

Blueprint Economic Impact Analysis: Phase One Results

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Introduction and Summary of Results

This report describes the results of an economic analysis of water supply restrictions affecting growers in the San Joaquin Valley. The economic analysis considers two types of restrictions: i) limitations on groundwater pumping implemented as part of the Sustainable Groundwater Management Act (SGMA), and ii) future reductions in surface water supplies available to farmers in the San Joaquin Valley resulting from several regulatory processes initiated by the State of California and the federal government.

Based on an analysis of SGMA and other anticipated water supply restrictions, we conclude that up to one million acres may be fallowed in the San Joaquin Valley over a period of 2-3 decades as a result of reduced ground and surface water availability. This amount of fallowing is approximately one-fifth of all acres currently under cultivation in the Valley. The farm revenue loss associated with this fallowing is \$7.2 billion per year.

The changes in water availability considered here will have a dramatic effect on the labor market in the San Joaquin Valley. We calculate that the direct employment losses from SGMA plus anticipated surface water reductions will total 42,000 jobs on average. These employment losses include direct farm employment and agricultural service sector jobs, and are distributed across all employee classes and compensation levels of workers engaged in farming. Direct employee

compensation losses (e.g., wages and salaries) total \$1.1 billion annually in the San Joaquin Valley.

Reducing production in San Joaquin Valley agriculture impacts other parts of the California economy in downstream sectors like transportation and food processing (e.g., indirect losses), and more generally as farmers and unemployed workers have less income to spend on household purchases (e.g., induced losses). Counting indirect and induced job losses together with direct losses, the SGMA and future surface water restrictions will result in as many as 85,000 lost jobs and \$2.1 billion in lost employee compensation annually.

Because ground and surface water usage are not evenly distributed across counties in the Valley, the economic impacts of SGMA and surface water reductions are also concentrated in certain areas. In particular, Fresno, Tulare and Kern Counties see the largest losses in employment and employee compensation. These counties, plus Kings County, see the largest reductions in harvested acreage and farm operating income. In this report, we show impacts at the Census tract level, and conclude that the impacts of the water supply restrictions considered here will be disproportionately large in the Valley's lowest-income communities.

Water Supply Restrictions

SGMA requires local groundwater users to bring groundwater use to sustainable levels by the early 2040s. Estimates of SGMA-related groundwater pumping restrictions are uncertain at present since local agencies are still developing plans. For purposes of this economic analysis, we adopt estimates of groundwater pumping reductions developed by the Public Policy Institute of California (PPIC) in February 2019. PPIC reviewed the prior 30 years of pumping and assumed that average overdraft would need to be eliminated as a result of SGMA. We note, however, that groundwater extraction was significantly higher in the latter half of the 30-year period examined by PPIC, averaging 2.4 million acre-feet annually for the San Joaquin Valley. We use this figure in our analysis since it incorporates current operating criteria and demand levels, and is thus more relevant.

Estimated overdraft is broken down across five sub-regions in the San Joaquin Valley: Northeast, Northwest, Southeast, Southwest and Kern. Each region is a composite of several groundwater sub-basins as defined by the California Department of Water Resources. The largest reductions in groundwater overdraft will need to be accomplished in the southern portions of the Valley.

We conduct two versions of our preliminary economic analysis: in one version we limit future water use reductions to those required by SGMA, and in the other we include SGMA together with anticipated reductions in surface water deliveries to farmers in the San Joaquin Valley.

These reductions in surface deliveries were provided by Walter Bourez of MBK Engineers and incorporate the effects of the following measures:

- Full implementation of San Joaquin River Restoration Plan,
- remand of 2019 BiOps and return to 2008/09 BiOps for Delta exports,
- climate-induced sea level rise, and
- rejection of Voluntary Agreements and implementation of State Board staff recommendations for Phases 1 and 2 assuming 45% Sacramento River Basin and Delta outflow unimpaired flow requirement and 40% unimpaired flow for San Joaquin River tributaries.

Note that these changes are broadly consistent with the assumptions used to develop the draft California Water Resilience Portfolio released in January 2020. Taken together, these measures would reduce surface water deliveries to San Joaquin Valley farmers by an average of 838,000 acre-feet per year relative to current levels. Note again that these water supply reductions are in addition to the SGMA-imposed restrictions on groundwater pumping.

Data

We base our economic analysis of ground and surface water restrictions on land use data compiled by Land IQ under contract to DWR. This is the same source of land use data used by PPIC in their February 2019. We use crop consumptive use (i.e., evapotranspiration, or ET) estimates compiled by Cal Poly researchers under contract to the State Water Resources Control Board. Crop acreages together with ET estimates give estimates of total agricultural water demand. We base our estimates of crop economics (e.g., yield, revenue and costs of production)

on the most current cost and return studies produced by UC Davis. We examine six crop types: nut crops, vines, fruit, corn, hay and pasture and field crops.

