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Research Note

Florida residents' perceived role in protecting water quantity and quality through landscape practices

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ABSTRACT

As in many places in the world, the state of Florida in the United States (U.S.) faces important water scarcity and quality issues due to a changing climate and growing population. Many organizations work to encourage appropriate landscape fertilization and irrigation practices to address these issues but factors that influence residential landscape management behaviors are not fully understood. This study employed quantitative survey methodology to evaluate differences in the factors that influence engagement in good landscape practices: Floridians' attitudes, perceived subjective norms, and perceived behavioral control towards good fertilization and irrigation practices. We found more positive attitudes, stronger social support, and greater perceived behavioral control surrounding water conservation compared to water quality protection. We also examined intent to engage in specific fertilization and irrigation practices, finding varied levels of intent exist. These results revealed an opportunity for landscape professionals to correct disconnects by helping residents understand their personal impact on water quality while providing support for the overall high attitudes, subjective norms, and perceived behavioral control toward good irrigation and fertilization behaviors.

1. Introduction

Professionals who plan and design landscapes and educate residents about landscape best management practices play an important role in helping citizens use research-based irrigation and fertilization practices and technologies. However, residents need to understand that their landscape practices do influence both water quality and quantity in order to choose good fertilization and irrigation techniques. People often view their home and neighborhood as a public portrayal of themselves (Nassauer, 1995) and see their front yard as a visible external symbol (Larsen & Harlan, 2006). In the state of Florida, U.S., residents' beliefs regarding the need for a green, lush lawn is extensive with it portraying the Florida lifestyle − one of year-round leisure and luxury (Huang, Lamm, & Dukes, 2016).

Floridians use an excessive amount of water in their home landscapes to maintain their desired public image. Florida landscapes are characterized by the state's year-round growing season with no clear winter (Romero & Dukes, 2014). The potential for residential landscapes to adversely affect water resources in Florida is exacerbated by a population growing at twice the rate of the rest of the U.S. (U.S. Census Bureau, 2015) coupled with a demand for aesthetically-pleasing landscapes (Shober, Denny, & Broschat, 2010) and the fact that most new homes have an in-ground irrigation system (Haley & Dukes, 2012). In fact, in 2014 public water supply demand exceeded agricultural water demands in the state of Florida (Florida Department of Environmental Protection, 2014).

Florida residents consume an incredible 134 gallons (507 liters) of water per person per day, and about half of this amount goes toward irrigating lawns and landscapes (Marella, 2014; South Florida Water Management District, 2008). Further, about half the water applied as irrigation may be lost to runoff caused by overwatering and evaporation (South Florida Water Management District, 2008). Available practices and technologies to reduce the impact of residential landscapes on water resources include seasonally adjusting irrigation controllers, reducing runoff from the landscape, modifying the landscape to need less water, using micro-irrigation, irrigating with alternative water sources, and using appropriate fertilizer products and rates to maximize plant uptake (Carey et al., 2012; Haley, Dukes, & Miller, 2007; Kjelgren, Rupp, & Kilgren, 2000; Shober et al., 2010). In addition, counties within the state of Florida have enacted watering restrictions where residents will be fined if they irrigate outside of the allotted watering time periods and fertilizer blackout dates when fertilizer cannot be

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applied to the landscape (Ryan, 2017).

Recent research indicates many residents are aware of the need to conserve water to preserve the social, environmental, and financial benefits it provides (Huang, Lamm, & Dukes, 2017; Leal, Rumble, & Lamm, 2015; Ryan & Lamm, 2017; Warner, Lamm, Rumble, Martin, & Cantrell, 2016). Research has also shown residents perceive water quality as important but feel less connected to being able to directly impact water quality issues with their own behavior than water quantity (Leal et al., 2015). Huang and Lamm (2015) found very few Floridians have experienced negative water quality issues, finding those that have are much more aware of their own behaviors associated with protecting water quality and willing to take action. Perhaps ownership over water conservation is more personal to Floridians while deteriorating water quality is seen as something they do not impact directly even though their fertilizer practices could be having a negative effect. Given this is largely unexplored in the literature, a study examining perceptions of both water quantity and water quality side by side could provide insight into public sentiment and behavioral engagement to mitigate the impacts of excessive water use and provide guidance on educating about proper fertilizer use.

Pro-environmental behaviors such as using good fertilizer and irrigation practices can be described by framing those behaviors as reasoned choices (Steg & Vlek, 2009). One such framework is known as the Theory of Planned Behavior (TPB; Ajzen, 1991), which explains people are most likely to intend to adopt a practice when they have a positive attitude toward it, believe they have the ability to adopt it (perceived behavioral control), and have social support (subjective norms) surrounding it. When people have intent to engage in a water protection practice, they are more likely to do so (Gao, Babin, Turner, Hoffa, Peel, & Prokopy, 2016).

