How much water do turf removal and irrigation equipment rebate programs save?

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Introduction

California experienced the most severe drought in the past 1,200 years from 2012-2016.[1] In response, Governor Brown issued an executive order for the first ever statewide mandatory water use reductions in response to drought, as well as a requirement to replace 50 million square feet of turf with drought-tolerant landscapes to reduce water use in the urban sector. California water agencies implemented this plan through rebate programs to incentivize property owners to replace turf, and spent over $350 million on these rebate programs during the last two years of drought.[2] There is a critical need to determine whether the expenditure and effort for rebate programs have led to measurable water savings. This would allow for science-based planning and guidance for future water conservation programs.

Study Question

What is the water savings resulting from turf removal and irrigation equipment rebate programs?

Methods

Santa Clara Valley Water District (SCVWD) is a wholesale water supply agency in Santa Clara County (Silicon Valley), CA. SCVWD's Landscape Rebate Program (LRP) is a long-standing program that offers the opportunity to study both turf removal and irrigation equipment water savings up to five years following installation. Water billing data were obtained from 10 retailers for single-family residences (SFRs) that participated in LRP from 2011-2015. The SFRs included in this study were restricted to those that obtained a single rebate type. Billing intervals were staggered differently for each account; thus, billing data were linearly interpolated at monthly intervals in order to obtain water use at consistent time intervals.

The water billing data used in this study is based on meters that measure both indoor and outdoor water use cumulatively. Thus, an assumption of this study is that all water use changes are due to changes in outdoor water use as a result of participation in LRP. This study does not account for possible indoor water use changes, or possible non-rebate related changes in outdoor water use.

Experimental Design

Pretest – Average water use (1-5 years) of households prior to landscape or equipment conversion

Intervention – Landscape or equipment conversion

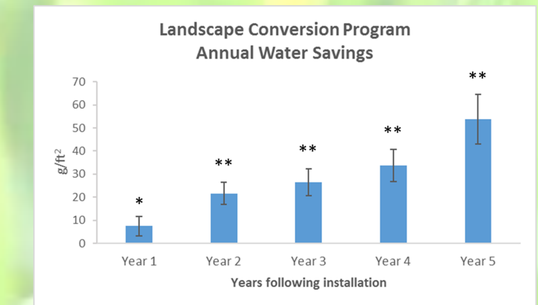
Posttest – Annual average water use of households following landscape or equipment conversion

T-tests were used to compare pre- and posttest data.

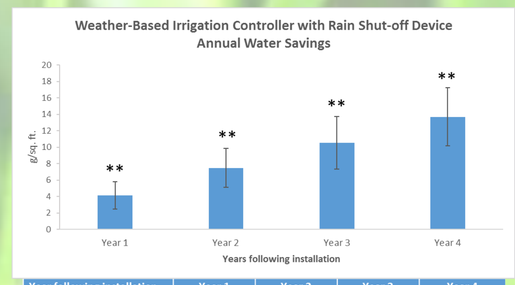
Results

A single asterisk (*) shows marginal significance ($p<0.1$) and a double asterisk (**) shows significance ($p<0.05$).

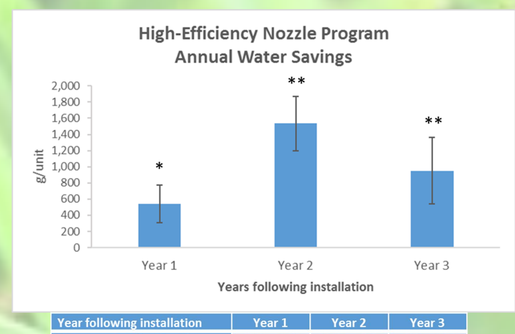
Landscape conversion – conversion of turf areas to a landscape of low-water use species and drip irrigation. The species selected for planting must be selected from the SCVWD's list of qualifying plants, which is adapted from the WUCOLS IV plant list.



