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Preferences for Sustainable Residential Lawns in Florida: The Case of Irrigation and Fertilization Requirements

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Abstract: The American landscape is well defined by the presence of turfgrass. To maintain the lush, green carpet, irrigation, fertilizer, and other necessary inputs are required. When these inputs are excessively applied, which is not uncommon, they are harmful to the natural environment. To mitigate potential adverse impacts, local and state governments are interested in policies that incentivize homeowners to maintain their lawns sustainably. But are there homeowners who are environmentally conscious and are willing to minimize their use of fertilizers or water? In this study, we evaluate the Floridian homeowners' preferences for high- and low-level inputs of irrigation water and fertilizer using latent class logit (LCL) regression models based on data collected from an online choice experiment survey. Results indicated that there are heterogeneous preferences for the level of irrigation water and fertilizer application by Floridian homeowners, including high-input users (33% of the sample), irrigation-conscious users (27%), fertilizer-conscious users (23%), and moderate-input users (17%). The policy and marketing implications for relevant stakeholders are discussed.

Keywords: homeowner preference; turfgrass inputs; irrigation; fertilizer; choice experiment; generalized multinomial logit; latent class logit

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1. Introduction

Turfgrass is an integral part of American urban landscapes. Yet, improper practices with excessive use of inputs to make the grass aesthetically pleasing and maintain its healthy condition can be detrimental to the local ecosystems [1–6]. To minimize potential environmental impacts, state and local governments develop and implement programs designed to incentivize homeowners to adopt alternative landscapes that require relatively less input with less turfgrass area [3,4]. Therefore, it is necessary to estimate homeowners' preferences for different levels of input into the two major areas of environmental detriment: irrigation and chemical fertilization. The prevalence of the turfgrass lawn in the U.S. is also evidenced by turfgrass covering more acreage than any other agronomically irrigated crop in the U.S. [7,8]. Sixty-one million U.S. households participated in lawn care activities in 2017, amounting to over USD 11.8 billion in total retail sales [9].

To maintain these vast lawns, proper maintenance of turfgrass is essential, including providing adequate micro- and macronutrients, water, and space for the plants to grow. Many residential lawns are managed using inputs such as irrigation, fertilizers, and pesticides to optimize growth and control pests [10]. Maintaining these areas up to the standard required to fulfill today's aesthetic norms requires extensive irrigation, mowing, and chemical usage [11–13]. As a result, practices such as excessively fertilizing and irrigating have come under scrutiny pertaining to water quality and quantity [1,2]. This is in part due to widespread incorrect or misunderstood maintenance practices and their potential negative effects on the environment and human health, and the growing water use of urban landscape irrigation in states such as Florida [3,4].

The success of reduced pollution in the water system is partially governed by homeowners' obedience to regulations and recommendations as well as their knowledge of lawn care, the condition of their lawns, and their considerations for environmentalism and future consequences in general. Concerns for the environment are generally more highly regarded by consumers. In fact, literature has shown that consumers are willing to pay price premiums for environmentally friendly goods and services [14–19]. Yet, urban homeowners prioritize multiple attributes including lawn attractiveness, ease of maintenance, and cost [5,6].

We seek to focus on the two main considerations (low irrigation and fertilization) that are the key components of sustainable urban landscape management in Florida. Previous literature has looked at these attributes but has not looked at them together for warm-season species [20–22] and has not considered whether they can be parsed out by categorizing the consumers and evaluating them by their demographics and lawn care practices. In this study, we hypothesize that among the latent classes, there will be heterogeneous preferences for irrigation and fertilization desires and a difference in the willingness-to-pay (WTP) for these attributes. Additionally, we hypothesize that homeowners who are more knowledgeable about turfgrass requirements will desire options that require lower inputs of fertilizers and irrigation. To achieve these goals, a discrete choice experiment was conducted with Floridian homeowners via online surveys. Discrete choice experiments have been widely used to infer consumer preferences for turfgrass attributes (e.g., Yue et al. [20], Yue et al. [21]) and environmentally friendly landscape features (e.g., Zhang and Khachatryan [14,23,24]).

2. Literature Review

Maintaining turfgrass in residential landscapes provides environmental, societal, and economic benefits. Yet, due to the excess inputs associated with inappropriately maintained lawns, there are environmental and societal concerns with maintaining turfgrass. The following sections summarize environmental, social, and economic benefits, followed by a discussion on the associated potential risks for humans and the environment.

2.1. Benefits Associated with Maintained Urban Landscapes

2.1.1. Environmental Benefits

Turfgrass moderates temperature in the landscape through evaporative cooling properties. This process dissipates the radiant heat and mitigates heat island effects, especially in urban areas [25–28]. Turfgrass can also help stabilize the soil by reducing water runoff, recharging the groundwater resources, and reducing soil erosion [29,30]. Specifically in urban centers and underutilized areas, turfgrass can maintain the soil profile and mediates harmful compounds in the environment by absorbing atmospheric pollutants produced through human-driven activities [31,32]. Mowing at lower frequencies can have a moderate effect on arthropod diversity and abundance in the landscape [33].

Encouraging the use of low-input landscapes is one step towards reducing resource depletion and potential environmental harm from improper maintenance practices [20,34,35]. Khachatryan et al. [35] found that environmentally friendly fertilizer attributes positively influence homeowners' preferences and WTP for lawn fertilizers. This was analogously found by Campbell et al. [36], who showed that lawn fertilizer attributes strongly influence respondents' likelihood of selecting different brand options. Conversely, price, N–P–K ratio, and effectiveness longevity (i.e., slow-release N) negatively impacted selection, but price and brand play a vital role in the selection of the fertilizer [36].

Previous studies show that homeowners highly value and prefer low input in turfgrass [20,21,37]. Building upon these findings, Yue et al. [21] studied preference heterogeneity in the demand for low-input, cold-season turfgrasses using a latent class logit (LCL) model. The consumers were categorized into three different classes: "*Balanced consumers*", "*low-input-conscious consumers*", and "*appearance-conscious consumers*". Additionally, consumers' preferences were greatly influenced by the maintenance requirement attributes.

Overall, water usage and fertilizer requirements were two of the most influential attributes for consumers, as indicated by high willingness-to-pay (WTP) premiums. This indicates that there is a strong demand for turfgrass species that can tolerate lower levels of water inputs. In addition, Ghimire et al. [22] conducted an LCL regression on warm-season turfgrass attributes including winterkill, shade tolerance, water requirements, maintenance costs, and saline tolerance. They found through a two-class LCL model that two types of consumers emerged: "*willing hobby gardeners*" and "*reluctant mature homeowners*". Overall, there was a preference for low water input and maintenance inputs with a desire for shade tolerance. When given the choice between artificial turf and natural turf in public spaces, homeowners had an affinity for the natural turf, calling for municipalities and breeding programs to assess the suitability of low-input natural turfs [38]. These studies demonstrate homeowners' preferences for different markets and the desire for different levels of inputs, turfgrass features, and turfgrass varieties, and displayed market heterogeneity in preferences for those traits.

