University of California
Agriculture and Natural Resources

UC's Role in Landscape Water Use Policy-Setting

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Introduction

Water conservation in urban landscapes is critical resulting in many of the recent water restrictions imposed during the drought becoming permanent. Historically, approximately 50% of California's urban water use is directed at landscape irrigation and between 40-60% of water applied by conventional sprinklers was lost to runoff from soil surfaces, deep percolation below root zones, and soil evaporation. California's population is expected to increase to 60 million by 2050, mostly in urban areas, increasing the water demand on an already limited water supply and distribution imbalance between Northern and Southern California, and projected impacts from climate change.

UC has been heavily involved in research and education in water use and conservation since the 1980s, including the development and implementation of the California Irrigation Management Information System (CIMIS), a network of over 140 automated weather stations located in distinct clime zones used to estimate reference evapotranspiration (ETo) for accurate irrigation scheduling (figure 1). The establishment of CIMIS quickly led to other advances by UC scientists including determining crop coefficients (Kc) for warm and cool season turfgrass species (0.6 and 0.8, respectively) and minimum irrigation requirements for approximately 200 additional ornamentals based on percent of ETo (figure 2).

Figure 1. CIMIS Station (UC Riverside)

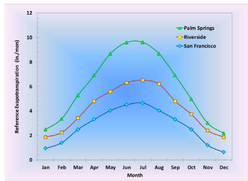

Figure 2. Reference Evapotranspiration (ETo) rates for three California climate zones used for irrigation scheduling

UC's Role in Legislation

Over the past 25 years, California has enacted policies that mandate the use of practices leading to improved water use efficiency and conservation in urban landscapes to ensure a steady and reliable water source in the future while maintaining healthy sustainable landscapes. UC researchers have been actively involved in developing and providing credible information used throughout the policy-making process.

AB 325: Water Conservation in Landscape Act (1990) authorized the CA Dept. of Water Resources (DWR) to convene an advisory task force to assist the legislature in developing a Model Water Efficient Landscape . The Act required categorizing plants based on water needs and climate zones; efficient irrigation systems; and, adoption of 'best practices' including regular repair and maintenance of irrigation systems. A central element of the Model Ordinance was the establishment of a landscape water budget based on a Maximum Applied Water Allowance (MAWA) calculated from the landscape area and the climate zone.

UC's Role: UC provided the leadership for the development of 'Water Use Classification of Landscape Species' (WUCOLS). The goal of WUCOLS was to categorize landscape plants in six climate zones (North Central Valley, Central Valley, South Coastal, South Inland Valley, High and Intermediate Desert, and Low Desert) into very low, low, moderate, or high water use classifications. Since the inception of WUCOLS in 1992, additional species were added with updates in 1994, 1999 and 2004. Currently, WUCOLS contains over 3,500 plants to supplement the approximately 200 plants whose water requirements have been measured in replicated field studies, which is a lengthy and resource-intensive process.

AB 2717: California Urban Water Conservation Council (2004) resulted in the formation of a stakeholder Task Force appointed by the California Urban Water Conservation Council (CUWCC) comprised of experts from UC, landscape and irrigation industry, and public agencies. The goal of the Task Force was to recommend ways to increase water use efficiency in new and existing urban landscapes. The Task Force report (entitled 'Water Smart Landscapes for California') was submitted to the Governor and the Legislature in December 2005. It included 43 recommendations such as updating the State Model Ordinance pursuant to AB 325.

UC's Role: UCCE horticulture advisors Laurence Costello (Emeritus UCCE horticulture advisor, San Francisco and San Mateo Counties) and Janet Hartin (San Bernardino, Los Angeles, and Riverside Counties) were appointed as the UC representatives on the Task Force and were instrumental in providing research-based information that played a central role in the development of final recommendations.

Major Task Force Recommendations included:

- Mandatory irrigation scheduling of large landscapes based on plant water needs, soil conditions, climate, and microclimate.
- Mandatory reduction of water loss due to runoff and deep percolation below the root zone.
- Properly designed, operated, and maintained irrigation systems that apply water uniformly across the landscape.