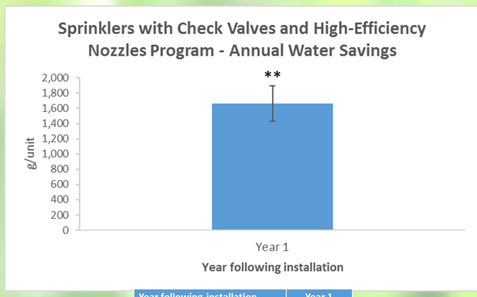
Year following installation	Year 1	Year 2	Year 3	Year 4	Year 5
Water savings (gal/ft²)	7 ± 4	22 ± 5	26 ± 6	34 ± 7	54 ± 11
Sample size	144	139	110	68	32
p-value of t-test between pre-installation and post-installation sample	0.0836*	<0.0001**	<0.0001**	<0.0001**	0.0002**



Year following installation	Year 1	Year 2	Year 3	Year 4
Water savings (g/ft²)	4 ± 2	7 ± 2	11 ± 3	14 ± 4
Sample size	85	61	35	16
p-value of t-test between pre-installation and post-installation sample	0.0001**	0.0007**	0.0009**	0.0049**



Year following installation	Year 1	Year 2	Year 3
Water savings (gal/unit)	541 ± 233	1,536 ± 337	949 ± 412
Sample size	52	40	11
p-value of t-test between pre-installation and post-installation sample	0.0626*	0.0001**	0.0291**



Year following installation	Year 1
Water savings (gal/unit)	1,661 ± 701
Sample size	17
p-value of t-test between pre-installation and post-installation sample	0.0384**

Comparison of Landscape Conversion Participants with Average Single Family Residence (SFR) Water Use

	Pre-installation annual water use (CCF)	Percent decrease in water use				
		Year 1	Year 2	Year 3	Year 4	Year 5
Participants	161 ± 9	5%	13%	18%	26%	37%
Average SFR	193 ± 5	-2%	7%	12%	21%	34%

Comparison of Weather-Based Irrigation Controller Participants with Average SFR Water Use

	Pre-installation annual water use (CCF)	Percent decrease in water use			
		Year 1	Year 2	Year 3	Year 4
Participants	249 ± 17	15%	17%	20%	27%
Average SFR	204 ± 6	9%	16%	20%	29%

Comparison of High Efficiency Nozzle Participants with Average SFR Water Use

	Pre-installation annual water use (CCF)	Percent decrease in water use		
		Year 1	Year 2	Year 3
Participants	254 ± 19	8%	20%	18%
Average SFR	180 ± 6	10%	23%	22%

Comparison of Sprinklers with Check Valves and High Efficiency Nozzle Participants with Average SFR Water Use

	Pre-installation annual water use (CCF)	Percent decrease in water use
		Year 1
Participants	305 ± 43	18%
Average SFR	186 ± 15	20%

Landscape conversion participants had lower pre-installation water use than average SFRs, and equipment rebate participants had higher pre-installation water use ($p<0.05$). Water use declined for participants in each rebate program. Average SFR water use declined due to drought. Further study could examine whether average SFR water use rebounds, while rebate program participant water use remains low.

Conclusions and Implications

- This study shows that the rebate programs offered by SCVWD have been successful in achieving water conservation.
- Landscape conversion and high-efficiency nozzle water savings were statistically significant after the first post-conversion year.
- There was an incrementally increasing trend in average annual water savings for landscape conversion and weather-based irrigation controllers.
- High-efficiency nozzle recipients could be provided information or assistance to adjust their irrigation run times in order to achieve immediate water savings.

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[1]Griffin, D., Anchukaitis, K.J. (2014) How unusual is the 2012–2014 California drought? *Geophysical Research Letters* 41, 9017-9023.

[2]Knickmeyer, E. (2016) "In California, a $350 million social experiment over lawns." *Associated Press*, https://apnews.com/c7ac174c2aec4470ba4c416944864d01/california-350-million-social-experiment-over-lawns, Accessed October 11, 2017.