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Are Homeowners Willing to Pay for "Origin-Certified" Plants in Water-Conserving Residential Landscaping?

Kynda R. Curtis and Margaret W. Cowee

This study investigates the value of local origin-labeling for a nonfood product by evaluating Nevada homeowner purchase propensity for "NevadaGrown" native plants for water-conserving residential landscaping. Homeowner survey results illustrate that homeowners may be willing to pay as much as a 14% premium for origin-certified native plants. WTP estimates are higher when uncertain responses are incorporated into the bidding structure. Preferences for local production and drought resistance in plants are the primary drivers of purchasing decisions in the absence of uncertain responses, while income levels and preferences for natural plant appearance additionally affect purchasing decisions when uncertainty is incorporated.

Key words: drought resistance, native plants, origin labeling, uncertainty, willingness to pay

Introduction

Drought conditions and shifting population centers have combined to make water an increasingly scarce resource in arid and semi-arid regions of the Western United States. As water resources decline, residential and commercial landowners are strongly encouraged to adopt water-conserving landscape strategies through both higher water costs and governmental incentive programs. For example, an incentive program through the Las Vegas Valley Water District called "Water Smart Landscapes" helps property owners convert from turf to water-conserving landscapes through the use of a per square foot turf buyback rebate system. The program has been so effective at reducing water usage in the Las Vegas Valley that the California Urban Water Conservation Council has initiated its own program (The Irrigation Association, 2005).

One of the most common of these water-conserving landscape strategies is xeriscaping, the principles of which include landscape design, soil evaluation, proper maintenance, and importantly, low water-use vegetation such as native plants.[1] These strategies are specifically designed to increase water system efficiency. Xeriscape is an effective water-conserving tool as illustrated in a study conducted by Sovocool (2005), where residents of Clark County, Nevada, realized a savings of 30% in total water consumption after converting to xeriscape. In addition to water savings, the xeriscape conversion costs (an average of $1.55 per square

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[1] Xeriscape landscaping is designed specifically for areas that are susceptible to drought and where water conservation is practiced. Xeriscape is not limited to desert plants, but capitalizes on measures that conserve water such as grouping plants with similar water requirements together, reducing grass use, and using proper irrigation systems (Wilson and Feucht, 2007).

foot) were offset by average decreases in landscape maintenance of 2.2 hours per month and average annual savings on maintenance expenditures of $206. Along with water conservation, water costs have been noted in the literature as a primary contributor of homeowner landscape choice. Based on findings reported by Hurd (2006) and Spinti, Hilaire, and Vanleeuwen (2004), New Mexico homeowners indicated that increased water costs reduce water use and water-intensive turf-grass landscaping. Homeowners rated water shortages, water-rate increases, and high water costs as the primary causes of lowering water use on their landscape (with "agree" or "strongly agree" ratings of 92.5%, 71.7%, and 71.5%, respectively).

Native and desert plants offer many landscaping advantages to landowners in arid and semi-arid climates over nonnative and high water-use plant species aside from their water efficiency and resulting water cost reductions. A key feature of arid native plants is their natural resistance to drought. While drought resistance reduces water usage and water expenditures, it also increases plant hardiness and reduces plant mortality, replacement expenditures, and maintenance needs. Because native plants are dense, they inhibit the spread of invasive plant species. Invasive plants choke out landscaped plants, increase replacement and maintenance costs, and foster fire hazards. Thus, limiting their presence is often beneficial for homeowners. Finally, native species create a more natural-looking landscape than nonnative and higher water-use plants.

In the high desert climate that characterizes Nevada, native plants and other water-conserving landscape vegetation must be conditioned to survive cold winters, hot dry summers, frequent high winds, and early frost conditions. In Nevada, the majority of native plants sold for residential landscaping purposes are started or grown prior to sale in nearby states such as California and Arizona. Only 17% of native plants purchased in Nevada are supplied by Nevada growers (Curtis, Cowee, and Slocum, 2005). Although plants grown in nearby states may be native to Nevada, plants started or "locally grown" in Nevada are better suited to local climactic conditions, with post-homeowner purchase loss rates of 10% versus the 50% loss rates of imported native plants [Strickland (2009); also see Conover and Poole (1984) and Gindel (1957) for information on the acclimatization requirements of plants moved to a new environment]. The primary objective of this study is to determine if Nevada homeowners are willing to use native plants in their landscaping choices, and if so, whether they are willing to pay a premium to secure "locally grown" native plants for their water-conserving landscapes.

