labor availability and cost, always important to California growers and processors, will be influenced to greater degrees by global political and competitive conditions. The entry of waves of cheap labor pools from Asia and the Americas has been, over time, fostered both by legislated programs and illegal immigration. While past periods of uncertain labor availability and/or rising labor costs have fostered development of important labor-saving technologies, the magnitude of recent growth, as well as the intensification of agricultural production, has resulted in more than offsetting increases in labor requirements. Total hired-worker employment in agriculture grew from about 200,000 man-year equivalents in the early 1960s to nearly a quarter million by the mid-1990s. While the number of regular workers (employees working 150 days or more by a single employer) did not increase over the period, seasonal employment did increase significantly, rising from 50 percent to 64 percent of average employment (Martin and Mason, p.158).

Agriculture's need for a cheap supply of relatively unskilled seasonal labor, as unattractive as this initial employment opportunity may be, has provided a common starting point for numerous immigrant groups who later move to more attractive jobs throughout the economy. At a time when California agriculture is nervously watching the production potentials of low-labor-cost competitors for U.S. and world market shares, two domestic policy issues loom on the horizon, casting much uncertainty about ample labor supplies. First, continued high recessionary unemployment may reduce prospects for legal, guest-worker types of federal programs. Second, tighter borders instituted as a part of elevated homeland security measures could reduce available supplies of low-cost labor to both agriculture and nonfarm service employers. President Bush's recently proposed immigration reform may reduce labor uncertainty if legislation follows to move a portion of the illegal immigrant workforce to legal, green-card status.

Overall, drivers 10 (capital) and 11 (labor) are judged to be less positive for agriculture in the coming years. Both are critically important. They differ only in their effect on farms with different characteristics. Increased segmentation of financing favors farms with more favorable commercial opportunities; medium-sized farms will continue to be financially challenged. Labor availability issues concern firms of all sizes.

Category D. Human Capital

Superior human capital is one of California agriculture's greatest assets. This historical strength will continue to be valuable in an increasingly competitive environment.

We expect that two of the three drivers, 12 (superior production management) and 13 (superior adaptive and risk management), will maintain the importance of their contribution to the positive performance of the industry while one driver, 14 (marketing and institutional innovation), is likely to diminish over time, potentially becoming a relatively less positive influence on future outcomes.

12. Superior Production Management—21st Century Impact: Remains High (maintain +++)
13. Superior Adaptive and Risk Management—21st Century Impact: Remains High (maintain +++)

Superior management capability and effective implementation are the hallmark of firms that achieve better economic performance even while constantly undergoing structural adjustment. Management expertise is one characteristic of firms surviving turbulent economic challenges. Successful California farmers and producers have accepted forces of change, including those often thrust upon them from external sources, as they seek to reduce per-unit costs of production as well as to react positively to production innovations and opportunities for new commodities and product forms. Adaptive skills are a necessity, including an acceptance of inherent risks and uncertainties along with strategies for managing potential risks to the firm, whether it be a farm, a ranch, or an agribusiness that extends beyond the farm gate.

Our evaluations of the three major historical epochs reflect the ever-increasing contribution of superior managerial skills to development of California agriculture. California farms and ranches, often more diverse in structure than is common elsewhere, are extremely demanding of managerial skills. The existence of multiproduct, integrated firms requires higher levels of managerial expertise. Smaller firms also require superior management in order to compete. The premium for a range of superior management skills will continue to be valued in forthcoming responses and initiatives that will be key to success and survival in California agriculture.

14. Marketing and Institutional Innovation—21st Century Impact: Less Positive (from ++ to +)

Marketing is obviously important to California farms and agribusinesses. Management and important institutional innovations contributed mightily to the growth and development of California's agriculture, especially in the early 1900s. Among the important institutional innovations were (1) an exemption from U.S. antitrust laws, permitting growers to act collectively to process and market their crops and to share information; (2) bargaining through grower cooperatives (beginning with the 1922 Capper-Volstead Act); and (3) growers' ability to act collectively to control various aspects of marketing their products by federal legislation (Agricultural Marketing Agreement of 1937) and state legislation (California Marketing Act of 1937). These were especially important to the growth of specialty-crop production (Carman et al.).

As the state's capacity to produce specialty crops expanded, several commodities quickly developed a dominant marketing cooperative that controlled a majority of the California market volume. Examples included Sunkist (citrus), Sunsweet (prunes), Sun-Maid (raisins), Almond Growers Exchange (almonds), Blue Anchor (fresh fruit), Nulaid (eggs), Diamond Walnut (walnuts), Calavo (avocados), California Canners and Growers, and Tri Valley Growers (canned fruits and vegetables). Early emergence of marketing cooperatives especially fostered the growth and development of irrigated agricultural production featuring more perishable fruits and specialty crops, but several cooperatives also emerged for field crops, e.g., RGA (rice) and CalCot (cotton). Cooperatives gave growers the opportunity to achieve scale economies by integrating collectively to gain benefits of larger volume processing and marketing activities as well as to benefit from joint information sharing and bargaining activity (Carman et al.).

Government-organized federal and state agricultural marketing agreements also grew from inception in popularity and importance, recently accounting for 54 percent of California's agricultural output, being most important for animal products, vegetables, and fruits and nuts and least important for field and nursery crops (Carman et al.). Depending on the specific marketing order, producers are required by law to contribute toward financing mandated marketing programs, the most common being for quality control involving standardized grades and minimum-quality standards by inspection, generic advertising and promotion in domestic and foreign markets, and research.

