Lawn Removal Motivation, Satisfaction, and Landscape Maintenance Practices of Southern Californians

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ADDITIONAL INDEX WORDS. conservation, drought, incentive, rebate, turf, water

SUMMARY. Conserving water in California landscapes is critical due to a limited water supply, recurring droughts, and the energy use and costs of transporting water from northern to southern California due to a water distribution and population imbalance. Metropolitan Water District of Southern California (MWD, Los Angeles, CA) spent more than \$310 million between 2014 and 2016 on lawn removal rebates in an effort to conserve residential water. In some cases, cities and local water districts augmented MWD rebates with their own incentives. We conducted a web-based study of 1153 southern Californians who removed all or a portion of their lawns over the past 10 years to identify their motivation, satisfaction, landscape water use, and related maintenance practices. Results indicate that rebates were less important for most respondents than the desire to conserve water, improve landscape appearance, and reduce costs. There was a high correlation between the overall satisfaction with the lawn replacement process and the appearance of transformed landscapes, supporting earlier findings regarding the importance consumers place on landscape appearance. Results of this study are timely for providing guidance to policymakers and water districts regarding the cost-effectiveness of lawn removal rebates to conserve urban water. This study also highlights a need and opportunity for water districts and Cooperative Extension to provide irrigation training to residents of stand-alone homes who maintain their own landscapes. While 90% of respondents indicated they singly (78%) or jointly (12%) determine irrigation schedules rather than rely on a gardener or landscaper, only 18% indicated they base irrigation schedules on soil moisture content or soil texture (6%). There is also a need to provide education to water districts that incentivize the use of synthetic turf in hot inland and desert areas regarding potential high-temperature injury to humans, pets, and wildlife.

Conserving water in California landscapes is critical due to a limited water supply, recurring droughts, urban heat islands, and the expense and energy required to transport large quantities of water from northern California to southern California due to a water distribution and population imbalance (Dieter et al., 2018; Griffin and Anchukaitis,

2014; Lee et al., 2021; Yigzaw and Hossain, 2016). Between 40% and 60% of urban water use in California is directed at landscape irrigation (Hanak and Davis, 2006; Hartin et al., 2018). A study of landscape water use in Los Angeles, CA, estimates that lawn evapotranspiration (ET) accounted for $\approx 70\%$ of total ET of urban landscapes in 2010 (Litvak et al., 2017). Furthermore, impacts of climate change heighten the risk of more intense, frequent, and longer droughts in the southwest United States (Melillo et al., 2014; Swain et al., 2018; Wilson et al., 2017).

Another pressure on California's limited water supply is a projected population increase from 39 million to 60 million people by 2050 (Dieter et al., 2018). Most growth is occurring in more affordable warmer inland and desert cities with larger landscapes and higher ET rates than in coastal communities (Hanak and Davis, 2006).

Lawns have historically played a central role in U.S. culture and landscapes (Ignatieva et al., 2015; Yabiku et al., 2008), representing an estimated 23% of land cover in urban areas of the United States in the mid-to late 20th century (Robbins and Birkenholz, 2003). Turfgrass covers more area in the United States than any other irrigated crop (Milesi et al., 2005), with an estimated industry value of \$13.3 billion (Haydu et al., 2006).

Properly maintained lawns reduce surface runoff of water, pesticides, and fertilizers and related waterway pollution; reduce soil and water erosion; cool urban heat islands; sequester carbon dioxide; provide a safe surface for sports and recreation; and enhance neighborhood aesthetics and property values (Alizadeh and Hitchmough, 2019; Beard and Green, 1994; Cameron et al., 2012; Lonsdorf et al., 2021; Zirkle et al., 2011). Other studies indicate the preferred use of living rather than synthetic turf in climates with hot summers due to its cooler surface temperature that prevents burns and injuries to people and pets (Petraas et al., 2014; Thoms et al., 2014).

However, since the turn of the 21st century, consumer interest in turfgrass lawn alternatives has increased due to a desire to conserve water, reduce landscape maintenance and related costs, and a greater familiarity with lawn alternatives (Barnes et al., 2018; Hugie et al., 2012; Hurd et al., 2006; Larson et al., 2009; St. Hilaire et al., 2010; Yue et al., 2016).

