

# Extension Education Methods

## Perceived Landscape Benefits Influence Engagement in Urban Landscape Irrigation and Fertilizer Best Practices

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**SUMMARY.** There are substantial opportunities for residents to conserve and protect water through irrigation and fertilizer best practices without sacrificing landscape quality. Promoting the adoption of practices and technologies to address water quality and quantity issues is one of the most important contributions extension can make to solving complex water problems. Extension needs to use innovative approaches to encourage adoption of landscape water conservation practices and technologies, and one underused behavior change strategy is social marketing. Social marketing can help extension encourage behavior change by positioning desired behaviors in terms of value to clientele. This study examined the relationship between the benefits people believe their home landscape provides and their engagement in good irrigation and fertilization practices. Aesthetics is the most valued landscape benefit but it is not strongly influential on good irrigation or fertilization practices. Individuals who perceive their landscape offers habitat benefits are most likely to engage in good irrigation practices, whereas individuals who believe their landscape provides environmental benefits are most likely to engage in good fertilization practices. People who believe their landscape offers monetary benefits are least likely to engage in good irrigation and good fertilizer practices. Extension professionals should develop programs that relate fertilization best practices to environmental benefits and irrigation best management practices to habitat benefits while emphasizing that landscape management best practices are compatible with landscape aesthetics.

Good landscape management practices can positively affect water availability and quality, whereas improper management can

degrade water quality in local and larger water bodies and contribute to water scarcity (Saurí, 2013; Shober et al., 2010). Horticultural educators, such as extension professionals, focus on decreasing the impact of landscape management practices on water resources (Bradley et al., 2016). Researchers have recommended landscape educational programs target people with irrigation systems because they tend to use more water and have greater potential to positively affect water resources (Bremer et al., 2012; Warner et al., 2016).

People who work on water issues need innovative strategies to promote the adoption of research-based best landscape management practices and they have increasingly turned to innovative approaches to changing consumer behaviors (Saurí, 2013). Extension professionals may incorporate principles of an underused behavior change strategy, social marketing (Warner et al., 2016), which is the “adaptation of commercial marketing technologies to programs designed to influence the voluntary behavior of target audiences to improve their personal welfare and that of the society of which they are a part” (Andreasen, 1994).

The social marketing process is structured by a number of calculated steps beginning with identifying the problem and then conducting substantial audience research to identify the audience’s values, perceived barriers, and benefits to change (McKenzie-Mohr, 2011). Social marketing strategies, informed by the audience research (McKenzie-Mohr, 2011; McKenzie-Mohr and Schultz, 2014), are designed to encourage behavior change by presenting an exchange with competing behaviors desirable to consumers based on their values (Lee and Kotler, 2011). The concept of product benefits, or combinations of concrete product characteristics, is used frequently in traditional marketing to appeal to customers’ values and create greater need for the product (Vriens and Hofstede, 2000). The “benefits desired from a product is the most practical way to understand an audience, because direct connections can be made between the motivations of an audience segment and their purchasing behavior” (Salmon et al., 2006). Following these principles, we sought to identify the benefits home irrigation users believe their landscape provides to guide future social marketing campaigns to change landscape management behaviors. The perceived value people placed on their urban landscapes was highlighted to determine if there was a relationship between landscape benefits and irrigation and fertilization best practices.

The research described in this manuscript was conducted as a possible foundation to inform social marketing campaigns to encourage good irrigation and fertilization practices among

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urban residents. The purpose of the study was to identify how home irrigation users perceived landscape benefits, and to determine whether these benefits influence irrigation and fertilization best practices in the landscape. The specific objectives that guided the study were to describe home landscape users' perceived landscape benefits, identify relationships between perceived landscape benefits and irrigation best practices, and to identify relationships between perceived landscape benefits and fertilization best practices.

## Materials and methods

Data were collected using a researcher-developed online survey instrument in May 2016. The target population of the study was urban residents nationwide who used and had decision-making responsibility over irrigation in their home landscape. Purposive sampling was used because there was "no list containing all or nearly all members of the target population" (Baker et al., 2016). A national sample ( $N = 540$ ) was accessed through Qualtrics, LLC (Provo, UT), a professional survey sampling company. Respondents were compensated through their membership with Qualtrics or survey research partner.

