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MONETARY INCENTIVES AND ECO-FRIENDLY RESIDENTIAL LANDSCAPE PREFERENCES FOR FLORIDA FRIENDLY LANDSCAPING

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Abstract

To mitigate potential impacts from the increasing maintained residential landscapes to the environment, state and local governments and water management organizations are interested in policies that promote resource-efficient landscaping practices by individual homeowners. Incentives including rebates, tax returns, and low rate financing, are common monetary instruments used to promote the adoption of eco-friendly equipment or practices (e.g., water-saving appliances). However, the effects of monetary incentives on homeowners' preferences for alternative landscapes are less understood. Using discrete choice experimentation, this study investigated homeowners' preferences for rebate incentive programs and willingness to pay (WTP) for alternative landscape attributes. The results reveal that homeowners are willing to pay a premium for rebate programs, and that the environmental benefit information improves homeowners' preference and WTP for alternative landscape attributes. Also, we clustered homeowners into low, medium, and high rebate preference groups, which allowed investigating the difference in WTP estimates for alternative landscape attributes. Results estimated by mixed logit in WTP space model revealed that homeowners in high rebate preference group assign higher weights to economic attributes, such as rebate and maintenance, while homeowners in the low rebate preference group give more importance to environmental friendly attributes such as smart irrigation or pollinator friendly habitat. The results offer implications for policy makers as they develop water conservation programs.

Keywords: sustainable landscaping, rebate, choice experiment, mixed logit in WTP space.

JEL Codes: Q56, D12

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1. Introduction

1.1 Background

Urbanization, along with the increasing number of people that live in urban areas, has substantially increased the area of maintained residential landscapes over the past decades (Nickerson et al., 2011). In the United States, most traditional residential landscapes are dominated by turfgrass with relatively small non-turfgrass/plantable areas (Robbins and Brikenholtz, 2003). The increasing trend in the heavily-maintained residential landscapes may also cause negative environmental consequences. For instance, when used excessively, irrigation can deplete water availability, increase waterway pollution/contamination due to fertilizer/nutrient runoff (St. Hilaire, 2008). In addition, excessive fertilization has resulted in nutrients running into adjoining watersheds which reduces water quality and damages aquatic ecosystems (Carpenter et al 1998; Bierman et al 2010, Khachatryan et al. 2016).

Concerns of potential negative consequences have prompted state and local government and policy makers as well as conservation groups to develop and promote residential water-efficient appliances and water-conservation programs and restrictions. In recent years, these programs focused on designing and managing landscapes more efficiently (Robbins and Birkenholtz, 2003), which could reduce external inputs (irrigation water/nutrients), support biodiversity (Helfand et al., 2006), thus providing essential support for local ecosystems (Larson et al., 2009).

Transforming traditional residential lawn with mostly turfgrass coverage into alternative landscape with partial turfgrass and micro-irrigated plantable area is one of the approaches to water conservation (Larson et al., 2009). Therefore, state and local governments as well as water management organizations are increasingly interested in policies/programs that promote the adoption of resource-efficient landscaping practices by individual homeowners. In the state of Florida, the Florida-Friendly Landscaping (FFL™) program is one such program that educates and promotes eco-friendly landscaping practices to Floridians.

In water conservation programs, monetary incentives have been applied for many years. Various water conservation programs have mainly focused on indoor and outdoor water appliances. Most commonly, these programs fall into three broad categories such as the use restrictions, variable rates, and incentives to change existing practices. For instance, the EPA's WaterSense® program labels water-efficient products (USEPA, 2016). In California, the SoCal Water$mart program provides rebates to homeowners who purchase water-efficient products (Water Management District of Southern California, 2016).

Water districts, municipalities, and state governments also offer landscape improvement incentives to promote more efficient irrigation water use in the urban environment. The programs include rebates, low rate financing, and tax return incentives, which aim to swap traditional turfgrass lawn with more water-efficient sustainable landscapes. Among all the incentive programs, landscape modification rebate is the most used instrument that encourages homeowners to reduce the amount of turfgrass in their yard and reduce outdoor water use.

1.2 Research questions and hypotheses

Landscape rebates have gained in popularity, and experts hypothesize that landscape rebate programs can have a significant impact on water usage (Allen, 2014). To the best of our knowledge, none of the previous studies investigated the effects of incentives on preferences for sustainable landscapes. Since the relationship between the rebates and homeowners' preferences for alternative landscapes remains less understood, the present study investigates the effects of landscape rebate incentives on preferences for resource-efficient residential landscapes.

The essential promise of incentive programs is that are expected to create an engaging moment with the recipients. Understanding how rebates influence homeowners' landscape preferences is a necessary step to evaluate the effectiveness of such programs. To address the knowledge gap in the existing literature regarding the effects of landscape incentives, this study aims to assess the effects of rebate programs on consumers' preferences and WTP for alternative residential landscapes. Therefore, we hypothesize that 1) rebate incentives will positively affect the adoption intention. In other words, homeowners will prefer the rebate incentive as one of the attributes; 2) Environmental benefits information will further improve homeowners' preference and WTP for the sustainable landscape attributes.