The contribution of both cooperatives and marketing

orders has been increasingly challenged in the recent past, such that we must conclude that their importance has declined in the late 1900s and will likely continue to decline in the future (Table 14). We have observed the gradual weakening of the position of grower cooperatives and have noted in our stylized history that several have disappeared (e.g., Tri Valley, CalCan, RCA) while others have had to deal with declining market share and financial challenges. Some aspects of mandated marketing programs have been problematic. Some programs have been terminated by grower referendums and others have suffered adverse court decisions in regard to quantity-control prorate programs or assessment of the benefits of generic advertising to individual private label firms.

The weakened competitive position of grower cooperatives and problematic features of mandated marketing orders are a consequence of the existence of large producers and integrated grower-processors of sufficient size to have market power of their own. This is now more common than it was in the 1920s and 1930s when enabling legislation was initially crafted. We believe that erosion in the contribution of co-ops and marketing orders will likely carry forward into the 21st Century.

Category E: Demand Factors

15. Population Growth—21st Century Impact: Remains High (maintain +++).
16. Economic Growth—21st Century Impact: Remains High (maintain +++)

Population numbers and per-capita incomes are the dominant determinants of ultimate demand for the produce of California farms and ranches. Table 14 reviews California, national, and worldwide prospects for population and economic growth. Demand within the state grew over the epochs with significant increases in population and per-capita incomes occurring in the recent past. The relative growth in California demands will likely exceed that of nationwide per-capita demands in the future, the result of continued immigration and rising incomes. Export demands, important in the early history of the state, have again become important, responding to rising incomes in important offshore markets in Europe, Asia, and elsewhere.

It is obvious that California agriculture, being demand-driven, must be sensitive to changes that effect state, national, and international demands for the products of its farms and ranches. Issues will relate not only to quantities in trade channels but also to quality and supply reliability. Future marketing opportunities will be defined in importance by trade to both local and distant markets as well as the location of competitive battles for market shares. High export dependency for many of its products, increased in-state population's demand for food products, slower growth in national markets, and, above all, the possibility of both growing populations and incomes in developing economies will be important determinants for success.

Category F: Public Investments

17. Public Infrastructure—21st Century Impact: Significantly Less Positive (from +++ to +)
18. Public Research, Education, and Extension—21st Century Impact: Switches from Positive to Negative (from ++ to –)

These two drivers reflect the most negative of our outlooks. Public investments in infrastructure support major drivers important to industry success. The SWP, which was funded differently than the CVP (by bonded debt service from users), may provide a financial model for future endeavors to serve particular sectors of the state, including agricultural, urban, and environmental water users. Highways are in a deteriorating state. Increased maintenance and traffic congestion add to transportation costs. Local roads are affected by inadequate local funding. Airports and harbors also face difficulties, including the need for health and security assurances.

"User pay" may also be the coming mantra for covering the costs of research, development, and extension services. Private agricultural R&D investments now exceed public expenditures, a trend that is sure to continue, possibly to the detriment of discovery of basic scientific research necessary for applied research products. It may also skew products toward large-market products, curtailing development of applied research products focused on smaller markets, e.g., for smaller-volume horticultural crops of the sort common to California. We have postulated that superior management will continue to be a hallmark of a viable agricultural sector in the future. Higher tuition costs reduce public contributions to each student's education at the state's colleges and universities. Here, too, the shift ap-

pears to be one of user pay, perhaps reducing educational opportunities and, along with that, less public support of the tenet that the benefits of a well-educated population serve society and the general welfare of the citizenry. Extension and public-education programs are also under budget scrutiny with the almost inevitable consequence of reduction if not elimination. Private extension and public-education programs may be developed for those willing to bear the cost. Programs without a core, definable economic market may cease to exist.

Category G: New Entrants

Our historical analysis suggested that all of the 18 drivers had impacts in all three historical periods, though clearly their relative importance has shifted. We then asked if there were new drivers that have emerged since WWII. We suggested there were two—regulatory pressures and resource competition—which are not exactly new to Californians. Cumulative impacts from both have grown steadily over the past half-century, but they did not exist as particularly omnipresent factors until the very recent past.

19. Regulation—21st Century Impact: More Negative (from – to ––)

The increasing regulation of agriculture is driven by environmental, worker, and consumer safety issues, among others. There has been a continuous increase in regulations, compliance challenges (including licensing and reporting requirements), and the like. The majority of regulatory pressures have been imposed since WWII during a period marked by rapid increases in the number of people living in California and a growing slate of concerns by the general public about the environment, labor, health, and consumer policies. A recent study of farmer responses to the effects of regulations (Carter et al.) reflects one attempt to categorize the broadening scope of regulatory activity: (1) employee-related regulations—safety and health, employee rights, disclosure, transportation; (2) community-related regulations—consumer health and safety, community public health and safety; (3) natural-resource-related regulations—air quality, water quality, water rights, threatened or endangered plants or animals, and wetlands; and (4) regulations related to transportation of materials—transportation of hazardous wastes and of goods and materials (not classified as hazardous). Regulations had a perceived effect on management practices, including those of employee safety and training, paperwork, technology, management support and improvement, cultural practices, scale of operations, and efficiency (Carter et al., pp. 89–114).

We in no way argue that regulatory activities are not in the public interest, but they do increasingly change the policy and regulatory environment within which economic activity exists, constraining options, increasing costs, and reducing the competitiveness of California agriculture. We can admit only to viewing the future as one in which regulations will have profound impacts on firm and industry productivity and competitive performance.