Demographic data revealed that about half the sample was female [50.2% ( $n = 271$ )]. The majority were homeowners [82.6% ( $n = 446$ )], and more respondents resided in the state of California [13.1% ( $n = 71$ )] than any other state. The mean age of respondents was 40 years and the greatest percentage of respondents had a 4-year college degree [34.3% ( $n = 185$ )], and earned between \$50,000 and \$74,999 per year [21.2% ( $n = 114$ )]. Although it is known that home irrigation users differ from the general public (Warner et al., 2015), these demographic characteristics are similar to other studies on the target population (Warner et al., 2017).

**INSTRUMENTATION.** The first part of the instrument contained screening questions to ensure respondents were 18 years or older, lived in the United States, had irrigation systems in their home landscape, and controlled their home landscape irrigation. Those who did not meet these criteria were excluded from this study. The next part of the instrument measured the study's eight independent variables which were

the perceived benefits attained from the landscape. These eight researcher-developed perceived landscape benefits variables were monetary, food, habitat, well-being, aesthetic, social, health and comfort, and environmental. We developed these categories following literature on ecosystem services (Brown, 2006; Carpenter et al., 2003; Fisher et al., 2009; Zube, 1987), which we modified to fit the urban landscape context.

We measured each benefit index by calculating the grand mean of several individual statements (Table 1). We presented respondents with a single statement ("I value my home landscape because it:") with possible responses next to a 5-point scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree). Therefore, each benefit index could potentially range from 1.00 (low perceived benefits) to 5.00 (high perceived benefits). The benefits were not mutually exclusive, and it was possible for respondents to indicate that they perceived landscape benefits in all categories.

In the next part of the survey, we measured the two dependent variables, intent to adopt irrigation best practices (irrigation intent) and intent to adopt fertilizer best practices (fertilizer intent). We used "intent" to measure behavior because people who intend to do something are considered more likely to do so (Ajzen, 1991), and we wanted to examine potential behavior changes that extension professionals may find useful for irrigation and fertilization programs. For both of these variables, we used a single statement to allow participants to indicate how likely or unlikely they were to engage in five irrigation and four fertilizer behaviors in the future. We developed the statements from the common best management practices recommended by extension landscaping programs. First, common recommended practices were compiled from extension publications, and then items were constructed to reflect those activities pertinent to proper fertilizer and irrigation practices. Participants completed this section using a 5-point scale (1 = very unlikely, 2 = unlikely, 3 = undecided, 4 = likely, and 5 = very likely). We measured intent by calculating the grand mean of five individual statements for irrigation intent and four individual statements for fertilizer

intent (Table 2). Each intent index ranged from 1.00 (low behavioral intent) to 5.00 (high behavioral intent).

We used an expert panel to establish face and content validity, or how well the survey instrument measured what it was designed to measure and how well the survey items represented the intended constructs (Field, 2013; Hardesty and Bearden, 2004; Haynes et al., 1995). The panel of experts included people who specialized in water-focused extension programming, agricultural communications, agricultural and biological engineering, and survey methodology. The panel of expert reviewed the instrument for relevance and representativeness of survey items in measuring targeted constructs, and also examined whether items reflected what they were designed to measure. On the basis of the panel expert review, we made minor changes to the survey instrument. The research protocol was then reviewed and approved by the University of Florida Institutional Review Board before we began the study.

**PILOT TEST.** Before data collection, a pilot study was conducted to ensure reliability as well as accurate interpretation of the survey questions. One hundred responses were collected in the pilot test. A common measure for scale reliability is Cronbach's  $\alpha$ , where an  $\alpha$  value of at least 0.700 is considered acceptable (Field, 2006). For each landscape benefit index, Cronbach's  $\alpha$  exceeded 0.745. For fertilizer intent, Cronbach's  $\alpha$  was 0.825; and for irrigation intent, Cronbach's  $\alpha$  was 0.947, indicating high scale reliability for all variables.