The hypotheses were tested using an online survey distributed to single-family homeowners in Florida. We also investigated whether different consumer segments (with different rebate preferences) respond to the rebate program differently. Specifically, we tested whether homeowners with different rebate preferences would have distinct WTP regarding sustainable landscape attributes, e.g., landscape design ratio, rebate, pollinator attractive habitat, smart irrigation, and maintenance level. Thus, our third hypothesis is that homeowners with different rebate incentive preferences will behave differently in terms of preferences and WTP for the attributes; specifically, homeowners in high rebate preference group assign more weights to the economic related attributes, e.g., rebate rate and maintenance requirement, while homeowners in low rebate preference group give more importance to environmental friendly attributes such as smart irrigation or pollinator friendly habitat.

Our main results can be summarized as follows: 1) landscape rebates yield positive WTP, and therefore increased the likelihood of adoption the alternative landscape, 2) environmental benefit related information would further improve WTP for rebates and sustainable landscape attributes, 3) homeowners clustered by different rebate preferences showed different WTPs for eco-friendly landscape and attributes (homeowners in a low rebate preference cluster willing to pay higher premiums for rebate program and sustainable attributes, compared to homeowners in a high rebate preference cluster), and 4) homeowners in different rebate preference groups also perceived attribute importance differently (homeowners in low rebate preference segment gave more importance to the pollinator friendly and smart irrigation attributes, but homeowners in the high rebate preference segment gave more importance to the maintenance requirement and rebate attributes).

These results fill the gap in the literature by providing deeper insights into the relationship between rebate program and homeowners' preferences and WTP for alternative landscapes. The results also shed light on the role and effects of environmental benefit information on WTP.

1.3 An overview of current incentive programs

To encourage adoption of sustainable landscape, economic incentives are often used as an element of water conservation programs. Economic incentive program, often called ''Cash for Grass,'' offers rebates and/or financing options for conversion of turf to water efficient landscapes. For example, the California Water Commission approved to pay homeowners up to \$3.75 per ft^2 to replace their traditional lawns with drought-tolerant landscapes. In Nevada, the Las Vegas Valley Water District also launched an incentive program, called "Water Smart Landscapes", which helps homeowners to convert from turfgrass lawns to water-conserving landscapes. The Oregon State University's WaterWise Gardening Program promotes using plants that use little-to-no water in the landscape (Oregon State University, 2016).

In the state of Florida, the St. John River water management district also implemented a rebate incentive program in recent years. The Turf Swap program offers property owners up to a $2,000 rebate for replacing high-irrigation landscaping with a more environmental friendly version (Alachua County EPD, 2017). These programs offer different incentives and cover diverse products and regions with unique water needs, and they all have the same goal of increasing homeowners' use of water-efficient technologies that improve water quality and conserve water resources.

Previous studies have focused mainly on the cost effectiveness analysis. For instance, the costs of rebates for each square meter of turf converted to a water-conserving landscape have ranged from $5.92 (Albuquerque, NM) to $14.32 (El Paso, TX) (Addink, 2008). The annual calculated water savings ranged from 733 to 2,526 L per square meter of turf removed. Based on the costs incurred during the first year of conversion, the cost per 1,233,532 L (1 acre-foot) of water saved was $6,714 and $6,990 in the North Marin Water District, CA, and Southern Nevada programs, respectively, and $9,433 and $24,077 in the Albuquerque, NM, and El Paso, TX, programs, respectively. This led Addink (2008) to conclude that "Cash for Grass" programs are an expensive way to save water. (St. Hilaire, 2008)

The next section reviews the previous studies about rebate programs in water and energy saving appliances. The third section describes the methods, including survey design and data collection. A mixed logit model (ML) in WTP space used for empirical analysis is also described in this method section. The fourth section presents the empirical results and discussions of the three homeowner clusters with low, medium, and high rebate requirement. In addition, the marginal WTP of different homeowners groups will be compared. The last section provides some conclusion remarks practical implications for relevant stakeholders.

2. Experimental Methods and Econometric Models

2.1 Choice experiment

We applied a Discrete Choice Experiment (DCE) method in our study. Choice experiments (CEs) follow random utility theory framework and Lancaster's (1966) theory of utility maximization, and have been widely used to study consumer preferences and WTPs for goods and attributes. We designed of the choice experiments by the Design of Experiment routine in JMP Pro 11 (SAS Institute Inc.). Considering the cognitive burden and fatigue of asking participants to evaluate a full factorial design, we used a fractional-factorial orthogonal design. We constructed 16 choice profiles with a D-efficiency of 90.3%. These profiles were then blocked into two sets with eight choice scenarios in each block, and the respondents were evenly and randomly assigned to one choice set.

In the choice experiments, we presented the alternative residential landscapes with a 1024*684 pixel picture on top of the corresponding descriptive attributes. Each choice scenario was consisted of three options: A, B or "would not choose any." The choice was made on alternative landscapes for a site with standardized 0.25 acres, 5,000 square feet plantable area, and house value of $250,000 (Florida median price). Photos presenting different landscape attributes, mainly reflected different landscape design ratios. These attributes were selected based on our experiences talking to landscape professionals in a focus group discussion, and the images were digitally edited by a professional landscape architect.

Among the landscape attributes, the four levels of landscape design ratios showed the percentage of turfgrass and plantable area areas in the landscape. For example, 75% turfgrass /

25% plant (Plant25) represented 75% of the plantable area is turfgrass and 25% is other plants (i.e., shrubs, perennials, annuals, trees, etc.) and mulch. This landscape design is often treated as the traditional landscape design. In addition, alternative landscape design ratios included 50% turfgrass with 50% plants (Plant50), 25% turfgrass with 75% plants (Plant75), and 100% plants (not include turfgrass) (Plant100).

