FINAL REPORT

USDA Census of Agriculture Trends 2012 – 2017

Prepared for

California Air Resources Board (CARB)

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Prepared by

ERA Economics LLC
In Collaboration with Cal Poly San Luis Obispo

ERA Economics
Environment • Resources • Agriculture

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1. Introduction

This report summarizes key changes in California's agricultural industry that occurred between 2012 and 2017. It also provides supporting analysis and data of factors driving these changes. The purpose of the report is to provide context and background for regulatory conditions and costs affecting San Joaquin Valley farming operations. This report describes the key changes that occurred between 2012 and 2017, but it is not intended to be an exhaustive inventory of all factors affecting farming in California. The information will be used to support the updated farm case studies being developed by Cal Poly under a separate component of this project.

California agriculture experienced significant changes in policy, market conditions, and resource availability between 2012 and 2017. The most significant policy change was the passage of the Sustainable Groundwater Management Act of 2014 (SGMA) that effectively limits groundwater pumping across the state. Market demand for key export crops, including nuts and processing tomatoes, increased prices significantly through 2014, but as exports slowed prices fell back to historical long-term averages. Finally, California experienced the most severe drought on record between 2014 and 2016. This report weaves 2012 and 2017 Census of Agriculture statistics into a narrative summary of three fundamental drivers of change in California: policy, markets, and resource availability.

This report extends an analysis competed in 2016 (work was completed between 2014 and 2015) that assessed the impact of regulatory costs on the agricultural economy in the San Joaquin Valley (McCullough, et al., 2018). That study developed a framework to assess the economic impact of regulations on San Joaquin Valley agriculture, from the individual farm through all supporting industries. The framework was based on publicly available data, including the 2012 Census of Agriculture, USDA National Agricultural Statistic Service (NASS), and University of California Cooperative Extension (UCCE) Cost and Return data. Additionally, the study collected primary data through 22 grower interviews in the San Joaquin Valley. This report summarizes: (i) new industry data available in the 2017 Census of Agriculture and (ii) key changes in California agriculture that are responsible for these trends.

California Agriculture Industry Changes, 2012 – 2017. Between 2012 and 2017, California saw the introduction of several landmark laws and additional regulations including the Sustainable Groundwater Management Act, new laws changing agricultural labor compensation, and changes in air and water quality standards. In addition, California experienced severe drought between 2014 and 2016, at the same time as exports of key commodities (including nuts and processing tomatoes) reached record highs. These regulations, in combination with other market forces, changed the agricultural landscape with rapid increases in tree nut plantings and a contraction in the dairy industry. This analysis does not attempt to isolate the impacts of all these factors, and it does not predict future changes in farming operations.

2. Policies, Markets, and Water Supply Driving Change in California's Agricultural Sector, 2012- 2017

Changes in policies, market conditions, and resource availability between 2012 and 2017 are continuing to drive changes in California's agricultural sector. Some of these changes are reflected in the 2017

Census of Agriculture data, but others are only starting to affect California agriculture. This section highlights the major regulatory, resource, and market changes between 2012 and 2017.

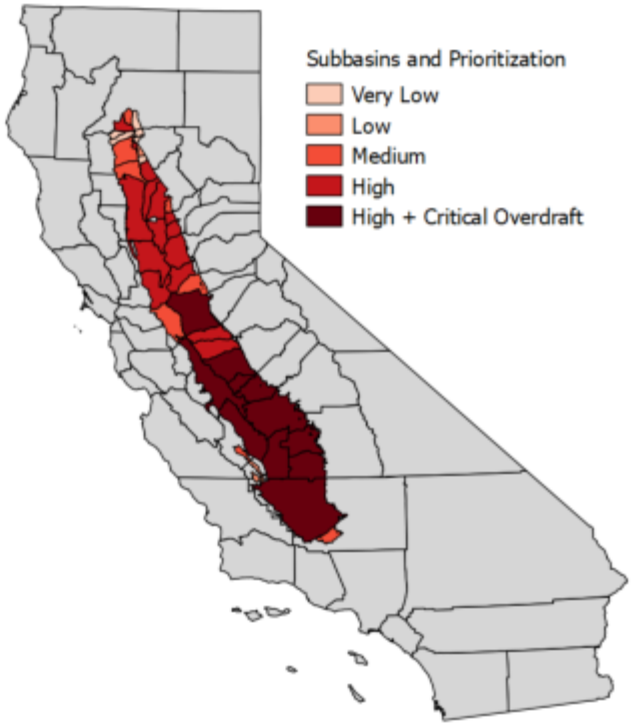
Between the 2012 and 2017 Census of Agriculture surveys, California experienced the introduction of several important policies, laws, and regulations that affect agricultural producers in the short and long run. Notable changes include SGMA, Assembly Bill (AB) 1066, Senate Bill (SB) 3, Irrigated Lands Regulatory Program, additional pesticide/material use restrictions, and stricter standards for air quality. This section summarizes major laws and regulations that were introduced between 2012 and 2017.

2.1 Sustainable Groundwater Management Act

The Sustainable Groundwater Management Act (SGMA) of 2014 is a set of laws (AB 1739, AB 1310, SB 1168) that mandate "sustainable" groundwater use in California. Sustainability is broadly defined as groundwater management to avoid six "undesirable results" of groundwater overdraft including lowering groundwater levels, reducing groundwater storage, seawater intrusion, water quality degradation, land subsidence, and depletion of connected surface water systems.

Sustainable management requirements specified in the law apply to individual groundwater subbasins classified by the Department of Water Resources (DWR). How SGMA will be implemented varies by groundwater subbasin. Within each subbasin, Groundwater Sustainability Agencies (GSAs) have been created to develop and manage a Groundwater Sustainability Plan (GSP) to meet address SGMA regulations. GSAs must develop GSPs by 2022 for high and medium priority subbasins, and 2020 for high priority subbasins that are in a state of critical groundwater overdraft. Subbasins must be sustainably managed by 2042 for high and medium priority subbasins, and 2040 for high priority subbasins that are critically overdrafted. Figure 1 illustrates subbasins in the Central Valley by prioritization. Most of the San Joaquin Valley is in a state of critical overdraft.

Figure 1. Central Valley Subbasins by Prioritization



One or more GSPs in each subbasin will define the water balance (and safe yield), specify "threshold" criteria for each of the undesirable results of overdraft, specify management actions or water supply projects to avoid thresholds, and specify costs and feasibility of the overall GSP. Chapters of GSPs for the GSAs in high priority critically overdrafted subbasins are currently being released (as of the publication date of this report).

