Chapter 10. California Vegetables

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Abstract

High-value, year-round production and marketing, and sensitivity to labor costs distinguish fresh vegetables from California's other crops. Fresh vegetables are relatively small-acreage crops with big values: some 250,000 acres of lettuce produced $2.4 billion worth of output in 2017, making California lettuce three times more valuable than four million acres of U.S. barley. Grower-shippers who market vegetables year-round are the key actors, producing in several areas, and importing to ensure a steady supply of vegetables for grocery chains and food-service firms. Labor costs are often one-third of variable costs to produce fresh vegetables; rising labor costs have set up a race between rising imports, labor-saving machines, and guest workers for how and where fresh vegetables are produced.

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With a value of $6.1 billion, California accounted for over half of U.S. fresh vegetable production in 2018.

Photo Credit: Shermain Hardesty, UC Davis

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Vegetables

Americans have about 150 pounds of fresh vegetables available to them each year, including U.S. production and imports. The U.S. produced $14.2 billion worth of fresh vegetables in 2019, imported $8 billion and exported $2.3 billion, for a fresh vegetable trade deficit of $5.7 billion (Parr, Bond, and Minor, 2020, ERS Vegetables and Pulses Yearbook Tables 7, 8). Over half of U.S. fresh vegetable production is in California ($6.1 billion), followed by 10 percent ($1.2 billion) in Arizona.

Excluding fresh potatoes, U.S. residents consumed (or had available to consume) an average 144 pounds of fresh vegetables in 2016, including 27 pounds of lettuce, 21 pounds of tomatoes, 19 pounds of onions, and 11 pounds of bell peppers. These four fresh vegetables accounted for over half of the fresh vegetables available to U.S. residents (Minor and Bond, 2017, Table 5).

Table 10.1. California: Six Major Fresh Vegetables, 2017

	Acres	Tons	Value	CA Share
		1,000	$ Millions	Percent
Broccoli	119,000	952	850	92
Carrots	58,500	1,082	615	89
Celery	23,500	734	302	96
Lettuce, All	199,700	3,044	2,415	66
Peppers, Bell	15,900	334	282	57
Tomatoes, Fresh	NA	331	206	63
Subtotal	NA	6,478	4,671	

Source: CDFA, *California Agricultural Statistics Review, 2017*. Available at: http://www.cdfa.ca.gov/Statistics/PDFs/2016-17AgReport.pdf

Note: CA share is for all peppers and all tomatoes; CA share is based on value of commodity.

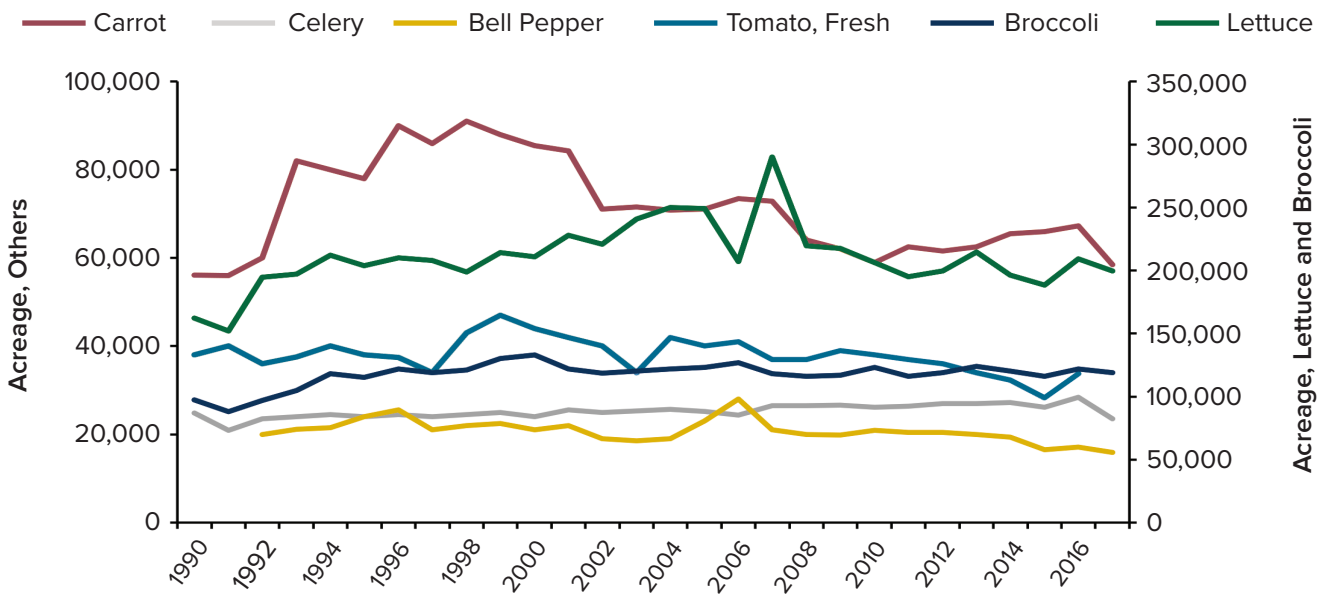
Table 10.2. Broccoli

All Broccoli	1985	1995	2005	2015
Harvested Acreage (acres)	94,902	122,178	122,702	120,035
Yield (tons/acre)				
Value of Production ($1,000)	228,173	329,697	292,647	356,372
Revenue ($/acre)	2,404	2,698	2,385	2,969

Fresh Broccoli	1985	1995	2005	2015
Harvested Acreage (acres)	48,320	96,023	77,868	60,100
Yield (tons/acre)	6.15	6.32	6.98	7.15
Value of Production ($1,000)	126,910	236,200	181,000	193,200
Revenue ($/acre)	2,626	2,460	2,324	3,214

Source: CDFA, *California Agricultural Statistics Review*, 2015. Available at: http://www.cdfa.ca.gov/Statistics/PDFs/2015Report.pdf

Figure 10.1. Acreage of Six Vegetables, 1990–2017



Source: CDFA, *California Agricultural Statistics Review, 2017*. Available at: http://www.cdfa.ca.gov/Statistics/PDFs/2016-17AgReport.pdf

Table 10.3. Carrots

	1985	1995	2005	2015
Harvested Acreage (acres)	33,087	58,018	58,970	51,076
Yield (tons/acre)*	17.03	25.82	23.99	23.12
Value of Production ($1,000)	271,908	237,749	240,034	193,842
Revenue ($/acre)	8,218	4,098	4,070	3,795

Source: CDFA, 2015

Note: *Yield data for fresh market carrot.

Six Vegetables

California's six most valuable fresh vegetables in 2015 were lettuce, worth $2.3 billion; broccoli, $866 million; carrots, $639 million; bell peppers and celery worth about $430–440 million each; and fresh tomatoes, $330 million (Table 10.1). These six commodities were farmed on less than 500,000 acres and generated almost $5 billion worth of commodities in 2015. By contrast, Kansas harvested over 8 million acres of wheat that generated $1.5 billion in sales in 2016.

Figure 10.1 plots acreage over time for these vegetables between 1985 and 2015. Lettuce and broccoli account for two-thirds of the acreage of the six major vegetables. Figure 10.1 data are from County Agricultural Commissioners' Reports and may provide duplicate counts.

Lettuce acreage increased until the mid-2000s, and has fallen since then, while broccoli acreage increased significantly between 1985 and 1995 and has been fairly stable since. Carrot acreage fluctuated, while fresh tomato and bell pepper acreage declined. Celery has registered a fairly steady increase in acreage. These data include acreage harvested, and multiple crops of lettuce and celery grown on the same land in one year.

The value of California broccoli has increased from stable acreage since 1995, reflecting higher yields and prices (Table 10.2). Fresh broccoli acreage increased, while broccoli for processing and other uses decreased. These data are from County Agricultural Commissioners' Reports and do not match the state's annual summary data precisely.