The cost of installation attribute was included in each option with four levels, which were estimated based on information provided by professional landscape architects. The other four attributes included hypothetical rebate rate, pollinator attractiveness, smart irrigation system, and maintenance requirement, with levels ranging from two to four. Instructions about the experiment, including the explanation of each attribute and a choice scenario example were presented prior to the experiment to facilitate the process. Table 1 summarizes the alternative landscape attributes and the attribute levels used in the choice experiment.

Table 1 Alternative Landscape Attributes and Attribute Levels

Attributes	Levels	Variable
Cost of Installation ($)	$4,500, $5,000, $5,500, $6,000	*Cost*
**Lot size 0.25 acres (10,890 sq ft)*		
**Plantable area: 0.11 acres (5,000 sq ft)*		
Landscape Design Ratio	75% turfgrass / 25% plant	*Plant25*
	50% turfgrass / 50% plant	*Plant50*
	25% turfgrass / 75% plant	*Plant75*
	100% plant	*Plant100*
Rebate rate	0%	*Reb0*
	25%	*Reb25*
	50%	*Reb50*
Pollinator Attractive Habitat	High	*Habitat*
	Low	
Irrigation System	Smart	*Irrigation*
	Conventional	
Maintenance requirement	Low	*Maintlow*
	Medium	*Maintmed*
	High	*Mainthigh*
Would-not-choose	"I would NOT choose any of these landscapes at this time"	*Optout*

Half of respondents were randomly selected to receive environmental benefits related information (treatment group). Homeowners are likely to have different perceptions about the environmental benefits of sustainable landscapes. Therefore, their preferences and WTP for sustainable landscape and attributes may differ depending on whether they received the information about environmental benefits of resource-efficient landscapes. Before conducting the choice experiments, the treatment group read the following information:

As you make your selections, please be aware of the environmental benefits offered by various landscapes. In general, landscapes provide homeowners with many environmental benefits, including:

Improve air quality, produce oxygen, sequester carbon
Improve soil quality and reduce erosion
Improve water quality, reduce storm water runoff and flooding
Reduce urban heat islands and urban glare
Reduce noise pollution
Provide windbreaks/privacy
Improve biodiversity

Alternative landscapes are landscapes that utilize plants and designs that minimize inputs (e.g. fertilizer, irrigation, pesticides, etc.) in order to conserve natural resources. Alternative *landscapes have the potential to provide several additional environmental benefits beyond those provided by conventional landscapes. Specifically, alternative landscapes have been shown to:*

Attract wildlife, aid pollinator insects, and promote biodiversity
Require less irrigation
Improve water quality
Require less fertilizer resulting in less pollution, runoff and nitrogen leaching

Following the choice experiment, the participants filled a questionnaire which included environmental knowledge, water conservation concerns, as well as their socio-demographic characteristics questions. The online questionnaire was distributed in Florida by a professional survey company, Qualtrics Inc, in November 2016. Florida was selected as one of the leading states in water conservation and landscape transformation programs. To ensure that homeowners were a representative sample of the target population and understood landscape practices, in the survey, we prescreened the participants living in a single-family house with irrigated landscape.

To further understand the difference across homeowners, we clustered those homeowners into three groups by asking them how much of a rebate they would accept to consider installing/converting a water-efficient alternative landscape (e.g. converting to an alternative landscape with 50% turfgrass and 50% plantable area). The participant homeowners then were clustered into three groups with low, medium, and high rebate preferences. The comparison of preferences and WTP across these segments provides practical information to relevant stakeholders.

2.2 Econometric Models

To account for heterogeneous preference structure, the mixed logit model (ML) was employed to analyze the choice experiment data. The mixed logit model allows the attribute parameters to vary randomly, which is not restrictive in situations where individual preferences are not homogeneous. The ML model also relaxes the assumption of independence of irrelevant alternatives (IIA) (Train, 2009). The mixed logit model is described as:

$$U_{njt} = \boldsymbol{X_{njt}} \boldsymbol{\beta_n} + \boldsymbol{\varepsilon_{njt}} \qquad (1)$$

where individual n (n= 1,2, …, N) chooses alternative j with the preferred attributes among J alternatives in t choice set. $\boldsymbol{X_{njt}}$ is a vector of observed attribute variables, including landscape design ratio, rebate rate, pollinator friendliness, smart irrigation, maintenance requirement level, and installation cost. $\boldsymbol{\beta_n}$ indicates the random coefficient vector that is unknown and varies with the density function $\phi(\beta \mid \theta)$, where θ is the true parameters of distribution for attributes preferences. $\boldsymbol{\varepsilon_{njt}}$ is assumed to be independent and identically distributed with type I extreme value (Gumbel) distribution.