SGMA reduces the amount of groundwater that can be pumped. Preliminary estimates indicate that average annual overdraft in the San Joaquin Valley alone ranges between 1 and 1.5 million acre-feet. As a result, as much as 500,000 acres could come out of production (more recent estimates indicate something in the range of 300,000 acres may be more likely). Many GSAs are considering restrictions on groundwater pumping that would increase competition for water (and increase the price of water). In addition to pumping restrictions, GSAs are considering options to develop new water supply sources, some of which are significantly more expensive than current water supplies. Example projects being considered by GSAs include developing new local sources or reoperation of local facilities, surface water transfers with willing partners, entering into contracts for new storage (e.g. Sites Reservoir), on-farm flood managed aquifer recharge (Flood-MAR), and development of dedicated recharge basins to capture and divert winter flood flows when they are available. The cost and availability of different water supply options varies by water year conditions (e.g. there are flood flows available in wet years), and by location (e.g. proximity to rivers increases the potential for winter recharge). Example costs include:

- An analysis using the Statewide Agricultural Production Model (SWAP) estimates that water prices could range from $250 per acre-foot in wet years to over $1,300 per acre-foot in dry years under SGMA implementation. These values were developed and included in the Water Storage

Investment Program (WSIP) for allocation of $2.7 billion in capital projects (see https://cwc.ca.gov/Water-Storage).

- Local surface water options are generally limited and can range in cost from $50 to $300 per acre-foot.
- Flood-MAR and recharge basin costs are similar, typically between $100 and $400 per acre-foot.
- Large scale storage options, such as Sites Reservoir, are generally limited and estimated to cost approximately $600 per acre-foot at the reservoir.

All costs are representative of statewide averages and do not include additional local water conveyance costs, system losses, or other region-specific considerations (e.g. subsidence or other local sustainability requirements).

The net effect of SGMA is higher water supply costs to growers in the San Joaquin Valley. The actual impact to any single grower will vary by parcel. Each parcel has a safe yield groundwater allocation plus any available surface water rights or contracts. The cost of this water supply will be similar to pre-SGMA conditions plus the cost of administering the GSP and annual and periodic updates. The blended cost of additional sources will depend on the share of each source, and what is available to each parcel. In general, parcels with limited, or no, access to surface water will experience significantly higher water supply costs. For example, with a safe yield of 0.5 af/ac and a water demand of 4 af/ac, with no access to surface water supplies a grower would need to purchase 3.5 af/ac from a water market (assuming one exists in the subbasin) at up to $1,000/af in dry year conditions.

2.2 Labor Regulations

The agricultural sector is heavily dependent on farm laborers and labor scarcity is increasing in California. A 2017 survey of California growers indicated that 55% of participants experienced employee shortages, and 69% of participants that rely on seasonal workers experienced labor shortages (CFBF, 2017). Changes in immigration policy, an aging workforce, and competition from other industries make it increasingly challenging for growers to find timely and reliable workers (Martin, 2017). As a result of labor shortages, growers are often forced to pay higher wages to attract workers. Recent changes in overtime pay and minimum wage will further increase wages, ultimately increasing grower production costs.

In September 2016, AB-1066 was signed into California law (CLI, 2018). AB-1066 changes the compensation and work hour requirements for agricultural employees. The bill allows farm workers to qualify for overtime pay (1.5 times normal wage) after working 8 hours in a day, or 40 hours in a work week by 2022. Prior to this bill, farm workers could work up to 10 hours a day or 60 hours a week before receiving overtime pay. Changes to overtime pay and work week hours will be phased in between 2019 and 2022, as summarized in Table 1.

Table 1. AB 1066 Overtime Thresholds

	2018	2019	2020	2021	2022
Hours/Day	10	10	9	9	8
Hours/Week	60	55	50	45	40

In addition to AB-1066, growers are required to comply with SB-3, which gradually increases the California minimum wage (CLI, 2018). Wages will increase annually from a base of $10 per hour in 2017 to $15 per hour by 2023—or by 2022 for firms with more than 26 employees.

The impact of changes in labor availability and cost vary by crop and the size of the operation. For example, labor costs account for nearly 80% of operating costs (i.e. the cost to produce the crop) for cherries, but only 10% of operating costs for field crops such as beans (Grant et al., 2017; Long et al., 2016). Crops and operations that rely more on labor will experience greater impact of increased labor costs. In addition, smaller operations that do not typically employ laborers year-round are subject to increasing overhead fees and wages from labor contractors.

AB-1066 and SB-3 did not directly affect California agriculture between 2012 and 2017 because minimum wage and overtime requirements were phased in starting in 2018. However, grower expectations for higher labor wages and immigration reform pressure (starting around 2016) have increased incentives to invest in machinery and automation. Some of these changes are reflected in the machinery purchases recorded in the 2012 and 2017 Agricultural Census.

2.3 Water Quality

Intensive agricultural production can adversely impact surface and groundwater quality through material runoff and discharge of organic matter. Maintaining water quality is important for agriculture, the environment, and human health.

In December 2012, the Central Valley Water Board (CVWB) adopted conditional Waiver of Water Discharge Requirements (WDRs), establishing the Irrigated Lands Regulatory Program (ILRP) (ILRP, 2016; CWBCV). ILRP requires growers to implement waste discharge management practices to meet WDRs, which regulate agricultural waste discharge (e.g. sediments, pesticides, nitrates) into surface and groundwater supplies. Growers must develop and submit farm evaluation and nitrogen management plans to the CVWB or their local water coalition.

Water quality regulations vary by region, depending on a variety of factors including salinity and nitrate concentration, crop mixes, and water discharge volumes. Annual fees required by ILRP have a wide range between $100 per farm plus $0.95 per acre to $6,384 per farm plus $3.41 per acre, depending on whether a grower is part of a coalition (CWB, 2018). Table 2 summarizes the ILRP fee schedule for the 2018-19 season. Tier I costs reflect a farm that is part of a coalition approved by the CVWB and manages fee collection and payment. Tier II costs reflect a farm that is part of a coalition approved by the CVWB but do not manage fee collection and payment. Tier III costs reflect a farm that is not part of a coalition approved by the CVWB.

Table 2. ILRP 2018-19 Fee Schedule

Classification	Acres	Fee Rate
Tier I	-	$100/farm + $0.95/acre
Tier II	-	$250/farm + $1.43/acre
Tier III	0-10	$511/farm + $17.05/acre
	11-100	$1,277/farm + $8.53/acre
	101-500	$3,192/farm + $4.26/acre
	501+	$6,384/farm + $3.41/acre

Growers incur direct cost through ILRP annual fees, but also incur substantial indirect costs through management time. A recent unpublished survey performed by ERA Economics (for an unrelated project) found that processing tomato growers can spend up to 160 hours per year complying with ILRP requirements. This includes attending meetings, developing management plans, testing water, filling out appropriate documents, and submitting water coalition documents. In many cases, the opportunity cost of management time can exceed the ILRP annual fees.