**DATA ANALYSIS.** Given an uneven distribution of responses with respect to independent variables (perceived benefits), and dependent variables (intent), little could be stated about each response category using the initial ordinal 5-point scale. Although a category with too few values can be used to isolate a few abnormal cases, the redefinition of categories is recommended so responses are evenly distributed for each variable (Pasta, 2009). For this reason, we converted all independent variables (eight benefits) and dependent variables (fertilizer intent and irrigation intent) to a binary (0, 1) scale to reduce the number of categories with too little data due to lack of variation in

**Table 1. Statements used to measure perceived landscape benefit categories in a study examining the relationship between landscape benefits and best fertilizer and irrigation practices.**

Perceived landscape benefits index	Individual benefits statements <sup>z</sup>
Aesthetic	Enjoyable to look at Screens unwanted views Aesthetically pleasing
Environmental	Decreases erosion Absorbs pollutants
Food	Increases air quality Provides fruits or vegetables Is a source of food
Habitat	Provides a place to garden Attracts desired wildlife Supports pollinators Provides a home for birds
Health and comfort	Improves health Reduces noise Increases privacy Provides oxygen
Monetary	Increases my property value Helps me to save money Increases my home's resale value
Social	Show my neighbors that I care Increases sense of community Provides a place to socialize Encourages conversations with neighbors Provides a space for family to gather
Well-being	Provides a place for recreation Is a place to relax Is a source of inspiration Provides a sense of place

<sup>z</sup>Individual benefits were measured by completing the phrase "I value my landscape because it ..." along a 5-point Likert-type scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree).

**Table 2. Statements used in fertilizer and irrigation intent in a study examining the relationship between landscape benefits and best fertilizer and irrigation practices.**

Index	Statements comprising intent index <sup>z</sup>
Irrigation intent	Prevent irrigation when it is raining Conserve water by reducing irrigation Follow good irrigation practices Irrigate only when needed Irrigate properly to reduce water use
Fertilizer intent	Apply fertilizers carefully to prevent their leaching Reduce the application of fertilizers to lawn Engage in good lawn fertilization practices Prevent spilling of fertilizers on paved surfaces

<sup>z</sup>Intent responses were collected on a 5-point Likert-type scale (1 = very unlikely, 2 = unlikely, 3 = undecided, 4 = likely, and 5 = very likely).

responses and a negatively skewed distribution. For the benefits variables, we converted scores that ranged from 1.00 to 3.99 (strongly disagree, disagree, and neither agree nor disagree) to 0 (where 0 = perceived value of landscape benefits not present), and scores that ranged from 4.00 to 5.00 (agree and strongly

agree) to 1 (where 1 = perceived value of landscape benefits present). We converted the intent variables such that scores ranging from 1.00 to 3.99 (very unlikely, unlikely, and undecided) to 0 (where 0 = unlikely to engage or absence of intent) and scores that ranged from 4.00 to 5.00 to 1 (where 1 = likely to engage or presence of intent).

Conversion of the data aided in greater accuracy in interpretation (Pasta, 2009). Following this conversion, we used a binary logistic regression model to estimate the relationship between perceived landscape benefits (independent variables) and intent (dependent variables). We conducted all analyses at a level of significance  $\alpha = 0.05$ .

For ease of interpretation of the logistic results, the predicted odds ratio by both models was converted to a percent. Given that there are two possible outcomes, the odds of one (intent to engage in good landscape practices) occurring is 50%. For landscape benefits that had positive impacts on intent to engage in best landscape practices, the predicted engagement percent was more than 50%. For landscape benefits that had negative impacts on intent to engage in best landscape practices, the predicted engagement percent was less than 50%.

## Results

**DESCRIBE PERCEIVED LANDSCAPE BENEFITS.** Most respondents perceived moderate-to-high landscape benefits in all eight categories (Table 3). However, the highest perceived benefits among respondents were aesthetics [84.3% (n = 455)] and well-being [70.7% (n = 382)], meaning the greatest number of respondents valued their landscapes for these benefits. Social [48.3% (n = 261)] and monetary benefits [53.0% (n = 286)] were the lowest perceived landscape benefits, meaning the fewest number of respondents valued their landscapes for these benefits.