2.1.2. Social and Human Health Benefits

Turfgrass has both direct human health benefits and benefits that affect society. Greenspace, especially turfgrass, provides communities with accessible and safe environments for exercise and socialization [39]. Green areas that have turfgrass are associated with enhanced creativity, intelligence, and cognitive ability in children [40–42]. People who have easy accessibility to greenspaces are more likely to lead a more physically active lifestyle and have a reduced risk of chronic diseases, such as hypertension and heart disease [43,44]. They also are more likely to have a lower body mass index [45,46]. Being near more urban greenspace is associated with fewer days of mental health complaints [47]. Having proximity to greenery provides a sense of tranquility and is associated with a reduction in stress and symptoms of depression [40,43,48]. Keeping "large, mowed areas" provides a unique sense of satisfaction for many people [49].

Turfgrass has been shown to decrease vehicle noise levels by 40% at 70 feet [50,51]. This noise abatement can be further augmented with trees and shrubs to provide a quieter neighborhood and home space. It creates a sense of communal space for neighborhood gatherings and community events. This improves social ties, community engagement, and overall quality of life [52]. Greenspace is inversely related to the incidence of crime, especially in urban areas where there was less vandalism, graffiti, and litter than in non-vegetated areas [53–55].

2.1.3. Economic Benefits

A well-maintained lawn will increase property value and homeowners' perceived valuation of their properties [24,56]. When landscape quality is improved, it can increase the home price by 17% [57]. Other documentation shows that a 1% increase in greenspace within approximately 250 feet of the residence increases the sale price of the property by 0.07% [58]. Lawns not only provide more value to properties but also mitigate costs by reducing air-conditioning energy needs [59,60].

2.2. Risks Associated with Maintained Urban Landscapes

2.2.1. Environmental Risks

Due to the high desire for rich green lawns, there are environmental concerns associated with turfgrass, including chemical runoff from fertilizers and pesticides which can affect the environment.

Turfgrass fertilizer has been connected to non-point-source water pollution. This has led to algal blooms and depleted oxygen levels in waterways [13,61–65]. Badruzzaman et al. [66] reviewed actions that lead to nutrient enrichment in water bodies in Florida and found that fertilizer type and its application (amount/frequency), irrigation, and rain frequency affect the level of nutrient leaching from residential lawns. Furthermore, the state of Florida has put into place regulations that control fertilizer use on residential turfgrass to reduce non-point-source pollution [67].

Due to climate change, droughts, urbanization of the population, and increasing demands on groundwater resources for human consumption, limitations have been put into place to restrict turfgrass irrigation in many cities to reduce the water demand during scarcity and for long-term longevity [68,69]. This includes the objective to flatten the peak in outdoor water usage demand by local water management agencies [70].

Seventy percent of urban water is used for maintaining landscape plantings [71]. Indoor water usage remains stable throughout the year, but outdoor water usage fluctuates depending on seasonality and the outdoor activities of the homeowner [72]. Householders using less water had a greater concern for conservation issues, local concerns, and the future preservation of water resources [73]. When given information about their water usage, households with inaccurate water assumptions made changes to their future water usage [74]. The findings of these studies suggest that people have a disinclination to engage in pro-environmental behaviors if they have a knowledge deficit.

2.2.2. Human Exposure Risks

A large perceived risk associated with maintained turfgrass is pesticide exposure and toxicity. There is a common fear of pesticides causing cancer. For example, the herbicide 2,4-D, one of the most commonly used lawn herbicides, is perceived as a carcinogen, and concerned groups seek to ban its use [75]. Yet, there is a general lack of substantial evidence that using correctly administered lawn pesticides leads to injury in humans or pets [76,77]. Regardless of the lack of clear evidence, the fear for human health led to calls for the reduction and elimination of the use of these pesticides on turfgrass [65,78]. Pesticides pose the greatest risk to the pesticide handler, whereas most of the public exposure to pesticides is insufficient to elicit a harmful response [79].

A much more common and less considered risk is lawn mower injuries. Each year, the number of injuries associated with lawn mowers ranges from 20,000 to 100,000, and some of these injuries include amputation [80].

2.2.3. Homeowner Lack of Knowledge

Another risk associated with maintained turfgrass is the general lack of knowledge of how to care for turfgrasses or handle associated equipment correctly. In the previous sections, we have discussed that more knowledgeable individuals are more pro-environmental and desire lawns with lower levels of inputs (irrigation and fertilizer). Lawn maintenance-related knowledge has also been shown to drive consumer preferences for different landscapes and influence the adoption of environmentally friendly landscapes. On average, high landscape care knowledge of turfgrass care and requirements increased the perceived aesthetic appeal and decreased perceived maintenance scores [5,81,82].

Yet, there is considerable heterogeneity in consumer preferences, including the lack of desire for low-input landscape options [3,71,83,84]. Khachatryan et al. [5] showed a related example, where consumers perceived a greater area of the landscape containing designed landscape plants (i.e., annual bedding plants and flowering perennials) as being easier to maintain than a landscape containing less turfgrass and more ornamental plants. Additionally, Khachatryan et al. [5] showed that there was an inverse relationship between perceived maintenance and aesthetic appeal, indicating that though consumers found landscapes with a relatively greater percentage of ornamental plants to be more aesthetically pleasing, they also perceived them to be harder to maintain. Compared to the study of Hayden et al. [71], in which consumers were given the choice between three different landscapes ranked as high managed (A), moderately managed (B), and low managed (C), landscape B was most aesthetically preferred, while landscape C was found to be the "most ecologically/environmentally friendly". Interestingly, 35% of respondents also felt they were not knowledgeable enough about the environmental health to use it in their landscaping decision-making.

Therefore, we investigate the effects of low-input turfgrass options (i.e., low irrigation and fertilization) for urban landscape management in Florida. Previous literature has looked at these attributes, but not it has not looked at them together for warm-season species [20–22] and has not considered whether they can be parsed out by categorizing the consumers and evaluating them by their demographics and lawn care practices. Using similar methodologies to Yue [20], Yue [21], and Ghimire [22], we hypothesize that among the latent classes, there will be heterogeneous preferences for irrigation and fertilization desires. Additionally, we hypothesize that homeowners who are more knowledgeable about turfgrass requirements will desire options that require lower inputs of fertilizers and irrigation. To achieve these goals, a discrete choice experiment was conducted with Floridian homeowners via online surveys.

3. Materials and Methods

3.1. Survey Structure and Participant Recruitment

This study uses data collected from 1051 participants who participated in an online survey of Floridian homeowners. The survey was pretested and conducted through the survey software Qualtrics in April 2020. Participants were screened out if they did not reside in a single-family home with a landscape (with and without irrigation). Participants were also screened out if they failed the attention check question to ensure participants were fully engaged throughout the survey. The attention check question read as follows: "To ensure participants are paying attention, please select 'Agree'". Information was presented to the participants in a discrete choice experiment.

A three-section questionnaire accompanied the discrete choice experiment. The sections included (i) landscape activity behavior, (ii) turfgrass maintenance-related knowledge quiz, and (iii) sociodemographic characteristics. Participants answered the landscape activity-related questions and knowledge quiz before the discrete choice section. The choice experiment included 16 choice scenarios split into two blocks of 8 choice scenarios (evenly, randomly distributed), which are described in further detail in the next section. After completing the choice task, participants completed a standard set of sociodemographic questions.