The IRLP did affect California growers between 2012 and 2017 and will continue to affect the industry as growers expect higher compliance costs in the future. Some of these changes are reflected in the 2017 Agricultural Census data.

2.4 Air Quality

San Joaquin Valley air quality is some of the worst in the U.S., failing to meet federal standards for ozone (smog) and particulate pollution. Poor air quality in the San Joaquin Valley is caused by urban expansion, emissions by passenger and freight vehicles, high-intensity agricultural production, and concentrated animal feeding operations (e.g. dairies).

Senate Bill (SB) 32 was signed into California law in September 2016. It requires reducing greenhouse gas emissions (GHGs) to 40% below 1990 levels by 2030 (CLI, 2018). SB 32 expanded on Assembly Bill (AB) 32, which was passed in 2006. AB 32 requires reducing GHGs to 1990 levels by 2020. Primary efforts to reduce GHGs are focused on the transportation sector, which accounts for more than one-third of total emissions in California.

The U.S. Environmental Protection Agency (EPA) established PM 2.5 (particulate matter less than 2.5 microns) in 1997 (USEPA, 2018). In 2012, the EPA lowered the emissions to 12 micrograms/cubic meter and set national air quality standards for ozone (O3) to 0.075 parts per million for 8 hours.

The Airborne Toxic Control Measure (ATCM) was approved in January 2005 and set requirements for some diesel-fueled engines used in agricultural production (CARB, 2018; CARB 2018a; CARB, 2008). On-farm diesel engines (e.g. pumps) are required to become compliant with ATCM by replacing old diesel engines with one of the following: alternative fuel engines (e.g. electric, gasoline, propane), new compliant diesel-fueled engine, installation of an approved exhaust after-treatment device, or use of an alternative diesel fuel (biodiesel). The ATCM was approved in 2005, but replacement began in 2011 and will continue through 2021, depending on engine model year and horsepower.

Changes in air emission laws, policies, and regulations affected California farmers between 2012 and 2017. The most immediate effect was an increase in equipment purchases to meet emission standards. Other adjustments include changes in farming practices to minimize dust and capital outlay planning to meet future GHG regulations.

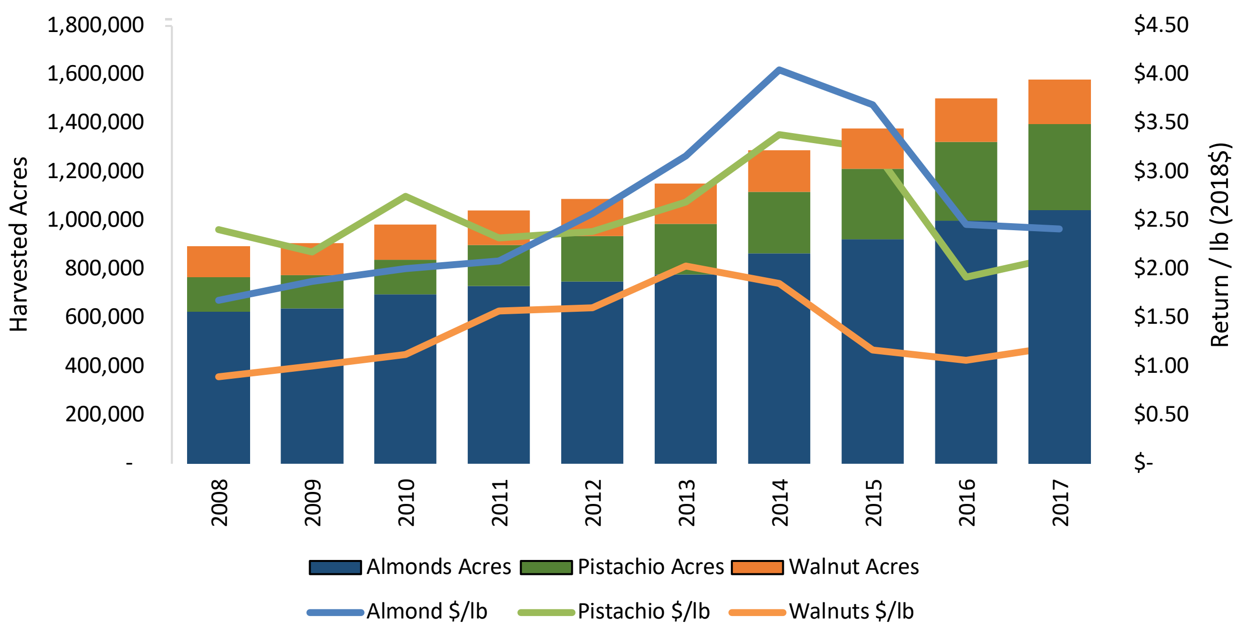
2.5 Changes in Market Conditions

Between 2012 and 2017 the global economy was still recovering from the Great Recession. Exchange rates were generally favorable for key importers of California agricultural products. As a result, California exports and farm-gate prices for California produce increased significantly. The 2014 season saw record prices for almonds, pistachios, walnuts, and processing tomatoes. Since 2014 the export market has cooled considerably in response to a stronger U.S. dollar and general weakening of global economic conditions. The following subsections summarize trends in the tree nut (almonds, pistachios, and walnuts) and dairy market that affected California producers between 2012 and 2017.

Between 2012 and 2017 California almond, pistachio, and walnut acreage increased by 44%, from 1.4 to 2 million acres (USDA, 2019). Over the same period, the farm-gate value (gross revenue) increased by 24% from $8.2 to $10.2 billion (NASS, 2017). Most of this growth was driven by expansion in almond production, which accounted for approximately 65% of nut production value in 2017.

Figure 2 illustrates harvested acres and return per pound for almonds, walnuts, and pistachios, between 2008 and 2017. Almond acreage expanded from 904,000 to 1,270,000 acres, walnut acreage grew from 310,000 to 394,000 acres, and pistachios increased from 189,000 to 358,000 acres. Most new orchard plantings occurred on lands that were historically used for field crops, hay and haylage, or on virgin land. Between 2012 and 2017, field crop acreage decreased 44% in the San Joaquin Valley from 834,000 to 469,000 acres and hay and haylage acreage decreased 11% from 1.58 to 1.4 million acres (USDA, 2019).