Background

In an effort to increase landscape water conservation, water districts throughout the southwest United

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Units			
To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.0929	ft ²	m ²	10.7639
3.7854	gal	L	0.2642
40.7458	gal/ft ²	L·m ⁻²	0.0245

States have invested millions of dollars in rebates and incentives for their customers who, in turn, agree to replace all or part of their lawns with nonturf ornamentals and mulch (and, sometimes, synthetic turf). The largest rebate program in the United States was conducted by the Metropolitan Water District of Southern California (MWD, Los Angeles, CA), a wholesaler that supplies 1.7 billion gallons of water daily to nearly 19 million residents of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura counties. Water is sourced from the Colorado River and the San Francisco Bay Delta as part of the State Water Project. Between 2014 and 2016, MWD provided over \$310 million in rebates resulting in more than 160 million square feet of lawn removal at a rate up to \$2.00/ft² (MWD, 2017). In some cases, cities and local water districts augmented the MWD rebate with their own incentives.

Several studies have been undertaken to determine the effectiveness of rebates and incentive programs offered by water districts as water conservation strategies. For example, Pincetl et al. (2019) found that $\approx 70\%$ of MWD customers opting for rebates removed all front yard turf; 11% at least some; and 19% none. The study did not monitor whether respondents replaced turf in their backyards. Pincetl et al. (2019) also found that rebates offered by the City of Los Angeles, CA, that supplemented MWD incentives did not uniformly increase participation rates. They also noted clustering of lawn removal among neighbors.

The Alliance for Water Efficiency (Mayer et al., 2015) compiled data across multiple turf-replacement programs and found household annual water savings of 11–76 gal/ft². A survey they conducted of participants and nonparticipants in the incentivized rebate programs in eight U.S. cities (including five in California) and two Canadian cities found similarities in attitudes about lawns between participants and nonparticipants. Even those not participating in lawn removal programs identified trees and shrubs (87%), flowers (79%), and entertainment space (73%) as preferable to a lawn (69%), and

ranked aesthetics (55%), low maintenance (48%), and low water use (42%) as the three most important aspects of their landscapes. In addition, 86% noted they liked the appearance of a neighbor's transformed landscape after lawn removal. Forty-five percent of respondents indicated that incentives alone would not convince them to remove their lawn. Water savings, maintenance, and saving money were major reasons they cited for considering lawn removal. Survey respondents who removed all or part of their lawns through an incentivized program ranked aesthetics, low maintenance, and low water use as the most important elements of their landscapes. Other research cites the preferred surface of a traditional turf lawn for outdoor recreation, play areas, and pets as well as ties linked to nostalgia, tradition, attractiveness, neatness, and social status (Armstrong et al., 2019; Barnes et al., 2020; Fuentes, 2021; Padullés Cubino et al., 2020; Wheeler et al., 2017).

Need for this study

While results of the studies discussed above are useful, there is a lack of published research examining motives and overall satisfaction of customers who removed their lawns in water districts offering incentives, whether they applied for the incentives or not. An unpublished study conducted by Western Municipal Water District in Riverside, CA, found that about one-half of their customers removed all or part of their turf without incentives, often due to the influence of a neighbor's transformation. Other research indicates that consumer attitudes regarding personal accountability for conserving resources plays a critical role in the decision to adopt water conservation measures (Willis et al., 2011), which likely relates to turf removal.

Our study was undertaken to examine motivations, satisfaction, and horticulture practices used by rebate recipients and nonrecipients within the same water districts who removed all or part of their lawns in coastal and inland areas of southern California. We identified motivations for lawn removal and overall satisfaction based on factors including appearance, costs, water conservation, maintenance level,

pesticide and fertilizer usage, ecological value, entertainment hardscapes, as well as watering practices and overall time spent in the landscape for recreational rather than maintenance purposes following lawn removal.