20. Resource Competition—21st Century Impact: Very Negative (from –– to ——)

The second set of new drivers is the flip side to the positive impact of population and income growth on demand: namely, competition for natural resources. Urban growth has already pushed agriculture virtually out of Los Angeles, Orange, San Diego, San Mateo, and Santa Clara Counties and is now spilling over the Tehachapis from the south and the Coast Range from the west into the Central Valley. Thirty-five million people demand more recreation space, more water, more land, and more public space (highways, airports, etc.). When we recognize that only a small part of California is hospitable to human habitation, which, in general, occurs in the same areas where agriculture thrives, the potential for increasing abrasion on the urban-rural interface is inevitable.

In summary, both drivers are responsive to the demands of a growing nonfarm population in the United States and in California. Both are external forces to which accommodation must inevitably be made. Litigation is only infrequently successful in preventing negative impacts. Agriculture has come to learn to work with other interest groups to make the best of possible outcomes. To the extent that they limit choices of producers and processors, they can add to the cost of production, reducing economic profitability and placing California producers at a competitive disadvantage to producers in other states and even in other countries that are not similarly affected. U.S. markets for some crops may not be affected unless there are alternate producers of the same or substitute products in other states or if there are offshore produc-

ers with lower costs of production. Shares of market in third-country markets may be affected if there are global competitors in those same markets with lesser constraints or nonregulated production options.

Concluding Comment: Factors Affecting the Future of California's Agriculture

Comparisons of the "Future" column of Table 14 to the "1950–2000" column identify six of the original 18 drivers as providing relatively lesser contributions to future growth and development of California agriculture. There is at least one driver for four of the first six categories—Biophysical Factors (water development), Access to Capital and Labor Inputs (access to capital and access to labor), Human Capital (marketing and institutional innovation), and Public Investments (public infrastructure and public research, education, and extension)—that have been instrumental in the evolution of California's agriculture as we know it today. These six, plus the two new entrants—regulation and resource competition—make up the list of drivers that may adversely affect California's agriculture in a relative sense in future years. Our concerns for each have been enunciated in the preceding discussion.

Nearly all of these eight drivers have one thing in common. They are directly or indirectly influenced by public policy. Therefore, it could be within the power of government, state and federal, to partially or wholly counterbalance potentially negative future influences. This is our lesson from history.

V. A POSSIBLE PROGNOSIS FOR THE FUTURE

Why California Agriculture Is Different

Willard Cochrane (1993) in his history of U.S. agriculture argues that agriculture in the United States has basically been "supply driven." That is, production was initiated for self-consumption (subsistence), but marketable surpluses emerged as productivity increased. Contrary to Malthus' prediction that demand would outrun supply, agriculture in developed countries has been characterized by production expanding more rapidly than demand (by expansion of area, yield increases, or both), leading to oversupply, low prices, and, ultimately, government intervention to support incomes. The individual farmer's main defense to such situations was to improve efficiency by adopting new technology. But if new technology was rational for one, it was rational for all, so aggregate supply expanded further, thus pressing prices to lower levels. The argument thus arises that agriculture is on a perpetual "treadmill" of overproduction and low prices (Cochrane 1958).

But California agriculture was not settled by small homesteaders intent on feeding themselves first and then possibly producing small surpluses of basic commodities—grain, milk, eggs, and meat. California agriculture started with big farms and ranches producing much more than could be consumed by the farmers directly. California farmers produced to meet someone else's demand—for hides and tallow on the East Coast and in Europe, meat for miners and those supplying miners, wheat for export, nuts and dried fruits for the East and Europe, and so on. This dominant focus on meeting changing product demands, coupled with the range of total products possible, meant that California agriculture could be opportunistic. But to be so, it had to constantly adapt to survive and, yes, thrive.

Constantly adjusting to changing opportunities has meant that California agriculture has a perpetual thirst for new technology—better and cheaper is always a potential market advantage. Being a long distance from markets for both outputs and inputs placed an extra premium on efficiency and adaptiveness. This set of factors pulled California agriculture through a quick sequence of changes that, as incomes climbed and population grew, meant that California agriculture became more and more diversified—200 crops in 1970, 350 in 2000.

A lesser focus on basic crops meant that California agriculture has been less influenced by, or dependent upon, U.S. farm programs. However, if programs offered opportunities, California agriculture made the best of them. After all, an agriculture that is more efficient or productive than that of the rest of the country should be able to perform better. California agriculture has done so in cotton, rice, and dairy.

Being less focused on Washington, California agriculture sought favorable state policies on water, transportation, research, and development, as well as favorable tax treatment. Until 1961, rural areas dominated the state senate. California agriculture was able basically to get its own way pre-WWII and remained a powerful force thereafter, at least until it lost the Peripheral Canal battles in the 1970s.

A few other distinctions will round out our case that California agriculture is different. It has always been a capital-intensive but simultaneously very seasonally labor-intensive agriculture. California agriculture has always had a strong dependence on distant markets but, as its own state market grew, it adjusted to meet growing "in-state" demands. It has benefited greatly from being in the middle of a rapidly growing and rich "domestic" market. Having access to 35 million local customers is preferable to having only 0.75 million (as in North Dakota) or even three million (Iowa).