In the mixed logit model, the choice probability that individual n would choose alternative i in choice scenario t can be expressed as:

$$Pr(y_n=i \mid \beta) = \int \frac{exp(\beta n' \boldsymbol{Xnit})}{\sum_{j=1}^{J} exp(\beta n' \boldsymbol{Xnjt})} \Phi(\boldsymbol{\beta_n} | \boldsymbol{\theta}) \boldsymbol{d\beta_n}, \; for\; i = 1, \ldots, J \qquad (2)$$

Since $\boldsymbol{\beta_n}$ is unknown, the unconditional probability is employed based on the distribution of β. As $\Phi(.)$ is the density function of a multivariate normal distribution, we can estimate the θ parameters, which are the mean and variances for the multivariate normal distribution. The estimation of the mixed logit (ML) model uses a maximizing simulated likelihood $LL(\theta) = \sum_{n=1}^{N} lnProb_n(\theta)$. Because there is no closed form, this expression cannot be solved analytically, and it is approximated using simulation methods, and the ML produces a set of means and standard deviations (SD) of the parameters (Train, 2009).

Since the estimated parameters have no direct practical implications (Train, 2009), to derive the economic implications, we need to calculate the WTP for comparison. Based on the estimated coefficients, the conventional way to estimate WTP is to calculate the negative ratio of the attribute coefficient to the price/cost coefficient. Under that assumption, the coefficient for installation cost variable is also random. As other coefficients with normal distribution, the estimation of WTP in preference space often results in counterintuitive distribution. Either the WTP distribution is unknown by dividing two normal distributed coefficients, or the value of the denominator is zero and WTP becomes extremely large (Khachatryan *et al*., 2016; Scarpa *et al*., 2008; Xie *et al*., 2015).

To obtain more accurate WTP estimates, we estimated the mixed logit model in WTP space following Train and Weeks (2005). In the WTP space model, WTP is directly estimated as opposed to the derivation using the negative ratio of the attribute and price coefficients in the preference space. Dividing the utility function by a scale parameter, S_n, will result in a new error term, v_{njt}, but without changing the simulation of consumer behaviors (Train and Weeks, 2005). The latent utility function in the WTP space is:

$$U_{njt} = -\frac{\beta_c Cost_{njt}}{S_n} + \frac{\beta_n' X_{njt}}{S_n} + \nu_{njt} \quad j = 1,\ldots, J,\ t = 1,\ \ldots,\ T, \tag{3}$$

where $cost_{njt}$ is the (installation) cost of alternative *j* in scenario *t* for individual *n*, and ν_{njt} is independent and identically distributed as type I extreme value (Gumbel).

If we set $\lambda_n = \frac{\beta_c}{S_n}$ and $W_n = \frac{\beta_n'}{\beta_c}$ which is the vector of WTPs for all attributes faced by individual *n* (notice β_c must be positive and assumed to follow a log-normal distribution), then the utility can be rewritten as:

$$U_{njt} = \lambda_n(-Cost_{njt}) + (\lambda_n W_n)' X_{njt} + \nu_{njt} \tag{4}$$

as the price coefficient is assumed to have a log-normally distributed coefficient and the WTP coefficients are assumed to be normally distributed. We convert the variable $cost_{njt}$ to negative value in the regression so that the WTP for attributes, W_n, can be directly estimated. The distribution of λ_n and W_n is similar as in the preference space.

3. Empirical Results

3.1 Sample Summary

We did two parallel surveys for the two-phase study regarding the adoption of eco-friendly landscapes. In this study, we had 610 homeowners from the state of Florida completed the questionnaire online. The summary statistics of socio-demographics are shown in Table 2.

Table 2. Summary statistics of socio-demographics characteristics

Demographic Characteristics	Whole Sample[a]	Control Group	Treatment Group
Observations	610	305	305
Age	49.2	49.3	49.0
Female (%)	59.0	60.3	57.7
Ethnic Group (%)			
Caucasian	81.6	82.6	80.7
African American	7.5	6.6	8.2
Hispanic	5.6	5.9	5.3
Others	5.4	4.9	4.6
Education (%)			
High School	12.0	10.1	13.8
College Degree	68.5	70.2	66.9
Graduate Degree	19.5	19.7	19.3
Employment (%)			
Employed full time	46.6	46.9	46.23
Employed part time	8.2	7.9	8.5
Self-employed	7.9	6.9	8.8
Unemployed	7.9	8.9	6.9
Student	1.2	1.0	1.3
Retired	25.7	25.9	25.6
Income (%)			
Less than $19,999	3.8	4.9	2.6
$20,000 – $59,999	36.9	37.1	36.7
$60,000 – $99,999	33.3	30.1	36.4
$100,000 – $139,999	14.9	16.4	13.4
$140,000 – $179,999	5.9	6.2	5.6
$180,000 – $299,999	4.1	4.3	3.9
More than $300,000	1.2	1.0	1.3

[a,b,c] refer to the whole sample group, control group, and economic benefit information treatment group, respectively

Fifty-nine percent of respondents were female. The average age was 49.2 years old, and 35.1% were in the 30-49 age range, while 54.8% were over 50-years-old. Regarding the ethnic distribution, 81.6% of respondents were Caucasian, 7.5% were African American, 5.6% - Hispanic, and 5.4% indicated other . The mean education level was some college to a college degree. About 88.0% of respondents completed college or above education. In addition, 62.7% were employed (full employment, part time employment, and self-employed). Annual income levels ranged from below $19,999 to above $300,000, but most responders (70.2.0%) were in the $20,000-$99,999 income range (Table 2).