Methods

We developed a “lawn removal satisfaction” survey using the Qualtrics (Provo, UT) software platform consisting of 27 questions that was approved by the University of California Institutional Review Board. A link to the survey that included a short introductory paragraph describing its purpose and scope was e-mailed to residential customers who had not applied for rebates or other incentives as well as those who did apply by five-member agencies of MWD of Southern California: San Diego County Water Authority (San Diego, CA), Santa Margarita Water District (Rancho Santa Margarita, CA), Irvine Ranch Water District (Irvine, CA), Elsinore Valley Municipal Water District (Lake Elsinore, CA), and Western Municipal Water District (Riverside, CA). Residential customers of Desert Water Agency (Palm Springs, CA) and Coachella Valley Water District (Palm Desert, CA) received survey links through an e-mail from University of California, Riverside (Palm Desert campus).

Survey eligibility required respondents to live in stand-alone residences and to have been active decision-makers resulting in all or portions of their lawns being removed between 2010 and the survey completion date. To reduce response bias that can occur from choosing from a list of predetermined answers, each respondent was required to list their main reason for removing all or a portion of their lawn, using an open-ended question format, before they could complete the rest of the survey. The rest of the survey consisted of multiple choice, continuous rating scales, and short- and long-answer questions. Topics included motivation for lawn removal (appearance, water use, maintenance level, maintenance cost, entertaining/hardscape, space for edibles, ecological factors, pesticide/fertilizer use, other) and opinions and observations related to subsequent water use, use of mulch, plant health,

Table 1. Questions in the “lawn removal satisfaction” survey completed by southern Californians.

- 1) Do you currently reside in a stand-alone residence in which all or a portion of the lawn (grass) was removed in the last 10 years: yes, no, unsure/don't know?
- 2) Whose decision was it to remove all or part of your lawn: yours, joint decision (yours and other household members), homeowners association, current owner (if a rental), former owner, don't know?
- 3) When did the lawn removal occur (please select all that apply): 2020 or later, 2019, 2018, 2017, 2016, 2015, 2014, 2013, 2012, 2011, 2010, unsure/don't know?
- 4) Before removal, about what percent of your landscape (planted area only) was a lawn: more than 75%, 50% to 74%, 25% to 49%, less than 25%?
- 5) After removal, about what percent of your landscape (planted area only) is a lawn: more than 75%, 50% to 74%, 25% to 49%, 1% to 24%, none?
- 6) What was the main reason that all or part of the lawn was removed?
- 7) Using the sliders below, please rate the importance of each factor in the decision to remove all or part of your lawn: eligibility for a water district rebate or equipment, to conserve water, for ecological reasons (biodiversity, habitat, pollinators), to save money on water bill, to improve the appearance of the landscape, to make room for food/edible plants, to make room for entertainment/dining area, advice/influence from a neighbor or another person, to reduce maintenance time, to reduce maintenance costs, to reduce pesticide/fertilizer use, didn't like it or use it anymore, other reason (please list)?
- 8) Since lawn removal, how are the replacement plants irrigated (please select all that apply): drip system, hose/watering can, sprinkler system, some or all of the landscape plants need no irrigation?
- 9) Who usually determines when to irrigate your landscape and how much water to apply (including setting irrigation timers): you, another household member, gardener/landscaper, owner, home owner association?
- 10) How do you determine when to irrigate your landscape and how much water to apply (please select all that apply): plant appearance, soil moisture content, season, type of soil (sand, silt, clay, etc.); “smart” controller does it for me, other (please list)?
- 11) Overall, how much water do the replacement plants require compared with your former lawn: less, more, about the same amount?
- 12) Since lawn removal, has your water bill: decreased, increased, stayed about the same, don't know (someone else pays it)?
- 13) What is the overall level of insect pests, weeds, and diseases in your landscape since lawn removal: more, less, about the same, don't know?
- 14) Is there currently a layer of mulch covering the soil around any of your shrubs, trees, and garden plants: yes, no, unsure/don't know?
- 15) What type of mulch is it (please select all that apply): fresh or composted wood chips; yard trimmings, etc.; gravel, rocks, or pebbles; other?
- 16) Since lawn removal, how much time do you and other household members spend outdoors (for pleasure or recreation) at home compared with before: about the same, a lot more, somewhat more, somewhat less, a lot less?
- 17) During COVID-19, how much time do you and other household members spend outdoors (for pleasure or recreation) at home compared with before the pandemic: about the same, a lot more, somewhat more, somewhat less, a lot less?
- 18) What was the lawn replaced with (please select all that apply): drought-resistant landscape flowers, shrubs, and trees; drought-resistant nonturf groundcovers (low-growing plants); a more drought-resistant grass than was removed (please list); edible plants (vegetables, fruits, berries, herbs, etc.); synthetic/artificial turf; hardscape; entertainment area; other (please list)?
- 19) Using the sliders below, please rate your satisfaction with your landscape since lawn removal based on the following factors (100 = totally satisfied, 0 = not at all satisfied): appearance, water use, maintenance level, maintenance cost, entertaining/dining area use, edibles (vegetables, fruits, herbs) use, ecological factors (biodiversity, habitat, pollinators, etc.), pesticide/fertilizer use, overall satisfaction.
- 20) What water agency/city supplies your water?
- 21) How would you describe yourself: female, male, nonbinary?
- 22) What is your age: under 18, 18 to 25, 26 to 40, 41 to 60, 61 to 80, over 80?
- 23) Where do you live: Los Angeles County, Orange County, San Bernardino County, Riverside County, San Diego County, other California County, other state/county?
- 24) What is your zip code?
- 25) How would you describe your ethnicity: Asian/Pacific islander, Latino/Hispanic, black/African American, white, Native American, multiethnic, other?
- 26) What are the primary languages spoken in your household (please select all that apply): English, Spanish, Chinese, Tagalog, Korean, Vietnamese, Japanese, other (please list)?
- 27) Please feel free to share any other thoughts regarding your lawn removal/landscape transformation process (positive or negative) you'd like us to know.

