Preliminary 2014 Drought Economic Impact Estimates in Central Valley Agriculture

Prepared for California Department of Food and Agriculture

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Summary

The UC Davis-ERA Economics research team conducted a first assessment of the socioeconomic impacts from reduced availability of water for irrigated agriculture in the Central Valley during the 2014 drought. The team used the Statewide Agricultural Production Model (SWAP) to estimate response by growers and direct impacts to agriculture, and the IMPLAN model to estimate multiplier effects in related industries. Surface water deliveries will be reduced by an estimated 6.5 million acre-feet and partially replaced by an increase of 5 million acre-feet of groundwater pumping (Table 1). The research team estimates nearly 410 thousand acres being fallowed, resulting in a reduction in gross farm revenue of $738 million. Regional economic impacts of these cuts were estimated using the IMPLAN model for the Central Valley, and show approximately 14,500 full time and seasonal jobs lost once the multiplier effects and part-time jobs are included. Drought losses measured in terms of regional value-added are estimated at $856 million. Most of the economic impact occurs in the San Joaquin Valley and Tulare Lake basins. Further work will update these results in June with new land fallowing information and expanded geographic coverage for the SWAP model. In addition, the research team will examine the combined effect of this year's drought followed by two “critical” water years in 2015 and 2016 under alternative scenarios of groundwater pumping capacity.

Although the agricultural water sector is estimated to show more resilience to the 2014 drought than anticipated earlier this year, the smaller than expected reduction of water availability, crop acres and employment comes at the expense of the exhaustion of reserve groundwater storage and a substantial increase in groundwater overdraft. There will be substantial long term costs of groundwater overdraft that are not reflected in this study. Furthermore, if another critically dry year occurs in 2015 the socioeconomic impacts will likely be much more severe.

Table 1. 2014 Drought and Central Valley Agriculture Summary

Drought impact	**Loss Quantity**	**Normal Quantity**	**Percent Loss**
Water delivery reduction	6.5 maf	20 maf	32.5%
Shortage after increased groundwater pumping	1.5 maf	20 maf	7.5%
Fallowed irrigated land	410,000 acres	7,000,000 acres	6%
Crop revenue loss	$740 million	$25 billion	3%
Revenue lost plus additional pumping cost ($450 million)	$1.2 billion	$25 billion	4.8%
Central Valley economic loss	$1.7 billion	N.A.	
Direct crop production job losses (seasonal and full time)	6,400	152,000	4.2%
Direct, indirect and induced job losses	14,500	N.A.	

maf = million acre feet.

These preliminary estimates will be updated with new information from DWR, NASA, and other sources in June.

SWAP Model Update and the IMPLAN model

During the past weeks the research team updated the SWAP model to include the latest available production costs, land, and water use information. The updated model calibrates to a base year of 2010 land use and regional cropping patterns for the Central Valley. Given the regional reductions in surface water availability and capacity to substitute with additional groundwater pumping, the SWAP model was used to estimate changes in irrigated crop area, production, water use, and gross farm revenues.

The research team used the latest version of the IMPLAN model for California to estimate the changes in output value, value added, and employment to agriculture and related industries. The Central Valley was divided into three regions. Figure 1 illustrates the Central Valley regions and table 2 summarizes the corresponding 20 counties within these regions.