Table 10.4. Celery

	1985	1995	2005	2015
Harvested Acreage (acres)	21,761	23,805	26,883	31,160
Yield (tons/acre)*		34.39	38.28	32.70
Value of Production ($1,000)	251,115	275,132	179,265	237,482
Revenue ($/acre)	11,539	11,558	6,668	7,621

Source: CDFA, 2015
Note: *Yield data for fresh market celery.

Table 10.5. Lettuce

	1985	1995	2005	2015
Harvested Acreage (acres)	195,536	205,828	205,023	191,212
Yield (tons/acre)*	14.04	10.60	16.46	13.96
Value of Production ($1,000)	1,251,212	1,291,369	1,021,351	991,103
Revenue ($/acre)	6,399	6,274	4,982	5,183

Source: CDFA, 2015
Note: *Yield data for lettuce leaf.

Table 10.6. Bell Peppers

	1985	1995	2005	2015
Harvested Acreage (acres)	10,324	23,851	20,048	16,196
Yield (tons/acre)	12.97	14.65	18.93	25.90
Value of Production ($1,000)	87,983	152,894	157,551	118,202
Revenue ($/acre)	8,522	6,410	7,859	7,298

Source: CDFA, 2015

The yield and the value of carrots have fluctuated, along with acreage (Table 10.3). Revenues per acre have recovered to the 1985 level of over $8,000 an acre. The value of celery production has increased with acreage and prices, but yields fluctuate.

Lettuce acreage and yields do not display consistent trends (Table 10.5). Revenues per acre and the value of production have increased, and the shift from head lettuce to leaf lettuce and romaine have increased revenues per acre.

Bell pepper yields and revenues per acre have increased, which increased the value of production. (Table 10.6). However, harvested acreage declined between 2005 and 2015.

The value of fresh tomatoes declined between 2005 and 2015, reflecting a sharp drop in acreage but higher yields (Table 10.7).

Structure of Production: Fewer and Larger Grower-Shippers

Consumers expect a year-round supply of fresh vegetables, and the consolidating grocery and food-service industries want to deal with grower-shippers who can provide a year-round supply. As a result, production of the major fresh vegetables is concentrated among a relative handful of large firms.

While the trend is well-recognized by industry members and observers, limited government data are available on the concentration of fresh vegetable production. These data show that the largest 50 farms account for 50 to 90 percent of total acreage and production of most fresh vegetables.

Table 29 of the Census of Agriculture reported almost 4,900 vegetable farming operations in California that harvested

Table 10.7. Fresh Tomatoes

	1985	1995	2005	2015
Harvested Acreage (acres)	28,142	37,917	35,782	22,544
Yield (tons/acre)	14.83	14.02	13.74	17.80
Value of Production ($1,000)	282,596	217,005	183,388	128,237
Revenue ($/acre)	10,042	5,723	5,125	5,688

Source: CDFA, 2015

Table 10.8. Largest Vegetable Growers: West, 2014

	Acreage	Crops	Other Crops
Grimmway	57,787	Carrots	Other Vegetables
D'Arrigo	36,847	Lettuce	Broccoli
Tanimura & Antle	25,527	Lettuce	Broccoli & Other Vegetables
Ocean Mist	24,890	Lettuce	Artichokes & Other Vegetables
Nunes	19,223	Lettuce	Broccoli & Other Vegetables
Subtotal	164,274		

Source: *Growing Produce*, http://www.growingproduce.com/vegetables/2014-top-25-vegetable-growers-west/

Note: Not all of these large vegetable growers are classified as vegetable farms. Grimmway Farms, which reports processing 80 percent of U.S.-grown carrots (http://www.grimmway.com/carrots/), is included in miscellaneous crop farming (NAICS 111998) rather than vegetable farming (http://www.labormarketinfo.edd.ca.gov/aspdotnet/databrowsing/empDetails.aspx?menuchoice=emp&geogArea=0604000029&empId=641807581). The *Growing Produce* list excludes Dole Fresh Vegetables, which produces and markets a range of fresh vegetables but is considered a fruit and vegetable merchant wholesaler (NAICS 424480) rather than a farmer, as are Bud of California, Mann Packing, and Taylor Farms (www.labormarketinfo.edd.ca.gov/majorer/countymajorer.asp?CountyCode=000053).

1.2 million acres in 2017, down from 6,100 operations but the same 1.2 million acres harvested in 2012.[1] Over 90 percent of California vegetable farming operations, and three-fourths of the vegetable acres harvested, are produced for the fresh market.

There were 812 broccoli farming operations that harvested 109,423 acres in 2017, almost all for the fresh market; broccoli had a farm gate value of $850 million in 2017. The 36 broccoli farming operations that harvested 1,000 or more acres accounted for almost 60 percent of all broccoli acreage. There were 785 carrot farming operations that harvested 62,700 acres in 2017, almost all for the fresh market; carrots were worth $615 million in 2017. The 25 carrot farming operations that harvested 500 or more acres accounted for two-thirds of the harvested carrot acreage. There were 323 celery farming operations that harvested almost 30,000 acres in 2017, 98 percent for the fresh market; celery was worth $302 million in 2017.

Lettuce is the most valuable vegetable grown in California, worth $2.4 billion in 2017. There were 1,114 lettuce farming operations that harvested almost 250,000 acres in 2017, all for the fresh market. The 67 lettuce farming operations that harvested 1,000 or more acres accounted for 80 percent of the harvested lettuce acreage, which included 102,000 acres of head lettuce, 90,000 acres of romaine lettuce, and 58,000 acres of leaf lettuce.

Some 780 bell pepper farming operations harvested 15,800 acres in 2017, including 80 percent for the fresh market; bell peppers were worth $282 million in 2017. The 49 bell pepper farming operations that harvested 100 or more acres accounted for 85 percent of the bell pepper acreage. There were 1,900 fresh tomato farming operations that harvested 24,300 acres in 2017; fresh tomatoes were worth $206 million in 2017. The 58 fresh tomato farming operations that harvested 100 or more acres accounted for 83 percent of the harvested fresh tomato acreage.

As shown in Figure 10.2 for California's six major fresh vegetables, the largest farms were less than 10 percent of all

[1] See https://www.nass.usda.gov/Quick_Stats/CDQT/chapter/2/table/29/state/CA.

farms producing each commodity, but they accounted for 60 to 85 percent of the harvested acreage of each vegetable.

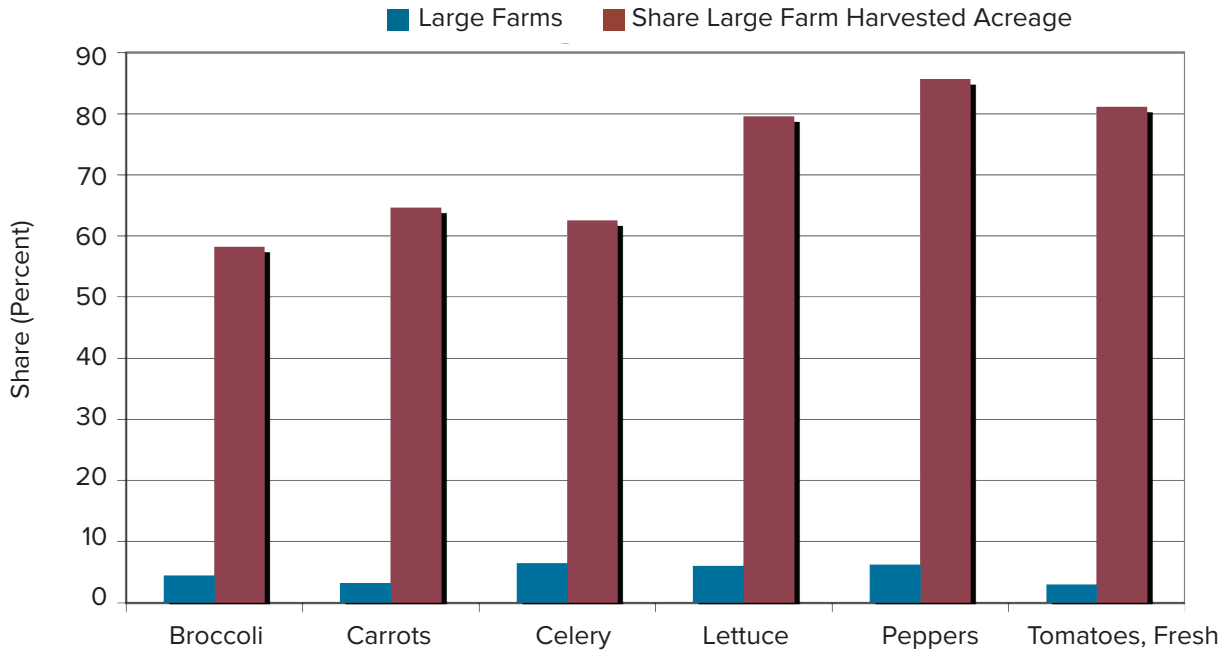
The value of California broccoli, carrots, celery, lettuce, bell peppers, and fresh tomatoes was $4.7 billion or 56 percent of the value of the state's vegetables. The acreage of broccoli harvested for the fresh market rose by 14 percent between 2012 and 2017; the acreage of carrots for the fresh market increased by 5 percent, and the acreage of lettuce rose by 8 percent. The acreage of bell peppers harvested for the fresh market fell by 20 percent between 2012 and 2017, and the acreage of tomatoes for the fresh market fell almost 40 percent. Other vegetable commodities include processing tomatoes worth $848 million in 2017; garlic, $390 million; cauliflower, $304 million; and mushrooms, $275 million.