As part of our land use analysis, we worked with the Blueprint steering committee members to identify so called “white areas” that are defined as areas that are exclusively serviced by groundwater. It is in the white areas that SGMA is anticipated to have the largest effect. In total, we estimate that there are just over 820,000 acres of white areas in the San Joaquin Valley – a somewhat smaller estimate than has been offered by other groups including PPIC. While the location of the white areas helps to determine where SGMA is expected to have the largest economic impact, it should be noted that the correlation is not perfect. There are many other areas where farmers have access to both ground and surface water supplies, and groundwater basins are still out of balance. Thus, the impacts of SGMA extend far beyond the white areas.

Economic Impacts on Farms and Other Businesses

We consider three basic measures of economic impacts on farms and other businesses: acres fallowed, crop revenues and operating income. Revenues are equivalent to crop sales and operating income is revenue above costs of production (e.g., wages, depreciation and cost of goods sold). The annual losses we estimate are based on current market conditions and production technologies, and incorporate current patterns of surface water trading. That said, the two scenarios we model are both based on the assumption that there is no trading of groundwater. In future work, we will evaluate the potential for groundwater markets to reduce the economic costs of water supply restrictions.

In the SGMA-only scenario, we conclude that farmers in the San Joaquin Valley can expect to experience the following impacts:

- Change in Crop Acreage: -798,000
- Change in Crop Revenue: -\$5.9 Billion
- Change in Farm Operating Income: -\$1.6 Billion

Adding the effect of anticipated reductions in surface water deliveries to farmers, expected effects are larger:

- Change in Crop Acreage: -992,000
- Change in Crop Revenue: -\$7.2 Billion
- Change in Farm Operating Income: -\$1.9 Billion

For context, note that there are roughly 5 million acres of irrigated farmland in the San Joaquin Valley. Thus, these estimates imply that with existing infrastructure, future restrictions on ground and surface water use in the region may reduce the scale of farming in the Valley by roughly one-fifth. Farm revenues and net income fall by similar percentages. It is worth repeating, however, that Valley-wide impacts mask the effect of SGMA and surface water supply reductions on the southern portions of the San Joaquin Valley where impacts are proportionally larger.

Tables 1 and 2 display the county-level impacts of SGMA and surface water reductions on harvested acreage and farm operating income. These impacts include direct, indirect and induced effects of changes in farming activity. That is, they include the effects of fallowing on farm employment, output and profitability; the effects on downstream and upstream industries such as agricultural services, transportation and food processing; and the effects of reductions in household income that depress spending and economic activity generally.

Table 1: Change in Harvested Acreage from SGMA Plus Surface Water Restrictions

	Hay and Pasture	Tree Nuts	Tree Fruits	Vines	Corn	Vegetables	Field Crops and Grains	Total
Total Area (Acre)								
Madera	-2,024	-17,065	-1,966	-7,891	-2,157	-972	-833	-32,908
Fresno	-14,892	-84,749	-33,668	-56,378	-11,039	-34,095	-19,542	-254,364
Merced	-7,291	-14,947	-1,023	-1,782	-8,028	-3,689	-4,294	-41,054
San Joaquin	-3	-130	-21	-12	-15	-3	-6	-190
Stanislaus	-4,101	-16,651	-1,121	-1,039	-5,811	-778	-1,007	-30,509
Tulare	-16,640	-35,809	-48,246	-16,031	-43,923	-1,338	-10,415	-172,401
Kings	-14,904	-25,702	-5,733	-3,013	-20,099	-15,004	-48,846	-133,301
Kern	-31,587	-132,763	-38,614	-42,941	-10,147	-30,269	-40,820	-327,141
Total	-91,442	-327,815	-130,394	-129,087	-101,219	-86,148	-125,764	-991,870

Harvested acreage declines by roughly 1 million acres. The largest impacts are in Fresno, Tulare, Kings and Kern Counties. Nut crops experience the largest anticipated acreage losses, with over 327 thousand acres (or 33 percent of the total decline) coming out of production.

Table 2: Change in Operating Income from SGMA Plus Surface Water Restrictions								
	Hay and Pasture	Tree Nuts	Tree Fruits	Vines	Corn	Vegetables	Field Crops and Grains	Total
<i>Operating Income (millions of 2016 dollars)</i>								
Madera	-1	-35	-27	-3	-1	-2	0	-69
Fresno	-7	-154	-287	-27	-5	-182	-9	-671
Merced	-3	-33	-9	-1	-3	-18	-2	-69
San Joaquin	0	-7	-15	0	0	-5	0	-29
Stanislaus	-3	-35	-4	-1	-4	-3	-1	-50
Tulare	-11	-42	-181	-11	-30	-4	-7	-286
Kings	-5	-43	-16	-1	-7	-35	-17	-123
Kern	-21	-195	-227	-29	-7	-134	-28	-641
SJV Direct	-51	-545	-767	-72	-57	-383	-64	-1,940
SJV Indirect	-32	-246	-334	-46	-51	-146	-32	-887
Other CA	-21	-109	-149	-73	-38	-89	-28	-507
Total	-105	-899	-1,251	-192	-146	-618	-124	-3,334

Different crops have different levels of revenue per acre and profitability. Table 2 shows the change in operating income from the acreage losses shown in Table 1. This table consists of two parts. The top portion shows direct operating income losses by crop and county from SGMA and surface water supply reductions. Tree nuts, tree fruits and vegetables experience the largest declines in operating income, and together account for nearly 90 percent of the total direct loss in operating income. Fresno and Kern Counties are the most impacted by SGMA plus surface water reductions with over \$600 million in lost farm income in each of these counties annually; Tulare County is third with over \$280 million in lost operating income annually.