3.2. Experimental Design

The attributes of interest are irrigation (high/low), fertilizer (high/low), and price per square foot (USD 1.00, USD 1.50, USD 2.00), as shown in Table 1. Irrigation is an interest because, as outlined in the literature review, water quality and quantity are being threatened in the state of Florida as a result of the growing population and urbanization. As part of a series of experiments focusing on Florida Friendly Landscaping, this survey also focused on fertilizer inputs to gain further insight into Floridian attitudes about fertilizer inputs. The inclusion of a price variable in terms of the price of sod or seed per ft^2 (including labor) is included to simulate the market purchase and to estimate the WTP for each hypothetical turfgrass attribute. The JMP Pro 15 (Cary, NC) Design of Experiment routine was utilized to generate 16 choice scenarios which were blocked into two blocks. An example choice set is displayed in Figure 1. Each participant responded to 8 choice scenarios. Unlike the survey of Yue et al. [21], which focused on cool-season grasses, this survey focuses on warm-season grasses.

Table 1. Attributes and Attribute Levels for the Choice Experiment.

Turfgrass Attribute	Attribute Levels
Irrigation Requirement	Low (once per week) High (twice or more per week)
Fertilizer Requirement	Low (once per year) High (3 times or more per year)
Price (per ft^2)	USD 1.00 USD 1.50 USD 2.00

Please choose your most preferred turfgrass option:

	A	B	C
Irrigation (per week)	High (twice or more)	Low (once)	Neither
Fertilization (per year)	Low (once)	High (3 times or more)	
Cost (per sq. ft.)	$1.50	$1.00	
I would choose…	A	B	C
	○	○	○

Figure 1. Example of one of the choice scenarios the participant viewed and selected from.

For each discrete choice scenario, participants chose between three scenarios: Option A, Option B, and Option C. Participants were asked to choose their "most preferred turfgrass option". Options A and B had combinations of price, irrigation requirements, and fertilizer requirements. If neither of the options would be the preferred option for the participant, they could choose Option C, which is to "opt out" of choosing either Option A or Option B. The opt-out alternative increases the realism of the choice task and reduces the hypothetical bias during experimentation. Participants were instructed to assume any additional attributes (such as turfgrass color or texture) to be considered identical for both options. The attributes were defined within the bounds of the survey as follows:

- Price: "Cost per square foot of turfgrass established using either seed or sod (includes labor)."
- Irrigation requirement: "The number of times per week that turfgrass option needs to be irrigated."
- Fertilization requirement: "The number of times per year that turfgrass option needs to be fertilized."

3.3. Latent Class Logit Model

The LCL model is an approach to model preference heterogeneity and is more suited for explaining the sources of heterogeneity related to both observed and unobserved socioeconomic characteristics and tastes of the decision-makers [21,85]. In the LCL model, respondents are assumed to be segmented into several latent classes. Each individual is characterized by homogeneous preference within each class but heterogeneous across classes [85,86].

Following Ouma et al. [85], the probability that individual i chooses alternative j in choice scenario t given that they belong to latent class c can be written as

$$Pr(y_{ijt}|c) = \prod_{t=1}^{T} \frac{e^{\beta_c x_{ijt}}}{\sum_{j=1}^{J} e^{\beta_c x_{ijt}}} \tag{1}$$

where x_{ijt} is a vector of observed lawn input attributes associated with alternative j in choice scenario t, and β_c is a class-specific parameter vector which captures the heterogeneity in preference across classes.

Because the class membership status is unknown, we specify the class probabilities by the form

$$Pr\left(c = \frac{e^{\theta_c z_t}}{\sum_{c=1}^{C} e^{\theta_c z_t}}\right) \tag{2}$$

where $\theta = (\theta_1, \theta_2, \ldots, \theta_{C-1})$ is the vector for class membership parameters and θ_C is normalized to zero. Z_t is a set of observable characteristics for individual i that enter the model for class membership.

3.4. Willingness to Pay for Turfgrass Attributes

Estimating the WTP for a particular attribute or variable allows for ranking potential turfgrass attributes. In the G-MNL model, WTP is computed by dividing the coefficient for the attribute by the coefficient for price.

$$WTP_{attribute} = -\frac{\beta_{attribute}}{\beta_{price}} \quad (3)$$

4. Results

4.1. Sample Descriptive Analysis

A total of 1051 responses were used in the analysis. Participants had an average age of 49 years, and 60% of the sample was female. The sample deviated slightly from the general Florida population, including having more females and older people with higher educations and higher incomes (Table 2). However, this is consistent with core horticultural consumers' sociodemographic characteristics (e.g., female, 45 years old and older, college graduates, and two-person households with annual incomes of USD 50,000 or more, according to Rihn and Khachatryan [87].

Table 2. Online Survey Sample Demographic Characteristics.

Demographic Characteristics	Sample
Female	59.94%
Age (mean, SD)	48.99 (15.19)
Income (categorical)	
Less than USD 19,999	9.13%
USD 20–USD 39,999	19.89%
USD 40–USD 59,999	19.12%
USD 60–USD 79,999	17.03%
USD 80–USD 99,999	10.85%
USD 100–USD 119,999	6.85%
USD 120–USD 139,999	4.85%
USD 140–USD 159,999	5.61%
More than USD 160,000	6.66%
Ethnicity	
White	75.93%
African American	9.51%
Hispanic	10.09%
Asian	2.47%
Native American	0.76%
Pacific Islander	0.10%
Education	
High school	17.51%
Some college	22.74%
Associates degree	13.32%
Bachelor's degree	26.83%
Master's degree or higher	14.37%
HH Size (mean, SD)	2.26 (0.98)
Urbaneness	
Urban	22.26%
Suburban	63.37%
Rural	14.37%

To assess the level of turfgrass basic care knowledge, participants answered six true or false questions on irrigation, plant growth, and fertilizer requirements of turfgrass. This quiz was adapted from the work of Suh et al. [88] (questions are available in Appendix A). Figure 2 displays the frequency of correct answers. Overall, participants' knowledge was normally distributed and showed a well-rounded sample from extremely knowledgeable to not very knowledgeable homeowners. This knowledge variable was used in the estimation to predict the probability of the latent class membership.

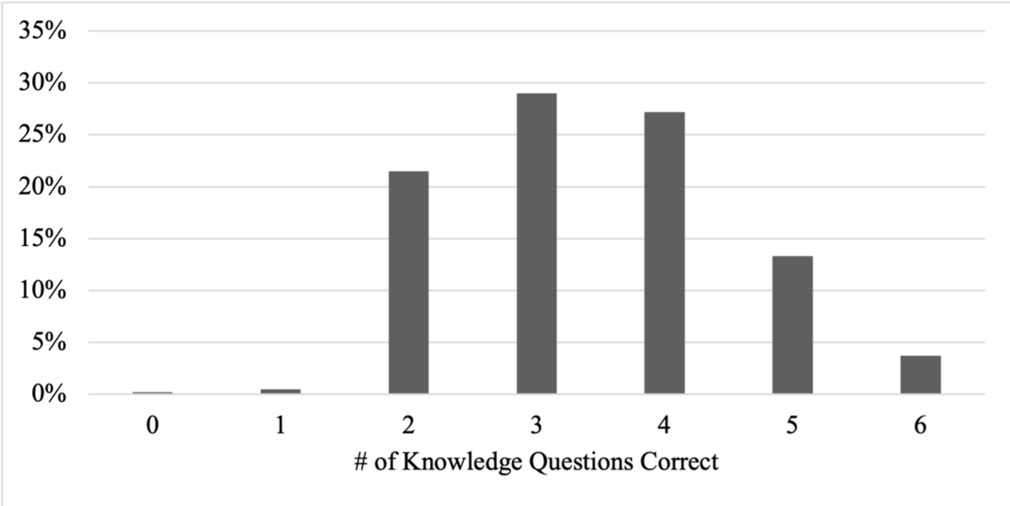

Figure 2. Frequency of Correct Selections in Knowledge Quiz.