The constant adjusting to meet changing demands of affluent consumers has had consequences for the nature of California agriculture. Since 1952, the share of output accounted for by annual field crops has fallen precipitously while production of higher-valued vegetable and perennial crops (nuts, fruits, ornamentals, nursery crops, and grapes) has increased substantially. Dairy production now dominates the livestock sector. The result is that a rising share of California agriculture is on longer, multiyear production cycles. This necessitates a longer planning framework if periodic price run-ups are not to be followed by rapid buildups in production capacity, which inevitably result in market gluts and falling prices. This is currently happening in the wine industry worldwide.

Thus, our case is that California agriculture is different in that, being demand-driven, it fills many niche markets that are by definition thin markets. Booms and busts, the result of thin markets combined with multiyear production cycles, have historically characterized these markets. California agriculture has dozens of "commodity cycles" going on simultaneously. This leads to constant instability, so the need for rapid adjustments is endemic. California agriculture has many production options and, thus, it has historically been nimble, quick, and able to demonstrate that it can meet changing environments, exploit opportunities, and be competitive in domestic and foreign markets. Examples include:

- It beat Europeans out of domestic and foreign markets for fruits and nuts at the turn of the 20th Century.
- It saved the processing tomato industry by radically altering the nature of the tomato and how it was harvested.
- It now dominates world markets for almonds, going from a marginal exporter to 80 percent of world markets in less than 20 years.
- It established a pistachio industry from nothing.
- It went from being an "also ran" producer of jug and popular-priced wines to a world-class wine competitor. A blind-tasting victory in Paris in 1976 proved that California could beat the French at their own game.

California agriculture has a remarkable, but not painless, history of successful adjustments to changing times, most of the time emerging as a different but stronger sector. We cannot find evidence from history that this picture will change materially in the next 25 to 50 years.

Bottom Line: What Are California Agriculture's Chances?

California Agriculture Compared to U.S. Agriculture

It is now time to end this story. We have consulted history. We have argued that California agriculture has performed well compared to U.S. agriculture. Based on the total value of crops and livestock marketed, California became the highest-ranking agricultural state in 1948. It has maintained that ranking ever since while increasing the difference between it and the second most important agricultural state (Table 15).

In 1950 California accounted for 8 percent of the total value of U.S. agricultural production. Since then, the share has steadily risen. In 2000 California agricultural production was worth $25.5 billion, amounting to 13 percent of the U.S. total. The value of California agricultural production of crop and animal products is now more than the combined value of the next two states, Texas and Iowa.

But California agriculture's dependence on federal

Table 15. **California's Increasing Share of U.S. Agricultural Production – Rank and Value of Agricultural Production in Billion Dollars, 1950–2000**

1950	1960	1970	1980	1990	2000
Rank and Value of Production					
1 CA 2.3	1 CA 3.2	1 CA 4.5	1 CA 13.5	1 CA 18.3	1 CA 25.5
2 IA 2.1	2 IA 2.5	2 IA 3.9	2 IA 10.0	2 TX 11.8	2 TX 13.3
3 TX 2.1	3 TX 2.3	3 TX 3.1	3 TX 9.0	3 IA 10.3	3 IA 10.8
4 IL 1.7	4 IL 1.9	4 IL 2.7	4 IL 7.9	4 NE 8.7	4 NE 9.0
5 MN 1.2	5 MN 1.4	5 MN 2.0	5 MN 6.3	5 IL 7.8	5 KS 7.9
U.S. 28.3	*U.S. 34.0*	*U.S. 48.7*	*U.S. 136.4*	*U.S. 169.3*	*U.S. 193.6*
California's Share of Total U.S. Value of Agricultural Production					
8%	8%	9%	10%	11%	13%

Source: U.S. Department of Agriculture, Economic Research Service 2003b.

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Table 16. **California Agriculture's Minor Dependence on Direct Government Payments, 1950–2000**

Payments in Million Dollars												
1950		**1960**		**1970**		**1980**		**1990**		**2000**	
CA	9	CA	22	CA	132	CA	14	CA	252	CA	667
IA	5	IA	21	IA	236	IA	45	TX	974	TX	1,647
TX	15	TX	73	TX	543	TX	231	IA	754	IA	2,302
IL	6	IL	18	IL	167	IL	36	NE	625	NE	1,407
MN	6	MN	32	MN	152	MN	70	IL	506	KS	1,232
U.S.	*185*	*U.S.*	*695*	*U.S.*	*3.7 bil*	*U.S.*	*1.3 bil*	*U.S.*	*9.3 bil*	*U.S.*	*22.9 bil*
California's Share of Direct Government Payments to U.S. Agriculture											
5%		3%		4%		1%		3%		3%	

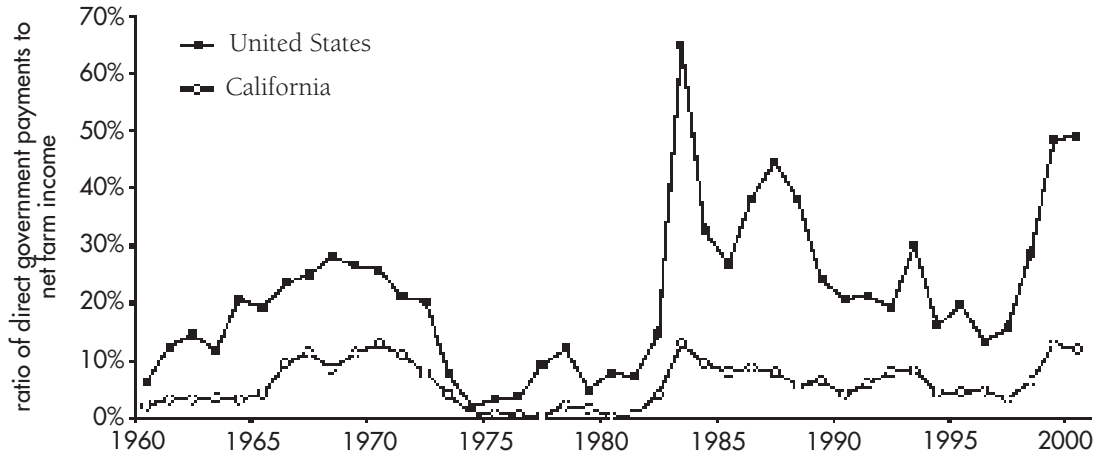
Source: U.S. Department of Agriculture, Economic Research Service 2003b.