The value of U.S. vegetables, potatoes, and melons was $20 billion in 2017; California's vegetable, potato, and melon sales were $8.4 billion or 43 percent of the U.S. total. The Census of Agriculture (COA) reports data in several ways, including by the North American Industry Classification System (NAICS) code in Table 75, and vegetables are NAICS 1112. There were 45,165 U.S. vegetable farms in 2017, with sales of $19.7 billion, including $17.2 billion worth of vegetables. However, the 9,900 U.S. vegetable farms that had sales of $50,000 or more accounted for 98 percent of U.S. vegetable sales.

Cook (2011) reported that the four largest iceberg lettuce producers controlled 60 percent of the market, and the eight largest had 80 percent, with new entrants deterred by the scarcity of high-quality land for year-round production and the need for contracts with produce buyers. The top two bagged salad firms, Fresh Express and Dole, accounted for almost 60 percent of sales in 2010, and the top four had 70 percent. Seven large produce firms studied for how they dealt with food safety had average sales of almost $200 million a year for lettuce and other leafy greens (Calvin, Jensen, Klonsky, and Cook, 2017). Most of these firms had lettuce as their major commodity (Table 10.8).

Growing Produce lists large vegetable growers by acreage. Its most recent list in 2014 reported that the five largest California-based growers had 164,000 acres, a third of the state's total fresh vegetable acreage, led by Grimmway and D'Arrigo, who together accounted for about 20 percent of the state's total vegetable acreage (Table 10.8).

Figure 10.2. Share of Vegetable Farms That Were Large in 2017 by Commodity, and the Share of Harvested Acreage of Each Commodity by These Large Farms



Note: Large farms harvest at least 100 acres (bell peppers, tomatoes), 500 acres (carrots, celery), or 1,000 acres (broccoli, lettuce).

Due to the organization of production, some government statistics do not provide information that helps determine the importance of major firms. In spite of their acreage and crop mixes, D'Arrigo, Tanimura & Antle (T&A), Ocean Mist, and Nunes are not listed among the major employers in Monterey County, reflecting the practice of many growers to use farm labor contractors to obtain workers rather than employing workers directly. Five farm labor contractors and harvesters listed as major Monterey County employers include: Al Pak Labor, Azcona Harvesting, Quality Farm Labor, and RC Packing; most are in the NAICS 115115 farm labor contractor category.[2] These contractors may or may not work with the large Monterey County grower-shippers on the *Growing Produce* list.

Large grower-shippers provide fresh vegetables to grocery chains and food-service firms year-round by producing in several areas. The best example may be lettuce, most of which is produced from April through November in the Salinas area and then directly east in the San Joaquin Valley for a month. Between December and March, lettuce and other leafy greens are produced mostly in the Yuma, Arizona area. The same grower-shippers are involved in all these areas and they harvest a variety of lettuces, including head, leaf, and romaine. Some deliver lettuce to bagged salad firms that have contracts to deliver particular quantities each week to grocery chains and food-service firms, prompting some growers to plant lettuce in Mexico as insurance against problems with cold weather in Yuma.[3]

Food Safety

Many factors favor fewer and larger grower-shippers of fresh vegetables, including economies of scale in production that mirror the consolidation of supermarkets and food-service firms. Another factor is food safety, especially for fresh vegetables that are often consumed without cooking. The number of produce-linked illnesses doubled between 1980–87 and 1987–95, prompting government and industry efforts to implement Good Agricultural Practices (GAPs) to prevent the contamination of fresh produce (Martin, 2016).

Bagged spinach on September 14, 2006, linked to an E. coli O157:H7 outbreak, killed three people and hospitalized over 100. The contaminated spinach, eventually traced to a 51-acre field leased by a spinach grower from a cattle rancher, was less than 1,000 pounds of the 680 million pounds of spinach consumed by Americans, but led to the recall of all bagged spinach and a slow recovery in fresh spinach sales and prices. Mixing contaminated spinach with other spinach meant that, instead of sickening only a few, thousands became ill (Calvin, 2007).

Spinach's so-called "9/14 moment", the day contaminated spinach was discovered, convinced industry leaders of the need for food-safety standards to restore consumer confidence in leafy green vegetables, which the voluntary California Leafy Green Marketing Agreement (LGMA) of 2007 embodied. The 71 handlers who accounted for 99 percent of the leafy greens produced in California agreed to buy produce only from growers with best practices to ensure that their produce was safe. Growers were required to have trace-back systems to link retail produce with the field and crew where it was grown and packed. The food-safety compliance system helped to overcome the externality that one producer's unsafe produce can adversely affect all producers by requiring everyone to adhere to food safety standards (Cook, 2011).

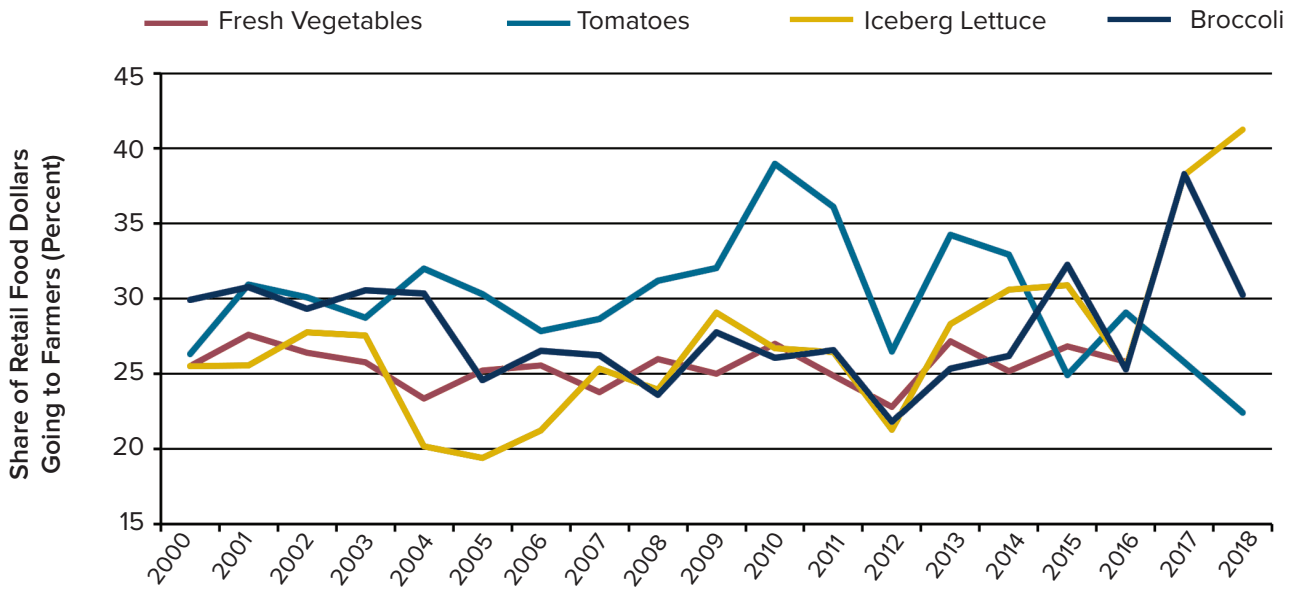
Calvin et al. (2017) examined the costs of seven fresh produce firms that implemented the LGMA and found that labor costs, including the cost of food safety staff and field supervisor[4] time to monitor protocols, accounted for two-thirds of these firms' compliance costs. The cost of audits was one-sixth of produce firms' costs, and lost product due to safety concerns was 10 percent. In other words, most of the cost of compliance with the LGMA was labor costs to implement and monitor safety protocols, not the cost of being unable to sell suspect produce.