4.2. Estimation Results: Latent Class Logit Model

The results from the four-class LCL model are selected and provided in Table 3. (The four-class LCL model outperformed other alternative model selections. Other model results are available upon request.) The "High Input" class users were used as the baseline class due to their extreme negative views of low inputs of irrigation and fertilizer. High-input users consist of approximately 33% of the sample. The other three classes share the remaining 67% of the sample. A positive and significant coefficient estimate for the attribute in the LCL model indicates that the utility or preference for that attribute is increasing or preferred by the homeowner.

The "Irrigation Conscious" users had the greatest preference for low irrigation input (with a coefficient of 3.1693) and preferred low fertilizer input (with a coefficient of 1.2217). The class membership probability function for irrigation-conscious users indicated that people with a higher knowledge of turfgrass needs were likely to be in this class. The "Fertilizer Conscious" users had the greatest preference for low fertilizer inputs into their turfgrass (2.9773). Fertilizer-conscious users also had a moderate preference for low irrigation input. Members of the last class, categorized as "Moderate Input" users, were willing to tolerate a greater price value and moderately preferred low irrigation and fertilizer inputs (−0.2087 and −0.1839). Of the classes, "Moderate Input" users were more likely to opt out of choosing turfgrass inputs. This indicates they did not have a strong preference for either irrigation or fertilizer inputs. It is not surprising that "Moderate Input" users tended to be less knowledgeable about turfgrass needs as compared to the "Hight Input" users. Homeowners knowledgeable about turfgrass needs were more likely to be "Irrigation Conscious" or "Fertilizer Conscious" users. Interestingly, the class membership function indicated that "Irrigation Conscious" users and "Moderate Input" users tended to be more educated as compared to the "High Input" users.

When comparing the latent classes by demographic characteristics, irrigation-conscious and fertilizer-conscious users had some similarities—and differences—with high-input users as shown in Table 4. Fertilizer-conscious users were slightly older than irrigation-conscious users, but neither were different from high-input users. Irrigation-conscious users had a higher mean number of females than fertilizer-conscious users and high-input users. The moderate-input group tended to be the oldest.

Table 3. Parameter estimates of the latent class logit model.

Variable	High Input	Irrigation Conscious	Fertilizer Conscious	Moderate Input
	Homeowner Segments			
Price	−1.2042 **	−0.9583 **	−0.7987 **	−0.9966 **
	(0.1611)	(0.1748)	(0.1815)	(0.0818)
Irrigation Low	1.1646 **	3.1693 **	0.9172 **	−0.2087 **
	(0.1672)	(0.2616)	(0.1761)	(0.0865)
Fertilizer Low	1.5182 **	1.2217 **	2.9773 **	−0.1839 **
	(0.1579)	(0.1807)	(0.2142)	(0.0789)
Opt Out	1.0406 **	−0.8213 **	−0.9674 **	−3.5673 **
	(0.2594)	(0.3010)	(0.3110)	(0.1605)
Class Share	33.3%	27.0%	22.9%	16.7%
Class membership model estimates: High Input as reference class				
Knowledge		0.2334	0.0137	−0.2732 **
Education level		0.1843	0.0850	0.1754 **
Constant		−1.5881	−0.4533	0.8433 **
AIC	14,405.878			
BIC	14,380.878			
Log-likelihood	−7103.470			

Notes: Robust standard errors in parentheses. ** Indicates significance at least 5% level.

Table 4. Pairwise mean comparison of demographic characteristics for the four classes of users.

	High-Input Users		Irrigation-Conscious Users		Fertilizer-Conscious Users		Moderate-Input Users	
Demographics of Latent Classes								
Age	47.3143 (0.2983)	AB	47.3764 (0.1638)	A	47.9696 (0.1606)	B	53.7119 (0.1990)	C
Female (%)	54.29 (0.97)	A	61.21 (0.53)	C	55.25 (0.52)	A	67.80 (0.65)	B
White (%)	72.81 (0.85)	C	75.57 (0.47)	A	75.14 (0.46)	A	79.24 (0.57)	B
Other Races (%)	27.62 (0.85)	B	24.43 (0.46)	A	24.86 (0.45)	A	20.76 (0.57)	C
Adults in HH	2.18 (0.02)	A	2.28 (0.01)	B	2.30 (0.01)	B	2.20 (0.01)	A
Children in HH	1.6762 (0.02)	A	1.7443 (0.01)	B	1.6851 (0.01)	A	1.39 (0.01)	C
Bachelor's Degree (%)	28.57 (0.88)	A	28.45 (0.48)	A	29.56 (0.47)	A	19.49 (0.59)	B
Full-Time Employed (%)	57.14 (0.96)	A	46.55 (0.53)	B	43.92 (0.52)	C	23.73 (0.64)	D
Income	4.68 (0.05)	B	4.32 (0.03)	A	4.38 (0.03)	A	3.50 (0.03)	C
Single-Family Dwelling (%)	78.10 (0.93)	A	61.78 (0.51)	C	72.93 (0.50)	B	44.07 (0.62)	D
Suburban Area (%)	53.33 (1.00)	C	66.67 (0.53)	B	62.98 (0.52)	A	63.56 (0.64)	A

Notes: Standard errors are reported below means in parentheses. Letters indicate pairwise comparison of group means. Letters across rows that are the same indicate no difference. Letters across rows that are different indicate statistical difference at 5% significance level. Income is a categorical variable ranging from 1 to 12 with 3 indicating an income level between USD 40,000 and USD 59,999 and 4 indicating income level between USD 60,000 and USD 79,999.

Different from the other three user groups, the high-input users were more likely to be full-time employed and have high income levels but were less likely to live in suburban areas. Both irrigation-conscious and fertilizer-conscious users had a higher mean number of white participants and a lower mean number of other races, a higher number of adults who live in the household, fewer bachelor's degrees, and lower income than high-input users. Irrigation-conscious users had the highest number of participants who lived in suburban areas compared to the other three classes. In sum, moderate-input users were more likely to be older, female, less diverse, and have fewer children in the household as compared to the other classes.

As for lawn care practices, the results are summarized in Table 5. Compared with high-input users, irrigation-conscious users had the same amount of sod installed at their homes, yet the mean percentage of turf irrigated was 12% less (Table 5). Additionally, a smaller number of irrigation-conscious users irrigated their lawns than fertilizer-conscious users and high-input users. They had nearly double the amount of total turfgrass area maintained, and coinciding with that result, their mean lawn maintenance expenditures were higher than those of the other three classes. A greater number of irrigation-conscious users use weed and disease/insect control than fertilizer-conscious users (but irrigation-conscious users were not different from high-input users in weed control).

Table 5. Pairwise mean comparison of lawn care practices for the four classes of users.

