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Research Brief

How Will Farmers Respond to the 2014 California Drought?

Meredith T. Niles†, Mark Lubell†, V. Ryan Haden*
† Department of Environmental Science and Policy, UC Davis
* Agricultural Sustainability Institute, UC Davis

Issue

For the first time in the 54-year history of the State Water Project, the Department of Water Resources forecast in late January 2014 that there would be zero water deliveries to the 25 million people and 1 million acres of farmland that typically rely on its services. While this could change, it was a move that clearly demonstrated the dire nature of our current California drought, which has left many wondering how farmers in the Central Valley will respond, especially as other surface water sources may also give zero allocations. Many farmers in the region are used to dealing with drought in California; yet, the extreme nature of this year's drought certainly presents new challenges for California's $34 billion agricultural industry.

How Will Farmers Respond?

> "If there's no surface water available, then that dictates that well water is the only thing available so that's a major factor."
> - Yolo County Farmer

How will farmers cope? This is the theme of numerous media reports in early 2014 both locally and nationally. Rather than speculate, we are using data to examine the issue. In 2011, UC Davis researchers conducted a survey to understand farmers' perspectives on climate change and their potential responses to water scarcity and extreme events. More than 160 farmers in Yolo County responded to the survey. While not representative of the whole Central Valley, its gives some insight into how farmers may adopt different water coping mechanisms in a dry year.

Table 1. *Parentheses indicate total number of respondents

Yolo County Farmers Water Sources in Varying Conditions			
Water Source	**Dry year**	**Normal year**	**Wet year**
Surface water only	16.4% (26)	30.2% (48)	28.3% (45)
Mostly surface water, some groundwater	18.9% (30)	20.8% (33)	15.7% (25)
Surface and groundwater, about equally	6.3% (10)	11.3% (18)	6.9% (11)
Mostly groundwater, some surface water	15.1% (24)	10.0% (16)	8.2% (13)
Groundwater only	38.4% (61)	30.9% (49)	29.6% (47)
Entirely dryland operations	4.4% (7)	4.4% (7)	4.4% (7)

Shift to Groundwater in Dry Years

Overall, we found that water resources shifted based on normal versus dry years (Table 1). In a normal year 51% of farmers use only or mostly surface water. Simultaneously, about 41% use only or mostly groundwater. The remainder use equal amounts of surface and groundwater or are entirely dryland operations.

Different Water Uses and Outcomes

"I'm on all ground water and it seems to be very stable. I mean in the worst drought, it's really no different than in the heaviest rain years."

"We're always gonna choose surface water first. It's cheaper. The particular area here where we're farming does not have great groundwater resources."

But, clear shifts happen in dry years - farmers using mostly surface water in a dry year drops to 35% from 51%, while farmers using mostly groundwater increases to nearly 54% from 41%.

Adopting New Strategies

The survey asked a very relevant question for the current drought- *"If the future climate in Yolo County resulted in more severe droughts or decrease in water availability, what is the likelihood that you would use the following management strategies, above and beyond what you currently use in a normal rainfall year?"* Figure 1 shows the responses for this question among farmers who considered the practice applicable to their farm. We found that nearly three-fourths said they were likely to pump more groundwater, while 63% were likely to use drip or micro-sprinkler irrigation. Fifty-eight percent said they would be likely to concentrate surface water on a smaller percentage of acreage and 53% would likely use drought tolerant varieties of crops they already grow.

But what about farmers who rely on different water sources? Will farmers relying on mostly surface water, who will likely receive a lower allocation this year, respond differently than

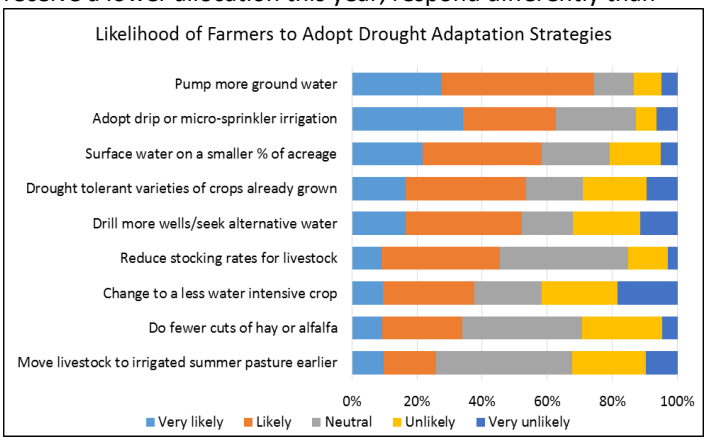

Figure 1. Likely drought adaptation responses ranked most to least likely. Percentages are based on total responses excluding farmers who indicated the practice was not applicable to their farm.