2 See www.labormarketinfo.edd.ca.gov/majorer/countymajorer.asp?CountyCode=000053.

3 In 2010, costs of lettuce production were similar in Central Mexico and Yuma, AZ, as lower Mexican wages were offset by lower Mexican yields (Calvin and Martin, 2010).

4 The average salary of harvest foremen, who monitor their workers' toilet and hand-washing facilities and ensure that harvest knives are sanitized several times a day, was reported to be $47,000 a year (Calvin et al., 2017). Foremen also look for animal intrusions that could contaminate the vegetables.

Figure 10.3. Farm to Retail Price Spreads, Fresh Vegetables, 2000–2018



Source: USDA, Economic Research Service. Available at: www.ers.usda.gov/data-products/price-spreads-from-farm-to-consumer/price-spreads-from-farm-to-consumer/#Fresh vegetables

The Food Safety Modernization Act of 2011 (FSMA, PL 111-353) gave the U.S. Food and Drug Administration (FDA) authority to regulate on-farm food safety practices, including requiring farms to document their efforts to prevent contamination. FDA issued a Produce Safety Rule in November 2015, that incorporated many of the best practices developed by the LGMA to govern how U.S. fruits and vegetables are grown, harvested, cooled, and transported. The rule included worker training on health and hygiene, and monitoring irrigation water, fertilizers, animals near fields, and sanitizing equipment (Collart, 2016).

Compliance with the Produce Safety Rule was required beginning in January 2018 for farms with annual gross revenues of $500,000 or more. The definition and enforcement of the provisions regarding agricultural water have been delayed, and industry concerns remain regarding the functionality of water-testing requirements. Self-regulation will be supplemented by government enforcement in the event of a food safety problem.

Challenges

California vegetable growers pioneered the separation of production and consumption of fresh vegetables by working with University of California and private scientists to develop plants that produce crops that could travel thousands of miles and be preferred to local produce. Both farm and nonfarm developments, including interstate highways and trucking deregulation, aided the growth of vegetable production in California.

Figure 10.3 shows that farmers receive an average 25 percent of the retail price of fresh vegetables. The farm share of average retail prices has been stable over the past two decades, fluctuating more for field-grown fresh tomatoes than for broccoli and lettuce. Retail vegetable prices do not reflect grower prices, which can change daily, and instead, reflect stable "everyday low prices" or feature sales that advertise one produce item on sale. Some food-service firms make contracts with grower-shippers that include prices or link prices to daily or weekly averages, reducing grower profit when prices are high and grower losses when prices are low.

Large grower-shippers have developed labels and packaging to differentiate their fresh vegetables. Most California vegetable producers provide both organic and conventional produce, and many sell produce under their own label as well as under private store labels. New types of packaging and value-added, fresh vegetable-based products also contribute to differentiation.

The fresh vegetable industry wants to make produce more accessible to consumers. Consumers typically get less than the two pounds they would get from a head of lettuce in a bagged salad, but are willing to pay for the convenience of ready-to-eat salads. Bagged salad firms have moved from offering only lettuce or spinach to complete salad meals and snacks with condiments, so that consumers can buy ready-to-eat salads. Higher-income households spend more on fresh vegetables, and are most likely to pay extra for convenience.

Is there a threat to California vegetable growers from vertical farms that produce near consumers? Farms in converted warehouses near major U.S. cities such as New York aim to compete with produce grown in open fields in California. New York City-based BrightFarms builds 1-acre or 43,560-square-foot rooftop farms for about $2 million that generate vegetable sales of $1 million to $1.5 million a year. In 2016, BrightFarms raised $30 million in venture capital funds by touting its use of less water and land to produce local produce.[5] Columbia University professor Dickson Despommier estimated that a 30-story, one-square-block farm could yield as much food as 2,400 outdoor acres.

Over the next decade, there is little prospect that indoor and local vegetable production will present serious threats to California vegetable growers, who have achieved economies of scale and developed an infrastructure to produce safe fresh vegetables efficiently. Grower prices of fresh vegetables fluctuate, and are often below total production costs, although growers continue to harvest if the prices they receive cover their harvesting costs and some of their fixed costs. Finding the labor to hand-harvest fresh vegetables is one of the major challenges facing California growers.

Labor

Harvest labor costs for major fresh vegetables range from 15 to 50 percent of production costs, with the higher percentages often including the cost of the container into which produce is packed for sale and marketing costs. Labor costs are often a third of variable production costs in fresh vegetables, and harvesting costs can be 70 to 90 percent of labor costs.

A 2010 University of California Cooperative Extension (UCCE) study of iceberg or head lettuce put total costs per 24-head, 42-pound carton at $12 for yields of 800 cartons an acre, with harvesting costs of $5.85 per carton accounting for almost half of production costs (Tourte and Smith, 2010).[6] These harvest labor costs include selling costs, but not the $1 a carton charge to cool harvested lettuce.

A similar 2017 study of broccoli in the Central Coast estimated non-land production costs at $8,000 an acre (Tourte, Smith, Murdock, and Sumner, 2017), including $4,200 to harvest and pack 700 14-bunch and 21-pound cartons per acre at a cost of $6 per carton, making harvesting costs over half of production costs (excluding land costs but including the cost of the carton into which broccoli is packed). A celery cost study for 2012–13 estimated harvesting costs of $5 per 55-pound carton (Takele, Daugovish, and Vue, 2017).

Most carrots are machine harvested and cut into "baby carrots," minimizing harvest labor costs. The most recent bell pepper study is for 2000 in Imperial County. It estimated harvesting costs at $4.40 per carton, or half of total costs of $8.75 per carton for yields of 1,000 30-pound cartons per acre, including land rent (Mayberry, 2000).

A 2007 study of mature-green fresh tomatoes in the San Joaquin Valley put harvesting costs at $62 a ton, including wages to pickers, payroll taxes, and contractor overhead and profit (Stoddard, LeStrange, Aegerter, Klonsky, and De Moura, 2007). Farm workers harvest tomatoes into 5-gallon buckets that hold 25 to 30 pounds, and pickers normally fill a bucket every two minutes before walking full buckets to a truck to dump the tomatoes and receive credit for what they have picked. Picking costs of $1,116 were 20 percent of total costs of $5,548 per acre, including land costs. Once

5 "BrightFarms (www.brightfarms.com) raises $30.1 million to set up futuristic greenhouses across the U.S.," September 21, 2016. TC News. https://techcrunch.com/2016/09/21/brightfarms-raises-30-1-million-to-set-up-futuristic-greenhouses-across-the-u-s/.

6 Land rent and taxes were assumed to be $1,200 per acre or $1.50 per carton and were included in production costs.

taken to packing sheds, harvested tomatoes are sorted and packed into 25-pound cartons. Stoddard et al. assumed a yield of 18 tons per acre and a pack-out rate of 72 percent, so that an acre of fresh tomatoes yields 1,040 cartons, each weighing 25 pounds. Harvesting costs were $1.07 per packed carton, hauling costs $0.21 a carton, and packing and marketing costs were $2.50 per carton.