	Homeowner Segments							
Practices	**High-Input Users**		**Irrigation-Conscious Users**		**Fertilizer-Conscious Users**		**Moderate-Input Users**	
Mowing (%)	80.00 (0.8)	AB	79.31 (0.44)	A	79.28 (0.43)	A	80.93 (0.53)	B
Fertilization (%)	59.05 (0.98)	A	54.89 (0.54)	B	50.55 (0.53)	C	31.78 (0.65)	D
Weed Control (%)	59.05 (0.98)	A	57.76 (0.54)	A	55.25 (0.53)	B	40.25 (0.65)	C
Disease/Insect Control (%)	36.19 (0.95)	A	42.53 (0.52)	B	37.29 (0.51)	A	27.97 (0.64)	C
Irrigation (%)	51.43 (0.96)	A	42.24 (0.52)	C	45.86 (0.52)	B	23.73 (0.64)	D
Soil Testing (%)	12.38 (0.49)	A	5.17 (0.27)	C	7.73 (0.26)	B	3.81 (0.33)	D
Turf Renovation (%)	18.1 (0.53)	B	8.33 (0.29)	A	8.01 (0.28)	A	2.12 (0.35)	C
Lawn Clippings/Leaf Removal (%)	34.29 (0.97)	A	41.67 (0.54)	B	43.09 (0.52)	B	36.02 (0.65)	A
Sod Installation (%)	13.33 (0.60)	A	12.07 (0.33)	A	9.12 (0.32)	B	7.20 (0.4)	C
% of Turf Irrigated	62.269 (0.75)	A	49.210 (0.41)	C	58.514 (0.41)	B	31.233 (0.50)	D
USD Spent on Lawn Maintenance	1.00 (0.15)	AB	1.56 (0.03)	C	1.125 (0.04)	B	1.00 (0.03)	A
Total Area of Lawn Maintained (ft^2)	2854.77 (887.10)	A	9930.36 (491.50)	B	3174.81 (469.12)	A	3138.78 (617.98)	A

Notes: Standard errors are reported below means in parentheses. Letters indicate pairwise comparison of group means. Letters across rows that are the same indicate no difference. Letters across rows that are different indicate statistical difference at 5% significance level.

As for fertilizer-conscious users, fewer users report engaging in lawn fertilizer practices, which would be expected from consumers who were highly conscious of their usage and input. They also engaged in less weed control and insect control. As a result, this consumer category may be less likely to administer chemicals on their turfgrass overall, not just fertilizers.

Moderate-input users did not stand out in their lawn care practices from the other classes. In general, they participated less in lawn care practices and reported fewer incidents of renovations, less sod installation, and lower spending on their maintenance practices.

5. Discussion

Our results confirmed the preference heterogeneity for turfgrass attributes as reported by Yue et al. [20], Yue et al. [21], and Ghimire et al. [22]. Overall, participants prefer turfgrass options with low irrigation and fertilizer requirement. Floridian homeowners are also willing to pay more for low-input attributes, which confirms the findings of Khachatryan et al. [35], Dennis et al. [89], Tully and Winer [19], and Engel and Potschke [17]. Florida homeowners place a high value on and prefer low input into their turfgrass; similar results were shown by Yue et al. [20] and Larson et al. [37].

Moreover, according to the estimated results from the LCL model, with approximately one-third of the sample and two classes of consumers seeking low-input turfgrasses, it is clear some consumers desire species that tolerate low irrigation and fertilizer levels. This result also suggests that there is a considerable majority of consumers who either are indifferent to the amount of water, chemicals, and maintenance they contribute to their turfgrass, as is the case for the moderate-input consumers, or they have stronger pressures to align with social norms with relatively low knowledge of how to care for their lawn (high-input consumers). This result is supported by Blaine et al. [6], who found that attractiveness, maintenance, and cost also contribute to the consumer's prioritization of how they care for their lawn. This was true with irrigation-conscious and fertilizer-conscious consumers, both environmentally conscious consumers, having higher knowledge about turfgrass than moderate-input and high-input consumers. These results are supported by the findings of Khachatryan et al. [35].

Our secondary aim in this analysis using an LCL model was to investigate whether homeowners who are more knowledgeable about turfgrass requirements will desire options that require lower inputs. Participants who had a higher knowledge of turfgrass requirements were more likely to be irrigation-conscious or fertilizer-conscious. Participants who preferred high or moderate inputs into their turfgrass tended to have less education and lower knowledge level about turfgrass than the irrigation- or fertilizer-conscious classes. This can be associated with the findings from previous literature showing that non-environmentalists tend to have less education and knowledge [90,91].

In conclusion, Floridian homeowners have varied preferences for lawn irrigation and fertilization requirements. In part, these differences can be characterized by their behaviors (lawn care practices) as well as their sociodemographic attributes. Water conservation programs aim to increase homeowners' knowledge about turfgrass, and the associated environmental impacts may influence homeowners' preference for low-input turfgrass. Perhaps this varied preference for different levels of input is further influenced by other factors not accounted for (or observed) within this analysis. Understanding and categorizing Floridian homeowners by their inputs can help policymakers understand what keeps some homeowners from participating in urban landscape conservation programs such as Florida Friendly Landscaping and how new policies can help positively influence homeowners' participation in lowering the waterway pollution.

Our results suggest consumer segmentation on considerations for landscape management and maintenance. An increased understanding of how consumer perceptions and sociodemographic characteristics impact lawn choices can aid in better positioning turfgrass products. Specifically, using words with "low-input" or "low-requirement" will attract greater attention from homeowners who are interested in using less irrigation and less fertilizer in their landscape.

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Appendix A. Turfgrass Care Knowledge Quiz Questions

1. True or False: The three basic nutrients included in lawn fertilizers are nitrogen, phosphorous, and potassium.
   - ○ True
   - ○ False
2. True or False: Lawns should be fertilized during the dormant season to allow for nutrients to soak into the soil before active growth.
   - ○ True
   - ○ False
3. True or False: The lawn should be irrigated with $\frac{1}{4}$″ of water immediately after fertilization.
   - ○ True
   - ○ False
4. True or False: Each irrigation session should run until the point of runoff to supply an adequate amount of water to the turfgrass.
   - ○ True
   - ○ False
5. True or False: Lawns should be irrigated right before the hottest part of the day so the turfgrass is well hydrated before the heat.
   - ○ True
   - ○ False
6. On average, how frequently does your lawn get irrigated during the growing season?
   - ○ Daily
   - ○ 3–4 times per week
   - ○ Twice per week
   - ○ Weekly
   - ○ Bi-weekly
   - ○ Monthly
   - ○ Bi-monthly
   - ○ I do not irrigate my lawn
   - ○ I do not know