Figure 1. SWAP Model Coverage in the Central Valley

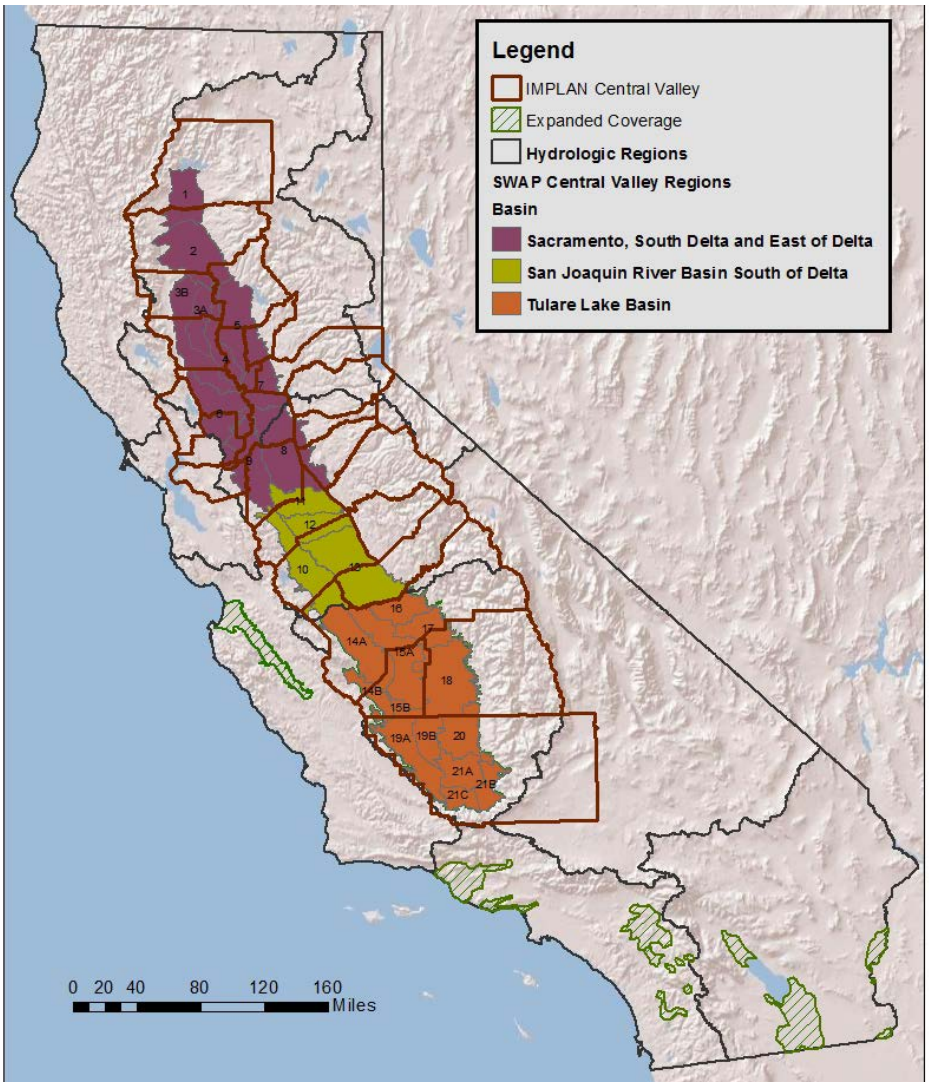

Table 2. IMPLAN Regions and Counties

IMPLAN Regions	Counties
Sacramento River	Shasta, Tehama, Butte, Calaveras, Colusa, El Dorado, Glenn, Yuba, Sutter, Placer, Yolo, Solano, and Sacramento Counties
San Joaquin River	Contra Costa, San Joaquin, Amador, Calaveras, Tuoloumne, Merced, Mariposa, and Madera Counties
Tulare Lake Basin	Fresno, Kings, Tulare, and Kern Counties

Water Availability

The preliminary drought impact analysis was based on expected Central Valley Project and State Water Project deliveries announced by the Bureau of Reclamation and California Department of Water Resources (DWR) on April 18, 2014. The project team surveyed major water districts in the Central Valley to determine expected shortages in local surface water supplies and the availability of carry-over storage. The short run ability to increase groundwater pumping was based on DWR's maximum groundwater pumping estimates for the years 2006-2010. The preliminary drought scenario estimates a reduction in surface water of 6.5 million acre-feet and groundwater replacement of 5 million acre-feet, for an approximate net shortage of 1.5 million acre-feet.

Table 3 summarizes the estimated 2014 surface water shortage by region, and the estimated ability to replace lost surface water using groundwater resources.

Table 3. 2014 Change in Surface Water and Estimated Groundwater Replacement

Basin	Surface Water (taf)	Groundwater (taf)
Sacramento Valley, South Delta and East of Delta	-1,298	617
San Joaquin	-1,620	1,178
Tulare Lake Basin	-3,595	3,191
Central Valley	***-6,513***	***4,986***

Irrigated Crop Acreage

Changes in the crop mix estimated by the SWAP model show an additional 410 thousand acres fallowed. More than 60% of the fallowed area is in the San Joaquin Valley and Tulare Lake Basins. Table 4 summarizes the impact of the drought on irrigated agricultural land use by region and crop group. The typical 20 crop groups in the SWAP model were aggregated into five larger categories, namely: (i) feed crops, (ii) vegetables, (iii) tree and vine, (iv) grains, and (v) other field crops.

Table 4. 2014 SWAP Estimated Changes in Irrigated Crop Area (acres)

Region	Feed Crops	Vegetables	Trees and Vine	Grain	Other Field	Region total
Sacramento Valley, SD and ED	-83,481	-3,801	-8,931	-40,785	-13,523	-150,521
San Joaquin Valley	-39,269	-2,638	-7,514	-20,105	-55,883	-125,409
Tulare Lake Basin	-23,967	-3,838	-24,483	-35,105	-45,501	-132,894
Central Valley Totals	***-146,718***	***-10,277***	***-40,929***	***-95,995***	***-114,907***	***-408,825***

Gross Revenue

Total gross farm revenue losses are estimated at $738 million. Table 5 summarizes the change in gross farm revenues by region and crop group. The losses are concentrated in the region south of the Sacramento/San Joaquin Delta, where water shortage is most severe. In addition to crop revenue decreases, farmers will face increased costs from additional groundwater pumping. The additional groundwater pumping of 5 million acre-feet is estimated to cost growers an additional $448 million. This cost is reflected in the loss of proprietor income.

