

# **Continued Drought in 2022 Ravages California's Sacramento Valley Economy**

Daniel A. Sumner and William A. Matthews,

Department of Agricultural and Resource Economics, University of California, Davis

August 29, 2022

Drought in 2022 is severe by any measure. The 2020 and 2021 water years left California, and especially California agriculture, damaged and vulnerable (Sumner et al. 2021, Medellín-Azuara, et al. 2022). After a promising start, the record failure of precipitation in January and February left the state with such a deficit that despite some snow and rain in March and April, levels of water tables, snowpacks, and reservoirs have left the available irrigation water supply in a perilous condition. The water situation for Sacramento Valley agriculture is as bad as it has ever been. The depth of this drought was reflected in repeated dismal announcements during the spring of huge reductions in projected irrigation availability.

In this report, we assess the likely economic impacts of drought for farms and ranches on the Sacramento Valley in 2022. First, we briefly describe the economics of Sacramento Valley agriculture in 2019, which, while still drought impacted, was relatively “normal” in the water situation and in the broader economic situation. We used data from Sacramento Valley county agricultural commissioners’ reports for values of farm output and the IMPLAN data set on linkages across sectors of the economy to extend implications of farm economics of the 2022 drought to the broader Sacramento Valley economy.

The Sacramento Valley, which here is taken to include Butte, Colusa, Glenn, Placer, Sacramento, Sutter, Tehama, Yolo, and Yuba Counties, has a large, diverse, and vibrant agricultural economy. Farms and ranches rely on precipitation within the Valley as well as the surrounding hills and mountains for production of crops and livestock.

## **1. Approach to the Projections, Key Assumptions and Results Highlights**

Several key assumptions and limitations of any projections of economic effects of the current drought must be listed at the outset. These are important to interpret our results.

First, irrigation water availability for the rest of the growing season and water year has been mostly determined; however, the growing conditions that affect crop yields and crop production as well as the market conditions that affect farm costs and revenues are yet to play out. That means, while we can project the economic impacts of this drought relative to a baseline, we cannot speak with great confidence about, for example, crop yields or market prices for the farm commodities currently growing or yet to be planted in the Sacramento Valley. Agricultural outcomes remain uncertain until final crops and livestock products are sold.

Second, because our main source of data on economic linkages across sectors of the economy is the IMPLAN data base, we formally delineate upstream connections from farms to purchased inputs used on farms. This limits the scope of the modeled impacts of drought and leaves out some important implications. When farm production falls in a region, there also will be less economic activity downstream a step or two from the farm and IMPLAN modeling based on farm-level data does not capture that. For example, Sacramento Valley peaches or tomatoes that are not produced cannot be processed or shipped. However, there is no comprehensive data to consider implications of farm production shortfalls for food processing and similar industries. A dearth of detailed data on economic linkages for many specific agricultural industries in the Sacramento Valley limits our ability to assess downstream impacts quantitatively for each industry. To partially remedy this limitation, we use the data that is available for rice and rice milling and processing, and extend those results (on a proportional basis) where appropriate to the rest of agriculture in the Sacramento Valley.

Third, the simulations that underlie our projected impacts are based on illustrative judgements about how much the 2022 drought is likely to cut crop and livestock output. As discussed more below, we assume, based on historical data, recent news about water cutbacks, and other assessments, the most probable output reductions relative to a normal water year. These current judgements are subject to revision as new information becomes available.

For the simulations in this report, we attribute the following output impacts to the 2022 drought relative to the 2019 base:

Rice: -50%;

Fruits and tree nuts: -10%;

Vegetables, other grains, and all other crops: -20%; and

Livestock and livestock products, including apiary services: -10%.

Of course, some farms will have much larger cuts than others, and some specific commodities within a category will face larger water cuts leading to increased output reduction. Our results are roughly proportional meaning, as data allows better projected output impacts, the economic impacts can be readily adjusted.