Some evidence suggests homeowners in the Southwest prefer landscapes incorporating native plants and shrubs. Spinti, Hilaire, and Vanleeuwen (2004) found homeowners in New Mexico chose native and desert plants for their landscaping primarily due to plant attractiveness (77.1% of respondents) and desired aesthetics (62.3%). Hurd (2006) reported that 64.5% of homeowners surveyed in New Mexico actually preferred natural landscapes, including 18.2% who favored little or no grass, and especially native/natural desert landscapes. However, these studies did not include potential benefits of reduced water usage and/or drought resistance.

This study examines homeowner willingness to pay (WTP) for local "origin-certified" and labeled native plants through a survey of homeowners in two metropolitan areas of Nevada. Homeowner characteristics and the effect of preferences for native plant attributes on WTP estimates are examined. Additionally, we evaluate how WTP values vary when respondent uncertainty is incorporated into the survey bidding structure through the use of a multiple-bounded discrete-choice format offering both certain and uncertain responses.[2] Thus, we expand

[2] Allowing for respondent uncertainty includes adding "probably yes," "not sure," and "probably no" to the traditional dichotomous choice options of "definitely yes" and "definitely no."

on the methodological research of previous contingent valuation studies. Although numerous studies have examined consumer WTP for origin-certified food products, to the best of our knowledge, only one other (Hustvedt and Bernard, 2008) examines a nonfood product.

Studies on the Importance of Geographic Labels

As with other credence attributes, geographic area of production cannot be detected through visual inspection, use, or consumption of a product, and must therefore be conveyed to consumers through labeling and/or certification practices. Previous studies show consumers are willing to pay a premium for geographic origin-labeled and certified products. For example, Umberger et al. (2003) found consumers in Chicago and Denver were willing to pay premiums of 11% and 24% for steak and hamburger with U.S. country-of-origin labeling (COOL). Loureiro and Umberger (2005) reported consumers were willing to pay premiums between 2.5%–2.9% for COOL chicken breasts, pork chops, and steak certified as having been produced in the United States. In an earlier study, Loureiro and Umberger (2003) found consumers were willing to pay a premium of 38% over the initial given price for a beef product labeled "U.S. Certified Steak" and a premium of 58% for a beef product labeled "U.S. Certified Hamburger." Based on findings by Hassan and Monier-Dilhan (2002), consumers were willing to pay a higher premium for nationally branded protected designation of origin (PDO) camembert than for PDO camembert with a store or generic label. Cicia, Del Giudice, and Scarpa (2002) surveyed Italian consumers of organic extra virgin olive oil and found that geographic origin was a primary factor in consumer WTP.

This study incorporates the "NevadaGrown" third-party certification program as an identifier of "locally grown" certified labels. The use of a third-party certification program was selected over first-party or brand certification (both first-party and brand certification are considered "self-certification") based on findings by Lusk and Anderson (2004), Loureiro, McCluskey, and Mittelhammer (2002), Gumpper (2000), and Bjork (1998). Consumers were willing to pay a premium for products bearing a third-party certified eco-friendly or "green" label over the same product without labels, indicating a WTP for products with third-party labels that certify the existence of credence attributes. Consumer faith in third-party certification programs is supported by Christensen et al. (2003) who found that U.S. consumers trust third-party certifications, especially those provided by the federal government. Further, the findings of Loureiro and Umberger (2007), Winfree and McCluskey (2005), Quagrainie, McCluskey, and Loureiro (2003), and Loureiro and McCluskey (2000) support the theory that consumers will pay premiums for geographic origin-labeled products when the perceived quality or reputation is related to geographic origin.