Figure 2. California Nut Harvested Acres and Farm Gate Value in 2018$, 2008-2017



2.5.1 **Almonds**

As of 2017, California comprised 80% of global almond production (ABC, 2017). Approximately 70% of California production is exported, averaging around 1.4 billion pounds annually (ERS, 2018). Between 2008 and 2017, almond exports increased 57% from 0.98 to 1.53 million pounds.

Europe, Asia, and the Middle East are the primary export markets for California almonds. Between 2012 and 2017, India, Thailand, and Indonesia imports increased 95%, 11%, and 79% in constant 2018 dollars (UN, 2019). Chinese imports decreased 29% over the time frame.

Almond prices reached record highs in 2014 at $4.05 per pound. As a result, growers began planting almonds at record rate across the state with the expectations that prices would remain high. Following peak prices in 2014, Asian demand, notably China, began to decrease, and prices fell to $2.43. Between June and August of 2015, the Chinese Shanghai Stock Exchange Composite index dropped 43%, forcing China to devalue their currency (Swegal, 2017). During the same time, the U.S. dollar began to strengthen against key export currencies, including India, Japan, and South Korea. The net effect was slowing export demand that resulted in farm-gate almond prices steadily decreasing following the 2014 season.

Despite lower prices since 2014, almonds continued to be planted with the expectation that prices would stabilize. Between 2015 and 2017 harvested almond acreage increased 12% in the San Joaquin Valley and 11% across the entire state (NASS, 2017).

2.5.2 **Walnuts**

Walnuts rank as the second most planted nut crop in California, with approximately 394,000 acres planted as of 2017 (NASS, 2017). Similar to other nut crops, walnuts are mostly produced for the export market. Between 2012 and 2017 walnut exports increased 31%, averaging approximately 375 million pounds annually, or approximately 71% of annual production (ERS, 2018).

Reliance on export markets mean that California walnut prices are sensitive to changes in trade agreements and competition from other exporters. China, U.S., and Chile are the dominant global walnut producers. China comprises approximately 50% of global production, followed by the U.S. at 28%, and Chile at 6%. China is a large producer but exports fewer than 5% of total production. Chile exports are increasing and competing directly with U.S. exports. Between 2012 and 2017, Chile walnut production increased 103% from approximately 44,000 tons to 90,000 tons (UN, 2019). Chile walnut production is estimated to exceed 225,000 tons by 2025 (Bianchini, 2017).

Despite increasing global competition, California walnut production has been expanding. Between 2012 and 2017, California farm gate walnut prices reached a historical high (in 2014) of $1.88/lb before returning to historical averages by 2017. Like almonds, the price increase was a result of strong export demand by Asian, European, and Middle Eastern countries. Lower prices since 2014 are a result of weaker Asian markets and a stronger U.S. dollar. Between 2012 and 2017, walnut acreage increased 26% from 312,000 to 394,000 acres statewide.

2.5.3 **Pistachios**

Pistachios rank as the third most planted nut crop in California, with approximately 358,000 acres in 2017 (NASS, 2017). Pistachios are also primarily produced for the export markets, with 68% of total production exported annually, averaging 161 million pounds (ERS, 2018). California accounted for approximately 55% of global pistachio exports, as of 2017. Iran is the other major global exporter, accounting for 42% of global pistachio exports in 2017. Iran pistachio acreage is approximately triple that of California. However, production is approximately one-third the yield of California orchards. Presently, geopolitical risk, access to capital, less efficient production methods, and food safety risks (aflatoxin) limit Iranian pistachio production and exports.

California pistachio export value increased 47% between 2012 and 2017 from approximately $985 million to $1.45 billion (UN, 2019). China makes up the largest California export market, accounting for 47% of export value in 2017, at approximately $675 million. Europe is the next largest export market. The export market in China is expected to expand as incomes rise, however recent tariffs and the strength of the U.S. dollar may dampen growth rates. Chinese consumers are price sensitive and will substitute to alternative nuts, or pistachios from Iran, when California pistachio prices are too high.

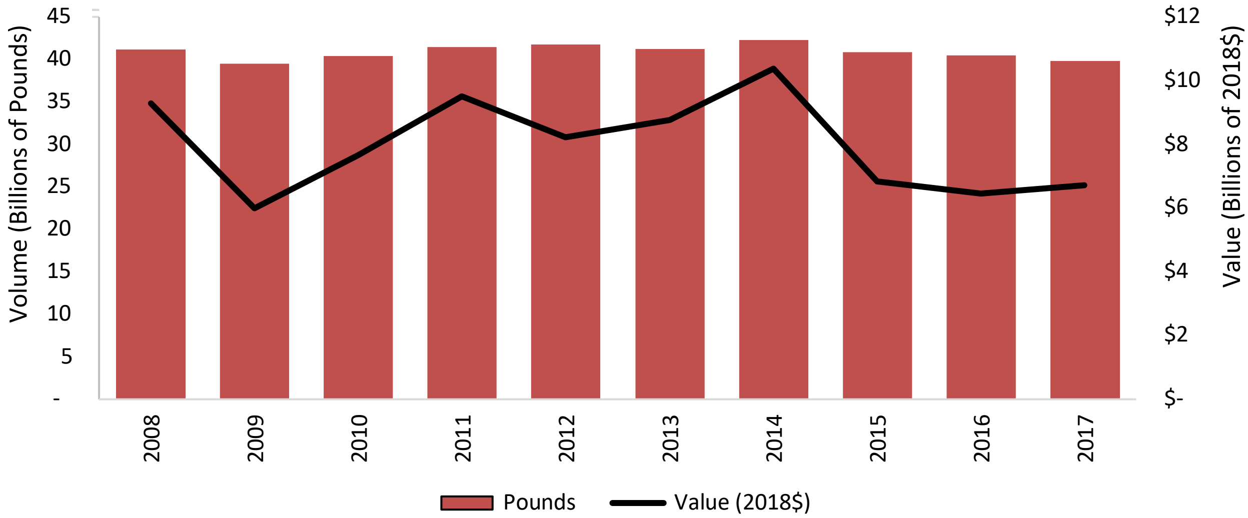
Between 2012 and 2017, California farm gate pistachio prices increased to historical highs before returning to historical averages. Price increases were largely due to increased demand from China and Europe, which drove prices from $2.36 to $3.19 per pound between 2012 and 2014 (USDA, 2017). High prices sustained in 2015 because of a dip in global production that was driven by poor fruit set and severe drought. In 2016, production rebounded, and pistachio prices crashed to $1.97 per pound before increasing slightly again in 2017. Strong prices encouraged growers to plant more pistachios. Between 2012 and 2017 pistachio acreage increased 89% from 189,000 acres to 358,000 acres statewide.

