California's Severe Drought Has Only Marginal Impacts on Food Prices

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Flexibility and resourcefulness by California farmers have minimized drought-induced supply reductions for tree, vine and vegetable crops, for which California has large market shares and for which retail prices would be sensitive to California disruptions. Water is being shifted away from field crops that enter the food supply indirectly and for which California is not a dominant producer. These facts mean that even a severe drought is having only slight impacts on supplies to consumers and thus only slight impacts on consumer food prices. Of course, the longer the drought lasts, the larger the impacts.

The severe drought that California has been experiencing for several years has idled hundreds of thousands of acres of cropland, reduced crop yields, cut the cattle herd on pastures throughout the state, and reduced farm production value by billions of dollars. Nonetheless, despite the fact that California is the most important farm state in the United States—leading the nation in production of major commodities such as milk, tree nuts and many fruits and vegetables, and supplying about half of U.S. fresh produce—most consumers have seen no sign of the drought in the cost of food. This article lays out the facts and economic logic for why this is true.

The previous articles in this issue have sketched the severity of this drought and what it has meant for irrigation water costs and availability, crop planting patterns, and production. This article takes the story through to food consumers.

The Simple Economics of Farm Production and Retail Food Prices

Food price changes follow from farm commodity supply and demand conditions. So if the drought reduces farm supplies and raises farm costs, then prices of food products derived from those farm commodities must rise. How much each food product price rises due to the drought depends on several common sense determinants:

- The magnitude of the supply reduction or farm cost increases for the commodities used in each of the food products.
- The share of the relevant commodity supply that is affected by the drought.
- The relative shares of the farm cost and other post-farm processing and marketing costs in the retail price of the related food product.
- The availability of substitutes for the food products affected.

The magnitudes of each of these determinants is different for each farm commodity affected by the drought, and we will discuss each in turn for major commodities.

California Commodity Supply Reductions and Cost Increases Caused by the Drought

As the previous articles in this *ARE Update* issue document, the California drought is likely to reduce acreage by close to 10%. But, almost all that reduction in acreage is occurring in the Central Valley and among the major forage, grain and other field crops, for two reasons.

First, in normal years, Central Valley agriculture relies on surface water deliveries from major government-owned or regulated projects. That means crops grown in the Central Valley have been more subject to government mandated water cuts than crops grown in regions with a higher reliance on groundwater or local deliveries.

Crops such as fresh vegetables, berries, avocados, and high-priced winegrapes are grown mostly in regions that have faced fewer mandated cuts in water supplies. Crops such as tree nuts and tree fruit, lower-priced winegrapes, and field crops tend to be grown in the Central Valley where they have been subject to more surface water cutbacks (Table 1).

Second, when droughts occur, farmers have strong incentives to shift water to crops with higher net revenue per acre-foot of water in order to minimize economic losses. Forage crops such as hay, corn silage, irrigated pasture, grain crops, and other field crops have much lower revenue per acre and require more acre-feet of water than tree and vine crops or vegetables (Table 1).

During a drought year, multi-crop farms have strong incentives to reallocate their water to crops that generate more potential profit or at least minimize losses—including losses of capital invested in orchards and vineyards. A farm growing say, grapes and wheat, will naturally leave the wheat field unirrigated to save water and keep vines alive and productive. And, farms that have the physical and legal ability to shift water to others, will naturally be more willing to transfer water away from low revenue per acre field crops and toward other farms, either nearby or, often, much further south, that use water for tree nuts, fruits, or vegetables.

Geography and irrigation infrastructure reinforces the tendency for concentrating supply reductions on field crops. The primary regions for growing fresh vegetables and berries in California

include the central and southern coastal valleys and Imperial County. Imperial County receives irrigation water from the All American Canal and the Colorado River system, thus insulating the region from this California drought. The coastal valleys have had low precipitation but rely primarily on local groundwater aquifers that have not been under as much pressure during this drought as those in the Central Valley.

Table 1 lists lettuce as the representative fresh vegetable crop, but the Central Coast is also home to most production of crops such as celery, broccoli, and spinach. The Central Coast, from Santa Cruz County down the coast to Ventura County, also produces most of the strawberries and raspberries. The high revenue per acre and per acre-foot of water for crops such as strawberries and lettuce also provide great incentives to apply the irrigation water needed to sustain production.

Irrigation water per acre varies widely by crop and region, from around one acre-foot per acre for winter and spring vegetables grown in cool coastal regions with ample humidity, up to perhaps five acre-feet per acre for some trees and alfalfa in the hot and dry southern San Joaquin Valley. Of course, crop yields are also high where irrigation use is high.