time spent in the landscape, and overall satisfaction with the transformation process. Questions pertaining to gender, ethnicity, and age were voluntary. A list of survey questions is found in Table 1.

Data were analyzed using statistical software (SPSS version 27; IBM Corp., Armonk, NY). Descriptive statistics were generated for all variables. Differences between means were examined by focusing on effect

sizes, identifying means for which there was no overlap in their 95% confidence intervals (CIs) (Cumming, 2012; Field, 2018). Pearson product moment correlation coefficients were calculated between key

Fig. 1. Percentages, by theme, of short-answer write-in responses regarding the main reason all or a portion of a lawn was removed in the last 10 years by southern California residential customers ($n = 1153$) of five-member agencies of the Metropolitan Water District of Southern California (Los Angeles, CA) in response to our online survey. Answering this initial open-ended question was required before respondents could complete the rest of the survey. They were not allowed to return to the question as they progressed through the rest of the survey, to preserve the integrity of their initial responses. More than 99% of answers fell into one of the five main themes reported.

variables related to motivation to remove lawns and satisfaction with the same factors as well as overall satisfaction.

Results

SURVEY PARTICIPANTS. Completed surveys were collected online between 12 Mar. and 2 June 2021. Of the initial 1587 survey respondents, 1153 (73%) met the required criteria (lived in a stand-alone residence; active participation in the decision to remove all or a portion of their lawn between 2010 and survey completion date; and answered the required initial short-answer survey question, “What was the main reason that all or part of the lawn was removed?”).

Respondents primarily identified themselves as “white” (73%) followed by “Asian/Pacific islander” (15%), “Latino” (4%), “other” (4%), “multiethnic” (3%), and “Native American” (<0.1%). They tended to be older (49% were between 61 and 80 years old and 41% were between 41 and 60 years old) and male (53%). Most (67%) resided in Orange County, followed by San Diego County (15%), and Riverside County (16%). Less than 2% resided in counties not targeted in the study.

WHAT MOTIVATED LAWN REMOVAL? Rebates were not primary motivators for partial or complete lawn removal for most home-owners completing our survey. The desire to conserve

water, improve appearance, and save money ranked higher in both the required short-answer initial question: “What was the main reason that all or part of the lawn was removed?” as shown in Fig. 1, and the subsequent question asking respondents to rate a list of factors motivating their decision on a 0 to 100 scale as shown in Fig. 2.