The drought in 2022 is likely to reduce direct farm and ranch value of output in the Sacramento Valley by about \$950 million, or more than 20%, in aggregate. These losses will cost the Sacramento Valley about 5,000 on-farm jobs and reduce the value added generated from farming and ranching by about \$560 million. The impact of these farm losses and their upstream impacts to the Sacramento Valley economy are a loss of more than 9,000 jobs and almost \$1 billion in economic value added. A fuller accounting, however, takes account of the impact of lost farm production on farm processing, marketing, transport, and related downstream implications. We do not have data for detailed calculations of these implications. However, using data from rice farm production and rice milling as a guide, we have made the best assessment available. **We project that the 2022 drought impacts on farm production are likely to cause a loss of about 14,300 jobs and about \$1.315 billion in economic value added in the Sacramento Valley.**

## **2. The Baseline, 2019**

In 2019, the region produced about \$4.83 billion of direct farm revenue. Table 1 lists agricultural value of output by commodity category for the Sacramento Valley based on data from County Agricultural Commissioners. Tree nuts, primarily almonds and walnuts, are the leading category of farm commodities, having recently grown to more than one-third of the value of output. Grains account for almost one-quarter of output; rice accounting for more than 80% of grains or almost 20% of the value of Sacramento Valley farm output. Other grains include corn, wheat, and grain seed crops. Fruits, especially wine grapes, olives, prunes, peaches, and other tree fruits, are important as are vegetables, led by processing tomatoes. Other crops include hay, pasture, and a variety of seed crops. Livestock include beef cattle, a few dairies, some poultry, and eggs and, importantly, products and pollination services from the apiary industry.

**Table 1. Farm and Ranch Commodity Output and Direct Agricultural Jobs in the Sacramento Valley, 2019**

<b>Commodity</b>	<b>Output, \$millions</b>	<b>Share, %</b>	<b>Direct Jobs</b>	<b>Direct Plus Upstream Jobs</b>
Tree nuts	\$1,735	36.0	15,903	24,007
Grains	\$1,146	23.7	2,247	7,685
Fruits	\$771	16.0	5,665	9,024
Vegetables	\$363	7.5	1,712	3,394
All other crops	\$374	7.7	6,779	8,491
Livestock and products	\$438	9.1	1,482	2,775
<b>Total</b>	<b>\$4,826</b>	<b>100%</b>	<b>33,787</b>	<b>55,372</b>

Source: County Agricultural Commissioner Reports and IMPLAN

Table 1 also includes direct farm and ranch jobs, which totaled about 34,000 in 2019, and the upstream jobs tied to farm and ranch output through indirect and induced effects. Indirect jobs are those tied to farm production because they are employed in industries that supply farm inputs and services and the jobs for input purchases that ripple out from there. These jobs include such services as farm equipment repair, veterinary services, or crop consultants. They also include jobs in industries that supply farm inputs such as feed processing, fertilizers, or farm equipment. Induced jobs are those caused by expenditures by proprietors and employees included in the direct and indirect impacts. So, for example, induced employment includes that generated by expenditures of farm operators and employees and the local businesses and employees from whom farms and ranches buy inputs.

As noted above, the standard approach to estimating economywide impacts using multimarket relationships is to only consider impacts from upstream linkages in order to avoid double counting and related errors. For example, local supermarket jobs are not linked to farm output within the local region, even though supermarkets certainly sell some products derived

from local farms. This is appropriate because people buy the same amount of food whether it is grown locally or not, and most food consumers live far from where their food is grown.

However, in important cases, upstream economic activity and jobs really are tied directly to local farm production. That is especially true for the shipping and processing of bulk farm commodities. For example, rice grown in the Sacramento Valley tends to be dried and milled in the Sacramento Valley. Likewise, tomatoes are almost always processed near where they are grown. These facts mean that, just as with the impact of rice production on rice milling and shipping jobs, Sacramento Valley tomato processing jobs fall when Valley tomato acreage and production declines. Below, when we assess Sacramento Valley economywide impacts, we include some downstream economic activity when we are confident that it is tied closely to local farm production quantities.

### **3. Likely Effects on Farm Output of the 2022 Drought**

Using 2019 as the recent base for a “normal” year, we apply our drought induced projected losses to the 2019 data to simulate 2022 drought impacts. Our assessments of the likely direct impact of the 2022 drought on output are based on past drought consequences and the cost to farms of making acreage and yield adjustments (Sumner et al. 2021a, b and Medellín-Azuara 2022).

The tree and vine crops tend to have the smallest acreage or yield adjustments of any crops, as farms typically try to avoid permanent adjustments to what may be a temporary water shortage. Additionally, tree and vine crop operators tend to be willing to pay extra to pump groundwater or to transfer water from annual crops. We project a 10% cut in tree and vine crop output to reflect additional culling of older vineyards and orchards as well as some yield reduction that follows from reduced water application rates.

Annual crop cutbacks for grains, oilseeds, hay and silage, vegetables and other crops are much larger than we expect for tree and vine crops, but still less severe than the reduction for rice. Higher prices for vegetables and harvested forage crops will offset some of the revenue declines caused by reduced acreage and yields. Historically, fallowing rates are moderate for these crops; even in the San Joaquin Valley where drought cuts usually have been more severe. The USDA Prospective Planting report, released on March 31, 2022, indicated only slight reductions in intentions to plant wheat, feed grains, and hay in California relative to 2020

(NASS, USDA). Rice was the exception to moderate intensions to reduce acreage planted. California rice growers indicated a 30% planned reduction in acreage.