The second part of Table 2 displays indirect and induced impacts as well as the total direct operating income losses. These indirect and induced impacts are calculated using the IMPLAN input-output model maintained by the Minnesota IMPLAN Group; note that source material for IMPLAN's employment and labor income estimates that we report are the Bureau of Labor

Statistics (BLS) Census of Employment and Wages. We separate these secondary impacts into those occurring in the San Joaquin Valley and those occurring statewide. Looking across all crops, total operating income losses are \$3.3 billion annually. Of this total, \$1.9 billion is direct losses (i.e., losses experienced by farmers in the Valley), roughly \$900 million is indirect and induced losses experienced in the San Joaquin Valley, and \$500 million is experienced outside the Valley.

Labor Market Impacts

This section highlights the impacts of SGMA and anticipated surface water reductions on workers employed in farming in the San Joaquin Valley, as well as on the indirect and induced labor market impacts experienced in the Valley and statewide. Direct losses include those who are directly employed on farm, those employed by farm labor contractors, and those providing agricultural services such as pesticide applicators, crop consultants and custom harvesters. It does not include downstream impacts to the trucking and food processing industries, among others, nor does it include induced impacts to the broader economy of the Valley due to changes in income and consumer demand resulting from direct and indirect employment impacts. These indirect and induced effects are reported separately in the lower half of Table 3.

Table 3: Change in Employment from SGMA Plus Surface Water Restrictions								
	Hay and Pasture	Tree Nuts	Tree Fruits	Vines	Corn	Vegetables	Field Crops and Grains	Total
FTE Employment								
Madera	-86	-175	-276	-337	-92	-10	-36	-1,012
Fresno	-692	-1,024	-3,570	-2,621	-513	-907	-908	-10,236
Merced	-256	-232	-148	-63	-282	-118	-151	-1,249
San Joaquin	-9	-57	-223	-37	-45	-32	-19	-421
Stanislaus	-223	-425	-92	-57	-316	-26	-55	-1,194
Tulare	-1,096	-286	-2,540	-1,056	-2,893	-21	-686	-8,578
Kings	-270	-254	-244	-54	-364	-205	-883	-2,274
Kern	-2,336	-1,762	-4,852	-3,175	-750	-1,045	-3,019	-16,939
SJV Direct	-4,968	-4,215	-11,949	-7,399	-5,255	-2,364	-5,757	-41,906
SJV Indirect	-3,062	-1,901	-5,209	-4,700	-4,684	-901	-2,909	-23,366
Other CA	-2,062	-844	-2,321	-7,484	-3,458	-549	-2,508	-19,227
Total	-10,092	-6,961	-19,479	-19,583	-13,398	-3,814	-11,173	-84,499

Table 3 displays the number of full-time equivalent jobs lost in the farm sector as a result of SGMA and surface water supply reductions. Total job losses are roughly 42,000 annually. These job losses occur in each of the study counties, and are concentrated in Fresno, Tulare and Kern Counties. Kern County is especially impacted, with nearly 17,000 farm jobs lost.

Because agriculture is linked to the broader economy of the San Joaquin Valley and the State of California, it is natural to expect that job losses will not be limited to farming. The lower half of Table 3 shows that there will be over 23,000 lost jobs in the Valley in addition to direct farm impacts; these impacts include both losses in downstream sectors as well as losses caused by reductions in income. Outside the San Joaquin Valley, roughly 20,000 jobs will be lost annually as a result of reduced agricultural activity resulting from SGMA and surface water reductions. Total job losses exceed 84,000 annually. Note that these losses are permanent, barring implementation of mitigation measures.

Table 4 shows changes in employee compensation (i.e., wages and salaries) in the San Joaquin Valley and statewide. The total loss in employee income is over \$2.1 billion annually, of which slightly more than half is direct (i.e., on farm) losses. The largest direct impacts occur in Fresno, Tulare and Kern Counties. Note that these employee income losses occur across the spectrum of farm sector jobs since the water supply reductions modeled are permanent changes that will result in a large percentage of farms ceasing operation. That is, the changes in water supply are too large to be accommodated by marginal changes in existing farms.

Total lost employee compensation in the San Joaquin Valley is \$1.7 billion annually, counting direct, indirect and induced effects. Outside the Valley, wages and salaries are expected to decline by \$400 million each year on average as a result of SGMA and surface water supply cuts.