In response to the required short-answer question (Fig. 1), 442 respondents (38.3%) indicated they removed their lawn to conserve water, 213 respondents (18.5%) to improve appearance, 207 respondents (18.0%) to save money, 123 respondents (10.7%) to reduce maintenance, 100 respondents (8.7%) to receive a rebate, and 52 respondents (4.5%) for ecological/environmental reasons. Other responses ($n = 16$) totaled less than 1% of answers and included a desire to add hardscape, grow edible crops, and influence from a neighbor.

Mean ratings of major motivational factors for lawn removal from a list of choices (Fig. 2) were water conservation (mean = 80), to improve appearance (mean = 74), and to reduce water cost (mean = 71). All three factors were significantly greater ($P < 0.01$) motivators than was rebate eligibility (mean = 56).

On a 0 to 100 scale (100 = most important, 0 = not at all important), residents of San Diego County rated the importance of receiving a rebate to remove all or part of their lawn significantly higher (mean = 68) than did

residents of Orange County (mean = 52). Residents of Riverside County rated the importance of a rebate (mean = 60) intermediate (Fig. 3).

WHEN AND HOW MUCH TURF WAS REMOVED? WHAT WAS IT REPLACED WITH? The majority of lawn removal (74%) occurred from 2015 through the date surveys were completed (12 Mar. to 2 June 2021). Before lawn removal, 44% of respondents indicated that 75% to 100% of their previous landscape was turf and 30% indicated that 50% to 74% was previously a lawn. At the time of survey completion, 54% of respondents had removed all of their lawns and less than 10% had more than 50% of their landscape still planted in turf.

Forty percent of respondents replaced lawns with purported drought-resistant flowers, groundcovers, shrubs, and trees; 17% with synthetic turf; and 29% with hardscapes (walkways, patio, pebble, or rock mulch) and/or entertainment areas (barbecue/cooking/eating area, seating, etc.). Less than 0.1% indicated their lawns were replaced with a more drought-resistant turfgrass species (Fig. 4).

IRRIGATION AND WATER USE AND COST OF RENOVATED LANDSCAPES. Survey respondents indicated they use drip irrigation (39%) as their primary method to water their renovated landscapes, whereas 22% use sprinklers and 15% hand water. Twenty-four percent of respondents indicated

Fig. 2. Ratings of factors motivating residential customers ($n = 1153$) of five-member agencies of the Metropolitan Water District of Southern California (Los Angeles, CA) to remove all or part of their lawns, in response to our online survey. Bars indicate mean ratings for each factor (100 = most important, 0 = not important) with the name of the factor and number of respondents choosing each factor shown below each bar. Respondents could select more than one item. Statistical significance of mean separations was determined by examining degree of overlap of 95% confidence intervals (CIs) around each of these means. CIs (95%) are shown at the top of each bar. When there is no overlap in CIs, the means are significantly different at the $P < 0.01$ level, and bars with different superscript letters appearing above the CIs are significantly different at the $P < 0.05$ level (Cumming, 2012; Field, 2018).

some or all of their plants require no irrigation. Season (30%) and plant appearance (26%) were the main reported determiners of when to water renovated landscapes (Fig. 5). While only 6% of respondents indicated that soil texture (sand, silt, clay) was a factor, 18% indicated they rely on soil moisture.

Seventy-eight percent of respondents indicated they determine when to

water and how much water to apply, whereas 12% indicated it is a joint decision with another member of the household. Only 8% indicated a gardener or landscaper was responsible for determining irrigation schedules.

Ninety-one percent of respondents indicated that their replacement plants require less water than the lawn required. Seventy-eight percent indicated their landscapes were mulched,

reducing evaporative water loss. Sixty-two percent of respondents indicated their water bills had decreased, 6% said they had increased, 28% indicated they had stayed about the same, and 4% were not sure.