Based on the June 30 USDA acreage planted report and local report from the industry and water district personnel, our judgment is that rice acreage will be down by about 50%. The water situation turned out to be even worse than growers expected during the survey period of mid-March. Also, most rice acreage is eligible for indemnities from prevented planting provisions in crop insurance policies when severe irrigation water cutbacks imply there will not be enough water to support the crop. Therefore, some of the loss to growers will be mitigated. Moreover, if rice acreage is left unplanted, some water that would have otherwise been used for rice can be transferred to other crops on the same farm, on nearby farms or to farms outside the Sacramento Valley.

Finally, we estimate that livestock output will decline by 10%. The drought affects irrigation for pasture and forage crops as well as the feed value of rainfed pastures. In addition, honeybees represent a significant livestock industry in the Sacramento Valley. The revenue from pollination services has been already earned. Honey yields are lower in drought years because bees have less forage, which contributes to our projected livestock losses. Only small reductions due to drought are expected for the (relatively small) Sacramento Valley dairy and egg industries.

Table 2 shows the results of applying these assumptions to the 2019 farm and ranch revenue data. The bottom line is that direct farm output is likely to be lower by about \$950 million or about 20% from 2019. The projected direct revenue loss is larger because farms and ranches will make many adjustments and incur higher costs to keep production losses to a minimum. Notice that more than half the overall loss of direct farm value of output is for grains, most of which is due to rice acreage left unplanted.

**Table 2. Impact of the 2022 Drought on Farm and Ranch Commodity Output in the Sacramento Valley**

<b>Commodity, (% reduction)</b>	<b>2019 Actual Output</b>	<b>2022 Projected Output</b>	<b>Projected Direct Output Loss</b>
	(\$ Millions)		
Tree nuts, (10%)	\$1,735	\$1,562	\$174
Grains, (Rice 50%; others 20%)	\$1,146	\$634	\$512
Fruits, (10%)	\$771	\$694	\$77
Vegetables, (20%)	\$363	\$290	\$73
All other crops, (20%)	\$374	\$299	\$75
Livestock and products, (10%)	\$438	\$394	\$44
<b>Total</b>	<b>\$4,826</b>	<b>\$3,872</b>	<b>\$954</b>

Source: Author calculations based on assumption in the text.

#### **4. Upstream Effects on Jobs and the Broader Sacramento Valley Economy**

The output losses discussed in Section 3 translate into on-farm job losses. The job losses are roughly proportional to output reductions within an industry. However, some parts of agriculture are more labor intensive than others, so they have larger influence on overall farm labor use. For example, fruit farming is much more labor intensive per dollar of revenue than is grain farming. The first column of Table 3 shows the 2019 farm and ranch jobs in the Sacramento Valley for each industry sector and for the total, which is taken directly from Table 1. We note that other crops are labor intensive because many of the farms are small, part time family is included in the totals.

The projected farm and ranch agricultural jobs in 2022 are listed in the second column of Table 3. For example, we project 14,313 jobs in the tree nut industry and a total of 28,780 farm

and ranch jobs. These are lower than the jobs in 2019 because of the impact of drought. The losses in direct farm and ranch jobs are shown in the third column. We project a direct loss of more than 5,000 jobs on farms and ranches in the Sacramento Valley due to the 2022 drought.

**Table 3. Impact of the 2022 Drought on Farm and Ranch Commodity Output Direct Jobs in the Sacramento Valley**

<b>Commodity, (% reduction)</b>	<b>2019 Actual Jobs</b>	<b>2022 Projected Jobs</b>	<b>Projected Direct Jobs Lost</b>
	(Jobs)		
Tree nuts, (10%)	15,903	14,313	1,590
Grains, (Rice 50%; others 20%)	2,247	1,243	1,005
Fruits, (10%)	5,665	5,099	567
Vegetables, (20%)	1,712	1,370	342
All other crops, (20%)	6,779	5,421	1,358
Livestock and products, (10%)	1,482	1,335	147
<b>Total</b>	<b>33,787</b>	<b>28,780</b>	<b>5,009</b>

Source: Author calculations based on assumption in the text.