3.2 Mixed Logit Model in WTP Space

The mixed logit model in WTP space relaxed the IIA assumption. In the estimation, all attributes coefficients were specified as random parameters with normal distributions and the mean coefficient of the price attribute was restricted to one with log-normal distribution. The estimations were then conducted using Stata 13, with 500 Halton draws to simulate the random parameters.

The estimates for the treatment group (environmental benefit information) and the control group are reported in Table 3. The first two columns are results for the control group and the third and fourth columns are results for the treatment group. The estimates for "would-not-choose" option (OPTOUT) are all negative and significant at 1% level, which means homeowners would prefer choosing one of the alternative landscapes rather than not choosing any. By using the means and standard deviations of the WTP estimates from the mixed logit model, we performed t-test to compare the WTP estimates for the control group with those of the information treatment group. The last two columns in Table 3 present the differences between the two groups and the *p* value for t-statistics. The *ΔWTP* column represents the difference between the WTP estimates across the information treatment and control groups and their corresponding t-test statistics are reported in the parenthesis in column 6.

The estimated WTP for landscape design (ratio), compared to the base level of conventional design (Plant25), indicated a positive WTP ($694 and $382) for 50% turfgrass with 50% plant design (Plant50), but negative (-$1,510 and -$1,588) for 100% plant design (Plant100). It implies that homeowners were willing to pay a premium for alternative landscape design with up to 50% turfgrass, but not for alternative landscape which tends to be very dissimilar from their conventional, predominantly turfgrass landscape designs. The significant negative WTPs for Plant100 design, however, indicated that homeowners dislike the design. The Plant75 design was found to be insignificant for both groups.

Although both estimated WTP for Plant50 indicate positive amounts, the environmental benefits information decreased homeowners' WTP to $382 for Plant50 design. Homeowners might prefer the Plant50 design ratio without any information treatment, but for homeowners receiving the environmental benefits information, they tend to prefer more plants design (Plant75). This pattern reveals that by gaining more information about the environmental benefits from alternative landscapes, homeowners would improve preferences for more plant design ratio and tend to be willing to replace their current landscape with a landscape with less grass and more plants. However, homeowners in both groups still were not willing to pay more to landscape design with all plantable area (Plant100).

Table 3. Comparison of information treatment and control groups: mixed logit model in WTP space, WTP value in thousand dollars.

	Control group		Treatment group			
	Estimates	SE	Estimates	SE	ΔWTP	(*p*-val.)
Mean estimates						
Cost (λ)	-0.560***	(0.180)	-0.574***	(0.171)	-0.014	(0.32)
Optout	-8.224***	(0.853)	-7.334***	(0.682)	0.890**	(0.02)
Landscape Design Ratio [Plant25]						
Plant50	0.694***	(0.252)	0.382*	(0.200)	-0.312***	(0.01)
Plant75	0.103	(0.246)	0.234	(0.225)	0.131	(0.23)
Plant100	-1.510***	(0.560)	-1.588***	(0.540)	-0.078	(0.43)
Rebate [REBATE0]						
Reb25	0.598***	(0.171)	0.816***	(0.190)	0.218***	(0.00)
Reb50	0.959***	(0.254)	0.885***	(0.238)	-0.074**	(0.04)
Pollinator Attractive Habitat [Low]						
Habitat	0.729***	(0.209)	1.114***	(0.226)	0.385***	(0.00)
Irrigation System [Conventional]						
Irrigation	0.401**	(0.169)	0.951***	(0.189)	0.550***	(0.00)
Maintenance Requirement [High]						
Mainlow	1.982***	(0.456)	1.841***	(0.422)	-0.141*	(0.05)
Mainmed	1.198***	(0.304)	1.295***	(0.307)	0.097***	(0.00)
Standard deviation estimates						
σ_{cost}	0.579***	(0.200)	0.499***	(0.154)		
σ_{optout}	5.727***	(1.160)	4.416***	(0.826)		
$\sigma_{plant50}$	1.637***	(0.363)	1.447***	(0.351)		
$\sigma_{plant75}$	2.213***	(0.470)	2.082***	(0.456)		
$\sigma_{plant100}$	6.293***	(1.379)	5.313***	(1.169)		
σ_{reb25}	0.184	(0.320)	0.217	(0.325)		
σ_{reb50}	0.729	(0.393)	0.056	(0.592)		
$\sigma_{habitat}$	1.175***	(0.312)	1.097***	(0.319)		
$\sigma_{irrigation}$	0.629	(0.445)	0.572	(0.377)		
$\sigma_{mainlow}$	1.275***	(0.456)	0.844	(0.552)		
$\sigma_{mainmed}$	0.104	(0.193)	0.034	(0.237)		
Observations	7,320		7,320			
Log-likelihood (LL)	-2018.827		-2032.899			

Notes: Baseline attributes are within square brackets.
*,**, *** represent significance at the 10%, 5%, and 1% levels, respectively; 500 Halton draws.
The ΔWTP presents differences of WTPs between environmental benefit information treatment group and those of the control group; p-values are in the last column and in parentheses.