Table 4: Change in Employee Compensation from SGMA Plus Surface Water Restrictions								
	Hay and Pasture	Tree Nuts	Tree Fruits	Vines	Corn	Vegetables	Field Crops and Grains	Total
<i>Wages and Salaries (millions of 2016 dollars)</i>								
Madera	-1	-10	-5	-6	-2	0	-1	-24
Fresno	-14	-58	-63	-54	-11	-25	-19	-244
Merced	-4	-15	-2	-1	-4	-3	-2	-31
San Joaquin	0	-3	-4	-1	-1	-1	0	-10
Stanislaus	-3	-22	-1	-1	-5	-1	-1	-34
Tulare	-22	-22	-53	-21	-58	-1	-14	-190
Kings	-6	-20	-4	-1	-8	-6	-20	-66
Kern	-49	-161	-96	-66	-16	-34	-63	-484
SJV Direct	-100	-310	-229	-151	-104	-71	-119	-1,083
SJV Indirect	-62	-140	-100	-96	-92	-27	-60	-577
Other CA	-41	-62	-44	-153	-68	-16	-52	-437
Total	-203	-512	-373	-399	-264	-114	-232	-2,097

Downscaling Results to Conduct Community-Level Analysis

Statewide models of the economy are useful tools for evaluating the costs and benefits of proposed policies to California. However, state level results provide little information about how policies will affect individual communities. In particular, the distributional component of costs and benefits will have broad implications with respect to policy impact and must be considered in order to ensure that vulnerable communities do not bear more than their share of the costs. Examples of past studies that directly considered policy impacts on disadvantaged communities include the Economic Assessment of SB350 commissioned by the California ISO and the Economic Analysis of California’s Long-Term Energy Strategy for the California Energy Commission.¹ To date, there has been little disaggregated economic analysis of this type conducted in California pertaining to water policy.

Here we use an approach to downscaling statewide economic impacts similar to the previous studies cited above, focusing in this study on detailed income and employment effects. For this assessment, we draw upon the latest version (3.0) of CalEnviroScreen to identify disadvantaged

¹ See <http://bearecon.com/portfolio-item/caiso-sb350/> and http://bearecon.com/portfolio-data/cecs-ltes/CEC_BEAR_LTES_Final%20Report180430.pdf

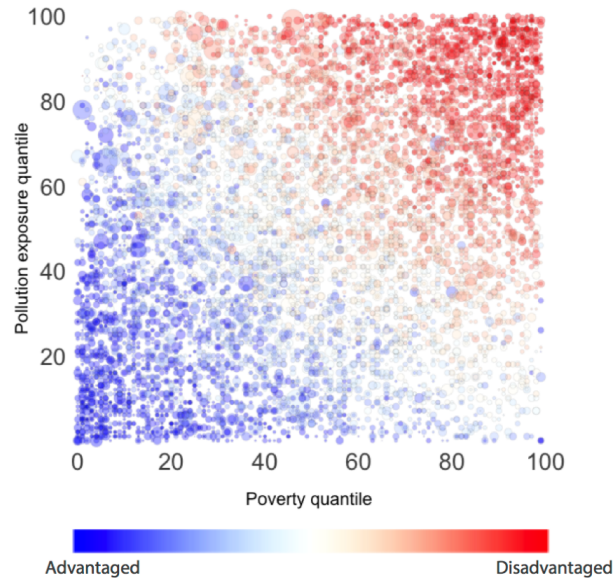
communities, updating Census level data used to calibrate community shares. We hope our approach will further develop the template for future analysis of more detailed water policy impacts on communities in California.

In order to identify communities that are disadvantaged with respect to selected economic and environmental criteria, the California Environmental Protection Agency (CalEPA) worked with the Office of Environmental Health Hazard Assessment (OEHHA) to develop a tool called CalEnviroScreen (CES) that evaluates economic and environmental conditions of every Census tract in California. The most recent version, CalEnviroScreen 3.0, was released in January 2017 and takes into account factors such as environmental conditions, health outcomes, and socioeconomic status to construct a score for each Census tract, which can then be used to identify vulnerable communities likely to be sensitive to changing policies. Disadvantaged Communities (DACs) are commonly defined using this tool as Census tracts in the top 25th percentile of CES scores. By this definition, there are currently 2,022 Census tracts designated as disadvantaged communities in California.

The communities that are designated as disadvantaged using this approach are burdened by a combination of low income, high exposure to environmental hazards, and poor health outcomes. To illustrate the importance of this combination of factors, Figure 1 highlights the relationships between pollution exposure, poverty, and CES score. Each point represents a Census tract in California and the axes show poverty and pollution exposure. CES score is represented by color. DACs are concentrated in the upper right corner of the figure where both pollution exposure is high and income is low. The figure highlights the fact that most Census tracts that are very poor, but exposed to low levels of pollution are not designated as disadvantaged by CalEnviroScreen 3.0. Similarly, wealthy communities exposed to high levels of pollution do not qualify as disadvantaged in this classification system. It is the combination of hazardous environmental exposure and socioeconomic status (and high health costs) that results in a community being designated as disadvantaged.

Figure 1

Relationship between Pollution Exposure, Poverty, and Disadvantaged Status.