Water costs per acre-foot also vary widely from lows of $20 to $50 per acre-foot for surface water in the north, in places where water has been plentiful or where groundwater tables are near the surface. Regular pumping costs or delivery costs can exceed $1,000 per acre-foot in some regions and during drought periods. (During this drought, limited amounts of water have been transferred at even higher prices, especially when farmers needed to keep trees and vines alive or pay urban prices for very high revenue crops.) In general, however, it is clear that where physically feasible and allowed by regulation, farms will tend to use available water on tree, vine, and a few other crops while shifting water away from field crops.

Table 1. Revenue per Acre and Growing Region for Selected California Commodities, 2013

Commodity	Revenue/Acre	California Growing Region
Almonds	$6,867	Central Valley
Cattle and Calves (Beef)	--	Foothill and Mountain
Grapes	$6,812	Central Valley & Coastal
Hay, Including Alfalfa	$1,090	Central Valley, Mountain and Imperial
Lettuce	$8,459*	Coastal and Imperial
Milk	--	Central Valley
Peaches	$6,050	Central Valley
Rice	$1,408	Sacramento Valley
Strawberries	$53,030	Coastal
Tomatoes, Processing	$3,532	Central Valley
Wheat	$663	Central Valley

Source: USDA, "California Agricultural Statistics, Crop Year 2013."
**Single crop only. Land often has multiple crops per year.*

The drought affects California production of livestock commodities mainly through impacts on forage crop output. Poultry, egg, dairy, and finished beef production relies mostly on grains shipped in from other states. But, California-produced hay, silage, and irrigated pasture are important for cattle. Hay and silage, mostly produced in California, comprise about 20% of California milk production costs. Therefore, a 50% increase in costs of hay and silage due to the drought would increase milk production costs at the farm by a bit less than 10%.

Market Shares and Effects on Farm Prices

Many observers point to the large share of California produce in the nation's supply. Table 2 indicates California's large share of U.S. production for tree, vine, and vegetable crops. These are the crops for which the current drought is not causing large supply cuts.

California has smaller market shares for livestock and field crops where California supply reductions are large. These facts mean that even when California supply falls significantly, say for wheat, rice or hay, the amount in the U.S. or relevant global market falls by a much smaller percentage. Two caveats affect the interpretation of these production shares.

First, for some important crops, the relevant markets are global. For example, Table 2 indicates that about two-thirds of California almonds and about half of California rice are exported. Global market share is crucial. For almonds, California also has a large share of the global market so if supply were to fall (as has not happened much during this drought), price would indeed rise.

Exports are also important for dairy products, processing tomatoes, and rice. Markets for each of these commodities faces particular conditions. In the case of milk and tomatoes, California ships processed products into competitive national and global markets. For rice, California is a tiny part of global markets, but produces a specialized style of rice for which California production shortfalls do affect price somewhat.

Finally, in the case of wine, imports matter as well as exports. While California dominates U.S. wine production, the market is quite competitive—especially in the case of wine from

Table 2. Share of U.S. Production and Export Ratio of Production for Selected California Commodities, 2013

Commodity	CA Share of U.S. Production Percent	Export Ratio of Production
Almonds	99	0.67
Cattle and Calves (Beef)	5	0.09
Grapes	89	0.20
Hay, Alfalfa and Other	6	0.21
Lettuce	78	0.10
Milk	21	0.30
Peaches	72	0.11
Rice	25	0.47
Strawberries	88	0.08
Tomatoes, Processing	96	0.31
Wheat	2	0.14

Sources: USDA, "California Agricultural Statistics, Crop Year 2013," and UC Agricultural Issues Center, "2013 California Export Data."

Central Valley grapes that are most likely to be affected by drought.

Marketing Costs and Retail Demand Conditions

Of course, farm price changes are not the only driver of retail prices. Costs added along the marketing chain to the final consumer often add as much or more than farm costs. For example, the farm share of retail cost for strawberries or lettuce is 30% but only about 7% for bread. These relationships mean that even if prices rise at the farm, the percentage impact for retail consumers is generally muted—and more muted for processed products and those subject to costly and specialized marketing and transport.

Flexibility by retailers and consumers also moderates price impacts. Given that drought has slowly evolving impacts with substantial warning, wholesale and retail buyers have ample time to plan ahead and source products from where they are most available. Finally, many consumers are willing to substitute across products such as types of melons or lettuce, or from table grapes to some other fruit if relative prices change.