We also obtained the significant and positive WTP for the rebate attribute (25% and 50%[1]) for both groups. The rebate attribute was treated as a categorical variable, because the two rebate rates can be seen as two different incentive programs. This result showed that offering rebate would encourage adoption intentions. Comparing the WTP values for the information treatment group with the control group, the results showed that homeowners in the treatment group preferred low rebate offerings ($816 vs $598 for Rebate 25%), and homeowners in the control group preferred more for the high rebate program ($959 vs $885 for Rebate 50%). One plausible explanation is that the environmental benefits information treatment effectively impacted homeowners to think more about the environment and accept low rebate rate programs. Because of these differences, our segmentation analysis (see section 3.3) further investigated homeowners' preferences for incentives. These findings can help landscape professionals and policy makers to develop more effective water conservation programs, which could eventually increase the adoption of environmental friendly landscapes.

The remaining attributes estimated included pollinator attractive habitat, smart irrigation system, and maintenance requirement. All the WTP estimates were statistically significant (Table 3), which indicated that homeowners in general would be willing to pay price premiums for eco-friendly attributes. In addition, homeowners of the information treatment group also had higher WTP for sustainable attributes, compared to the control group (e.g. for pollinator friendly habitat, $1114 vs. $729, and for smart irrigation, $951 vs. $401). We conclude that the environmental benefits information was effective in improving homeowners' preference and WTP for sustainable landscape attributes. Further, homeowners in the information treatment group were more tolerant with comparatively higher maintenance requirement levels.

3.3 Homeowner Segmentation

To compare homeowners' WTP for landscape attributes across segments, we asked homeowners for their rebate incentive preference, i.e., the minimum rebate rate they would accept to replace their current landscapes to a sustainable landscape. The question asked "how much of a rebate would you need in order to consider installing an alternative landscape?" According to their answers, we clustered them into three, low rebate preference group (<=25%), medium rebate preference group (>25% and <=50%), and high rebate preference group (>50%). These ranges were based on two considerations. Incentive programs usually apply a rebate rate in a quarter percentage accumulation. To be consistent with current practices we used these rebate rate accordingly. Secondly, the three segmentations provided us a comparable sample size. This direct self-stated incentive preference approach has advantage over data driven latent class segmentation, when consumers are clustered into segments, at times resulting in small sample sizes per segment.

Respondents in the lower rebate preference group (<=25%) were very likely to accept the alternative landscapes at a low rebate rate. There were 148 respondents in this category. The second segment (25% to 50% rebate preference group) included 250 respondents . The rest of the 212 participants preferred high rebate rate (beyond 50%), which means that conversion to alternative landscapes under low rebate incentive programs would be less likely[1].

Understanding homeowners' segmentation according to their incentive preference and the inter-group difference is important, because homeowners can behave quite differently with different incentive preference. Understanding their different response toward sustainable landscape program can provide insights for policy makers for future designing and adjustment of program elements. We estimated WTP by employing mixed logit model in WTP space respectively to the three homeowner segments, for both control and environmental benefit treatment group.

Total six sets of estimated results are shown in Table 6. It is worth mentioning that we

[1] The descriptive statistics for homeowner segments are available upon request.

defined rebate attribute in the estimation as positive and nonrandom. This assumption was supported by the result from the previous estimation. The SD estimates for rebate attributes were insignificant and implied a nonrandom, uniform distribution (SDs were insignificant in the control and treatment group samples as well).

Table 6. Willingness to pay for the homeowner segments with low (<=25%), medium (>25% and <= 50%), high (>50%) rebate preference for converting to alternative landscapes.

	Control Group			Treatment Group		
Attributes	Rebate preference low (<=25%)	Rebate preference medium (>25%, <=50%)	Rebate preference high (>50%)	Rebate preference low (<=25%)	Rebate preference medium (>25%, <=50%)	Rebate preference high (>50%)
[Rebate0]						
Rebate25	0.929**	0.752***	0.716**	1.251*	0.638***	0.802**
	(0.407)	(0.284)	(0.295)	(0.697)	(0.203)	(0.313)
Rebate50	1.253**	1.075***	0.999***	0.628	0.676***	0.968**
	(0.600)	(0.400)	(0.368)	(0.791)	(0.258)	(0.408)
Rebate	**1.253**	**1.075**	**0.999**	**1.251**	**0.676**	**0.968**
Weight	**15.1%**	**15.5%**	**18.9%**	**13.2%**	**12.9%**	**14.4%**
[Plant25]						
Plant50	0.547	0.627*	0.499	1.369	0.088	0.357
	(0.465)	(0.343)	(0.329)	(0.974)	(0.223)	(0.317)
Plant75	-0.126	0.122	0.23	0.878	0.098	0.142
	(0.583)	(0.310)	(0.366)	(0.797)	(0.241)	(0.354)
Plant100	-2.512***	-2.162**	-0.311	-1.313	-1.026**	-2.274**
	(0.898)	(0.921)	(0.692)	(2.119)	(0.448)	(0.947)
Design Ratio	**3.059**	**2.789**	**0.81**	**2.672**	**1.094**	**2.631**
Weight	**36.9%**	**40.3%**	**15.4%**	**28.1%**	**20.8%**	**39.1%**
Habitat	1.818***	0.745**	0.916**	1.594**	1.127***	0.771**
	(0.569)	(0.300)	(0.365)	(0.726)	(0.272)	(0.346)
Pollinator friendly	**1.818**	**0.745**	**0.916**	**1.594**	**1.127**	**0.771**
Weight	**21.9%**	**10.8%**	**17.4%**	**16.8%**	**21.5%**	**11.5%**
Irrigation	0.666**	0.399	0.625**	1.331**	0.975***	0.557**
	(0.323)	(0.262)	(0.295)	(0.642)	(0.234)	(0.274)
Smart Irrigation	**0.666**	**0.399**	**0.625**	**1.331**	**0.975**	**0.557**
Weight	**8.0%**	**5.8%**	**11.8%**	**14.0%**	**18.6%**	**8.3%**
[Mainhigh]						
Mainlow	1.504**	1.913***	1.926***	2.662*	1.377***	1.799***
	(0.767)	(0.669)	(0.697)	(1.610)	(0.431)	(0.684)
Mainmed	1.346**	0.953**	1.314***	1.654	1.003***	1.256**
	(0.582)	(0.391)	(0.484)	(1.023)	(0.313)	(0.500)
Maintenance	**1.504**	**1.913**	**1.926**	**2.662**	**1.377**	**1.799**
Weight	**18.1%**	**27.6%**	**36.5%**	**28.0%**	**26.2%**	**26.7%**
Total WTP	8.3	6.921	5.276	9.51	5.249	6.726
	100%	100%	100%	100%	100%	100%