Table 5. 2014 SWAP Estimated Changes in Gross Revenue ($ in millions)

Region	Feed Crops	Vegetables	Trees and Vine	Grain	Other Field	Region total
Sacramento Valley, SD and ED	-72	-13	-42	-78	-14	-219
San Joaquin Valley	-38	-12	-35	-34	-68.0	-187
Tulare Lake Basin	-39	-20	-162	-48	-63	-332
Central Valley Totals	**-149**	**-45**	**-239**	**-160**	**-145**	**-738**

Region-wide Economic Impacts

The preliminary impact analysis estimates that for the Central Valley, there will be approximately $738 million in direct impacts from gross farm revenue reductions. The overall effect to the greater agricultural industry in the Central Valley is estimated to equal nearly $1.7 billion with about 14,500 full time and seasonal jobs lost. California's gross domestic product is estimated to decline by almost $855 million, and household income is estimated to decline by $555 million due to drought impacts to Central Valley irrigated agriculture. Table 5 summarizes results from the IMPLAN model output.

Table 6. 2014 Central Valley Drought Impacts ($ in millions)

Impact Type	Employment jobs	Labor Income	Value Added	Output
Direct Effect	-6,400	-$248	-$280	-$738
Indirect Effect	-4,225	-$117	-$207	-$344
Induced Effect	-3,875	-$191	-$367	-$589
Total Effect	-14,500	-$555	-$854	-$1,671

These economic impact estimates include the loss of proprietor income as a result of increased groundwater pumping costs for agriculture. The estimates of employment impacts may also vary since the proportion of agricultural employment costs from labor contracts ranges by region from 30 to 60 percent of the total agricultural production costs. Job losses could increase by up to 20% if adjustments to hired labor are too low. The research team will work to refine these data and estimates in the coming weeks, as more information on labor and other factors becomes available. Total employment impacts, as measured by jobs per $1 million of gross revenue, are smaller than those estimated in 2009, yet are within an expected range of 15 to 30 full time and seasonal jobs per million dollars of output.

Livestock, Dairies and Food Processing

Crop farming serves as an essential input for the livestock production, dairy and food processing industries. However, input-output models like IMPLAN are not forward-looking, and are designed to trace expenses backwards in the economic chain, for example the amounts of inputs required for crop farming. In a worst case scenario, losses in crop farming products used locally for livestock and food processing can be linked to livestock, dairies and food processing. At this stage, the analysis does not include these values in the total impact estimates. The level of impacts will heavily depend on the ability of livestock, dairies and food processors to replace crop farming inputs from other production regions within the state, or from out of state sources. This approach will require further refinement as the research team refines the data on the interaction between crop farming and other sectors that rely on it.

Comparison with 2009 Drought

The preliminary analysis of the socioeconomic impacts of the 2014 drought finds that impacts are likely to be significantly higher than those in 2009. The 2009 drought resulted in estimated total job losses of 7,500 jobs and 270,000 acres fallowed. In contrast, the 2014 drought is estimated to cause 14,500 jobs lost and 410,000 acres fallow. The most significant difference between the 2009 and 2014 drought is that CVP and SWP water availability will be significantly lower. In addition, Friant Division contractors are projected to receive no deliveries and many east-side regions local surface water supplies are reduced due decreased Sierra snowpack. The combined effect is socioeconomic impacts that are up to 50 percent more severe than in 2009.

Preliminary Impact Summary and Ongoing Work

The research team estimates that the 2014 drought scenario considered in this preliminary study will result in direct farm revenue losses of $738 million, with a net water shortage of about 1.5 million acre-feet. The total surface water shortage is estimated to equal 6.5 million acre-feet, of which 5 million acre-feet is estimated to be replaced through increased groundwater pumping. The increased groundwater pumping in 2014 comes at a cost of $488 million. Approximately 60% of the economic impacts will be south of the Delta, in the San Joaquin Valley and the Tulare Lake Basins.

The research team is continuing to refine the SWAP model and collect additional data. Immediate tasks include expanding the SWAP model coverage to coastal areas and southern California and refining the drought scenarios. The preliminary drought impact estimates depend critically on the regional capacity to substitute groundwater for surface water. The research team is working with DWR to link the SWAP model to the C2VSim groundwater-surface water model to better estimate the capacity to pump groundwater and the short and long-run effects on water levels. In addition, we anticipate using remotely sensed estimates of fallowed acres from NASA and DWR studies to cross-check the SWAP model results as they become available.

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