farmers who rely mostly on groundwater resources? Our data suggests yes. Table 2 shows the average likely adoption (on a scale of 1-5, with 5 being very likely and 1 being very unlikely) of drought adaptation practices based on water source in a wet and dry year. Many farmers use the same type of water in both normal and dry years; however, farmers who shift towards more groundwater are more likely on average to adopt different practices. Not surprisingly, they are more likely than other farmers to allocate less surface water on their acreage (and likely even fallow some land) and to pump more groundwater. However, they are also more likely to drill more wells or seek alternative water sources as well as implement conservation measures including drip or micro-sprinkler irrigation or using less water intensive crops. The results also suggest that farmers using only surface water are less likely to adopt drip or micro-sprinkler irrigation, while farmers using only groundwater are less likely to use drought tolerant varieties.

> "In years when we know water's gonna be scarce we definitely like to talk about which crops can be sold for more per acre because that is how we can judge water efficiency"
> - Yolo County Farmer

Conclusion and Future Work

In short, farmers will use groundwater as a first line of defense in a dry year and then consider conservation practices. Farmers who shift to groundwater in dry years are also the farmers most likely to adopt other kinds of water scarcity and drought adaptation practices. This suggests that in these tough times farmers are looking to adopt new practices to help them cope with the extreme drought. With little or no surface allocations expected this year from the State Water Project, we can expect that farmers who rely on some type of surface water will shift to groundwater if possible, seek out new water sources, and also shift to conservation measures like drip irrigation. Simultaneously, a shift towards more groundwater pumping could potentially deplete groundwater resources if the drought is extensive and prolonged. The data also suggests a continued role for university and industry research as well as Cooperative Extension to develop varieties that are able to withstand droughts and are less water intensive overall.

For more information contact:
Meredith Niles- mtniles@ucdavis.edu or see these resources:

Center for Environmental Policy and Behavior Climate Change and Agriculture Project: http://environmentalpolicy.ucdavis.edu/project/climate-change-and-agriculture

Niles et al. (2013) Published in Global Environmental Change: http://www.sciencedirect.com/science/article/pii/S0959378013001404

Haden et al. (2012) Published in PLoS ONE: http://www.plosone.org/article/info:doi/10.1371/journal.pone.0052882

Jackson et al. (2012) California Energy Commission Report: http://www.energy.ca.gov/2012publications/CEC-500-2012-032/CEC-500-2012-032.pdf

"Farmers' Average Likely Adoption of Drought Adaptation Strategies Based on Water Sources (1= Very Unlikely, 5= Very Likely)

	Water Source in a Normal and Dry Year					
Strategy	Only Surface Water (n= 26)	Only Mostly Surface Water, Some Groundwater (n=21)	Only Equal Surface & Groundwater (n=6)	Only Mostly Ground Water, Some Surface Water (n=9)	Only Groundwater (n=47)	Shift to Groundwater (n=36)
Allocate surface water on a smaller percentage of acreage	3.35	3.50	3.80	3.89	3.31	3.88*
Pump more ground water	2.63*	3.95	4.00	3.56	3.82	4.53*
Drill more wells or seek alternative water sources	2.24*	3.68	3.80	3.78	3.07	3.64*
Adopt drip or micro-sprinkler irrigation	3.20*	4.00	4.17	3.57	3.86	4.09**
Use drought tolerant varieties of the crops already grown	3.27	3.38	3.83	3.44	2.88*	3.53
Change to a less water intensive crop	2.57	2.61	3.33	2.75	2.66	3.28*
Do fewer cuts of hay or alfalfa	3.33	2.89	2.67	2.83	2.7	3.33
Move livestock to irrigated summer pasture earlier in season	2.75	3.25	4.00	3.00	3.00	2.92
Reduce stocking rates for livestock	2.75	3.67	4.00	3.75	3.33	3.27

*Using a one way anova test to compare each group of farmers on average with all other farmers using alternative water sources. Farmers in the shift to groundwater category shift towards increased groundwater from any other category. Significance level *p $\leq$0.05, ** p <0.10