Survey Data Description

Data for this study were collected through a mail survey of randomly selected homeowners in the greater Reno and Las Vegas, Nevada, metropolitan areas in the fall of 2004. The survey was pre-tested in July 2004 at a local Reno nursery to evaluate bidding structures and bid amounts. Minor adjustments were made as a result of the pre-test. An initial mailing of 1,000 surveys in the Reno area yielded 138 responses, representing a response rate of 13.8%. Another 800 surveys were mailed to Las Vegas households, yielding 112 returned surveys (a response rate of 14%) for a total of 250 surveys (an overall response rate of 13.9%). Survey statistics are reported in table 1.

Table 1. Survey Sample Statistics

Respondent Attribute/Attitude	Total Sample	Greater Las Vegas Area	Greater Reno Area
Number of respondents	250	112	138
Female	52.1%	45.2%	55.8%
Mean age (years)	55.6	55.4	55.8
Household size (no. of persons)	2.2	2.3	2.2
Median annual household income	$60–$75,000	$60–$75,000	$45–$60,000
Median home value	$300–$450,000	$300–$450,000	$300–$450,000
Education (high school diploma)	97.6%	95.9%	98.6%
Labor force participation rate	61.3%	58.9%	63.0%
Respondent looks for plant original label before purchasing	27.0%	20.3%	31.4%
Median annual gardening/landscaping expenditures	$200–$400	$200–$400	$200–$400
Annual gardening/landscaping expenditures:			
1. Less than $200	30.5%	37.5%	27.1%
2. $200–$400	29.9%	25.0%	32.3%
3. $400–$600	16.8%	15.6%	17.3%
4. $600–$800	5.6%	6.3%	5.3%
5. $800–$1,000	6.6%	7.8%	6.0%
6. More than $1,000	10.7%	7.8%	12.0%
Respondent purchases plants primarily at:			
1. Nursery/plant specialty store	39.1%	44.6%	33.8%
2. Landscaping provider	4.1%	3.3%	4.6%
3. Hardware store	42.2%	37.0%	47.5%
4. Discount/warehouse store	14.6%	15.2%	14.2%
When purchasing plants:			
1. Price is more important	57.6%	61.2%	55.9%
2. Price and origin are equally important	28.1%	23.9%	30.2%
3. Origin is more important	14.3%	14.9%	14.0%
Drought resistance is most important native plant attribute	52.6%	52.2%	58.1%
Natural appearance is most important native plant attribute	29.4%	24.3%	35.4%

The survey found that the median annual expenditures on gardening and landscaping supplies were $200–$400, or approximately 0.07% of annual household income. The greatest percentage of respondents (42.2%) preferred to purchase plants at hardware stores such as Lowe's and Home Depot. Smaller nurseries and plant specialty stores are the most likely outlets for local value-added plant products and were the second most-preferred outlet at 39.1%. Plant origin labels were considered by 27% of respondents when making plant purchases. Greater emphasis on label inspection was found in the Reno sample (31.4%) as compared to the Las Vegas sample (20.3%). Respondents were asked to rate the importance of plant prices relative to plant origins when making landscaping purchasing decisions on a 10-point Likert scale, where 1 indicated price was all important and 10 indicated origin was all-important. Over the entire sample, the average rating was 3.61, confirming that plant price was more important to respondents than plant origin. To better understand the distribution of responses to this question, the scale was divided into three categories: (*a*) price is more important than origin (ratings of 1–3), (*b*) price and origin are equally important (4–6), and (*c*) origin is more important than price (7–10). Only 14.3% of respondents fell into the third category.

Respondents were presented with four potential beneficial attributes of native plants (drought resistance, natural appearance, invasive species protection, and prevention of soil erosion) and were asked to rank their preference for these attributes in terms of landscaping benefits. Respondents, in some cases, assigned identical rankings to one or more of the attributes, indicating equal preferences for some attributes (see the appendix for survey question description). Drought resistance was the most favored attribute of native plants, with 52.6% of respondents assigning it a ranking of one; natural appearance was second at 29.4%. The Reno sample ranked drought resistance and natural appearance higher than the Las Vegas sample.