Figure 3. Catchment can test measuring sprinkler system precipitation and distribution uniformity (DU) of turfgrass at an ETAF study site.

AB 1881 Water Conservation (2006) required DWR to update the Model Ordinance in accordance with specified requirements, many of which were recommended by the Landscape Task Force in AB 2717 (described above). Local agencies were required to adopt the ordinance by January 1, 2010, adopt it temporarily while crafting their own, or adopt their own local landscape ordinance that was "at least as effective in conserving water as the updated model ordinance". DWR decreased the ETAF from 0.8 to 0.7 due partly to results of the UC-conducted ETAF study.

UC's Role: Fujino, Oki, and Hartin served as principal investigators on the AB 1881 Task Force's recommended DWR-funded 'Evapotranspiration Adjustment Factor (ETAF) Study'. The goal of the study was to determine the efficacy of reducing the current ETAF from 0.8 to 0.7. Health, appearance, and water use of 30 large landscapes (including parks, school grounds, private grounds, business parks, and golf courses) with a wide variety of species, microclimates, densities, irrigation schedules and technologies were assessed over a two year period in the six WUCOLS climate zones. Hands-on training to increase distribution uniformity (DU) of sprinkler systems and correct sprinkler system malfunctions was a key instructional practice (figure 3).

Figure 4. ETAF team (partial) at UC Riverside Field Day (l-r): Hartin, Fujino, Duenow, Oki, and Baker.

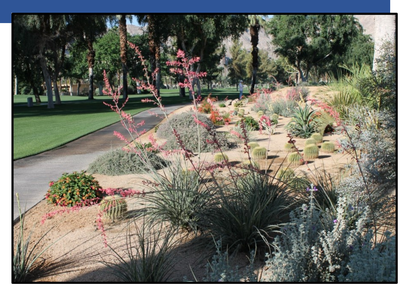

Figure 5. Very low water-requiring landscape (0.2) ETAF)

Results of UC's ETAF Study:

- 21/30 sites met the 0.7 ETAF goal after 'best practices' were implemented, equating to a 21% reduction in water application from the former 0.8 ETAF.
- 26/30 sites used used less water after 'best practices' were adopted.
- Average decrease in water use was 0.45% ETAF while the average increase in water use at the 5 sites using more water was 0.12% ETAF (stuck valves, leaks).
- Applied principles and practices of this work were disseminated to over 7,000 landscapers, urban foresters, and turfgrass managers attending workshops, field days (figure 4) and other events led by our UC team.

Relevance of ETAF Study to Clientele:

- Drip irrigated mixed landscapes consisting of low and very low (figure 5) water use species can include small areas of warm season sprinkler-irrigated turf and perform adequately at the current ETAF's of 0.55 and 0.45, for residential and non-residential, respectively).
- Landscapes planted in very low and low (fig. 5) water requiring plants can include small areas of warm season grass and perform adequately at 0.55 ETAF

Overall Impact of UC's Involvement

The combination of objective UC research and the direct involvement of UC personnel on committees formed by legislative action to drive policy-setting aided in a significant reduction of water use and waste in urban landscapes. Potable water conservation was 20 percent greater in May 2017 (124,537 acre-feet or 40.6 billion gallons) than in May 2013. Based on an average Californian using 0.2 acre-feet of water per year, the savings can supply 622,000 Californians with adequate water for one year. The US Geological Survey reported a 17% reduction in urban water use throughout California between 2010-2015.

'Next Steps'

More studies under replicated conditions are needed to determine the long-term reliability of WUCOLS and plant factor methods for estimating minimum irrigation requirements of heterogeneous landscape plantings. Newer projects include a study at UC Riverside led by Amir Haghverdi to refine 'best practices' that more precisely identify minimum irrigation requirements of turfgrass and other ornamentals using smart irrigation technologies (soil moisture-based and evapotranspiration based), remote sensing (RS) and geospatial analysis under controlled conditions monitored by a network of time-domain reflectometry (TDR) soil moisture sensors that will continuously monitor soil water status within and below the root zone.

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