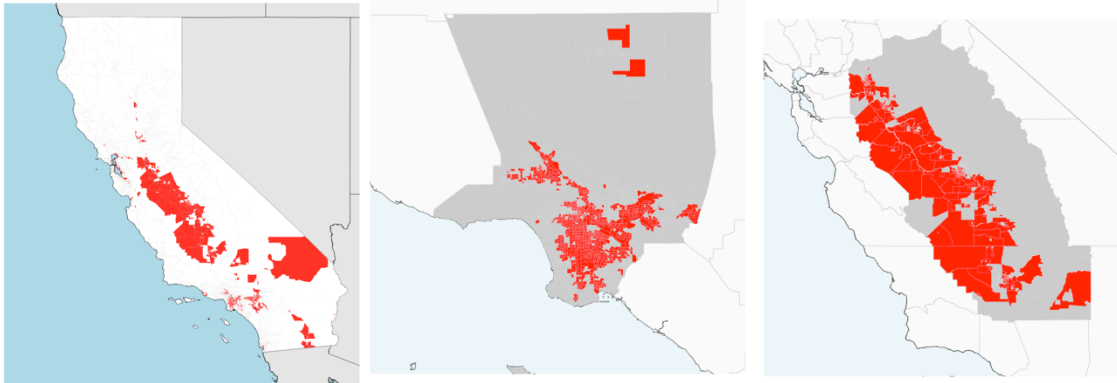


Note: The x-axis shows where the Census tract ranks relative to other tracts with respect to poverty, the y-axis shows the pollution exposure rank, and the color shows the CES score rank. The size of the point is proportional to the Census tract population.

The regional distribution of DAC communities is apparent from Figure 2. While there are disadvantaged communities throughout the state, they are highly concentrated in two regions: the Central Valley and Los Angeles. In fact, approximately half of the disadvantaged communities are in Los Angeles County alone. This includes 51% of disadvantaged Census tracts representing 46% of the disadvantaged population. Another 20% of disadvantaged communities are located in the Central Valley (21% Census tracts, 23% of disadvantaged population) so collectively these two regions comprise nearly 75% of all disadvantaged communities. While Los Angeles County and the Central Valley are distinct in many ways, both areas include poor air quality and substantial populations of low-income residents, the qualities that designated disadvantaged status for the purpose of evaluating California environmental policy. The remaining disadvantaged communities are mostly spread across, however, none of the regions besides Los Angeles and the Central Valley contain more than 10% of the disadvantaged communities or population.

Figure 2

Los Angeles County and the Central Valley Contain Nearly 75% of All California DACs



The spatial distribution of disadvantaged communities (DACs) in the state (left), Los Angeles County (middle), and the Central Valley (right).

Naturally, disadvantaged communities are less well-off economically than non-disadvantaged communities and these differences show up across the spectrum including lower income, education, and asset ownership. Across the state, households in DAC communities average 53% lower per capita income than their non-disadvantaged counterparts and are 93% more likely to live below the poverty line.²

Overall DAC households are substantially more likely to be employed in the agricultural sector (4.3% vs 1.8%), however, this discrepancy is particularly stark in the Central Valley where more than 15% of DAC households are in the agricultural sector compared to less than 7% of non-DAC households. DACs also skew more heavily towards unskilled labor such as manufacturing (11.4% vs 9.3%), retail (12.0% vs 10.8%) and transportation (6.3% vs 4.2%).

Downscaling Employment Results

Directly modeling the economic impact of statewide policies at the DAC level would require complete data on economic activities for every Census tract in California. Since these data do not

² Source: Authors' calculations combining ACS 5-year average income estimates with CES 3.0 DAC designations.

exist we instead utilize state-wide impacts disaggregated to the Census tract level and then highlight impacts in those Census tracts designated as disadvantaged. The process of disaggregating statewide results to the Census tract level is different for each outcome and these processes are described in detail below.

Our land retirement scenarios produce job impact estimates measured as total jobs by sector and county. Jobs impacts are downscaled from the county to the Census tract using occupational and sector employment information in the American Community Survey (ACS). We use ACS 5-year estimates (2011-2015) of the share of number of households with residents employed in each sector and each occupation. We rely on the assumption that changes in jobs are uniformly spatially distributed across the state within sector and occupations so total job changes at the county level are allocated evenly across households within that county and sector.

Direct employment is distinguished from indirect and induced employment using employment intensities for the sectors directly impacted by the land retirement scenarios. These direct effects are then netted out to determine the indirect and induced employment impacts of a given scenario.

Figure 3 shows the distribution of direct job losses by Census tract. Areas highlighted with red borders are disadvantaged communities and the remainder are highlighted in yellow. It is apparent that the largest lost FTE occur in communities near farming regions in the southern part of the San Joaquin Valley, which are the areas with the largest water supply losses from SGMA and surface water reductions.