2.5.4 **Dairy**

Dairy has historically ranked as the highest grossing agricultural product in California, valued at $6.7 billion as of 2017. The gross value of California's dairy output dropped 23% between 2012 and 2017. This was caused by excess national supply that depressed milk prices.

Between 2012 and 2017, dairy production in California contracted 5% from 41.8 million pounds to 39.8 million pounds (CDFA, 2017). The San Joaquin Valley accounts for approximately 90% of California dairy production, with Tulare, Merced, and Kings Counties making up over 50% of production. Figure 3 illustrates California milk production volume and value between 2008 and 2017. Between 2014 and 2017 prices and production were declining.

Figure 3. California Milk Production and Farm Gate Value in 2018$, 2008-2017



California exports approximately 24% of the milk it produces, which makes the industry sensitive to changes in foreign demand, trade agreements, currency valuation, and competition from other exporters. California dairy exports peaked in 2014 at $2.58 billion before contracting to $1.64 billion in 2017 (UN, 2019). Strong demand from Asian export countries supported exports through 2014. As the Chinese economy weakened in 2015 and the U.S. dollar appreciated against the Yuan, exports fell.

California's dairy industry purchases imported feed (grain from the Midwest and hay from other Western states) in addition to local hay and silage. Silage is produced on approximately 1.1 million acres in the San Joaquin Valley (USDA, 2017). Between 2012 and 2017 silage acreage contracted 9% from 1.19 to 1.08 million acres. The reduction in acreage is due to contraction in dairy production and competition for land from other high-value crops, notably tree nuts.

The California dairy industry is subject to regulations to ensure animal, human, and environmental health and safety. The cost of complying with regulations puts additional pressure on the industry. For example, air quality compliance costs include costs of paperwork, equipment, and additional labor, and are estimated to total 9.6% of the dairy industry's net profit (Zhang, 2013). In 2017 the San Joaquin Valley Water Quality Control Board adopted a General Order for Confined Bovine Feeding Operations that sets waste discharge and monitoring requirements. Prior to the General Order, water quality compliance costs were estimated at over $19,000 annually (Cady and Francesconi, 2010).

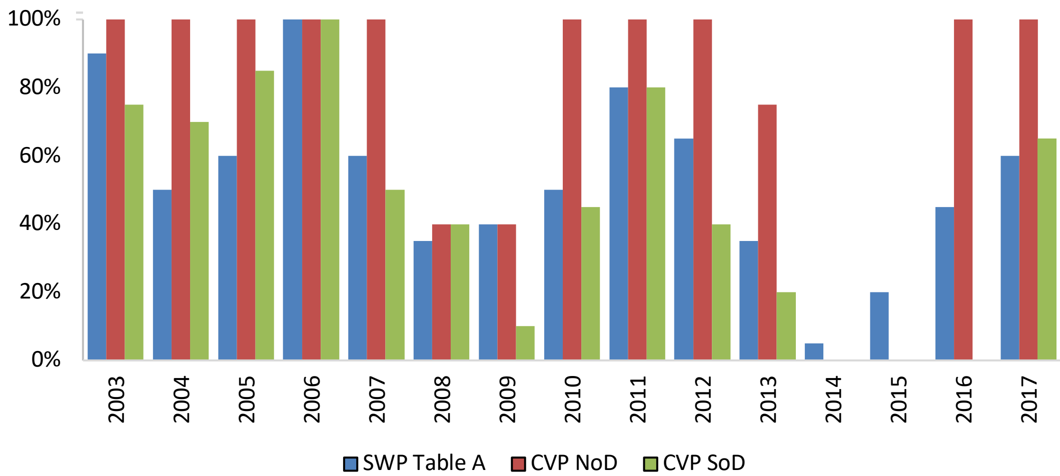
As a result of changing export market conditions and increased regulations, the California dairy industry has contracted. This trend is likely to continue for the foreseeable future and possibly accelerate as SGMA is rolled out across the San Joaquin Valley.

2.6 Resource Availability: Drought

California experienced one of the most severe droughts on record between 2014 and 2016. State and Federal surface water deliveries were significantly reduced, and in some cases were zero, for many irrigation districts across the state. As a result, growers with access to groundwater turned to pumping from wells to supplement irrigation demand. This increased groundwater overdraft-related issues in many parts of the San Joaquin Valley (subsidence and lowering of groundwater levels), from which some areas have not yet recovered.

Figure 4 illustrates the percent of State Water Project (SWP) (Table A) and Central Valley Project (CVP) deliveries for agricultural water north of the Delta (NoD) and south of the Delta (SoD). Agricultural water deliveries in 2014, 2015, and 2016 dropped to effectively zero for many districts. Even senior water rights holders, including CVP Settlement Contractors in the Sacramento Valley and Exchange Contractors in the San Joaquin Valley did not receive full water allocation. As a result, groundwater pumping increased (which increased water supply costs) and thousands of annual crop acres were fallowed across the state.

Figure 4. SWP and CVP Delivery Shares, 2003 - 2017



The drought created a substantial economic cost estimated at $2.2 billion in 2014, $2.7 billion in 2015, and $603 million in 2016 (Medellin-Azuara et al., 2016; Howitt et al., 2015; Howitt et al. 2014). Most of the land fallowing was in annual field and row crops. Plantings of permanent crops, particularly almonds, pistachios, and walnuts, continued to increase in spite of the drought. This was because growers were able to rely on groundwater to establish new orchards. However, as groundwater levels continued to fall across the San Joaquin Valley in response to increased pumping this created an additional $454 million in 2014, $590 million in 2015, and $303 million in 2016 in higher groundwater pumping costs. The net effect of the drought was movement toward higher valued permanent crops across most regions in the San Joaquin Valley.

2.7 2012 – 2017 Industry Trends Summary

Changes in laws, regulations, water supply, and markets are responsible for California agriculture industry trends between 2012 and 2017. New laws and regulations limit water supply in some areas and make irrigation water costs more expensive in others. This affects farm profitability. At the same time, changes in exchange rates and export demand for California products can cause large swings in farm-gate prices. California agriculture realized record high prices around 2014 that have since settled closer to long-run averages. The net effect of these industry shifts is reflected in the changes in the Agricultural Census data between 2012 and 2017.