Of course, the losses to the broad economy from drought in agriculture go much deeper than the direct losses of jobs. Table 4 summarizes economywide losses in the Sacramento Valley caused by drought in agriculture for value of output, employment, labor income and value added. (Value added is the measure of economic activity that removes any double counting across industry segments and is used for economic aggregates such as national, state, and regional GDP).

The first row of Table 4 shows the direct agricultural losses and the losses for value of output and employment that are familiar from Tables 2 and 3. Labor income in column 2 shows



earnings from jobs, including earnings of the proprietors such as farm owners and operators. As expected, many of these agricultural jobs are seasonal and many farms are operated part time, so the annual earnings are well below what full-time, year-around employees of full-time business operators would earn. The “value added” column represents the wages paid to hired workers and income attributed to proprietors. Another way to think of value added is the revenue of the industry minus the value of goods and services purchased directly from other industries. Value added for the economy as a whole is economic output being careful to remove any potential double counting. For example, output of the dairy industry includes the value of the grain, hay and other feeds that are turned into milk by the dairy cows and sold by the farm. Value added of the dairy industry nets out the value of all inputs purchased by the dairy farming industry, including purchased feed and nutrition consultant services, and others. The sum across industries of all the direct losses of agricultural output due to drought in 2022 is \$954 million, whereas loss of value added is \$572 million, which may be thought of as loss income earned by hired workers and farm operators (farms and ranches) within the agricultural industry.

The second row of Table 4 includes losses to upstream suppliers to Sacramento Valley agriculture. Industries that supply goods and services to farm and ranch operations lose sales and profits and their workers lose jobs when farm output falls due to drought. Such businesses include local repair shops, fertilizer firms, insurance companies or law offices that work with farms and ranches. These indirect effects reflect losses of output jobs, labor income and value added of Sacramento Valley businesses that rely on farm and ranch customers. The third row of Table 4 includes induced losses. These reflect lost output, jobs and income in all sectors affected by lost agricultural incomes (mostly reduced incomes of labor and those contributing labor, management, and capital). This includes the reductions in goods and services that farmer and farm worker families buy in the Sacramento Valley. The ripple effects of such purchases include everything from haircuts to autos and schooling.

The direct and upstream losses for the Sacramento Valley economy, shown in row 4 of Table 4, are the sum of the direct, indirect, and induced effects. One must be careful interpreting the sum of the direct and indirect *output* rows. The direct output includes the value of inputs used in production; therefore it incorporates the indirect output and to simply add them up would be double counting. For example, the output of almonds includes the contribution of the honeybees (included in livestock income) that pollinated the crop. Thus, in evaluating the overall

contribution of agriculture and the economywide impact of the drought we focus on value added in the fourth column.

We note that Table 4 contains only the farm and the upstream economywide losses due to drought. Upstream economywide losses due to specific agricultural industries are in an appendix available from the authors.

**Table 4. Economywide Upstream Impacts Projected Agricultural Losses from the 2022 Drought in the Sacramento Valley**

<b>Impacts</b>	<b>Output Losses</b>	<b>Employment Losses</b>	<b>Labor Income Losses</b>	<b>Value Added Losses</b>
	<i>\$ millions</i>	<i>Jobs</i>	<i>\$ millions</i>	
<b>Direct Agriculture</b>	954	5,009	267	572
<b>Indirect</b>	351	2,632	139	211
<b>Induced</b>	300	1,755	98	184
<b>Total</b>	1,604	9,396	504	967

Source: Author calculations using IMPLAM based on assumption in the text.

In this section, we emphasized the results in Table 4 are upstream impacts. This means that the reduced economic activity in transport and processing of farm commodities is not included in the impacts. We do not have data to estimate such impacts for agriculture broadly. For some products, the downstream economic activity within the Sacramento Valley may be relatively small. For example, many calves raised and sold in the Sacramento Valley are shipped to feedlots in the Midwest and slaughtered and processed outside the Sacramento Valley. However, for other important products such as tree nuts, processed fruits and vegetables, there is substantial value added in the Sacramento Valley and jobs in downstream industries depend on Sacramento Valley farm production.

Fortunately, we do have data within the IMPLAN system on rice milling, which is an important downstream agricultural processing industry that relies on farm production of rice in the Sacramento Valley. The next section shows how considering rice milling indicated a larger economywide economic impact of the 2022 drought.

## **5. Illustration showing 2022 drought impacts from rice losses, including rice milling in the Sacramento Valley**

Above, rice farm value of output was combined with other grains, which is how rice farming is reported within the IMPLAN data sets. The Agricultural Commissioners data show that the value of farm rice production in 2019 was almost \$0.95 billion based on about 500,000 acres of rice. These totals, as expected, differ slightly from the aggregate statewide data from the USDA, National Agricultural Statistics Service.