Lettuce and fresh tomatoes are commodities in which some of the major producers have union contracts. The United Farm Workers (UFW) represents workers employed by lettuce and other vegetable growers D'Arrigo and George Amaral Ranches, and Teamsters Local 890 has long represented Dole vegetable workers. The UFW in May 2016 reported contracts with tomato grower Pacific Triple E covering 450 workers; Gargiulo Tomatoes, 350 workers; and San Joaquin Tomatoes, 350 workers.[7]

For most of the 1990s and early 2000s, the piece rate for mature-green picking tomatoes was $0.475 a bucket or about 1.6 cents a pound. However, piece rates increased after several of the firms lost cases in which the UFW charged they failed to bargain in good faith. In the Pacific Triple E contract, piece rates increased to $0.625 per bucket or 2.1 cents a pound between 2015 and 2018.[8] The UFW said that tomato harvesters average $18 to $20 an hour picking mature-green tomatoes.[9] The workers employed on fresh-vegetable farms are similar to those employed throughout California agriculture—namely, mostly Mexican-born men who are not authorized to work in the United States (Martin, 2020).

Mechanization

The slowdown in Mexico-U.S. migration since the 2008–09 recession and, more recently, the increase in California's minimum wage to $11 an hour in 2018 and scheduled to be $15 an hour in 2022, puts upward pressure on labor costs. Other state labor-law changes, including requiring overtime pay for farm workers after eight hours of work a day or 40 hours a week by 2022, and a requirement that piece-rate workers receive their average hourly earnings while on paid rest breaks, add to rising labor costs.[10]

Fresh vegetable growers have responded to rising labor costs in several ways, including hastening efforts to develop machines to replace workers and requesting more H-2A guest workers. Lettuce and broccoli are usually field packed, meaning that workers cut and trim these crops and place them on a slow-moving platform traveling ahead of harvesters that carries workers who wrap and pack produce into cartons. Field conveyor belts reduce the need for workers to carry harvested produce, making them more productive.

Baby leaf and romaine lettuce can be harvested by machines that use water jets to cut the lettuce just above the ground. Water-jet machines are in development to harvest cabbage and celery. Ramsey Highlander developed a water-jet machine that it says can harvest 12,000 pounds of romaine lettuce an hour into tote containers, and harvest faster by putting the heads of lettuce in bulk containers.[11]

The major issue slowing mechanization in head lettuce, broccoli, and other fresh vegetables is non-uniform ripening. The once-over harvesters common throughout U.S. agriculture make one pass through the field, but using a once-over harvester for head lettuce would mean losing up to one-quarter of the crop. Plant genetics and transplants can increase uniform ripening, facilitating the use of once-over harvesters.

Transplanting lettuce reduces labor needs by ensuring a uniform crop without thinning, and allows growers to harvest two or more crops a year on the same land. Machines can thin seeded lettuce, so the plants that survive produce

7 See https://migration.ucdavis.edu/rmn/more.php?id=1978.

8 Pacific Triple E signed a three-year agreement with the UFW on May 22, 2012, even though the UFW was certified to represent Triple E workers in 1989. The 2012–15 contract guaranteed tomato pickers at least $8.50 an hour and $0.56 to $0.575 per bucket. The contract prohibited Triple E from requiring "cupped" or overfull buckets and discouraged workers from "fluffing" their buckets to make them appear fuller than they are. https://migration.ucdavis.edu/rmn/more.php?id=1717.

9 See https://migration.ucdavis.edu/rmn/more.php?id=1924.

10 AB 1066 requires 1.5 times normal wages after eight hours of work in a day and 40 hours a week by 2022; employers with 25 or fewer employees have extra time to comply. AB 1513 requires California farmers to pay piece-rate workers at their average hourly earnings for mandatory rest periods and other nonproductive time. https://migration.ucdavis.edu/rmn/more.php?id=2016.

11 See https://bit.ly/2UcLY0H.

marketable heads.[12] Plant breeders, who in the past focused on maximum yields and disease resistance, are now developing plants more amenable to machine planting and harvesting. As labor costs rise, more farmers may decide that once-over harvesting machines are more profitable even if they can sell only 80 percent of the marketable heads. Machine harvesting and sorting costs for 80 percent of the crop generate more profits than the hand-labor costs of marketing closer to 100 percent of the crop.

An alternative to uniformly ripening crops and once-over harvesters is selective harvesters, machines that select ripe heads of lettuce and do not damage immature heads. Selective harvesters are more difficult to develop because they must be able to distinguish between ripe and unripe crops, a much greater engineering challenge than simply harvesting everything in the field and later sorting the harvested produce.

H-2A Guest Workers

Fresh vegetable growers are also hiring more H-2A guest workers. The H-2A guest worker program requires farmers anticipating labor shortages to satisfy three major requirements—namely, try and fail to recruit U.S. workers, provide free housing for guest workers and out-of-area U.S. workers, and pay an Adverse Effect Wage rate of $14.77 an hour in California in 2020. Farm employers must prepare job orders spelling out wages and work requirements and promise work or wages for three-fourths of the contract period.[13]

There were 3,000 jobs in California certified to be filled by H-2A workers in FY12, and 23,000 in FY19, a sevenfold increase in seven years. Most of the statewide increase in H-2A workers is in the Salinas area, where vegetable and berry farms employ guest workers.

Housing costs in the area discourage prospective workers, making the H-2A program more attractive for growers. The Monterey County "salad bowl" has relatively high-cost housing, making it difficult for low earners to find affordable housing. The 40th percentile Fair Market Rent (FMR) for Monterey County in 2018 was $1,433 for a two-bedroom apartment, meaning that 40 percent of the two-bedroom rental units in the county rented for $1,433 or less, and 60 percent for $1,433 and more.[14] A worker earning $12 an hour and employed 160 hours a month would earn $1,920, so a one-earner household paying the FMR would devote 75 percent of gross earnings to rent, far more than the usual rule of devoting less than 30 percent. East Salinas includes areas with very high population density, reflecting several families sharing one home with converted garages and backyard sheds rented out to farm workers.

High housing costs also mean that the most difficult requirement for employers in the Salinas area is housing. Many of the H-2A workers currently in the Salinas area live in motels that do not satisfy standards for major chains. However, several growers have or are building new farm worker housing, often over the objections of local residents. T & A opened a $17 million, 800-bed facility ($21,000 a bed) in Spreckels meant for H-2A workers in 2016, but found that many of its current solo male workers were willing to pay $125 a month for beds in 900 square-foot, two-bedroom, two-bath units. The Nunes Company plans a $20 million, 600-bed complex ($33,000 a bed) in North Salinas.

Fresh vegetable production is consolidating on large and specialized farms that rely on hired workers whose cost is rising, prompting efforts to make workers more productive with mechanical aids and to reduce the need for hand labor with labor-saving machines. Many fresh vegetable firms have operations around the U.S. and abroad, making trade the third major factor affecting the future of California's fresh vegetable industry.

12 Tanimura & Antle uses Plant Tape to transplant lettuce seedlings, while other lettuce producers continue to seed lettuce and use the See and Spray machine developed by Blue River Technology to thin lettuce plants after they emerge from the ground. Geoffrey Mohan, "As California's labor shortage grows, farmers race to replace workers with robots," *Los Angeles Times*, July 21, 2017. http://www.latimes.com/projects/la-fi-farm-mechanization/.

13 These job offers are available in a public job registry at: https://icert.doleta.gov/.

14 See: https://www.huduser.gov/portal/datasets/fmr.html.

Trade

Almost a third of the fresh vegetables available to Americans are imported, up from less than 10 percent in the early 1990s. Mexico, the most important source of fresh vegetable imports, exported fresh vegetables worth $7.5 billion to the U.S. in 2016 (including potatoes and mushrooms). Mexico accounted for 74 percent of the value of U.S. fresh vegetable imports, followed by Canada with 13 percent and Peru with 4 percent (Minor and Bond, 2017).