PREVALENCE OF INSECTS AND DISEASES IN RENOVATED LANDSCAPES. Fifty-seven percent of respondents indicated that there was a decrease in insects and diseases since turf was

Fig. 3. Mean ratings by California county of residence (San Diego, Riverside, and Orange) of the importance of receiving a rebate or other incentive from water districts by residential customers ($n = 1059$) of five-member agencies of the Metropolitan Water District of Southern California (Los Angeles, CA) in response to our online survey. Bars indicate mean ratings for each factor (100 = most important, 0 = not important) with the name of the factor and number of respondents choosing each factor shown below each bar. Respondents could select more than one item. Statistical significance of mean separations was determined by examining degree of overlap of 95% confidence intervals (CIs) around each of these means. CIs (95%) are shown at the top of each bar. When there is no overlap in CIs, the means are significantly different at the $P < 0.01$ level, and bars with different superscript letters appearing above the CIs are significantly different at the $P < 0.05$ level (Cumming, 2012; Field, 2018).

Fig. 4. Total number of survey responses (2152) for each selected category by residential customers of five member agencies of the Metropolitan Water District of Southern California (Los Angeles, CA) when asked to indicate what they replaced turf they removed with, in response to our online survey. Respondents could select more than one item from a drop-down menu of eight choices.

removed, whereas 23% indicated levels had stayed about the same, 7% indicated there was an increase, while 13% were unsure.

TIME SPENT OUTDOORS IN RENOVATED LANDSCAPES. Fifty-seven percent of respondents also indicated that, since lawn removal, they and other household members spend about the same amount of time outdoors at home for pleasure or recreation, whereas 18% and 19%, respectively, said they spend “a lot more” or “somewhat more.” When asked about time spent in their landscapes during the COVID-19 pandemic compared with before, 41% indicated it was “about the same,” whereas 27% said “a lot more” and 22% “somewhat more.”

OVERALL SATISFACTION WITH RENOVATED LANDSCAPES. Respondents rated both their overall satisfaction and their satisfaction with the appearance of their renovated landscape 87 on a 0 to 100 scale (Fig. 6). Second tier ratings were satisfaction with water use, maintenance level, and maintenance cost, which all rated higher than other factors. It is important to note that not all items were rated by all respondents, and some items may have been rated lower than others if the item did not specifically pertain to them. For instance, if a respondent did not have an original desire to grow food or enhance the biodiversity of the landscape, the item may have been unrated in Fig. 6.

Other results

Beyond defined survey questions, we received over 600 responses to the following voluntary open-ended statement at the end of the survey: “Please feel free to share any other thoughts regarding your lawn removal/landscape transformation process (positive or negative).” Three main themes emerged: pleasure with the appearance and water conservation properties of their transformed landscapes; acknowledgment of how a related class taught by a participating water district helped them during and after the process; and how much they noticed and appreciated ecological consequences not evident before (pollinators, wildlife, etc.).

Fig. 5. Total number of survey responses (1338) for each selected category by residential customers of five member agencies of the Metropolitan Water District of Southern California (Los Angeles, CA) when asked to indicate how they determine when to irrigate and how much water to apply, in response to our online survey. Respondents could select more than one item from a drop-down menu of six choices.

Fig. 6. Mean ratings of satisfaction with eight factors related to lawn renovation as well as overall satisfaction for residential customers ($n = 1153$) of five-member agencies of the Metropolitan Water District of Southern California (Los Angeles, CA), in response to our online survey. Bars indicate mean ratings for each satisfaction dimension (100 = maximum satisfaction, 0 = no satisfaction) with the dimension identifiers and number of respondents endorsing each shown below. Statistical significance of mean separations was determined by examining degree of overlap of 95% confidence intervals (CIs) around each of these means. CIs (95%) are shown at the top of each bar. When there is no overlap in CIs, the means are significantly different at the $P < 0.01$ level, and bars with different superscript letters appearing above the CIs are significantly different at the $P < 0.05$ level (Cumming, 2012; Field, 2018).

CORRELATIONS BETWEEN AND AMONG FACTORS RELATED TO MOTIVATION AND SATISFACTION. A high Pearson product moment correlation coefficient [r (df)], probability level, and 95% CI was found between overall satisfaction with the lawn removal and replacement process and satisfaction regarding the appearance of the transformed landscape [r (1023) = 0.81, $P < 0.01$, 95% CI = 0.79–0.83]. Although relatively few respondents indicated they removed their lawn specifically to grow food, there was a high correlation between the motivation to grow food and satisfaction with growing food [r (430) = 0.70, $P < 0.01$, 95% CI = 0.64–0.74].