The top half of Table 5 uses rice farm revenue data, together with linkage multipliers from the IMPLAN data set that are applicable to the “grains” category, to assess upstream economywide contributions of Sacramento Valley rice in 2019. Notice the results reported in the top half of Table 5 data equal 80%, or more, of the magnitude of the impacts for grains as a whole in 2019. Total direct sales, jobs, labor income and value added are all only slightly lower than for all grains in 2019.

The bottom four rows of Table 5 represent the economic output and other aggregates for rice milling as an industry. Because these results are for rice milling, the main upstream input (indirect output) is rice grown on farms. The direct output is milled rice, which has a price and output value almost double that of farm rice output. The output of farm rice is the main contributor to the indirect output of \$1,282 million for rice milling. Because of this, economywide impacts on rice milling are built directly on the base of rice farm output; therefore, anything that reduces rice farm output necessarily reduces rice milling output in the Sacramento Valley. The economywide impacts of drought on rice milling subsume the effects of rice production and capture much of the downstream impact.

**Table 5. Economywide Effects of Rice Production and Rice Milling, 2019**

<b>Commodity</b>	<b>Output</b>	<b>Employment</b>	<b>Labor Income</b>	<b>Value Added</b>
<b>Rice Production</b>	<i>\$ millions</i>	<i>Jobs</i>	<i>\$ millions</i>	
<b>Direct</b>	944	1,850	261	532
<b>Indirect</b>	477	2,978	165	270
<b>Induced</b>	374	2,105	123	227
<b>Total</b>	1,794	6,933	548	1,029
<b>Rice Milling</b>				
<b>Direct</b>	1,792	2,498	186	284
<b>Indirect</b>	1,282	4,625	395	723
<b>Induced</b>	416	2,438	136	254
<b>Total</b>	3,489	9,561	716	1,261

Source: Author calculations based on assumption in the text.

Table 6 shows the projected effects of the 2022 drought, which, based on currently available information, we assume cuts rice production by 50% and reduces economic contribution of rice production and milling by 50%. The bottom panel shows that the reduction in rice output caused by the drought reduces Sacramento Valley employment by 5,293 jobs: including jobs in rice farming and milling as well as the other indirect and induced losses. The important effects on Sacramento Valley income are the loss of labor income of \$398 million and reduced value added in the Sacramento Valley of \$703 million. The loss of value added is 36% larger (\$703 million/\$514 million) than the impact of rice farming without capturing the first step downstream. The employment impact of rice milling is 52% higher than of rice farming. These results for rice milling show the importance of capturing downstream economic activity when it is reliant on local farm production. Unfortunately, we do not have enough data to fully evaluate the contributions of other processing activities in the Sacramento Valley for crops such as tree nuts, fruits, and processing vegetables. Nonetheless, we expect the impacts for these industries may be similar to those of rice. In the final remarks we make the appropriate adjustments to the results of Table 4 to take into account the first step of downstream impacts.

**Table 6. Projected Economywide Losses from the 2022 Drought on Rice and Rice Milling in the Sacramento Valley**

<b>Commodity, (% reduction)</b>	<b>Output</b>	<b>Employment</b>	<b>Labor Income</b>	<b>Value Added</b>
<b>Rice Farming</b>	<i>\$ millions</i>	<i>jobs</i>	<i>\$ millions</i>	
<b>Direct</b>	472	925	131	266
<b>Indirect</b>	238	1,489	82	135
<b>Induced</b>	187	1,052	61	114
<b>Total</b>	897	3,467	274	514
<b>Rice Milling</b>				
<b>Direct</b>	896	1,249	93	142
<b>Indirect</b>	717	2,547	218	399
<b>Induced</b>	267	1,497	88	163
<b>Total</b>	1,880	5,293	398	703

Source: Author calculations based on assumption in the text.

## 6. Final Remarks

Table 4 showed projected losses from the 2022 drought for the Sacramento Valley, including direct and upstream indirect and induced impacts, are: employment loss of 9,396 jobs, labor income loss of \$504 million, and economic value-added loss of \$967 million. Using the more detailed results for rice presented in Table 6, however, we show that these upstream results do not capture the true extent of the economic implications and are likely too small by between one third and one half. When we adjust the employment and value-added results to account for downstream processing, using the rice results as a guide, we find substantially larger impacts. Our best estimates are that the farm impacts of the 2022 drought are likely to cause economic losses of about 14,300 jobs and loss of value added of about \$1.315 billion.

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