Notes: Baseline attributes are within square brackets.
*,**, *** represent significance at the 10%, 5%, and 1% levels, respectively; 100 Halton draws.
Importance is the weight of attributes in total WTP range.

3.3.1 Rebate Attributes

For homeowners in the control group, preferences for the rebate attributes differed across the three segments (Table 6). Participants expressed WTP of $929, $752, and $716 for Rebate25, respectively. However, participants in the low rebate preference segment were willing to pay a highest premium of $1,253 for Rebate50. Rebate50 had been beyond their expectation and therefore, they prefer higher incentive. In addition, from the low incentive preference segment to the high incentive preference segment, the WTPs for Rebate25 and Rebate50 show a decreasing trend. Homeowners who were in the high rebate incentive preference group, would expect higher incentive, and less prefer the current rebate rate.

Participants in treatment group with different incentive preference were willing to pay a premium of $1,251, $638, and $802 for Rebate25 attribute, respectively. The environmental benefits information affected homeowners' WTP, across the three incentive preference segments as well. The environmental benefits information might have more impact on those homeowners with low incentive preference, and they were willing to pay a premium Rebate25 of $1,251 (Table 6, row 1 column 4). After receiving the environmental benefits information, homeowners might switch their focus further from the rebate attribute to other environmental friendly attributes, and WTP for Rebate50 became insignificant. In general, we found that participants in the environmental benefits information treatment group preferred Rebate25 more, while the control group participants preferred Rebate50 more (Table 6), implying positive effects of the environmental benefits information.

3.3.2 Environmental friendly attributes

For the landscape design attribute, the WTP results were mainly significant for the Plant100 attribute. Although WTPs for Plant50 and Plant75 attributes were insignificant for the control group, it indicated the indifference of WTP over Plant25 (traditional turfgrass lawn). Homeowners in the low incentive preference segment showed lowest preference for the Plant100 design (i.e., negative WTP or compensation $2,512) (Table 6, Column 1 row 11). Homeowners in the medium incentive preference segment did not prefer the Plant100 design (negative WTP $2,162)as well. Finally, results for homeowners in the high incentive preference group were insignificant.

For the treatment group, the WTP for all landscape design rates were insignificant for homeowners in the low incentive preference segment (Table 6, Column 4, Row 7-11). The environmental benefits information might have effects on their decision making, and the insignificant result showed the preference heterogeneity among homeowners in this segment. However, the positive sign of WTPs made certain practical sense. It implied that homeowners in the treatment group in general preferred these landscape designs. In addition, WTP for Plant100 design were negative.

The estimation result for landscape design attribute illustrated that the information treatment can make homeowners in low and medium incentive preference segment to be more tolerant of the Plant100 design, though it would not change the mindset of homeowners in the high incentive preference segment. The information treatment did not have statistically significant impact on homeowners' WTP in the low and medium incentive preference segments for Plant50 and Plant75 design attributes.

For pollinator friendly habitat, WTPs increased for the medium incentive preference segment and decreased for the low and high incentive preference segment, after receiving the information. A bit different pattern for the smart irrigation attributes; WTPs increased for the low and medium incentive preferences segment and decrease for the high incentive preference group.

The results showed that homeowners in the high incentive preference segment were willing to pay much less for these environmental friendly attributes, especially in the treatment group with $771 (table 6, Column 6 Row 15). However, they were willing to pay more or equally for maintenance requirement attributes (Table 6, Row 23).

For the environmental friendly attributes, the environmental benefits information treatment can generally improve the WTP of homeowners in low and medium incentive preference segment, but not for homeowners in the high incentive preference segment. Homeowners in the high incentive preference segment might be more economic oriented, and they were not easily influenced by receiving the environmental benefits information. Also, homeowners in the high incentive preference segment might weigh economic attribute more than those environmental friendly attributes. Therefore, they tend to give lower WTP. Thus, it is necessary to assess how those homeowners in different segments weigh the attribute important.

3.3.3 Attribute Weight

We compared the top three weighted attributes across the three segments to understand the inter-difference in attribute importance using a method that is in line with Cattin and Wittink (1982) and Meißner et al. (2016). We estimated the WTP directly and the weight of individual attribute was measured by taking the WTP range of each attribute and dividing that by the sum of all WTP range across all attributes (not included prices).