References

1. Carey, R.O.; Hochmuth, G.J.; Martinez, C.J.; Boyer, T.H.; Nair, V.D.; Dukes, M.D.; Toor, G.S.; Shober, A.L.; Cisar, J.L.; Trenholm, L.E.; et al. A Review of Turfgrass Fertilizer Management Practices: Implications for Urban Water Quality. *HortTechnology* **2012**, *22*, 280–291. [CrossRef]
2. Groffman, P.M.; Grove, J.M.; Polsky, C.; Bettez, N.D.; Morse, J.L.; Cavender-Bares, J.; Hall, S.J.; Heffernan, J.B.; Hobbie, S.E.; Larson, K.L.; et al. Satisfaction, Water and Fertilizer Use in the American Residential Macrosystem. *Environ. Res. Lett.* **2016**, *11*, 034004. [CrossRef]
3. Florida-Friendly LandscapingTM Program—University of Florida, Institute of Food and Agricultural Sciences—UF/IFAS. Available online: https://ffl.ifas.ufl.edu (accessed on 20 April 2022).
4. Romero, C.C.; Dukes, M.D. Net Irrigation Requirements for Florida Turfgrass Lawns: Part 3-Theoretical Irrigation Requirements: AE482, 8/2011. *EDIS* **2011**, *2011*. [CrossRef]
5. Khachatryan, H.; Rihn, A.; Hansen, G.; Clem, T. Landscape Aesthetics and Maintenance Perceptions: Assessing the Relationship between Homeowners' Visual Attention and Landscape Care Knowledge. *Land Use Policy* **2020**, *95*, 104645. [CrossRef]
6. Blaine, T.W.; Clayton, S.; Robbins, P.; Grewal, P.S. Homeowner Attitudes and Practices towards Residential Landscape Management in Ohio, USA. *Environ. Manag.* **2012**, *50*, 257–271. [CrossRef] [PubMed]
7. Hoffman, G.J.; Evans, R.G.; Jensen, M.E.; Martin, D.L.; Elliott, R.L. *Design and Operation of Farm Irrigation Systems*; American Society of Agricultural and Biological Engineers: St. Joseph, MI, USA, 2007.
8. Milesi, C.; Running, S.W.; Elvidge, C.D.; Dietz, J.B.; Tuttle, B.T.; Nemani, R.R. Mapping and Modeling the Biogeochemical Cycling of Turf Grasses in the United States. *Environ. Manag.* **2005**, *36*, 426–438. [CrossRef] [PubMed]
9. Cohen, P. National Gardening Survey, 2018. 2018. Available online: https://garden.org/store/view/2/National-Gardening-Survey-2018-Edition/ (accessed on 20 April 2022).
10. King, K.; Balogh, J.; Hughes, K.; Harmel, R. Nutrient Load Generated by Storm Event Runoff from a Golf Course Watershed. *J. Environ. Qual.* **2007**, *36*, 1021–1030. [CrossRef]
11. Kjelgren, R.; Rupp, L.; Kilgren, D. Water Conservation in Urban Landscapes. *HortScience* **2000**, *35*, 1037–1040. [CrossRef]
12. Priest, M.; Williams, D.; Bridgman, H. Emissions from In-Use Lawn-Mowers in Australia. *Atmos. Environ.* **2000**, *34*, 657–664. [CrossRef]
13. Reid, S.B.; Pollard, E.K.; Sullivan, D.C.; Shaw, S.L. Improvements to Lawn and Garden Equipment Emissions Estimates for Baltimore, Maryland. *J. Air Waste Manag. Assoc.* **2010**, *60*, 1452–1462. [CrossRef]
14. Zhang, X.; Khachatryan, H. Interactive Effects of Homeowners' Environmental Concerns and Rebate Incentives on Preferences for Low-Input Residential Landscapes. *Urban For. Urban Green.* **2021**, *65*, 127322. [CrossRef]
15. Hall, C.R.; Dickson, M.W. Economic, Environmental, and Health/Well-Being Benefits Associated with Green Industry Products and Services: A Review. *J. Environ. Hortic.* **2011**, *29*, 96–103. [CrossRef]
16. Khachatryan, H.; Campbell, B.; Hall, C.; Behe, B.; Yue, C.; Dennis, J. The Effects of Individual Environmental Concerns on Willingness to Pay for Sustainable Plant Attributes. *HortScience* **2014**, *49*, 69–75. [CrossRef]
17. Engel, U.; Pötschke, M. Willingness to Pay for the Environment: Social Structure, Value Orientations and Environmental Behaviour in a Multilevel Perspective. *Innov. Eur. J. Soc. Sci. Res.* **1998**, *11*, 315–332. [CrossRef]
18. Straughan, R.D.; Roberts, J.A. Environmental Segmentation Alternatives: A Look at Green Consumer Behavior in the New Millennium. *J. Consum. Mark.* **1999**, *16*, 558–575. [CrossRef]
19. Tully, S.M.; Winer, R.S. The Role of the Beneficiary in Willingness to Pay for Socially Responsible Products: A Meta-Analysis. *J. Retail.* **2014**, *90*, 255–274. [CrossRef]
20. Yue, C.; Hugie, K.; Watkins, E. Are Consumers Willing to Pay More for Low-Input Turfgrasses on Residential Lawns? Evidence from Choice Experiments. *J. Agric. Appl. Econ.* **2012**, *44*, 549–560. [CrossRef]
21. Yue, C.; Wang, J.; Watkins, E.; Bonos, S.A.; Nelson, K.C.; Murphy, J.A.; Meyer, W.A.; Horgan, B.P. Heterogeneous Consumer Preferences for Turfgrass Attributes in the United States and Canada. *Can. J. Agric. Econ. Can. Agroecon.* **2017**, *65*, 347–383. [CrossRef]
22. Ghimire, M.; Boyer, T.A.; Chung, C. Heterogeneity in Urban Consumer Preferences for Turfgrass Attributes. *Urban For. Urban Green.* **2019**, *38*, 183–192. [CrossRef]
23. Zhang, X.; Khachatryan, H. Investigating Homeowners' Preferences for Smart Irrigation Technology Features. *Water* **2019**, *11*, 1996. [CrossRef]
24. Zhang, X.; Khachatryan, H. Effects of Perceived Economic Contributions on Individual Preferences for Environmentally Friendly Residential Landscapes. *Land Use Policy* **2021**, *101*, 105125. [CrossRef]
25. Amani-Beni, M.; Zhang, B.; Xu, J. Impact of Urban Park's Tree, Grass and Waterbody on Microclimate in Hot Summer Days: A Case Study of Olympic Park in Beijing, China. *Urban For. Urban Green.* **2018**, *32*, 1–6. [CrossRef]
26. Dousset, B.; Gourmelon, F. Satellite Multi-Sensor Data Analysis of Urban Surface Temperatures and Landcover. *ISPRS J. Photogramm. Remote Sens.* **2003**, *58*, 43–54. [CrossRef]
27. Jenerette, G.D.; Harlan, S.L.; Stefanov, W.L.; Martin, C.A. Ecosystem Services and Urban Heat Riskscape Moderation: Water, Green Spaces, and Social Inequality in Phoenix, USA. *Ecol. Appl.* **2011**, *21*, 2637–2651. [CrossRef] [PubMed]
28. Steinke, K.; Chalmers, D.R.; Thomas, J.C.; White, R.H. Summer Drought Effects on Warm-Season Turfgrass Canopy Temperatures. *Appl. Turfgrass Sci.* **2009**, *6*, 1–11. [CrossRef]