Figure 3
Job Losses by Census Tract

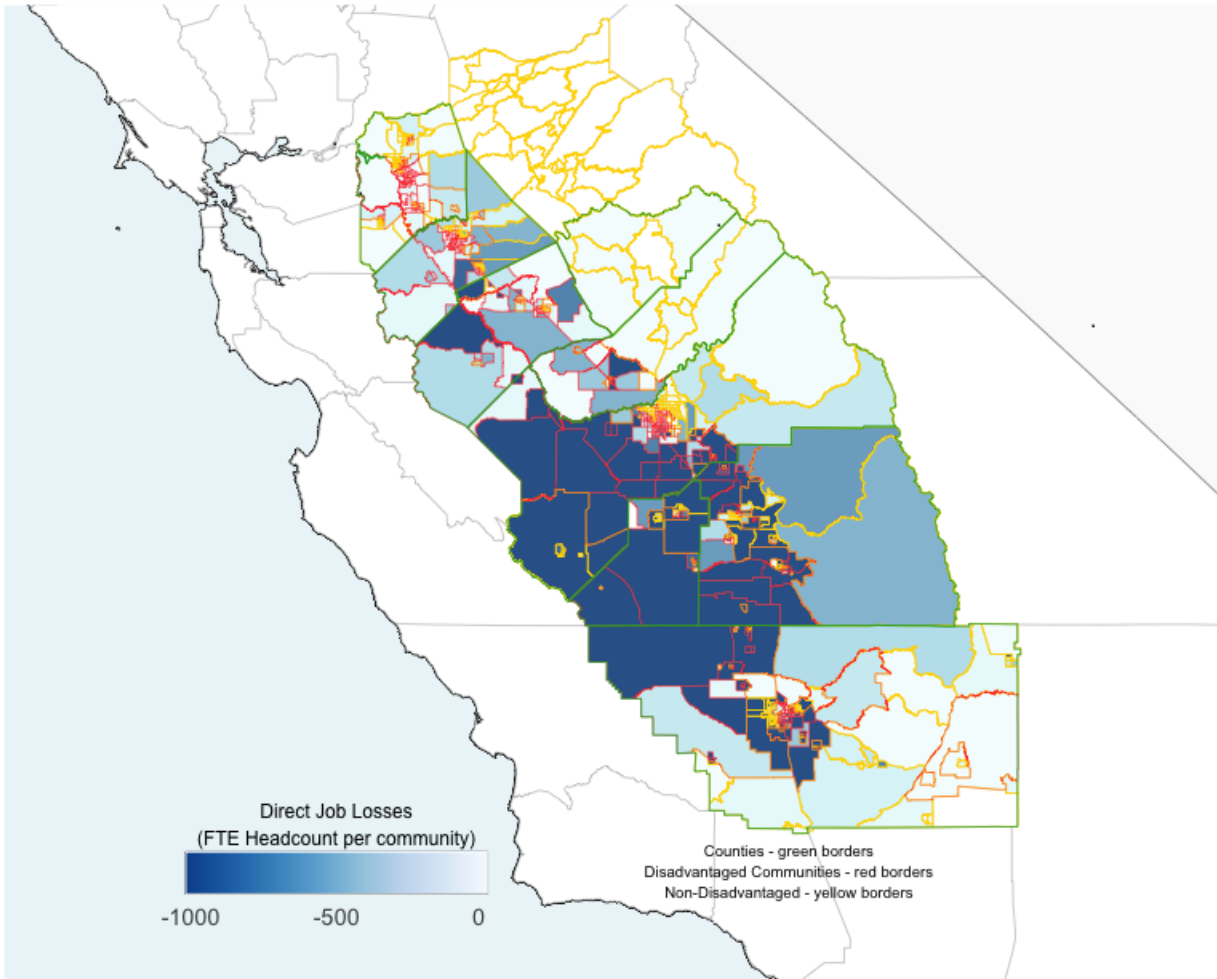


Figure 4 shows a count of direct job losses by Census tract in the San Joaquin Valley. Figure 5 shows the same information in percentage terms where the denominator is the total number of FTE jobs in the Census tract. In both figures, the data are separated by DAC status. The left panel of Figure 4 shows the distribution of job losses for disadvantaged communities, while the right panel shows the same data for other Census tracts. The data reveal that 224 DAC and 235 non-DAC communities experience job losses from SGMA and surface water reductions in the San Joaquin Valley, with higher percentage losses in DACs. Figure 5 reveals that a total of 57 DAC and 19 Non-DAC Census tracts lose more than 5% of their existing jobs. Displacement is

about equally distributed when losses are below 1%, but DACs are twice as likely to have higher rates, and 16 times as many DACs see displacement over 10% of the existing labor force.