3. Agricultural Census Data Summary, 2012 - 2017

The 2012 and 2017 Census of Agriculture data is used to illustrate the change in permanent plantings, number and size of farms and dairies, labor usage and cost, and the value of machinery by farm size in the San Joaquin Valley. Factors that influence operations include changes in regulation, market forces, and other external factors. This analysis provides a snapshot of operational and land use changes and does not attempt to isolate how individual factors influenced market changes or estimate how operation characteristics will change in the future.

3.1 Crop Prices and Yields

Crop prices and yields are correlated. Yields are primarily influenced by environmental conditions (e.g. drought, pest and disease pressure, temperatures) and can vary by production region within California. As yields fall and aggregate production (supply) decreases, prices tend to increase. An individual grower has no control over these market forces. Crops that are produced in concentrated areas or during certain times of the year (e.g. almonds in California or table grapes in the San Joaquin Valley) are more likely to experience price shifts when supply fluctuates. Commodity crops that are produced in other domestic and international regions (e.g. alfalfa or wheat) are less likely to experience price changes with a low yield in California, as California production is a small share of total production.

Table 3 summarizes yields and prices between 2012 and 2017 for major crops produced in the San Joaquin Valley (USDA, 2017). Yields across nearly all crops remained steady, despite severe drought conditions in 2014, 2015, and 2016. Crops that are grown for processing or fresh market (e.g. onions, potatoes, broccoli, safflower) experienced the most substantial yield changes. This is likely a result of the warm, dry conditions that persisted during the drought.

Price trends between 2012 and 2017 vary across three primary groups: tree nuts, field crops, and fresh market crops. Global demand for nuts pushed prices to record highs in 2014 and then dropped as a result of slowing Asian economies and a stronger U.S. dollar. Field crop prices remained steady between 2012 and 2017. A few select field crops that are produced for domestic and export markets (e.g. alfalfa and processing tomatoes) saw prices increase in 2014, followed by a return to historical prices in 2017. Crops produced for primarily domestic, fresh market, consumption (e.g. table grapes, tangerines and mandarins) realized higher prices between 2012 and 2017. Price increases in fresh produce commodities were driven by strong consumer demand for fresh foods. For example, grapes represent a top-five fresh produce commodity by value, making up nearly 6% of retail produce sales in the U.S., typically growing around 3% annually (PMG, 2017). Tangerines and mandarins, more commonly known as “easy peels,” represent one of the fastest-growing produce items in the U.S., with sales growing 13% between 2016 and 2017 (PMG, 2017).

Table 3. San Joaquin Valley Yield and Returns, 2012 and 2017

	2012	2014	2017	2012	2014	2017
		yield/acre			*return/ton (2018$)*	
Alfalfa	7.54	7.70	7.57	239	261	191
Almonds	1.11	1.05	1.11	5,139	8,097	4,828
Beans (Dry)	1.47	1.35	1.30	1,001	1,076	870
Broccoli	5.88	6.29	6.64	554	463	1,158
Corn (Grain)	6.00	5.86	5.19	282	268	216
Cotton (Pima)	0.86	0.80	0.68	2,867	3,577	3,068
Grapes (Table)	11.09	11.78	11.54	1,565	1,490	1,812
Grapes (Wine)	11.11	10.76	11.82	447	385	367
Onions	22.61	20.64	27.96	269	266	224
Oranges (Navel)	13.61	12.13	13.52	597	735	663
Pistachios	1.45	1.17	1.14	4,777	6,766	4,255
Potatoes (Fresh Market)	25.03	27.63	23.84	222	242	332
Safflower	0.96	1.57	1.26	585	553	376
Tangerines & Mandarins	8.13	8.64	10.48	1,508	1,539	1,723
Tomatoes (Fresh Market)	17.51	18.70	16.51	472	644	451
Tomatoes (Processing)	53.84	51.83	50.05	78	89	72
Walnuts	1.89	1.80	1.72	3,206	3,703	2,422
Wheat	3.07	3.23	2.60	282	288	190

3.2 Permanent Plantings

Permanent crop (e.g. tree and vine) plantings in the San Joaquin Valley increased 17% between 2012 and 2017, from approximately 2.2 to 2.5 million acres. Table 4 summarizes permanent crop plantings in San Joaquin Valley counties between 2012 and 2017. The greatest increase in permanent plantings was in Tulare and Merced Counties. These two counties have historically led the state in total dairy cows. As nut prices have increased some dairies have switched or diversified operations by planting tree nuts on what was historically used for silage production. Trends revealed in acreage data generally support that this is occurring across most of the San Joaquin Valley. Almonds, pistachios, and walnuts grew 37%, 45%, and 31% between 2012 and 2017 in the San Joaquin Valley. Combined, these three crops accounted for approximately 61% of permanent acreage in 2017 in the San Joaquin Valley. The fastest-growing permanent crops are tangerines and mandarins. Acreage doubled from 30,000 to 60,000 acres, driven by strong consumer demand for “easy peel” snacking fruit.

Table 4. San Joaquin Valley Permanent Crop Acreage Changes, 2012 and 2017

	2012	2017	2012-2017 Change	
	Acres		*%*	*Quantity*
Fresno	537,729	639,299	19%	101,570
Kern	446,391	499,084	12%	52,693
Kings	305,705	343,271	12%	37,566
Madera	237,980	263,779	11%	25,799
Merced	185,162	246,685	33%	61,523
San Joaquin	219,481	244,787	12%	25,306
Stanislaus	161,650	185,468	15%	23,818
Tulare	75,905	108,107	42%	32,202
Central Valley	**2,170,003**	**2,530,480**	**17%**	**360,477**

3.3 Farm Size

Farm size in the San Joaquin Valley between 2012 and 2017 changed dramatically. Over this time frame, 16% of farms between 1 and 50 acres (2,463) and 8% of farms between 50 and 179 acres (408) exited the industry. Fresno and Tulare Counties experienced the largest reduction in number of farms dropping 16% and 15% over the time frame. The change reflects a greater consolidation of farming operations in the San Joaquin Valley. Table 5 summarizes farm size changes by county between 2012 and 2017.