government farm payments has been significantly less than that of the rest of U.S. agriculture (Table 16). In 2000 California's payments amounted to $667 million out of total U.S. direct government payments of $22.9 billion—only about 3 percent of the total. In contrast, Iowa received about 10 percent of U.S. payments and Texas received about 7 percent. It is likely that payments to California producers will fall relative to grain-belt areas because field-crop production will continue to decline as growers shift to higher-gross-income crops as markets permit.

An additional way to indicate the relative independence of California agriculture from direct government payments is to look at the share of net farm income (gross sales minus production costs) made up of direct government payments. Over the period 1990–2000, direct government payments to U.S. producers were 28.3 percent of net farm income. The comparable average for California was 7.4 percent of net farm income. Figure 20 shows annual ratios over the period 1960–2000.[15] Direct government payments constituted 49 percent of U.S. net farm income in 2000 and 12 percent of California net farm income.

Direct government payments increase the fixed cost of agricultural production without any corresponding increases in productivity (Bernard et al., p. 26).[16] In the U.S. heartland (the Midwest corn belt), direct government payments account for nearly a quarter of the value of farmland (Bernard et al., p. 28). A recent (2001) study

Figure 20. **Direct Government Payments as a Percentage of Net Farm Income for California and the United States, 1960–2000**



Source: U.S. Department of Agriculture, Economic Research Service 2003b.

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of soybean production in Argentina and Brazil concluded that production costs were 20 to 25 percent lower than in the U.S. heartland even though variable input costs per acre were lower in the U.S. (Schnepf, Dohlman, and Bolling, p. 31). Annual land costs were as much as $80 per acre higher in the U.S. Thus, higher capitalized asset values affect competitiveness. California agriculture is more flexible and more responsive to changes in market conditions with its managerial ability to meet market-driven domestic and worldwide consumer demands. Part of that flexibility and responsiveness comes from less reliance on direct government payments.

Bottom Line: California agriculture is growing more rapidly than U.S. agriculture, is more flexible in selecting production alternatives, is more responsive to market-driven demand signals, and is significantly less vulnerable to federal budget cuts. Every one of these attributes is a plus.

Diversified Product Mix

As noted, California produces an incredible and ever-growing variety of products. Babcock argues that historically a never-ending quest for low cost and efficiency guided the structure of U.S. agriculture in the direction of high-volume, low-cost production of basic commodities (wheat, corn, soybeans, etc.), but, as incomes continue to rise, things change.

> *That is, once we can afford all the food we could possibly want to eat, we will begin demanding high-end food that often can only be produced using costly production practices. Once this occurs, agriculture must develop new market channels and market regulations to give producers who invest in product quality a chance to obtain a return on their investment.* (p. 3)

Babcock's case parallels arguments saying that, as consumers become wealthier and production techniques more precise, designer and niche markets will quickly replace bulk, undifferentiated commodities. California seems well placed to address these changing market requirements.

Globalization, plus increased ethnic diversity in California and the U.S. population in general opens additional niche possibilities. Historically, expansion in the number of California crops was partly driven by ethnic-food demands from rising numbers of immigrants from around the world, especially from Asia and Latin America.

Bottom Line: Our agroecological heritage plus demand diversity will be a distinct, continuing advantage for California agriculture. Who really cares if we can compete in barley, soybeans, and hogs when we can sell avocados, pistachios, and wine?

Population Continues to Grow in our Most Important Markets

In the 21st Century, the three most important markets for California agriculture will be California, the United States, and higher-income, developing countries. All will continue to experience significant population growth (Table 17).

While projected growth in California to 2040 will not be as rapid as in the last 40 years (70 percent versus 117 percent), it will still be substantial—an increase of more than 24 million customers compared to a smaller increase (18.6 million) in the preceding 40-year period. For the U.S. market, projected growth is slightly higher in the next 40 years (38 percent versus 34 percent). Most important, U.S. growth represents an increase of an additional 105 million customers, a larger growth increment than for the preceding 40-year period. As noted earlier, global population will increase by around 2.8 billion people with the majority residing in developing countries. A

Table 17. Population Growth (Millions) in California and the United States for 1960, 2000, and 2040

Year	California		United States	
1960	15.9	+117%	179.3	+34%
2000	34.5		275.3	
2040	58.7	+70%	380.0	+38%

Sources: California State Department of Finance 1998, 2001; U.S. Department of Commerce 2002.

[15] The California ratio of payments to net farm income never exceeded 15 percent during the past four decades and exceeded 10 percent in only seven of the years. In contrast, the U.S. share of net farm income made up by federal direct payments was below 10 percent in only nine years, exceeding a quarter of net farm income in 14 years and a maximum of 65 percent in 1983.

[16] Urban influences also increase agricultural asset values in the same manner.