**RELATIONSHIP BETWEEN PERCEIVED LANDSCAPE BENEFITS AND IRRIGATION BEST PRACTICES.** When we examined the relationship between perceived landscape benefits and engagement in irrigation best practices, we found six of the eight benefits (habitat, health and comfort, environmental, food, social, and well-being) increased irrigation intent, meaning those who perceived their landscape offered these benefits were more likely to engage in irrigation best practices (Fig. 1). Given an initial engagement rate of 50% (where values above 50% represent increased engagement and values below 50% represent decreased engagement), those who perceived their landscape provided habitat benefits were most likely to engage in irrigation

best practices, estimated at an engagement rate of 65.4%. Similarly, those who perceived their landscape provided health and comfort benefits were also likely to engage in irrigation best practices, estimated at an engagement rate of 64.6%. Perceived value of monetary and aesthetic benefits had a negative impact on engagement in irrigation best practices. When respondents perceived their landscape provided monetary benefits, their predicted engagement in irrigation best practices was reduced to 36.0%. When respondents perceived their landscape provided aesthetic benefits, their predicted engagement in irrigation best practices was reduced to 42.3%.

**RELATIONSHIP BETWEEN PERCEIVED LANDSCAPE BENEFITS AND FERTILIZATION BEST PRACTICES.** When we examined the relationship between perceived landscape benefits and engagement in fertilization best practices, we found six of the eight benefits (environmental, well-being, food, habitat, social, and aesthetic) increased fertilizer intent, meaning those who perceived their landscape offered these benefits were more likely to engage in fertilization best practices (Fig. 2). Given an initial rate of 50% (where values above 50% represent increased engagement and values below 50% represent decreased engagement), those who perceived value of environmental benefits were most likely to engage in fertilizer best

practices, estimated at 80.5%. However, perceived value of health and comfort had a negative impact on engagement in fertilizer best practices, reducing estimated engagement rate to 47.2%. Monetary benefits also had a negative impact on fertilizer best practices, reducing estimated engagement rate to 41.6%.

## Discussion

Many extension professionals who focus on water issues do so by encouraging clientele to adopt technologies and practices that positively affect water quality and availability. Extension can positively affect water quality by encouraging clients to fertilize plants when they are actively growing and choose the appropriate fertilizer placement, formulas, and rates (Carey et al., 2012; Shoher et al., 2010). Extension can positively affect water availability by encouraging clientele to use alternative water sources, adjust irrigation scheduling, and use precise irrigation technologies so water use can be minimized (Shoher et al., 2010).

The most promising strategies to change water stewardship behaviors are those that relate to personal values (Saurí, 2013) and the “first step toward improving water quality and conservation in urban watersheds is to carefully evaluate fundamental perceptions and practices of homeowners in watering their lawns” (Bremer et al., 2012). This study revealed relationships between perceived landscape benefits and landscape best management practices. Therefore, this work completed a first step in designing social marketing behavior change programs that appeal to perceived landscape benefits.

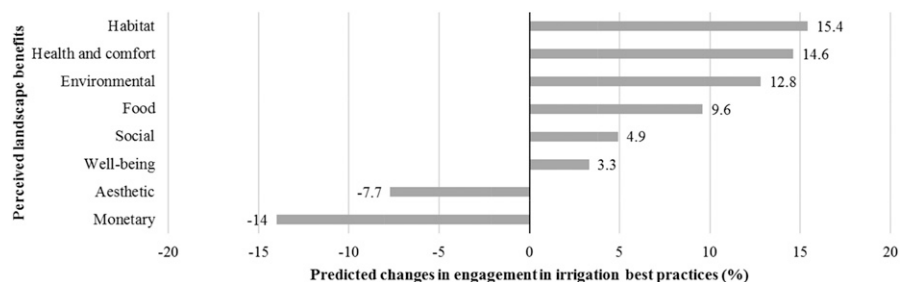
The findings revealed urban residents who believe their landscapes offer habitat benefits are most likely to engage in irrigation best practices, whereas those who believe their landscapes offer monetary benefits are least likely to engage in irrigation best practices. The findings also indicated those who believe their landscape offers environmental benefits are most likely to engage in good fertilization behaviors, whereas residents who believe their landscape provide monetary benefits are least likely to engage in good fertilization behaviors.