Figure 4

Number of Communities with Direct Job Losses

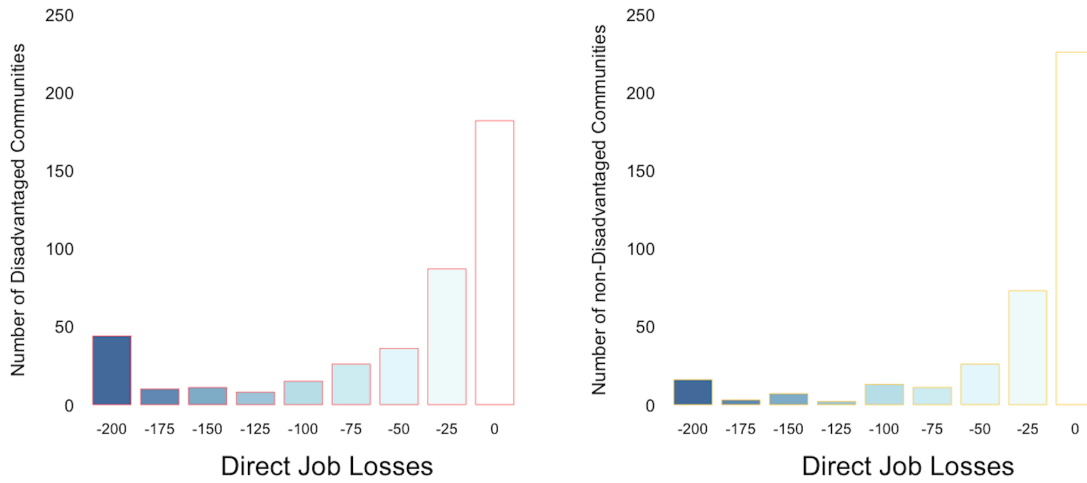


Figure 5

Direct Job Losses as a Percent of the Local Community Labor Force

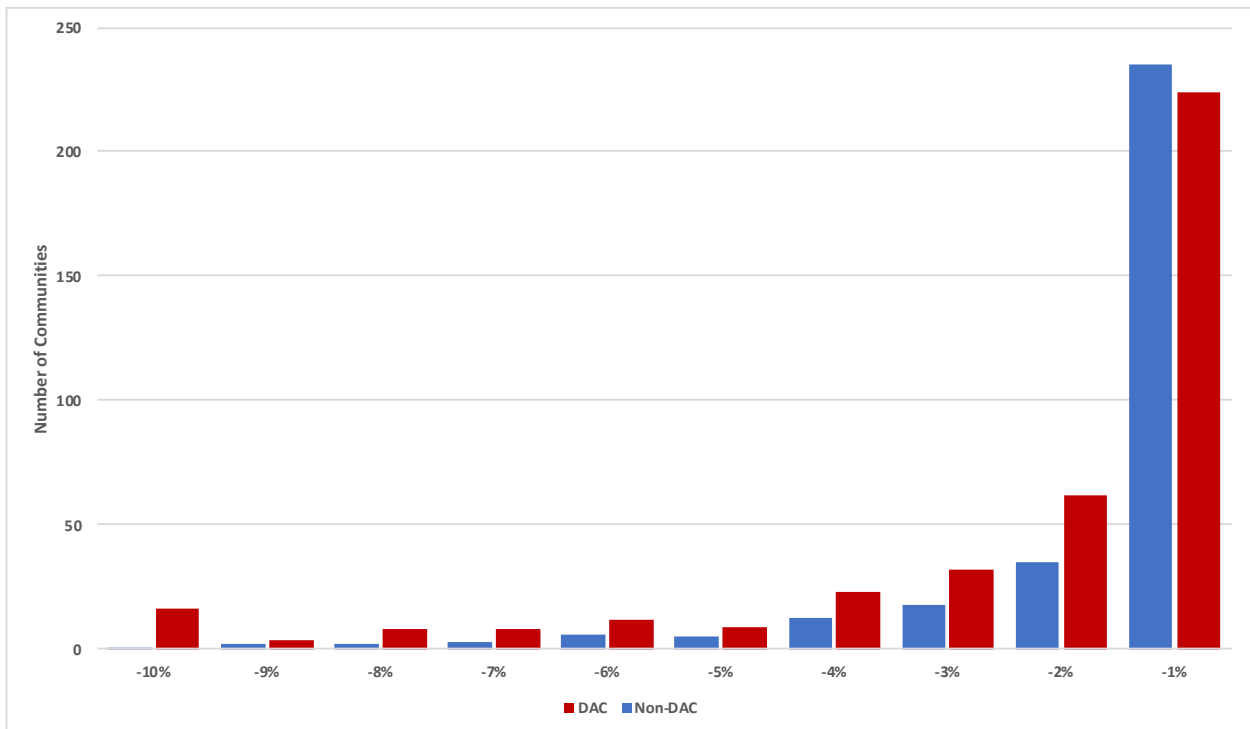
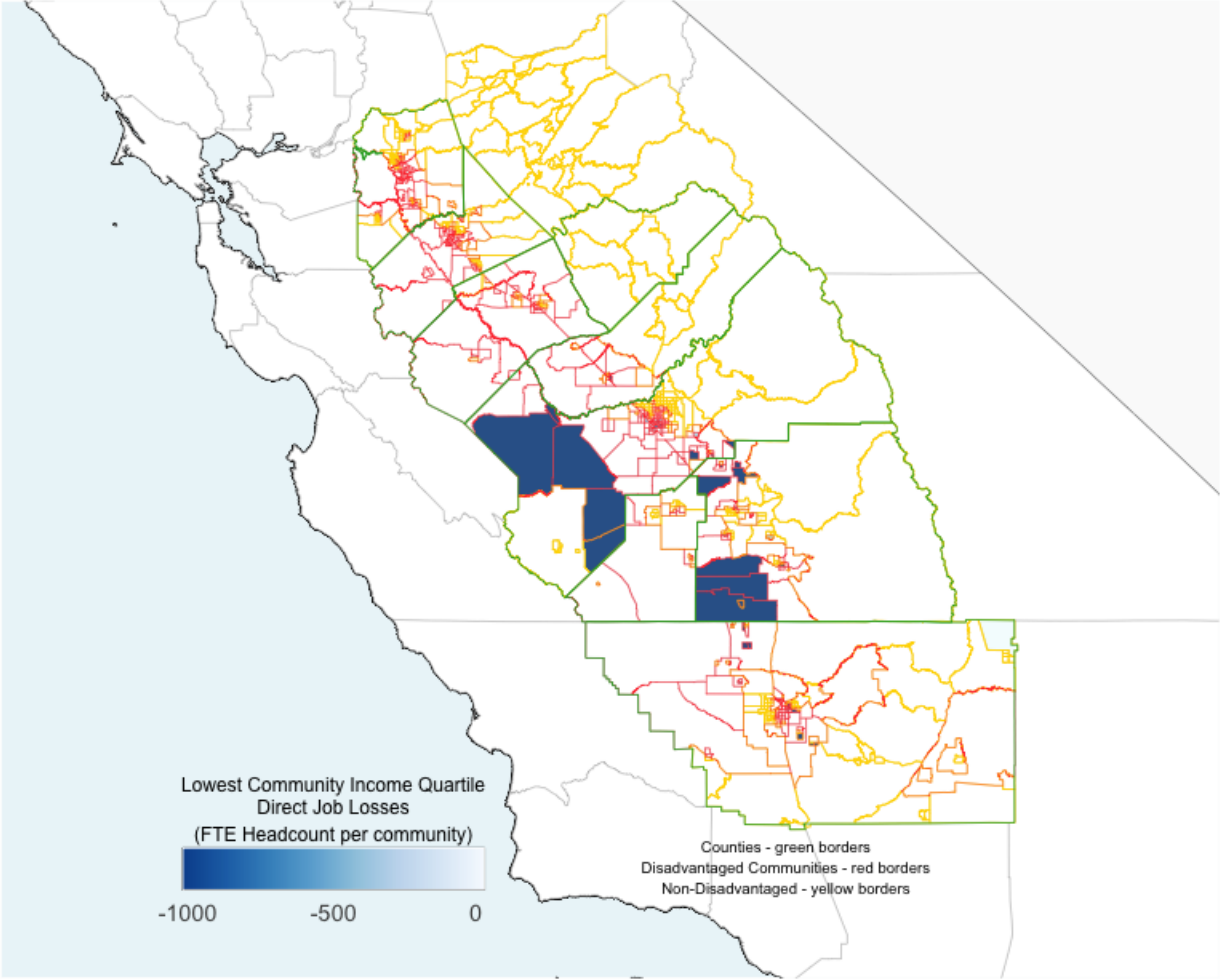