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further plus is that their incomes should also be growing rapidly.

Bottom Line: California agriculture is well positioned to take advantage of continued growth in state, national, and global population with parallel growth in incomes.

Vulnerability to External Shocks

California agriculture has always been vulnerable to its external environment precisely because it is demand-driven. Given that it produces predominantly income-sensitive products, growth, recession, depression, and global economic events (e.g., the East Asian crisis in late 1990s) all potentially cause significant changes in prices. This fact, coupled with a rising share of California output being perennial crops and livestock, means that the potential for boom or bust cycles is probably rising. Thus, the operative question is whether the external environment is becoming more volatile with increased global interdependence along with the rising dependence of all nations on trade.

Leaving aside war and massive natural disasters (e.g., international droughts, floods, earthquakes, and major weather events), lowered trade barriers and freely functioning financial markets should increase international market stability compared to a world of protection and controlled financial flows. On the other hand, it is less and less possible for nations to isolate themselves from international economic events.

Bottom Line: While there is no strong evidence that global markets are becoming less stable, it is possible that, as individual countries liberalize, domestic price instability could increase, presenting additional challenges to farmers, growers, and ranchers.

California Agriculture at the Beginning of the 21st Century

California agriculture grew very rapidly over the past half-century. Real value of production increased 70-fold. Agricultural production is now widely diversified to more than 350 commercial plant and animal products, exhibiting a constantly shifting composition and changes in the location of production, all abetted by growing demands for its products and rapid science-based technological changes. California agriculture is strongly buffeted by growing urban pressures for availability of key natural resources—reliable water supplies and productive land. Relentless pressure from environmental and other non-agricultural interests remain with respect to water quality, chemical contamination, air pollution, wildlife and aquatic habitats, and worker safety in the forefront.

Agricultural prices clearly became more volatile after the global instability of the early 1970s. As agriculture became more complex internally, both technically and economically, it also became more interdependent with the rest of the economy and the world. It now purchases virtually all of its variable inputs from the nonagricultural economy and has a massive need for credit—short-term, long-term, and, increasingly, intermediate credit. It has probably become more export dependent despite the enormous growth of the California consumer market. In sum, it is more dynamic, more complex, more unstable, and more diverse, thus making California agriculture more vulnerable to external events.

At many critical points in California history, California agriculture has been written off, but these periods of difficulty have been interspersed with more numerous periods of explosive growth (Tables 18 and 19).

The share of perennials, or multiyear-production-cycle products, increased as California agriculture moved away from production of annual field crops (wheat, barley, cotton) and canning vegetables and shifted toward tree nuts, fresh fruits, and wine grapes. The frequency and amplitude of product price cycles (booms and busts) seemed to increase. For example, an overabundance of average-quality wine grapes is occurring as recent plantings (those planted in the late 1990s) have come to harvest maturity. There have been cycles in other products, such as prunes, clingstone peaches, and raisin grapes. The first years of the 21st Century are only the second time in history that low prices occurred across the entire product spectrum. The first was during the long-lasting Great Depression. But already in 2003 and at the beginning of 2004 there are signs of improvement in some prices, promising an improved economy.

Table 18. **Difficult Periods for California Agriculture**

In the 1860s Decimation of cattle herds by floods and drought.
In the 1890s Collapse of the wheat industry.
In the 1920s and 1930s Severe overdraft of groundwater supplies.
In the 1960s Termination of Bracero Program.
In the 1970s Collapse of export markets; Medfly crisis.
In the late 1980s Prolonged drought of 1987–1992.
In the late 1990s Collapse of virtually all commodity markets (low prices).

Table 19. **Periods of Explosive Growth in California Agricultural Industries**

1850–1860	Cattle
1870s	Sheep
1880s	Wheat
Early 1900s	Dried Fruits and Nuts
1920s	Fruits and Processed Vegetables
Late 1940s	Cotton
1950s and 1960s	Beef Feedlots
1970 to Present	Dairy
1970s and 1980s	Specialty-Product Exports(almonds, citrus)
1970s	Fresh Vegetables
1980s	Premium Wines
1980s	Nursery and Greenhouse Products

Bottom-Bottom Line

What about the future in the long run? There are no sure predictors. Can we draw upon our understanding of the forces that have shaped the past to reflect on the future? What history suggests is that, for more than 150 years, California agriculture has generally flourished even as it was being constantly buffeted by what seemed at the time to be "disaster after disaster." So far, it has emerged from each crisis by rapidly adjusting and changing. California agriculture in 2003 is very different than it was in 1953, 1903, or 1853. It is bigger, more diverse, and very much alive, adjusting, as always, to its ever-dynamic environment. No doubt California agriculture in 2023 or 2053 will be very different than it is now, but it will have maintained its vitality though experiencing, as is its fate, chronic and sometimes powerful adjustment pressures. Those forecasting its demise simply do not understand its natural and human assets nor do they acknowledge the dynamic resilience of California agriculture.

Consequences for California Agriculture

The issues presented here are certainly not an exhaustive list, but they are sufficient to illustrate the unease one hears from many parts of California agriculture. Both sets of issues (direct and indirect), plus additional local and regional difficulties, lead to a perception of much greater uncertainty and more variability in the future in terms of prices of products and inputs; access to resources and markets; and, ultimately, profitability for California's farmers and ranchers.