Table 5. San Joaquin Valley Farm Size Changes, 2012 and 2017

	2012 Census			2017 Census			2012 - 2017 % Change		
	1 to 50	50 to 179	180+	1 to 50	50 to 179	180+	1 to 50	50 to 179	180+
	# of Farms by Acreage						*% Change*		
Fresno	3,394	1,204	1,085	2,582	1,076	1,116	-24%	-11%	3%
Kern	786	373	779	698	311	722	-11%	-17%	-7%
Kings	541	195	320	471	191	301	-13%	-2%	-6%
Madera	675	420	412	577	434	375	-15%	3%	-9%
Merced	1,409	490	587	1,251	465	621	-11%	-5%	6%
San Joaquin	2,275	664	641	2,130	675	625	-6%	2%	-2%
Stanislaus	2,849	684	610	2,364	645	612	-17%	-6%	0%
Tulare	3,020	1,037	874	2,413	862	912	-20%	-17%	4%
Total	14,949	5,067	5,308	12,486	4,659	5,284	-16%	-8%	0%

3.4 Dairies

Between 2012 and 2017 the number of dairy operations in the San Joaquin Valley decreased 13% from 2,223 to 1,930. The decrease in number of dairies was offset by the increase in number of cows per dairy (increasing 13%). Changes in the number of dairies and average number of cows per dairy are summarized in Table 6.

Table 6. San Joaquin Valley Dairy Operation Comparison, 2012 and 2017

	2012		2017		# of Dairies		Avg Cows/Dairy	
	# of Dairies	*Avg Cows/Dairy*	*# of Dairies*	*Avg Cows/Dairy*	*% Change*	*Change in Qty*	*% Change*	*Change in Qty*
Fresno	169	1,328	130	1,675	-23%	-39	26%	347
Kern	118	3,184	82	3,253	-31%	-36	2%	69
Kings	222	1,468	202	1,651	-9%	-20	12%	183
Madera	72	1,629	68	2,184	-6%	-4	34%	555
Merced	447	1,102	404	1,303	-10%	-43	18%	201
San Joaquin	214	851	194	995	-9%	-20	17%	144
Stanislaus	472	866	380	932	-19%	-92	8%	66
Tulare	509	1,651	470	1,826	-8%	-39	11%	175
Central Valley	2,223	1,335	1,930	1,502	-13%	-293	13%	167

Pressure on dairy industry profitability is likely to continue in the future as new regulations are implemented and water supplies are increasingly scarce and expensive. Production in other states including Colorado, Kansas, Texas, Michigan, and Indiana becomes more competitive as California production costs increase. A recent report indicated that only 1 of 27 new milk processing plants from 2017 to 2020 is, or will be, in California (Sumner, 2018). The trend is indicative of headwinds from increasing operating costs, regulations, water supply, and a trend toward other high-value crops.

California's dairy industry has been contracting and consolidating over the last several years. Larger dairy operations are able to achieve greater economies of scale. Table 7 summarizes the total cost (operating, cash, and non-cash capital) to produce milk in the U.S. in 2015 (ERS, 2015). As the number of head increase, the total cost to produce a hundredweight (cwt) of milk decreases. This is the result of fixed (capital and regulatory) costs spread over more head. The cost to produce milk in an operation with less than 50 head is 278% higher than the cost to produce milk in an operation with more than 1,000 head.

Table 7. U.S. Milk Production Costs, by Operation Size, 2015

< 50 cows	50-99 cows	100-199 cows	200-499 cows	500-999 cows	1,000 + cows
		total cost per cwt sold			
$53	$41	$33	$29	$24	$19

3.5 Labor

Labor costs typically account for a significant share of farm operating costs. Laborers are important during critical points throughout the growing season, including planting, thinning/hoeing, and harvest. Between 2012 and 2017 the number of workers employed in agricultural operations in the San Joaquin Valley decreased by 23%, or roughly by 90,000 workers. Approximately half of the reduction in farm workers in the San Joaquin Valley were in Fresno County. This could partially be explained by the shift towards permanent crops that are more mechanized than fresh fruit and vegetable production.

The number of Central Valley farm workers decreased but the cost to employ workers increased 23%, or $877 million, between 2012 and 2017. The increased labor cost is partially a result of labor scarcity. AB 1066 and SB 3 were not implemented as of 2017. Therefore, higher wages were caused by competition for labor, typically resulting in higher wages to attract and retain workers. The cost of labor is likely to increase further as AB 1066 and SB 3 are phased in over the next several years. The effect of AB 1066 and SB 3 are not shown in the 2017 Agricultural Census data.

Table 8. San Joaquin Valley Labor Summary, 2012 and 2017

	2012		2017		# of Workers		Labor Cost (millions)	
	# of Workers	*$ Cost (millions)*	*# of Workers*	*$ Cost (millions)*	*% Change*	*Change in Qty*	*% Change*	*Change in Qty*
Fresno	117,248	730	75,638	1,075	-35%	-41,610	47%	345
Kern	69,002	803	40,938	679	-41%	-28,064	-15%	-124
Kings	16,770	250	13,996	370	-17%	-2,774	48%	120
Madera	28,100	235	31,308	391	11%	3,208	67%	156
Merced	34,530	442	31,132	547	-10%	-3,398	24%	105
San Joaquin	49,744	507	39,482	510	-21%	-10,262	1%	3
Stanislaus	29,314	334	25,426	475	-13%	-3,888	42%	141
Tulare	50,494	545	46,466	676	-8%	-4,028	24%	131
Central Valley	395,202	3,846	304,386	4,724	-23%	-90,816	23%	877

3.6 Machinery

Farm machinery purchases increased between 2012 and 2017. This is due to a combination of a stronger economy, strong crop prices, and regulations that require growers to invest in new equipment. The share of farms with machinery valued at greater than $50,000 between 2012 and 2017 increased from 56% of farms to 63%. Table 9 summarizes farm machinery holdings by county in the San Joaquin Valley.

Table 9. San Joaquin Valley Farm Machinery Value, 2012-2017

	2012 Census		2017 Census		2012-2017 % Change	
	<$50,000	$50,000+	<$50,000	$50,000+	<$50,000	$50,000+
	# of Farms by Value of Machinery				*% Change*	
Fresno	2,647	3,036	1,677	3,097	-37%	2%
Kern	621	1,316	559	1,172	-10%	-11%
Kings	396	660	302	661	-24%	0%
Madera	583	924	466	920	-20%	0%
Merced	976	1,508	753	1,584	-23%	5%
San Joaquin	1,568	2,012	1,304	2,126	-17%	6%
Stanislaus	1,982	2,161	1,509	2,112	-24%	-2%
Tulare	2,487	2,444	1,740	2,447	-30%	0%
Total	11,260	14,061	8,310	14,119	-26%	0%

A contributing factor to changes in the share of farms with higher machinery value is the cost to purchase or lease new machinery that is compliant with Tier 4 emission standards (San Joaquin Valley

APCD, 2006). Large equipment retailers will increase tractor prices approximately 6% to 8% annually to account for additional technology to meet air quality standards. New technologies also require more costly maintenance, which are typically performed by dealerships rather than an on-farm mechanic. A newly awarded CARB contract "Assessing the Cost and Fuel Consumption of Off-Road Agricultural Equipment Project" will be investigating these claims in detail.