Moderate Pearson product moment correlations were found between motivation to enhance habitat/pollinators (ecological reasons) and satisfaction enhancing habitat [r (610) = 0.65, $P < 0.01$, 95% CI = 0.60–0.69], motivation to reduce maintenance time and satisfaction with maintenance cost [r (824) = 0.68, $P < 0.01$, 95% CI = 0.64–0.72], and motivation to reduce maintenance cost and motivation to reduce the use of pesticides/fertilizers [r (653) = 0.63, $P < 0.01$, 95% CI = 0.58–0.67].

Discussion

Findings of this study indicate that water district incentives and rebates are

not primary motivators for lawn removal, raising questions regarding their justification and expense. The fact that survey respondents considered water conservation, landscape appearance, and reducing costs more important than water district incentives is important to note since southern California water districts spent over \$415 million on incentives during the 2011–17 California drought. Other residential water users who have not previously removed turf but choose to do so during the current drought may also do so based on factors other than rebates and incentives. Our findings support results of a survey conducted by the Alliance for Water Efficiency (2018) that found that less than one-half of respondents said they would remove their lawns based on rebates alone and that water savings, maintenance, and saving money would be more important. Our survey confirmed that these motivations hold true for households who actually removed their lawns.

The high correlation we found between overall satisfaction with the lawn replacement process and the appearance of transformed landscapes supports earlier findings regarding the importance consumers place on landscape appearance (Cameron et al., 2012; Hayden, et al., 2015; Hooper et al., 2008; Hurd, 2006; Hurd et al., 2006; Khachatryan et al., 2020;

Lockett et al., 2002; McCammon et al., 2009; Morera et al., 2020).

Several participants expressed how useful education provided by the water districts was during the transformation process. Augmenting future incentives with education on a wider scale, especially regarding plant selection and care, could maximize water conservation and plant health. Providing contact information on water district websites for local land-grant university Master Gardener volunteer programs and advisors/extension agents would also be useful, whether lawns are removed or not. This is important since previous studies indicate that poor irrigation practices cause more water waste than is often saved by replacing turf with other species (Hartin et al., 2018; Reid et al., 2018) and that individuals completing Cooperative Extension classes on home irrigation adopted more water conservation technologies and practices compared with nonparticipants (Hurd, 2006; Hurd et al., 2006).

Limitations of our study include not collecting data on economic status and income of respondents and offering the survey only in English. These are all factors that may influence lawn removal motivation based on available rebates and other incentives. Although we gathered information

on the ethnicity of survey respondents, we were unable to compare it to the larger population of residents living in stand-alone homes in the geographical areas surveyed due to lack of reliable data. While our study did find significant differences regarding the motivation to remove turf based on rebates between Orange County and San Diego County respondents served by different water districts that could be income-related, we did not evaluate other possible factors such as amount of the rebate and the potential impact of rebates offered by secondary entities (e.g., cities) augmenting the original rebate. Another possible limitation is the relevance of our study to other geographic regions with different water rate structures and incentives.

Conclusion

Our study provides useful evidence-based information for policymakers and water districts to consider regarding whether rebates and other incentives are cost-effective motivators for residential lawn removal. Respondents in our study predominantly removed their lawns to conserve water, improve the aesthetics of their landscapes, and reduce costs rather than to receive a rebate. Results of this study are especially timely due to the climate change-fueled droughts coupled with urbanization pressures.

Our study also highlights the need and opportunity for water districts and Cooperative Extension educators and Master Gardeners to provide irrigation training to residents of stand-alone homes since 90% of respondents indicated they singly (78%) or jointly (12%) determine irrigation schedules themselves rather than relying on a gardener or landscaper. This education is important since relatively few respondents indicated they base irrigation schedules on soil moisture (18%) and soil texture (6%). In addition, since less than 0.1% of respondents indicated their lawns were replaced with a more drought-resistant turfgrass species, education in this area would be useful, as well. There is also a need to educate water district policymakers in urban inland and desert communities that high surface

temperatures of synthetic grass can result in burns and injuries to people and pets and should not be incentivized.

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