The results are shown in Table 6 and top three weighted attributes summarized in Table 7, in the panel below the WTP of each attribute. The results revealed an interesting pattern across the homeowner segments. For instance, the top three weighted attributes for the low and medium incentive preference segment were landscape design (PlantXX), pollinator friendliness (Habitat), and maintenance requirements (MaintXX) (Except for the medium incentive preference segment in the control group, one of the top three switched from pollinator friendliness (Habitat) to the Rebate attribute (RebateXX)). However, for homeowners in the high incentive preference segment, the top three attribute changed with respect to the rebate rate (RebateXX) and maintenance requirement (MainXX). Other than that, pollinator friendliness ranked the third in control group, and the landscape design ranked first after receiving the environmental benefits information treatment. There was a tendency for the high incentive preference segment to weigh economic related attributes more variations, i.e., rebate and maintenance requirement. The shift of importance from landscape design attribute to rebate attribute implied that those different homeowners' segments weighted attributes differently and allocate the quite different weight on attributes.

Table 7. Top 3 weighted attributes across homeowner segments.

Top 3 weighted attributes	Low incentive Pref.		Medium Incentive Pref.		High Incentive Pref.	
	Control	Treatment	Control	Treatment	Control	Treatment
1	Design Ratio (36.9%)	Design Ratio (28.1%)	Design Ratio (40.3%)	Maintenance (26.2%)	Maintenance (36.5%)	Design ratio (39.1%)
2	Pollinator (21.9%)	Maintenance (28.0%)	Maintenance (27.6%)	Pollinator (21.5%)	Rebate (18.9%)	Maintena nce (26.7%)
3	Maintenance (18.1%)	Pollinator (18.1%)	Rebate (15.5%)	Design Ratio (20.8%)	Pollinator (17.4%)	Rebate (14.4%)

The maintenance requirement attribute for all six segments is among the top three weighted attributes. This attribute should be communicated more properly in alternative landscape promotional programs, and highlight the differentiated benefits for homeowners in different segments, i.e. environmental benefits for low incentive preference segment homeowners, and economic benefits for high incentive preference segment homeowners. Policy makers, program designers, and landscape professionals should target consumers using tailored communications accordingly. Reinforcing environmental benefits of the attributes of alternative landscapes and highlighting the incentive and economic benefits to convince homeowners with low and medium incentive preference segment would increase adoption rates.

4. Conclusions

Resource conservation programs using rebate incentives, have gained a significant attention from the state/local government as well as water management organizations interested in encouraging homeowners to transform their water inefficient residential landscapes to environmental sustainable landscapes (e.g. FFL™ program in Florida). This study investigated homeowners' preferences and WTP for alternative landscapes, specifically focusing on rebate incentives underlying the sustainable landscape program. Our result showed that rebate incentives have positive effects on alternative landscape adoption intention. Homeowners in general were willing to pay price premiums to receive these rebate incentives. In addition, the environmental benefits information treatment improved participants' preferences (i.e., less negative WTP amount) for the 75% non-turfgrass landscape design, and showed slightly more WTP amount for the included environmental friendly attributes (i.e., pollinator friendly habitat and smart irrigation).

Currently, incentive programs were offered to homeowners indifferently. In this study, we found that homeowners could be influenced by the environmental benefits information and adjust their WTP for sustainable landscape attributes. However, for homeowners with different incentive preferences, their WTP and weighted importance for attributes were considerably different. Understanding homeowners' preferences across low, medium, or high rebated rate can provide stakeholders with an opportunity to implement rebate-based programs more effectively. Educational program and incentive approaches can then be utilized to the target homeowners.

We clustered homeowners into three incentive preference segments and found their WTP with regard to rebate attribute and environmental friendly attributes were significantly different. Although homeowners in all three segments significantly preferred the rebate incentive, rebate incentives have considerably more effects on homeowners with low incentive preference than on homeowners in the other segments. In addition, homeowners with high incentive preference treated economic attributes more importantly, while low incentive preference homeowners weigh environmental attribute more, according to the findings of the top three important attributes. For instance, highlighting economic benefits of sustainable landscapes for homeowners with high incentive preferences can be effective than only highlighting environmental benefits.

This study contributes to the sustainable residential landscape research by differentiating homeowners with incentive preference segments and investigating their preferences respectively. Our findings can be used to refine social marketing approaches aiming to change homeowners' landscape adoption intention and better anticipating behavior changes. For instance, by asking incentive preference directly, we can know homeowners who belong to the low incentive preference segment. We can highlight the environmental benefits of the sustainable landscapes to influence their adoption decision and then follow by low rebate incentive program, e.g. range at 25% to 50%. For homeowners with high incentive preference, we can highlight the environmental benefits, but with more efforts on the economic benefits, and aim to change their perceptions regarding the sustainable landscapes.

Future research could focus on the landscape attribute attendance among those attributes, and study how the attribute attendance affects homeowners WTP regarding economic and environmental friendly attributes differently. Previous rural landscape studies raised up the attribute non-attendance issues (ANA) (Scarpa et al., 2007 and 2009) In addition, the role of Homeowner Associations (HOAs) in landscaping practices or alternative landscape adoption process should also be studied as local ordinances or HOA regulations can significantly influence the adoption of alternative landscapes.

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