To many, the beginning of the 21st Century is a period of great uncertainty, if not a crisis, in California agriculture. Some article titles give a flavor of the concern: "The End of Agriculture in the American Portfolio" (Blank 1998); "Is This California Agriculture's Last Century?" (Blank 2000); and "Agriculture in Crisis: What California Must Do to Protect Its Most Precious Industry" (Soares).

Are radical changes likely, and, if so, what will they be? What will be the impact of any such changes on the industry, individual farms and ranches, or even on individuals employed throughout the food and fiber sector?

To quote Ann Scheuring (p. 4), writing in the early 1980s, "California agriculture in the 1980's—*as it has always been* [emphasis added]—is in a period of transition." Will California agriculture continue its tradition of perpetual adjustment so as to weather yet another stormy period? The remainder of this report tries to shed some light on these questions.

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APPENDIX

Table A1. California's Top 20 Commodities, 1950–2000

1950	1960	1970	1980
1 Cattle and Calves	1 Cattle and Calves	1 Cattle and Calves	1 Milk and Cream
2 Dairy Products	2 Dairy Products	2 Milk and Cream	2 Cattle and Calves
3 Cotton	3 Cotton	3 Grapes	3 Cotton
4 Grapes	4 Hay	4 Hay	4 Grapes
5 Hay	5 Eggs, Chicken	5 Eggs, Chicken	5 Hay
6 Eggs, Chicken	6 Grapes	6 Cotton	6 Nursery Products
7 Oranges	7 Oranges	7 Lettuce	7 Almonds
8 Barley	8 Potatoes	8 Nursery Products	8 Rice
9 Lettuce	9 Lettuce	9 Sugar Beets	9 Flowers and Foliage
10 Potatoes	10 Turkeys	10 Oranges	10 Lettuce
11 Peaches	11 Barley	11 Tomatoes, Fresh	11 Eggs, Chicken
12 Sugar Beets	12 Rice	12 Rice	12 Wheat
13 Turkeys	13 Tomatoes, Fresh	13 Potatoes	13 Tomatoes, Processing
14 Lemons	14 Prunes	14 Cut Flowers	14 Strawberries
15 Rice	15 Tomatoes, Processing	15 Tomatoes, Processing	15 Oranges
16 Beans, Dry	16 Peaches	16 Peaches	16 Chicken
17 Prunes	17 Cut Flowers[a]	17 Almonds	17 Sugar Beets
18 Hogs	17 Sugar Beets	18 Barley	18 Turkeys
19 Wheat	19 Walnuts	19 Turkeys	19 Peaches
20 Tomatoes, Fresh	20 Broilers	20 Strawberries	20 Walnuts

[a] Cut flowers, potted plants, florist greens, and bedding plants (U.S. Census of Agriculture 1964).
Sources: California Crop and Livestock Reporting Service 1951a, 1951b, 1951c, 1951d, 1958, 1961a, 1961b, 1961c, 1962, 1967, 1971b; California Department of Food and Agriculture 1981, 1991, 2001, 2002.

1990		2000		2001	
1	Milk and Cream	1	Milk and Cream	1	Milk and Cream
2	Cattle and Calves	2	Grapes	2	Grapes
3	Grapes	3	Nursery Products	3	Nursery Products
4	Cotton	4	Lettuce	4	Cattle and Calves
5	Nursery Products	5	Cattle and Calves	5	Lettuce
6	Hay	6	Cotton	6	Oranges
7	Flowers and Foliage	7	Flowers and Foliage	7	Hay
8	Lettuce	8	Strawberries	8	Cotton
9	Tomatoes, Processing	9	Hay	9	Strawberries
10	Almonds	10	Almonds	10	Almonds
11	Oranges	11	Tomatoes, Processing	11	Flowers and Foliage
12	Eggs, Chicken	12	Broccoli	12	Rice
13	Strawberries	13	Chickens	13	Broccoli
14	Chickens	14	Avocados	14	Salad Greens, Miscellaneous
15	Turkeys	15	Carrots	15	Tomatoes, Processing
16	Tomatoes, Fresh	16	Oranges	16	Walnuts
17	Broccoli	17	Tomatoes, Fresh	17	Lemons
18	Avocados	18	Celery	18	Peaches
19	Lemons	19	Walnuts	19	Chickens
20	Walnuts	20	Onions	20	Avocados

Table A2. **Changing Location and Concentration of Production for Selected Commodities – Percent of California Total**

1950	Percent	1960	Percent	1970	Percent
Part A. Almond (Acreage)					
1 Butte	14.7	1 Butte	14.1	1 Merced	17.2
2 Colusa	9.9	2 San Joaquin	11.9	2 Stanislaus	13.5
3 San Joaquin	9.4	3 Merced	11.4	3 San Joaquin	12.2
4 Yolo	8.8	4 Colusa	9.2	4 Butte	11.6
5 San Luis Obispo	8.5	5 Yolo	9.0	5 Colusa	6.6
Top 5	*51*		*56*		*61*
Part B. Oranges (Acreage)					
1 Orange	27.0	1 Tulare	26.8	1 Tulare	37.1
2 Tulare	16.8	2 Orange	18.8	2 Riverside	11.2
3 Los Angeles	16.6	3 Riverside	12.6	3 Ventura	9.6
4 San Bernardino	15.3	4 San Bernardino	12.6	4 Fresno	9.5
5 Ventura	9.2	5 Ventura	12.4	5 Kern	8.8
Top 5	*85*		*85*		*76*
Part C. Processing Tomatoes (Acreage)					
1 San Joaquin	34.2	1 San Joaquin	27.5	1 Yolo	24.8
2 Yolo	14.8	2 Yolo	–	2 San Joaquin	18.3
3 Sacramento	118.0	3 Sacramento	7.4	3 Fresno	8.1
4 Stanislaus	8.6	4 Solano	7.2	4 Solano	7.9
5 Sutter	4.9	5 Sutter	5.4	5 Sutter	6.1
Top 5	*74*		*73*		*65*
Part D. Dairy Products (Quantity of Milk Produced)					
1 Los Angeles	18.1	1 Los Angeles	17.0	1 San Bernardino	15.4
2 Stanislaus	10.0	2 Stanislaus	8.6	2 Stanislaus	9.2
3 Merced	8.6	3 Merced	7.1	3 Tulare	9.1
4 San Joaquin	5.3	4 Tulare	6.9	4 Riverside	7.9
5 Tulare	5.3	5 San Bernardino	6.8	5 Merced	7.4
Top 5	*47*		*46*		*49*