29. Bouwer, H. Artificial Recharge of Groundwater: Hydrogeology and Engineering. *Hydrogeol. J.* **2002**, *10*, 121–142. [CrossRef]
30. Dai, Z.; Puyang, X.; Han, L. Using Assessment of Net Ecosystem Services to Promote Sustainability of Golf Course in China. *Ecol. Indic.* **2016**, *63*, 165–171. [CrossRef]
31. Montgomery, J.A.; Klimas, C.A.; Arcus, J.; DeKnock, C.; Rico, K.; Rodriguez, Y.; Vollrath, K.; Webb, E.; Williams, A. Soil Quality Assessment Is a Necessary First Step for Designing Urban Green Infrastructure. *J. Environ. Qual.* **2016**, *45*, 18–25. [CrossRef]
32. Thwaites, D.I.; Tuohy, J.B. Back to the Future: The History and Development of the Clinical Linear Accelerator. *Phys. Med. Biol.* **2006**, *51*, R343. [CrossRef]
33. Proske, A.; Lokatis, S.; Rolff, J. Impact of Mowing Frequency on Arthropod Abundance and Diversity in Urban Habitats: A Meta-Analysis. *Urban For. Urban Green.* **2022**, *76*, 127714. [CrossRef]
34. Khachatryan, H.; Suh, D.H.; Xu, W.; Useche, P.; Dukes, M.D. Towards Sustainable Water Management: Preferences and Willingness to Pay for Smart Landscape Irrigation Technologies. *Land Use Policy* **2019**, *85*, 33–41. [CrossRef]
35. Khachatryan, H.; Suh, D.H.; Zhou, G.; Dukes, M. Sustainable Urban Landscaping: Consumer Preferences and Willingness to Pay for Turfgrass Fertilizers. *Can. J. Agric. Econ. Can. Agroecon.* **2017**, *65*, 385–407. [CrossRef]
36. Campbell, J.; Rihn, A.; Khachatryan, H. Factors Influencing Home Lawn Fertilizer Choice in the United States. *HortTechnology* **2020**, *30*, 296–305. [CrossRef]
37. Larson, K.L.; Nelson, K.C.; Samples, S.; Hall, S.J.; Bettez, N.; Cavender-Bares, J.; Groffman, P.M.; Grove, M.; Heffernan, J.B.; Hobbie, S.E.; et al. Ecosystem Services in Managing Residential Landscapes: Priorities, Value Dimensions, and Cross-Regional Patterns. *Urban Ecosyst.* **2016**, *19*, 95–113. [CrossRef]
38. Barnes, M.R.; Watkins, E. Differences in Likelihood of Use between Artificial and Natural Turfgrass Lawns. *J. Outdoor Recreat. Tour.* **2022**, *37*, 100480. [CrossRef]
39. Brosnan, J.T.; Chandra, A.; Gaussoin, R.E.; Kowalewski, A.; Leinauer, B.; Rossi, F.S.; Soldat, D.J.; Stier, J.C.; Unruh, J.B. A Justification for Continued Management of Turfgrass during Economic Contraction. *Agric. Environ. Lett.* **2020**, *5*, e20033. [CrossRef]
40. Frumkin, H. Beyond Toxicity: Human Health and the Natural Environment. *Am. J. Prev. Med.* **2001**, *20*, 234–240. [CrossRef]
41. Heerwagen, J.H.; Orians, G.H. The Ecological World of Children. *Child. Nat. Psychol. Sociocult. Evol. Investig.* **2002**, 29–64.
42. Kahn, P.H., Jr.; Kellert, S.R. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*; MIT Press: Cambridge, MA, USA, 2002.
43. Barrett, M.A.; Miller, D.; Frumkin, H. Parks and Health: Aligning Incentives to Create Innovations in Chronic Disease Prevention. *Prev. Chronic. Dis.* **2014**, *11*, E63. [CrossRef]
44. Young, D.R.; Coleman, K.J.; Ngor, E.; Reynolds, K.; Sidell, M.; Sallis, R.E. *Associations between Physical Activity and Cardiometabolic Risk Factors Assessed in a Southern California Health Care System, 2010–2012*; Centers for Disease Control and Prevention: Atlanta, GA, USA, 2014.
45. Bell, J.F.; Wilson, J.S.; Liu, G.C. Neighborhood Greenness and 2-Year Changes in Body Mass Index of Children and Youth. *Am. J. Prev. Med.* **2008**, *35*, 547–553. [CrossRef]
46. Song, Y.; Manson, J.E.; Meigs, J.B.; Ridker, P.M.; Buring, J.E.; Liu, S. Comparison of Usefulness of Body Mass Index versus Metabolic Risk Factors in Predicting 10-Year Risk of Cardiovascular Events in Women. *Am. J. Cardiol.* **2007**, *100*, 1654–1658. [CrossRef] [PubMed]
47. Akpinar, A. How Is Quality of Urban Green Spaces Associated with Physical Activity and Health? *Urban For. Urban Green.* **2016**, *16*, 76–83. [CrossRef]
48. Beyer, K.M.; Kaltenbach, A.; Szabo, A.; Bogar, S.; Nieto, F.J.; Malecki, K.M. Exposure to Neighborhood Green Space and Mental Health: Evidence from the Survey of the Health of Wisconsin. *Int. J. Environ. Res. Public. Health* **2014**, *11*, 3453–3472. [CrossRef] [PubMed]
49. Kaplan, R. The Nature of the View from Home: Psychological Benefits. *Environ. Behav.* **2001**, *33*, 507–542. [CrossRef]
50. Cook, D.I.; Van Haverbeke, D.F. *Trees and Shrubs for Noise Abatement*; USDA Forest Service: Washington, DC, USA, 1971.
51. Van Renterghem, T.; Forssén, J.; Attenborough, K.; Jean, P.; Defrance, J.; Hornikx, M.; Kang, J. Using Natural Means to Reduce Surface Transport Noise during Propagation Outdoors. *Appl. Acoust.* **2015**, *92*, 86–101. [CrossRef]
52. Hartig, T.; Mitchell, R.; De Vries, S.; Frumkin, H. Nature and Health. *Annu. Rev. Public Health* **2014**, *35*, 207–228. [CrossRef]
53. Kuo, F.E.; Sullivan, W.C. Environment and Crime in the Inner City: Does Vegetation Reduce Crime? *Environ. Behav.* **2001**, *33*, 343–367. [CrossRef]
54. Kuo, F.E.; Bacaicoa, M.; Sullivan, W.C. Transforming Inner-City Landscapes: Trees, Sense of Safety, and Preference. *Environ. Behav.* **1998**, *30*, 28–59. [CrossRef]
55. Bedimo-Rung, A.L.; Mowen, A.J.; Cohen, D.A. The Significance of Parks to Physical Activity and Public Health: A Conceptual Model. *Am. J. Prev. Med.* **2005**, *28*, 159–168. [CrossRef]
56. Laverne, R.J.; Winson-Geideman, K. The Influence of Trees and Landscaping on Rental Rates at Office Buildings. *J. Arboric.* **2003**, *29*, 281–290. [CrossRef]
57. Elam, E.; Stigarll, A. Landscape and House Appearance Impacts on the Price of Single-Family Houses. *J. Environ. Hortic.* **2012**, *30*, 182–188. [CrossRef]
58. Conway, D.; Li, C.Q.; Wolch, J.; Kahle, C.; Jerrett, M. A Spatial Autocorrelation Approach for Examining the Effects of Urban Greenspace on Residential Property Values. *J. Real Estate Financ. Econ.* **2010**, *41*, 150–169. [CrossRef]