Some labor-intensive fresh vegetables that were once widely grown in California are now mostly imported, including asparagus, whose acreage fell from 37,000 in 2000 to 8,000 in 2016. Asparagus is a perennial plant whose spears must be harvested several times a week during a 60- to 90-day harvest season. A machine harvester is in development, but may arrive too late to offset asparagus imports from Peru, the major source of U.S. fresh asparagus.

Climate is Mexico's major competitive advantage in producing fresh vegetables for U.S. consumers. Mexico can produce some vegetables when there is little or no U.S. production, except in Florida, just as Chile can produce and export a variety of fresh fruits during the winter months when there is little U.S. production.

What began as off-season production in other countries has become more direct competition for U.S. producers, as foreigners extend the period in which they produce and export fresh vegetables. Mexico is a leader in protected culture farming, using structures that protect plants from pests and disease. Mexico had 21,000 hectares of greenhouses, plastic-covered frames, and other protected culture structures in 2014, which produced 3.5 million tons of mostly vegetables worth $1.5 billion. Sinaloa, (22 percent), Jalisco (15 percent), and Baja California (12 percent) had half of the protected culture area in Mexico.

Protected culture has implications for California farmers, as sheltering plants reduces pest and disease issues, increases yields, and extends the shipping season for produce. Americans have shown a preference for vine-ripened over mature-green tomatoes, which is one reason Mexico now supplies over half of the fresh tomatoes consumed in the United States. Protected culture also changes labor relations, extending periods of farm work and encouraging previously migrant workers to settle near the farms where they can work for longer periods.

Conclusion

California has a vibrant fresh vegetable industry that accounts for almost 20 percent of the state's farm sales from 5 percent of the state's irrigated crop land. High-value fresh vegetables are capital-intensive and risky, making grower-shippers in vegetables the key players in these commodities. Vegetable grower-shippers agree to supply broccoli or lettuce year-round, and do this by planting in areas with climates that allow production at various times of the year.

Americans are consuming more fresh vegetables. The number of buyers is shrinking as supermarkets and the food-service industry consolidates, which reinforces trends toward fewer and larger grower-shippers and marketers. Larger growers and marketers have the capital and expertise to operate in many areas and to manage production abroad and imports. There is more concentration in the fresh vegetable than in the tree fruit industry, which includes more diverse and smaller growers with perennial crops who often market their crops via co-ops. New challenges, from food safety to recruiting guest workers, reinforce incentives to get larger or get out of the vegetable industry.

Most fresh vegetables are labor-intensive, with harvest labor costs 15 to 40 percent of variable production costs. Efforts to develop once-over harvesters appear more promising than efforts to develop selective harvesters that can make multiple passes through a field, harvesting only mature produce. Commodities that do not ripen uniformly and are fragile are most difficult to mechanize, often requiring changes in farming practices such as elevated rows with hard edges to guide machines.

Trade poses challenges and opportunities for California's fresh vegetables. Rising incomes abroad increase the demand for California produce, while free-trade agreements and improved technologies facilitate imports from countries with lower wages. The major source of imported fresh fruit and vegetables is Mexico, whose expanding export sector has developed with the help of California producers and marketers. Mexican imports, which once complemented California production while competing with Florida production, are arriving earlier and continuing longer, so they overlap with California production of the same commodity. Direct competition between California and Mexico may increase as Mexico expands production under protected culture structures that reduce risks and increase yields.

California's fresh vegetable industry has overcome many challenges, from growing to marketing, to emerge as the most vibrant in the United States. The major current challenge may be labor costs, which are rising rapidly due to fewer unauthorized immigrants and high housing costs in the coastal areas of California, where fresh vegetable production is concentrated. As labor costs continue rising, there is likely to be more labor-saving mechanization, more reliance on guest workers, and more imports of fresh vegetables. Trade and migration policies, combined with the pace of new developments in plants and machines, will shape California's vegetable industry.

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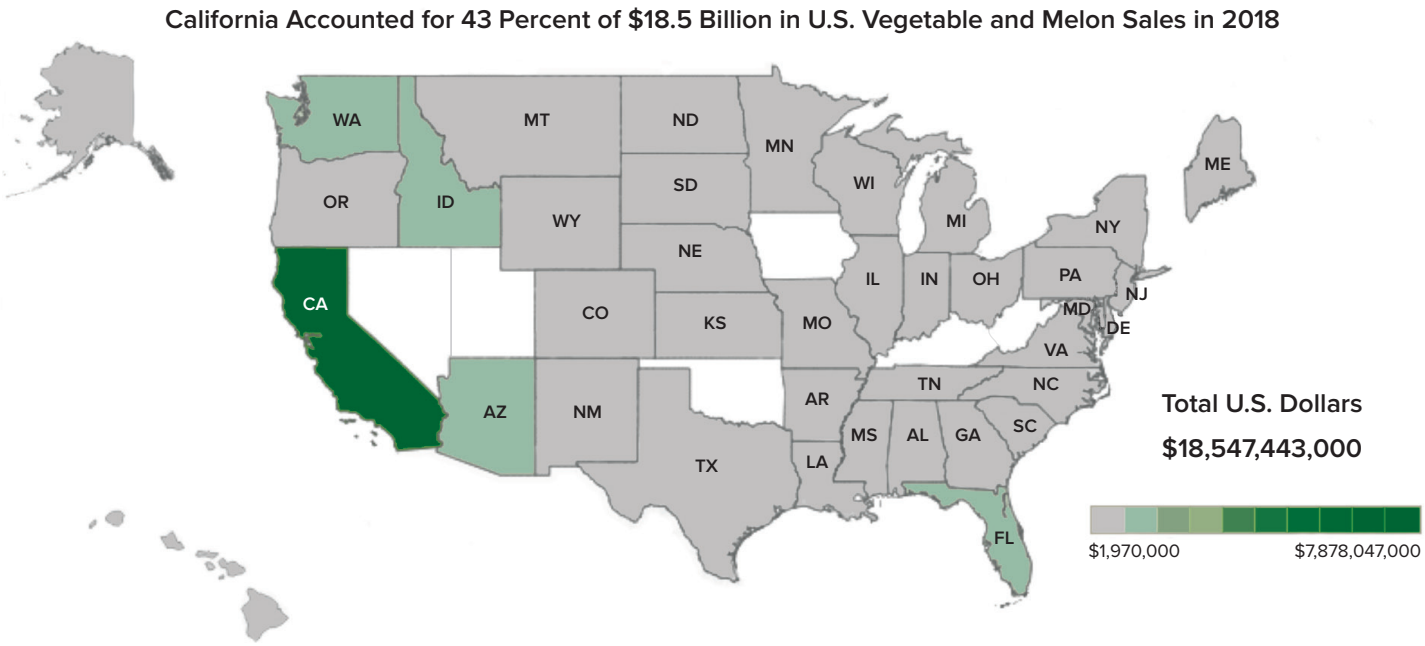
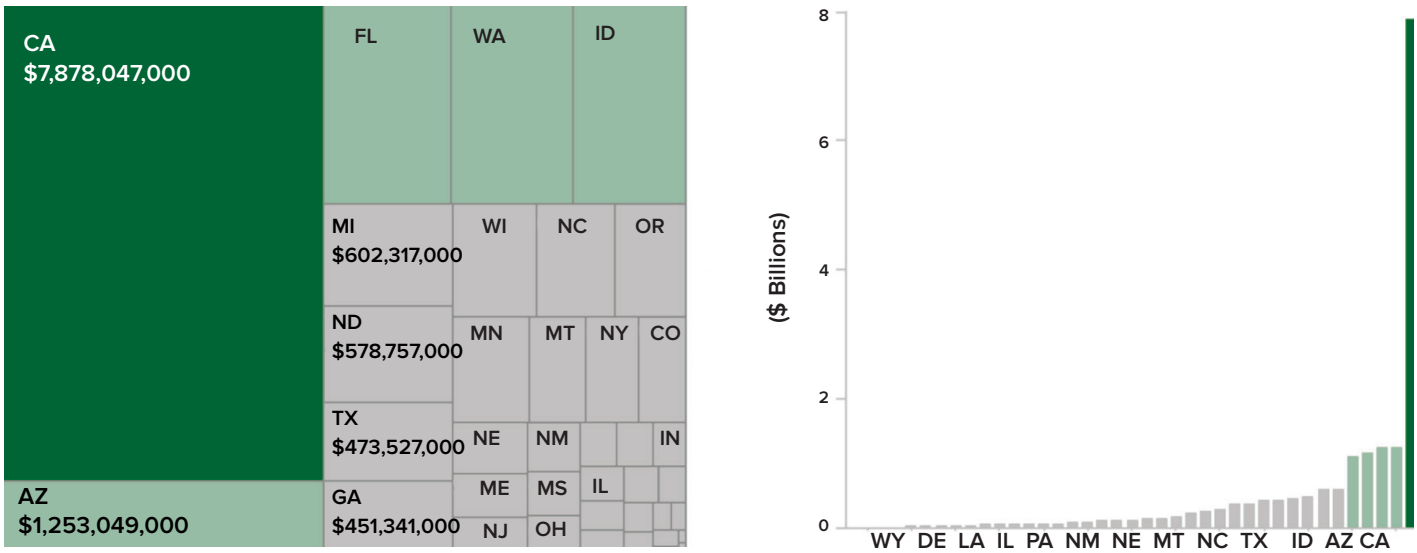
Appendix