**Table 3. Perceived landscape benefits in a study examining the relationship between landscape benefits and fertilizer and irrigation best practices.**

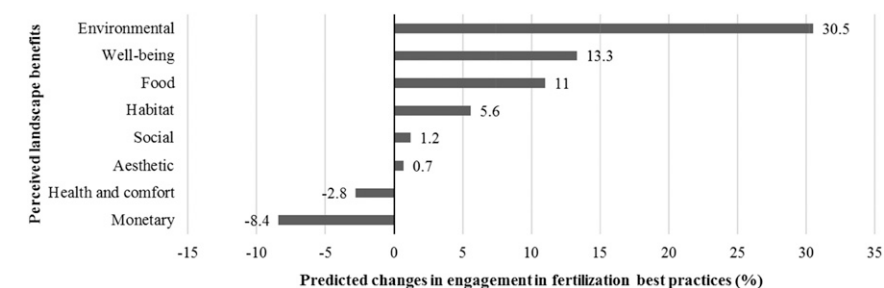
Variable	Respondents (no.) <sup>z</sup>	Respondents (%) <sup>y</sup>
Aesthetic	455	84.3
Well-being	382	70.7
Health and comfort	345	63.9
Environmental	329	60.9
Habitat	296	54.8
Monetary	286	53.0
Food	269	49.8
Social	261	48.3

<sup>z</sup>Frequency of respondents who perceived value from landscape benefits.

<sup>y</sup>Percentage of respondents who perceived value from landscape benefits.



**Fig. 1. Relationship between perceived landscape benefits and predicted increase or decrease in engagement in irrigation best practices.**



**Fig. 2. Relationship between perceived landscape benefits and predicted increase or decrease in engagement in best fertilization practices.**

Perceptions of home landscapes' environmental and habitat contributions are significant in residents' landscape management practices. However, perceptions that residential landscapes serve a financial purpose somehow serves as a barrier to engagement in good landscape management practices. Returning to the application of a promising behavior change approach, social marketing, extension professionals should design programs that appeal to the landscape benefits residents value when encouraging desired irrigation or fertilizer behavior changes. Extension professionals should communicate how these behavior changes are compatible with and can enhance these valued benefits.

The most strongly perceived benefits were not the most influential on fertilizer and irrigation behaviors, and therefore, extension professionals should stress perceived benefits that are most influential on behavior while emphasizing that landscape management best practices are compatible with those benefits residents value most. For example, aesthetics is the most valued landscape benefit, but this benefit is not very influential on landscaping practices. Environmental benefits were most influential on behavior, but perceived by only  $\approx 61\%$  of respondents. Extension professionals should specifically help people understand that individual landscapes contribute to the environment, and adopting irrigation and fertilization best practices does not adversely affect visual quality.

When people value their landscape for habitat benefits (e.g., providing shelter and food for animals) they are most likely to engage in water conservation behaviors. Therefore, extension can help promote irrigation best practices by targeting people who are interested in pollinators, birds, and other animals. An extension program might help people appreciate how their landscapes support habitat while conveying how the use of appropriate water application is compatible with aesthetics.

People are generally able to connect landscape irrigation and fertilization behaviors with impact on the environment, but there is a difference between how perceived environmental benefits are interpreted for fertilization and irrigation behaviors. People are

most willing to adopt fertilizer best practices when they believe their landscapes provide environmental benefits. This implies people may be somewhat less aware of how irrigation behaviors affect the environment (e.g., water quantity) and more aware of how fertilization behaviors affect the environment (e.g., water quality). Extension can help to correct this disconnect by educating clientele on the relationship between landscape management practices and both water quality and quantity.

We found that when people believe their landscape contributes to a larger system beyond the household (e.g., environment, habitat) they are more likely to use landscaping best practices, while people who valued landscape benefits that do not extend beyond the household (e.g., monetary) were less likely to do so. The fact that people who understand their landscape practices contribute to a larger system are more likely to take action to protect water bodies aligns with Steg and Vlek (2009). Extension should educate clientele on how individual landscapes connect to causes beyond the household on larger scales, such as their contribution to watershed health.