Table 3. Expected Effects of the California Drought on Retail Prices of Cheese, Lettuce, and Rice

	Cheese	Lettuce	Rice	Wine
Farm Share of Retail Price	0.3	0.3	0.3	0.1
Own-price Elasticity of Retail Demand	-0.3	-0.5	-0.5	-0.5
California Share of Relevant U.S. Market	0.2	0.8	0.5	0.5
Percent Change in Quantity Supplied by California Farms	-5%	-3%	-33%	-1%
Percent Change in Retail Price	1%	1.5%	10%	0.1%

Sources: Author estimates based on data from USDA, California Agricultural Statistics, Crop Year 2013; *USDA ERS, "Price Spreads from Farm to Consumer." www.ers.usda.gov/data-products/price-spreads-from-farm-to-consumer.aspx#2565; Abigail M. Okrent and Julian M. Alston, "Demand for Food in the United States: A Review of Literature, Evaluation of Previous Estimates, and Presentation of New Estimates of Demand," Giannini Foundation Monograph 48,"April 2011, http://giannini.ucop.edu/monograph.htm; and personal communication from Dr. James Lapsley, June 25, 2015.*

Summary of Retail Price Impacts of the Drought

A simple pair of equations summarizes the expected percent change in retail price caused by a change in quantity supplied of the associated California farm commodities. First consider the farm price impact:

$$\%\text{change } P_{farm} =$$

$$(1/e)\, S_c(\%\text{change } Q_{Calfarm})$$

where **%change** P_{farm} is the farm price of the commodity, **e** is the own price elasticity of farm demand for the commodity, which measures how much quantity demanded falls when price rises, S_c is the share of California production in the market supply, and **%change** $Q_{Calfarm}$ is how much the quantity produced in California will fall due to the drought. To simplify the calculation, in this equation I assume farms do not add to production in response to the drought-induced higher price.

The relationship between the change in farm price and percentage change in the retail prices is given by the simple proportionality:

$$\%\text{change } P_{retail} = S_r(\%\text{change } P_{farm}),$$

where P_{retail} is the price of the retail commodity, and S_r is the farm commodity share in the retail price of the product. Putting these two equations together tells us how the drought is likely to affect the retail price of each item.

Using these relationships, we will consider price impacts for four retail products for which California supply plays an important role in the national market: cheese, lettuce, rice, and wine. Table 3 shows the parameters and results for each product.

California produces about 20% of the U.S. milk supply, which can be processed into cheese. The farm share of the retail price for cheese is about 30%. That is, the price of milk before it has been processed into cheese makes up 30% of the cheese retail price. The own-price elasticity of demand for milk, a measure of the responsiveness of quantity demanded to a given change in price, is -0.3. Given the reduced hay and forage supplies to the dairy industry and associated higher prices, we estimate that California milk production may decrease by 5% due to the drought. Plugging these parameters into the equation tells us that the retail price of cheese would increase by 1%.

California is the dominant supplier of fresh produce in the U.S. during much of the year, and its share of the U.S. lettuce market is about 80%. Given a 3% decrease in the quantity of lettuce supplied by California farms, retail price would increase by about 1.5%.

California produces japonica rice for the U.S. and international markets. California rice accounts for about half of the relevant U.S. market, some of which uses specialized California rice and some of which uses medium grain rice produced elsewhere. The market share and demand elasticity reflect that California rice is unique for certain uses in some markets and has close substitutes for other uses. Because of severe reductions in surface water availability, California quantity of rice will likely fall by about 33%, and is therefore likely to cause a 10% increase in retail price.

As a highly processed farm product, grapes account for only about 10% of the retail price of wine. We use an average elasticity of demand for winegrapes of about -0.5. We estimate that California makes up about half of the relevant market for U.S. wine sales, with imports comprising much of the rest. The reduction in grape quantity of only 1% due to the drought reflects the relatively low share of water costs in grape production costs and the limited supply flexibility for a perennial crop. These parameters imply the drought is likely to cause an increase in the retail price of California wine of about 0.10%.

Despite drought, produce from California will remain plentiful for consumers.

Summary and Concluding Remarks

Flexibility and resourcefulness by California farmers have minimized the supply reductions of precisely those tree, vine and vegetable crops for which California has large market shares. Crop production is being cut for field crops that enter the food supply indirectly and for which California is not a dominant producer. These facts mean that even a severe drought is having only slight impacts on supplies to consumers and thus only slight impacts on consumer food prices. Of course, the longer the drought lasts, the larger the impacts. But for the foreseeable future, California farms will remain reliable suppliers of tree nuts, fruits, vegetables, dairy products and much more.

Suggested Citation:

Sumner, Daniel A. "California's Severe Drought Has Only Marginal Impacts on Food Prices" *ARE Update* 18(5):12-15. University of California Giannini Foundation of Agricultural Economics.

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For additional information, the author recommends:

Sumner, D.A., 2015. "Food Prices and the California Drought." California WaterBlog. http://californiawaterblog.com/2015/04/22/food-prices-and-the-california-drought/

USDA ERS, 2015. "California Drought: Food Prices and Consumers." www.ers.usda.gov/topics/in-the-news/california-drought-farm-and-food-impacts/california-drought-food-prices-and-consumers.aspx.

York T., and D.A. Sumner, 2015. "Why Food Prices Are Drought-Resistant: California Farmers Are Using a Variety of Tactics to Stay Competitive in a Global Marketplace." *The Wall Street Journal*. www.wsj.com/articles/why-food-prices-are-drought-resistant-1428876222.