59. Parker, J.H. Landscaping to Reduce the Energy Used in Cooling Buildings. *J. For.* **1983**, *81*, 82–105.
60. McPherson, B.D.; Curtis, J.E.; Loy, J.W. *The Social Significance of Sport: An Introduction to the Sociology of Sport*; Human Kinetics Publishers: Champaign, IL, USA, 1989.
61. Carrico, A.R.; Fraser, J.; Bazuin, J.T. Green with Envy: Psychological and Social Predictors of Lawn Fertilizer Application. *Environ. Behav.* **2013**, *45*, 427–454. [CrossRef]
62. Cook, E.M.; Hall, S.J.; Larson, K.L. Residential Landscapes as Social-Ecological Systems: A Synthesis of Multi-Scalar Interactions between People and Their Home Environment. *Urban Ecosyst.* **2012**, *15*, 19–52. [CrossRef]
63. Martini, N.F.; Nelson, K.C.; Hobbie, S.E.; Baker, L.A. Why "Feed the Lawn"? Exploring the Influences on Residential Turf Grass Fertilization in the Minneapolis- Saint Paul Metropolitan Area. *Environ. Behav.* **2015**, *47*, 158–183. [CrossRef]
64. Robbins, P.; Birkenholtz, T. Turfgrass Revolution: Measuring the Expansion of the American Lawn. *Land Use Policy* **2003**, *20*, 181–194. [CrossRef]
65. Robbins, P.; Sharp, J.T. Producing and Consuming Chemicals: The Moral Economy of the American Lawn. *Econ. Geogr.* **2003**, *79*, 425–451. [CrossRef]
66. Badruzzaman, M.; Pinzon, J.; Oppenheimer, J.; Jacangelo, J.G. Sources of Nutrients Impacting Surface Waters in Florida: A Review. *J. Environ. Manag.* **2012**, *109*, 80–92. [CrossRef]
67. Miller, K.L. State Law Banning Phosphorus Fertilizer Use. Available online: http://www.cga.ct.gov/2012/rpt/2012-R-0076.htm (accessed on 27 September 2013).
68. Boyer, T.A.; Kanza, P.; Ghimire, M.; Moss, J.Q. Household Adoption of Water Conservation and Resilience under Drought: The Case of Oklahoma City. *Water Econ. Policy* **2015**, *1*, 1550005. [CrossRef]
69. Kenny, J.F.; Barber, N.L.; Hutson, S.S.; Linsey, K.S.; Lovelace, J.K.; Maupin, M.A. *Estimated Use of Water in the United States in 2005*; US Geological Survey; United States Department of the Interior: Washington, DC, USA, 2009.
70. Beard, J.B.; Kenna, M.P. Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes. In *Proceedings of the Workshop on Water Quality and Quantity Issues for Turfgrasses in Urban Landscapes, Las Vegas, NV, USA, 23–25 January 2006*; Council for Agricultural Science and Technology: Ames, IA, USA, 2008.
71. Hayden, L.; Cadenasso, M.L.; Haver, D.; Oki, L.R. Residential Landscape Aesthetics and Water Conservation Best Management Practices: Homeowner Perceptions and Preferences. *Landsc. Urban Plan.* **2015**, *144*, 1–9. [CrossRef]
72. Jorgensen, B.; Graymore, M.; O'Toole, K. Household Water Use Behavior: An Integrated Model. *J. Environ. Manag.* **2009**, *91*, 227–236. [CrossRef] [PubMed]
73. Gregory, G.D.; Leo, M.D. Repeated Behavior and Environmental Psychology: The Role of Personal Involvement and Habit Formation in Explaining Water Consumption 1. *J. Appl. Soc. Psychol.* **2003**, *33*, 1261–1296. [CrossRef]
74. Seyranian, V.; Sinatra, G.M.; Polikoff, M.S. Comparing Communication Strategies for Reducing Residential Water Consumption. *J. Environ. Psychol.* **2015**, *41*, 81–90. [CrossRef]
75. National Pesticide Information Center. 2,4-D: Ingredients Used in Pesticide Products: 2,4-D. United States Environmental Protection Agency. 2021. Available online: http://npic.orst.edu/ingred/24d.html (accessed on 11 October 2022).
76. Murphy, R.R.; Haith, D.A. Inhalation Health Risk to Golfers from Turfgrass Pesticides at Three Northeastern US Sites. *Environ. Sci. Technol.* **2007**, *41*, 1038–1043. [CrossRef] [PubMed]
77. Harris, S.A.; Solomon, K.R. Human Exposure to 2, 4-D Following Controlled Activities on Recently Sprayed Turf. *J. Environ. Sci. Health Part B* **1992**, *27*, 9–22. [CrossRef]
78. Robbins, P.; Polderman, A.; Birkenholtz, T. Lawns and Toxins: An Ecology of the City. *Cities* **2001**, *18*, 369–380. [CrossRef]
79. Kamrin, M. *Traces of Environmental Chemicals in the Human Body*; American Council on Science and Health: New York, NY, USA, 2003.
80. Letton, R.W.; Chwals, W.J. Patterns of Power Mower Injuries in Children Compared with Adults and the Elderly. *J. Trauma* **1994**, *37*, 182–186. [CrossRef]
81. Suh, D.H.; Khachatryan, H.; Rihn, A.; Dukes, M. Relating Knowledge and Perceptions of Sustainable Water Management to Preferences for Smart Irrigation Technology. *Sustainability* **2017**, *9*, 607. [CrossRef]
82. Wei, X.; Khachatryan, H.; Rihn, A. Consumer Preferences for Labels Disclosing the Use of Neonicotinoid Pesticides: Evidence from Experimental Auctions. *J. Agric. Resour. Econ.* **2020**, *45*, 496–517.
83. De Val, G.D.L.F.; Atauri, J.A.; de Lucio, J.V. Relationship between Landscape Visual Attributes and Spatial Pattern Indices: A Test Study in Mediterranean-Climate Landscapes. *Landsc. Urban Plan.* **2006**, *77*, 393–407. [CrossRef]
84. Kendal, D.; Williams, K.J.; Williams, N.S. Plant Traits Link People's Plant Preferences to the Composition of Their Gardens. *Landsc. Urban Plan.* **2012**, *105*, 34–42. [CrossRef]
85. Ouma, E.; Abdulai, A.; Drucker, A. Measuring Heterogeneous Preferences for Cattle Traits among Cattle-Keeping Households in East Africa. *Am. J. Agric. Econ.* **2007**, *89*, 1005–1019. [CrossRef]
86. Boxall, P.C.; Adamowicz, W.L. Understanding Heterogeneous Preferences in Random Utility Models: A Latent Class Approach. *Environ. Resour. Econ.* **2002**, *23*, 421–446. [CrossRef]
87. Rihn, A.; Khachatryan, H.; Campbell, B.; Hall, C.; Behe, B. Consumer Preferences for Organic Production Methods and Origin Promotions on Ornamental Plants: Evidence from Eye-Tracking Experiments. *Agric. Econ.* **2016**, *47*, 599–608. [CrossRef]
88. Suh, D.H.; Khachatryan, H.; Guan, Z. Why Do We Adopt Environmentally Friendly Lawn Care? Evidence from Do-It-Yourself Consumers. *Appl. Econ.* **2016**, *48*, 2550–2561. [CrossRef]

89. Dennis, J.H.; Lopez, R.G.; Behe, B.K.; Hall, C.R.; Yue, C.; Campbell, B.L. Sustainable Production Practices Adopted by Greenhouse and Nursery Plant Growers. *HortScience* **2010**, *45*, 1232–1237. [CrossRef]
90. Gilg, A.; Barr, S. Behavioural Attitudes towards Water Saving? Evidence from a Study of Environmental Actions. *Ecol. Econ.* **2006**, *57*, 400–414. [CrossRef]
91. Hilaire, R.S.; VanLeeuwen, D.M.; Torres, P. Landscape Preferences and Water Conservation Choices of Residents in a High Desert Environment. *HortTechnology* **2010**, *20*, 308–314. [CrossRef]