3.7 Net Farm Income

Regulations tend to impose a greater burden on smaller producers, due to their inability to spread regulatory costs over a larger operation. Typically, operators will achieve economies of scale as an operation size grows, allowing costs to be spread over more acres (or head in the case of a dairy). Operations that spread regulatory costs across larger operations generally realize a higher profit per unit (e.g. acre or head) than smaller operations.

Table 10 compares net income by operation size between 2012 and 2017. Net income for the 3 smallest operation sizes, ranging between 1 and 69.9 acres showed the largest percentage decreases in net income between 2012 and 2017. In contrast, net farm income increased for larger farm operations (except 1,000 – 1,999-acre operations). On average, California net farm income increased by 3.6% in real terms between 2012 and 2017. The substantial increases in net income from larger operations offsets the losses from smaller operations. Net income fell by as much as 50% for smaller operations that are not able to spread overhead and fixed costs over a larger number of acres. Net income is likely to continue decreasing for smaller operations as regulatory and other input costs continue to increase.

Table 10. California Net Return by Operation Size, 2012 and 2017

	2012	2017	2012 - 2017	
	Net Income (2018$)		$ Change	% Change
1 to 9.9 acres	-$2,138	-$3,222	-$1,084	-51%
10 to 49.9 acres	$19,248	$15,031	-$4,218	-22%
50 to 69.9 acres	$90,279	$60,014	-$30,265	-33.5%
70 to 99.9 acres	$78,964	$84,564	$5,600	7.1%
100 to 139 acres	$121,675	$100,280	-$21,395	-17.6%
140 to 179 acres	$135,357	$138,305	$2,948	2.2%
180 to 219 acres	$183,766	$169,824	-$13,943	-7.6%
220 to 259 acres	$209,406	$262,569	$53,163	25.4%
260 to 499 acres	$291,089	$255,696	-$35,392	-12.2%
500 to 999 acres	$388,867	$460,450	$71,583	18.4%
1,000 to 1,999 acres	$675,205	$674,716	-$489	-0.1%
2,000+ acres	$1,353,186	$1,453,411	$100,225	7.4%
Average	$295,409	$305,970	$10,561	3.6%

Table 11 summarizes the effect of changes in price, yield, and production costs for key San Joaquin Valley crops between 2012 and 2017 on net return over operating costs. Fresh market crops including broccoli, onions, oranges, potatoes, tangerines, and mandarins saw increasing net returns between

2012 and 2017. The balance of the major crops produced experienced an overall decrease in net return between 2012 and 2017. Table 11 also shows 2014 net returns because crop prices spiked in that year.

Table 11. San Joaquin Valley Net Return Over Operating Costs per Acre, 2018$

	2012	2014	2017	2012-2017
	Net return over operating costs (2018$)			*% change*
Alfalfa	401	603	48	-88%
Almonds	1,528	4,286	1,158	-24%
Beans (Dry)	529	510	188	-64%
Broccoli	-2,186	-2,531	2,245	203%
Corn (Grain)	513	390	-59	-111%
Cotton (Pima)	1,191	1,565	812	-32%
Grapes (Table)	-511	-319	3,045	695%
Grapes (Wine)	2,404	1,586	1,780	-26%
Onions	874	262	1,035	18%
Oranges (Navel)	1,840	2,628	2,681	46%
Pistachios	4,146	5,101	2,055	-50%
Potatoes (Fresh Market)	-606	518	1,741	387%
Safflower	327	637	243	-26%
Tangerines & Mandarins	-1,864	-827	3,933	311%
Tomatoes (Fresh Market)	1,750	5,530	942	-46%
Tomatoes (Processing)	835	1,285	257	-69%
Walnuts	3,160	3,755	1,266	-60%
Wheat	231	295	-142	-162%

4. Summary of 2012 – 2017 Trends in Census of Agriculture Data

Data from the 2012 and 2017 USDA Census of Agriculture were used to quantify how agricultural operations in California's San Joaquin Valley have changed in response to changes in regulatory, market, and other external conditions.

Landmark regulations introduced between 2012 and 2017 are likely to reshape California agriculture for the foreseeable future. Regulations are intended to ensure environmental, animal, human safety, and sustainability, but impose direct and indirect costs on producers. The most notable policy change was SGMA, introduced in 2014, that will bring groundwater pumping back into balance with "sustainable" yields. Under SGMA, water costs are expected to increase, and the agricultural footprint will contract. The impact will be most significant in "white areas" in the San Joaquin Valley that do not have access to alternative surface water supplies.

Market conditions continue to change the agricultural footprint in California. Strong global demand for tree nuts supported a 44% increase in acreage and 24% increase in value between 2012 and 2017. New tree nut plantings replaced what was traditionally annual field crops (including silage, hay, and haylage for dairy feed). SMGA will increase water values and accelerate this trend. In contrast to nuts, the dairy industry has contracted as a result of depressed national milk prices and increases in production costs.

This report summarized key trends between 2012 and 2017 but some of these changes are just starting to affect producers. For example, SGMA implementation formally starts in 2020 and increases in labor wages are phased over the next several years. Many of these impacts will not show up until the 2022 Agricultural Census. It is important to continue to monitor key industry changes that will affect California agriculture over the next several years, including:

- Additional regulations that affect the agricultural supply chain. For example, food safety regulations from wholesale and retail markets increases both labor and capital costs for fresh vegetable, berry, nut, and fruit growers. As another example, the U.S. and California transportation polices affect truck driver availabilities. Although California has seasonal and competitive advantages in most specialty crops it will be important to keep those issues in mind over time.
- Water supply availability and cost will continue to limit farming in the San Joaquin Valley. SGMA implementation will reduce total groundwater pumping by 1.5 to 2 million acre-feet per year, with implementation starting in 2020. In addition, all water costs will increase as the cost of compliance is spread across all irrigators. This will increase fallowing and pressure to move toward higher value crop in the future.
- The combined (aggregate) effect of multiple regulations by industry. The cost of regulations is typically additive. That is, the higher marginal cost of water under SGMA is in addition to higher labor costs to comply with increasing minimum wage requirements.

The trends and data in this report are intended to support policy and regulation planning purposes. In addition, the information is intended to be merged with case-study information developed by Cal Poly researchers under a separate component of this project. The integrated data and narrative will provide state policymakers with a more robust understanding of the myriad factors driving trends in California agriculture.

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