Appendix Figure 10.1A. Vegetables and Melons, Cash Receipts by State in 2018, U.S. Dollars

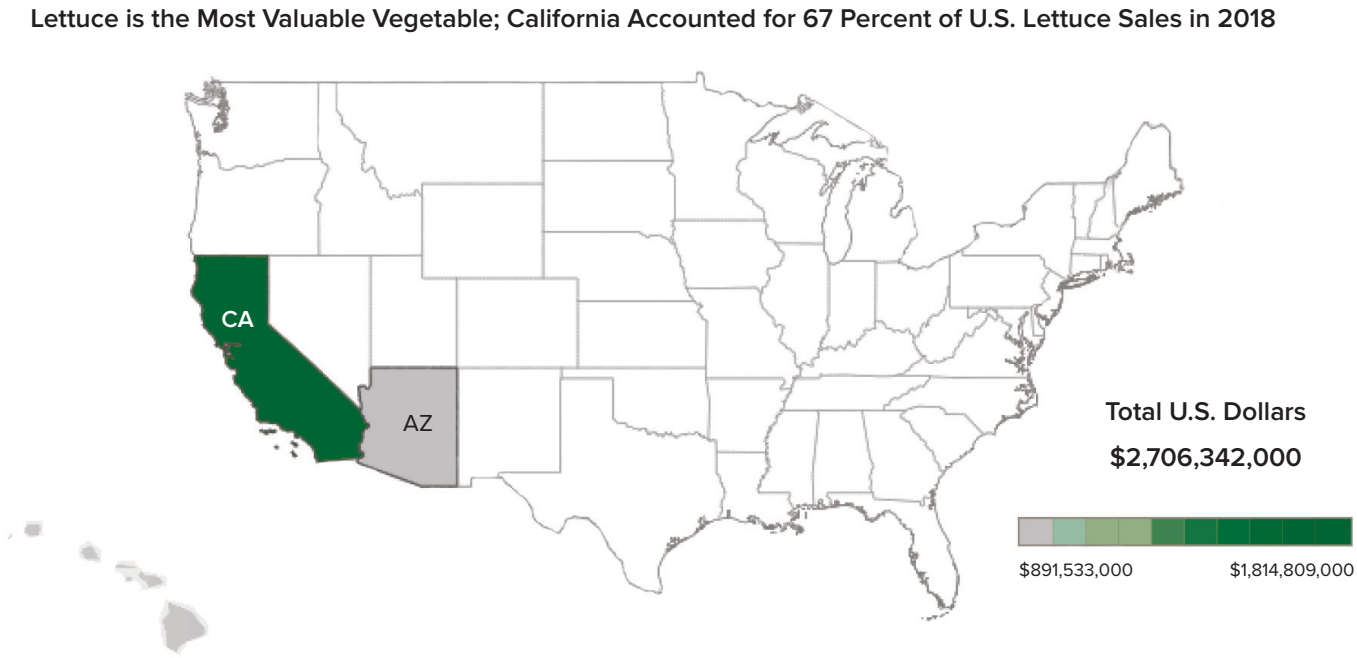


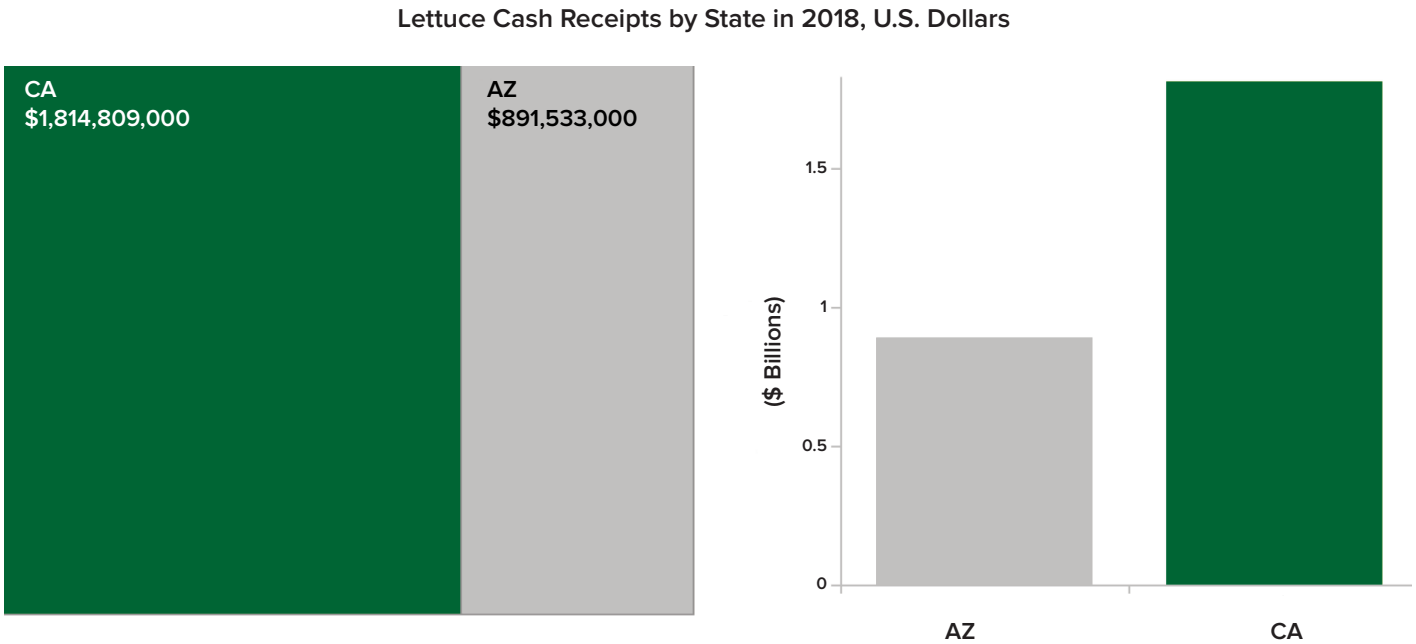


Source: The ERS Farm Income Team. Available at: https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx

Note: States without shading have no production for this commodity or are included in miscellaneous crops or all other animals and animal products.