Sources: California Agricultural Statistical Service 1991, 2001b; California Crop and Livestock Reporting Service 1951a, 1951c, 1951d, 1961a, 1961c, 1962, 1971a, 1972, 1981.

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1980	Percent	1990	Percent	2000	Percent
1 Kern	18.7	1 Kern	17.4	1 Stanislaus	17.2
2 Stanislaus	13.9	2 Stanislaus	16.5	2 Kern	16.0
3 Merced	13.7	3 Merced	14.3	3 Merced	14.9
4 Butte	9.6	4 Madera	9.4	4 Fresno	11.1
5 San Joaquin	9.4	5 San Joaquin	8.7	5 Madera	9.2
Top 5	*65*		*66*		*68*
1 Tulare	42.2	1 Tulare	46.0	1 Tulare	51.7
2 Kern	11.8	2 Kern	15.3	2 Kern	17.2
3 Fresno	10.7	3 Fresno	11.4	3 Fresno	12.8
4 Ventura	9.6	4 Ventura	9.1	4 Riverside	6.4
5 Riverside	9.1	5 Riverside	7.4	5 Ventura	4.9
Top 5	*83*		*89*		*93*
1 Yolo	25.6	1 Fresno	25.6	1 Fresno	38.6
2 Fresno	17.2	2 Yolo	19.0	2 Yolo	16.3
3 San Joaquin	10.3	3 San Joaquin	9.0	3 San Joaquin	8.3
4 Sutter	10.2	4 Colusa	7.2	4 Colusa	7.0
5 Solano	8.0	5 Solano	6.2	5 Stanislaus	6.7
Top 5	*71*		*67*		*77*
1 San Bernardino	19.6	1 Tulare	17.1	1 Tulare	23.2
2 Tulare	13.2	2 San Bernardino	15.7	2 Merced	13.3
3 Riverside	10.3	3 Merced	11.4	3 San Bernardino	10.7
4 Stanislaus	9.6	4 Riverside	11.0	4 Stanislaus	10.5
5 Merced	9.2	5 Stanislaus	10.8	5 Kings	7.9
Top 5	*62*		*66*		*66*

Table A3. **The Shifting Composition of California's Agricultural Production – California Commodities with One Percent or More of the Total Value of Production for 1960, 1980, and 2000**

	1960		1980		2000	
Value of Production	$3.187 billion		$13.539 billion		$25.509 billion	
	Crop	**Percent**	**Crop**	**Percent**	**Crop**	**Percent**
Field Crops	Cotton	10.8	Cotton	10.0	Cotton Lint	3.5
	Hay	5.4	Hay	5.2	Hay	2.9
	Potatoes	2.5	Rice	3.1		
	Barley	2.1	Wheat	2.6		
	Rice	1.8	Sugar Beets	1.3		
			Potatoes	1.2		
			Barley	1.1		
			Corn	1.1		
Fruit and Nut Crops	Grapes	4.0	Grapes	8.8	Grapes	11.1
	Oranges	3.2	Almonds	3.4	Strawberries	3.0
	Prunes	1.6	Oranges	1.6	Almonds	2.7
	Peaches	1.4	Peaches	1.3	Oranges	1.4
	Walnuts	1.1	Walnuts	1.2	Avocados	1.4
			Lemons	1.0	Walnuts	1.1
Vegetable Crops	Lettuce	2.3	Lettuce	2.7	Lettuce	5.8
	Tomatoes, Fresh	1.7	Tomatoes, Proc.	2.4	Tomatoes, Proc.	2.4
	Tomatoes, Proc.	1.6	Strawberries	1.5	Broccoli	2.1
			Broccoli	1.0	Carrots	1.4
					Tomatoes, Fresh	1.3
					Celery	1.2
					Onions	1.0
					Peppers	1.0
Livestock and Livestock Products	Cattle and Calves	15.7	Milk and Cream	12.8	Milk and Cream	14.5
	Dairy Products	11.7	Cattle and Calves	10.4	Cattle and Calves	5.0
	Eggs	5.1	Eggs	2.7	Chickens	1.8
	Turkeys	2.2	Chickens	1.7		
	Broilers	1.1	Turkeys	1.3		
Nursery and Flowers	Nursery Products	1.4	Nursery Products	3.6	Nursery Products	8.8
	Cut Flowers, Etc.	1.1	Flowers and Foliage	2.9	Flowers and Foliage	3.3

Sources: California Crop and Livestock Reporting Service 1961d; California Department of Food and Agriculture 1981, 2001; U.S. Department of Commerce, Bureau of the Census 1961a.

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