People who value their landscape's monetary value may be more resistant to adopting water conservation practices than fertilizer practices. These individuals may strongly associate irrigation with landscape value and consequently water conservation as detrimental to the landscape. Therefore, extension should help clientele understand how low-water landscapes can positively contribute to property values as well as save money for the household.

We found that people associate irrigation best practices with negative consequences to landscape aesthetics and fertilizer best practices with positive consequences on landscape aesthetics. Although others have identified negative relationship between aesthetic values and environmental behavior (Askew and McGuirk, 2004; Cook et al., 2012; Larson et al., 2009), our results support this finding for irrigation best practices but not for fertilization best practices. From this finding, we concluded people do not connect best landscape irrigation practices with attractive landscapes and thus there is a need to help

residents understand water-saving landscapes can be aesthetically pleasing. Therefore, if extension professionals can help people see that best irrigation management practices can produce aesthetically pleasing landscapes, they can promote water conservation in the landscape. For example, there are many different types of low-water landscape design and low-water plants of which extension clients may not be aware.

Best landscape management programs should be designed based on the audience's values. Extension may target people who value environmental and habitat benefits because these individuals indicated the greatest likelihood of adopting landscaping best practices. Extension professionals can consider using the framework presented here to guide program planning activities. Before a program, they can identify the benefits extension clients perceive and design the program to build on the identified benefits. Alternatively, the audience might be educated to appreciate some of the other values. Extension programs can target those who do not see their values as being compatible with water conservation or fertilization best practices and work to correct the disconnect between some landscape values and landscape best management practices.

In this study, we examined how the individual landscape benefits perceived by home irrigation users influenced their intent to engage in irrigation and fertilization best practices. Future research can examine how these benefits interact with one another to influence irrigation and fertilization behaviors. Identifying perceived landscape benefits is one way to understand landscape practices, and other variables such as attitude toward water quality and quantity, and normative beliefs can enhance this understanding. Future researchers can segment home irrigation users by their landscape benefits to develop a typology of the home landscape "consumer" so they can better understand and promote engagement in water quality and quantity protection behaviors.

Future studies should explore the different benefits dimensions more deeply. Although we considered monetary benefits to include both saving money and increasing

property values, and found a negative relationship with fertilizer and irrigation best practices, there may be more than one monetary dimension that could reveal important information about these behaviors. It is possible that if there is more than one monetary dimension, they might not both be negatively related to engagement in good fertilizer and irrigation practices. We also did not examine how the cost or perceived value of water may influence the perceived monetary benefits and corresponding landscape practices, and the possible relationship needs to be further explored. Different intent statements and corresponding variables could be used in future research. A qualitative approach may also be used to determine if there are important benefits categories that were not included in this study.

Future research should further explore how these benefits relate to peoples' perceptions of water resources in terms of effect on their quality and quantity. Another possible approach is examining the relationship between residents' type of landscape and perceived benefits obtained from the landscape. Finally, we looked only at future irrigation and fertilization practices, and research should explore the relationship between perceived landscape benefits and current irrigation and fertilization practices.

## Conclusions

In this research, we took a perspective informed by social marketing and used perceived landscape benefits to explain landscape irrigation and fertilization behaviors to inform extension educational strategies. The results revealed a relationship between perceived landscape benefits and landscape irrigation and fertilization best practices. Among the benefits, environmental, well-being, food, habitat, and social benefits were positively associated with good landscape practices, whereas monetary benefits had negative relationship with fertilization and irrigation intent. Among all landscape benefits, environmental benefits substantially increased engagement in fertilization best practices, whereas habitat benefits substantially increased engagement in irrigation best practices. Perceived monetary benefits decreased engagement in fertilization and irrigation best practices the most. To promote

irrigation and fertilization best practices, extension professionals should target people who value environmental landscape benefits as well as correct the disconnect between some landscape benefits and good irrigation and fertilization practices.

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