Appendix Figure 10.2A. Lettuce, Cash Receipts by State in 2018, U.S. Dollars

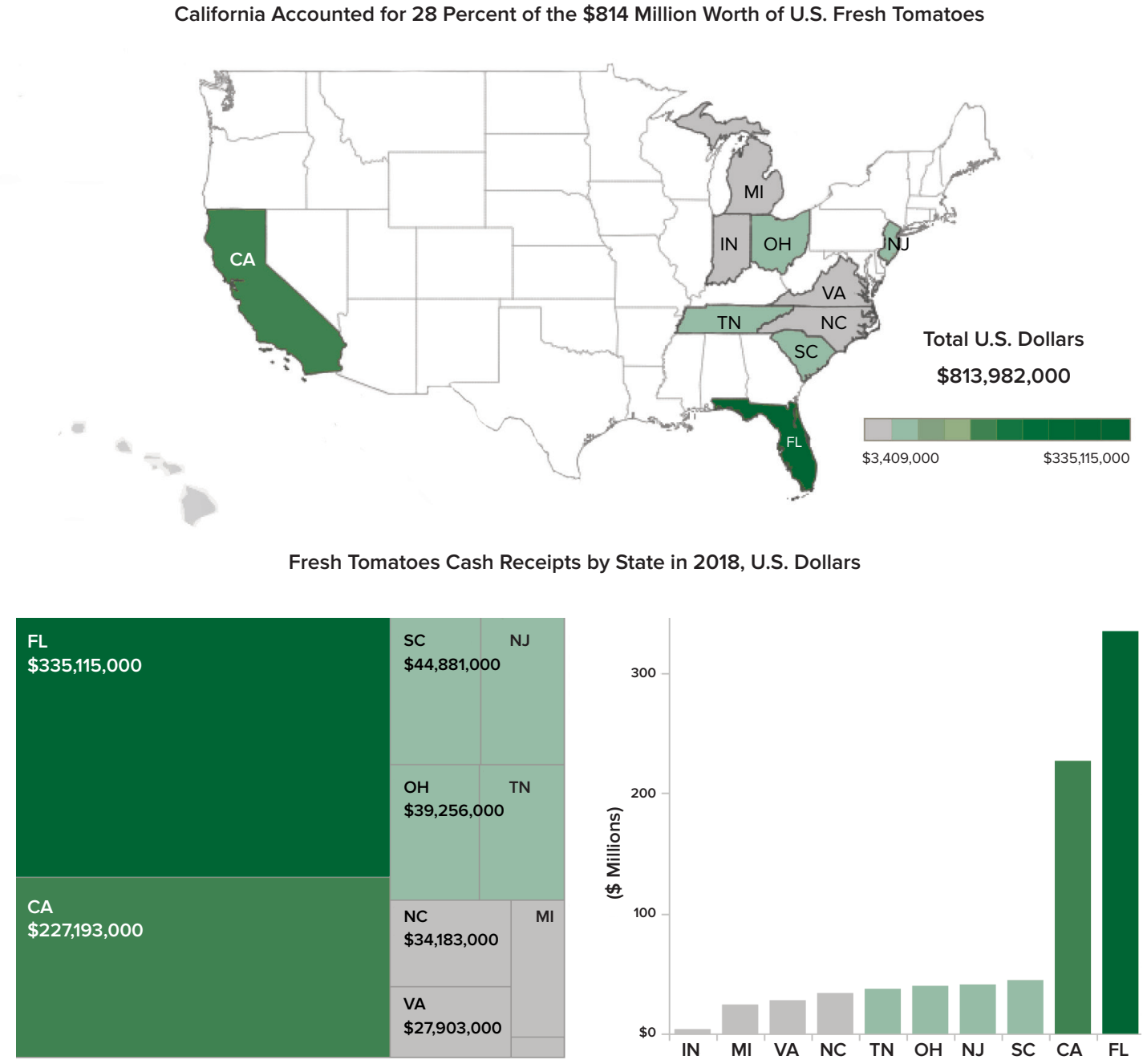




Source: The ERS Farm Income Team. Available at: https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx

Note: States without shading have no production for this commodity or are included in miscellaneous crops or all other animals and animal products.

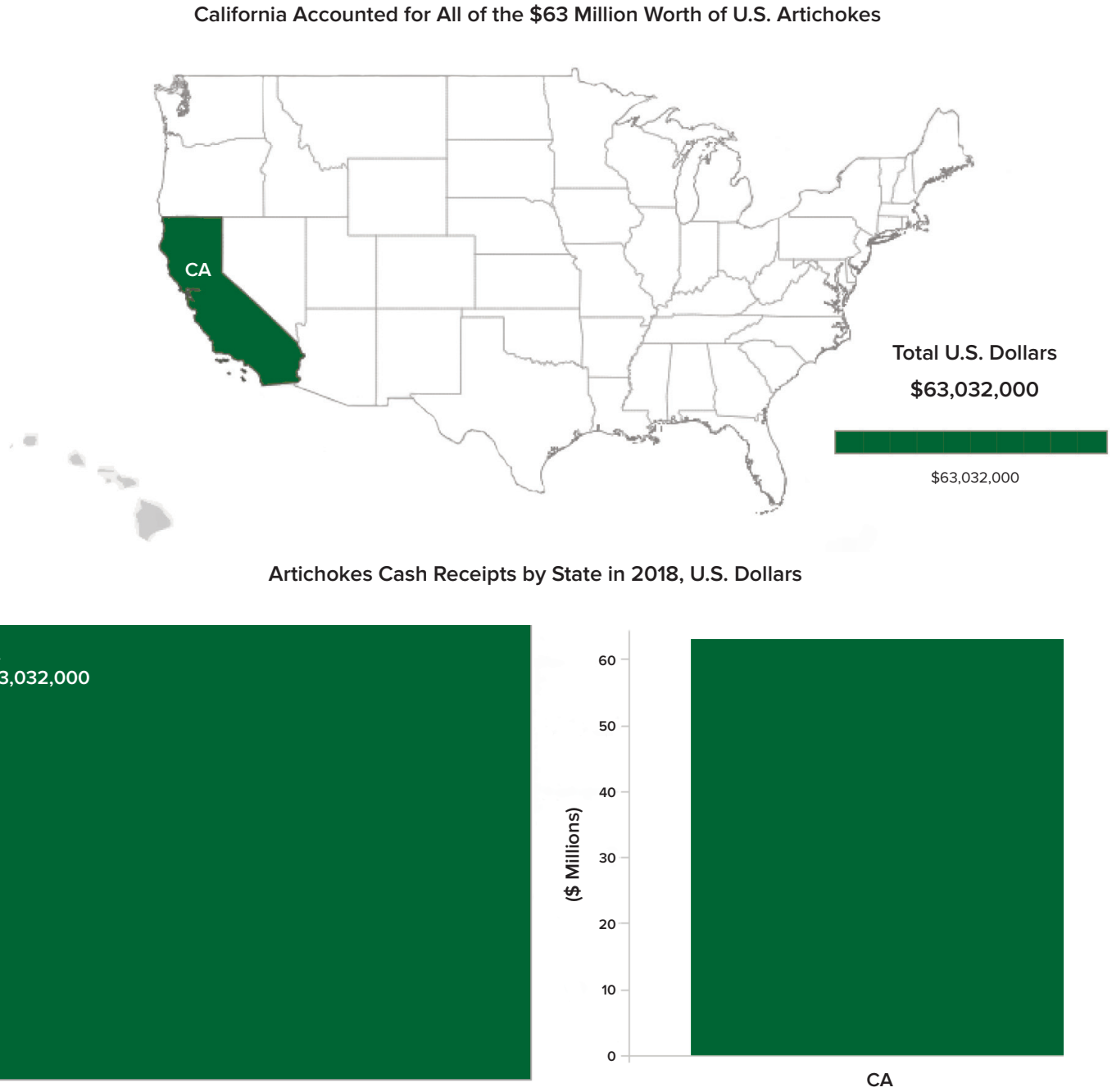
Appendix Figure 10.3A. Fresh Tomatoes, Cash Receipts by State in 2018, U.S. Dollars



Source: The ERS Farm Income Team. Available at: https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx

Note: States without shading have no production for this commodity or are included in miscellaneous crops or all other animals and animal products.

Appendix Figure 10.4A. Artichokes, Cash Receipts by State in 2018, U.S. Dollars



Source: The ERS Farm Income Team. Available at: https://www.ers.usda.gov/data-products/farm-income-and-wealth-statistics.aspx

Note: States without shading have no production for this commodity or are included in miscellaneous crops or all other animals and animal products.