Figure 6 displays job losses in the most economically disadvantaged Census tracts defined as those with a poverty headcount over 75% (e.g., communities where 75% of the population lives below the California poverty line). As shown by the color coding, these communities appear in dark blue, meaning that they are the same ones with the largest numbers of direct job losses from SGMA and surface water reductions.

Figure 6
Direct Job Losses in the Most Economically Disadvantaged Census Tracts



State and Local Tax Revenues

Reductions in economic activity imply changes in state and local tax collection. Based on the changes in farm acreage and output estimated in this report, we calculate that lost state and local tax revenues from SGMA and surface water supply reductions are \$535 million annually. Of this amount, \$293 million is lost state tax revenue, while \$242 million is revenue lost by county and city governments. We note that the significant unemployment that will result from these water supply limitations will place additional burdens on local governments throughout the San Joaquin Valley. We do not calculate the size of these increased expenditures, but reserve an examination of this question for later research.

Conclusions and Future Work

Reducing the scale of agricultural production impacts nearly every sector of the San Joaquin Valley economy. Farming is one of the principal industries in the region, and those directly engaged in farming patronize other local businesses. In this way, lost farm income translates into losses in other sectors as household spending is curtailed. Further, farm products are inputs into downstream industries such as transportation and food processing.

In future work we will examine the ability of water markets to reduce the economic impacts of water supply restrictions. This research will account for the restrictions on groundwater exports that have been imposed by local governments in the San Joaquin Valley, and the historic experience of groundwater trading in adjudicated basins across California.

Finally, in Phase Two of this project we will also examine the potential of certain infrastructure investments to mitigate the negative socioeconomic impacts of SGMA and surface water supply reductions. These investments will be spelled out in the Blueprint and focus on creating additional opportunities for storing and conveying water within the San Joaquin Valley to maximize the efficiency of water use.