Attitudes are the positive or negative values an individual associates with a behavior (Ajzen, 1991). Subjective norms refer to how much individuals perceive the people who are important to them approve of the behavior (Ajzen, 1991). Perceived behavioral control refers to the level of ability someone believes they have to adopt a behavior (Ajzen, 1991). In the context of landscape management practices to protect water resources, when attitudes are positive, subjective norms are strong, and perceived behavioral control is high surrounding residential landscape behaviors (e.g., seasonally adjusting irrigation controllers and using appropriate fertilizer products and rates to maximize plant uptake), it is expected residents will intend to engage in good landscape practices (Warner, Rumble, Martin, Lamm, & Cantrell, 2015). Greater intent to engage in good fertilization and irrigation practices is likely to lead to actual engagement in the behaviors.

An understanding of these variables, as they relate to water availability and quality behaviors, could provide valuable insight into strategies landscape professionals and educators can use to encourage good irrigation and fertilization practices. Specifically, the research could identify effective education and outreach strategies as well as specific behaviors programs should address going forward. Further, evaluating factors that influence water protection behaviors in a state with a year-round growing season could inform the focus and increase efficacy of behavior change programs with application on a much larger scale.

2. Purpose and objectives

To better understand home irrigation users, we examined TPB characteristics related to the use of appropriate irrigation practices to protect water availability and appropriate fertilizer practices to protect water quality. The specific objectives were to compare respondents' a) attitudes toward water quantity behaviors and water quality behaviors; b) perceived subjective norms surrounding water quantity behaviors and water quality behaviors; c) perceived behavioral control over water quantity behaviors and water quality behaviors; and d) describe respondents' intent to engage in specific water quantity behaviors and water quality behaviors.

3. Materials and methods

We implemented a Florida statewide research study with individuals who used irrigation in the home landscape. Almost half of the respondents in the study had turfgrass (42.3%) and annual flowering plants (50.0%) in their landscape (Kumar Chaudhary & Warner, 2017). Due to unavailability of an existing sampling frame of individuals who used irrigation in the home landscape in Florida (Warner et al., 2015), a web-based survey sampling company recruited a purposive sample (N = 2100) for our research in December 2016. In the absence of an existing sampling frame, non-probability samples can provide either comparable or sometimes better results compared to probability-based samples (Twyman, 2008; Vavreck & Rivers, 2008).

We used a web-based survey sampling company to invite 12,802 Floridians to participate in our survey. Potential participants were identified through their membership in the company's research panel or members of one of the company's partners. After four screening questions (age above 18 years, Florida residents with lawn/landscape and irrigation, presence of an irrigation system, and residents' control over irrigation), 5326 were considered eligible to complete the survey. With 2100 complete responses, the participation rate was 39.4% (Baker et al., 2016).

We used a researcher-developed instrument to examine attitudes, subjective norms, and perceived behavioral control related to both water quality (WQL) and water quantity (WQN). The survey items for these constructs were adapted from established survey instruments (Kumar Chaudhary, Warner, Lamm, Israel, Rumble, & Cantrell, 2017; Warner et al., 2015, 2016) and in addition we used a panel of experts to establish face and content validity. We used semantic differential scales to develop the water quality and quantity attitude and perceived behavioral control indexes and Likert-type scales to develop the subjective norm indexes (Table 1). To ensure respondents understood the terms used in the survey, we defined *good irrigation practices* (the efficient use of water during irrigation to prevent wasting water) and *good fertilizer practices* (selecting the right type of fertilizer and applying it at the right time and in the right amount for maximum plant uptake and benefit).

We calculated reliabilities *ex-post facto* and found Cronbach's alpha values of 0.84 or higher, which provided evidence that the scales were suitable for use (Santos, 1999). We analyzed the data by first calculating descriptive statistics for each of the six indexes and then comparing corresponding WQL and WQN variables using paired sample t-tests. We also measured behavioral intent to engage in 13 specific landscape water conservation (WQN) behaviors and 10 responsible fertilizer use (WQL) behaviors on a five-point Likert-type scale (1 = *very unlikely* to 5 = *very likely*). The behaviors were selected from commonly used, research-based landscape best management practices that are promoted statewide for the purpose of protecting water resources. For ease of interpretation, we combined these responses so lack of intent was captured by one category (*very unlikely* and *unlikely* responses) and presence of intent was combined into another (*likely* and *very likely* responses). We analyzed this data by calculating frequencies and percentages.

3.1. Respondents' demographics

Just over half of the respondents (56.5%, n = 1186) were female, which is slightly more than that of the general Florida population in 2016 (51.1%). On average, respondents were 47 years old which is older than the median age (41) of Floridians as of 2012 (EDR, 2013). More of our sample described themselves as white (88.0%, n = 1849) compared to Florida census (77.6%, U.S. Census Bureau, 2015). Most of the respondents owned their home (86.4%, n = 1814) compared to 65.3% per the Florida census. Just over half (51.8%; n = 1086) had a 4-year college degree or higher level of education, which is almost double the Florida average (27.3%; U.S. Census Bureau, 2015). Nearly half (47.7%; n = 1002) of the respondents were members of a homeowners'