After collecting information about landscaping purchase habits and plant preferences, the survey provided respondents with a description of the "NevadaGrown" labeling program. In addition, information was furnished regarding the potential benefits of locally started (grown) native plants so that respondents would have a basic understanding of the potential benefits of Nevada native plants (see the appendix for both descriptions). Respondents were provided a price of $5.00 for a one-gallon-sized standard native plant (i.e., not a "NevadaGrown" certified labeled plant). The price represented current market value in July 2004. Respondents were then asked to compare the standard native plant to the "NevadaGrown" certified native plant and were offered a series of 10 randomly ordered bids, ranging from $5.00 (standard plant price) to $10.00 (double the standard plant price), for the "NevadaGrown" certified plant.[3]

Respondents were given five response options for each price: "definitely yes," "probably yes," "not sure," "probably no," or "definitely no" (see the appendix for survey question description). Five different versions of the survey were created, with each presenting bid amounts in a different random order to test for anchoring (i.e., the second and following bids were not contingent on the first bid).

Research Methodology

The methods used to collect stated preferences in contingent valuation studies have been highly debated, and more efficient methods of survey construction are continually proposed. A variety of studies over the past several decades have endeavored to find efficient elicitation methods for WTP in contingent valuation studies using discrete choice (DC). Initial single-bounded (SB) DC methods generally have been abandoned in favor of more statistically efficient double-bounded (DB) DC methods (see Hanemann, Loomis, and Kanninen, 1991; Cameron and Quiggin, 1994; Ready, Whitehead, and Blomquist, 1995; Alberini, Boyle, and Welsh, 2003). A one-and-one-half-bounded (OOHB) approach was found to be less efficient than the DB method in terms of information derived even though it is less sensitive to follow-up bids and is more efficient in terms of coefficients of variation than both the SB and DB formats (Cooper, Hanemann, and Signorello, 2002). The triple-bounded (TB) DC format was considered a more efficient alternative to the DBDC (Kanninen, 1993; Langford, Bateman, and Langford, 1996), but has been mostly disregarded due to the complexity of the format (which may increase item nonresponse bias) and the inability to correct for starting-point bias (Whitehead, 2002).

This study uses a multiple-bounded discrete-choice (MBDC) format by offering respondents a panel of bids to eliminate starting-point bias while also offering both certain and uncertain

[3] A specific plant quantity and size was chosen to prevent ambiguity issues (see Corsi, 2007).

response choices to provide respondents with an outlet to express their uncertainty (Loomis and Ekstrand, 1998; Cameron et al., 2002; Whitehead, 2002; Vossler et al., 2003; Vossler et al., 2004; Vossler and McKee, 2006; Svedsater, 2007; Bostedt, Ericsson, and Kindberg, 2008; Wang, Xie, and Li, 2008). Welsh and Poe (1998) found that allowing respondents to choose an uncertain response biased WTP estimates downward, indicating any uncertain response is really a "no." However, Cooper, Hanemann, and Signorello (2002) and Alberini, Boyle, and Welsh (2003) reported that WTP estimates are higher when incorporating uncertainty. Further, Vossler and McKee (2006) cautioned that care must be taken when interpreting uncertain responses because providing this option may encourage respondents to express false uncertainty. Importantly, a common conclusion of these studies has been that additional research is necessary before any assertions can be made as to the validity of responses incorporating uncertainty.

Empirical Model

Homeowner WTP for a "NevadaGrown" certified one-gallon native plant was estimated using maximum-likelihood estimation (MLE) following a construct similar to that of Wang (1997)—with the difference only in the use of the lognormal distribution. Due to the prevalence of consumer willingness to pay premiums for third-party certified products in the literature, homeowners were assumed to view the certified third-party designation of origin label as a positive attribute. Therefore, respondents were presented a base price (no premium) and positive premium amounts. The lognormal distribution was used based on this assumption and restricts the distribution to the positive quadrant. The WTP model is given as:

$$\ln\left[WTP_i\right] = \mathbf{x}_i'\boldsymbol{\beta} + \varepsilon_i;\ \varepsilon_i \sim N(0, \sigma^2), \tag{1}$$

where WTP_i indicates willingness to pay for respondent i (i = 1, …, n), $\mathbf{x}_i$ is a vector of explanatory variables, $\boldsymbol{\beta}$ is the vector of estimated coefficients, and ε is assumed to be distributed normally.

The likelihood function for a respondent who accepts the highest offered bid ($10.00) can be derived as:

$$p(\text{"yes" to } B_{10}) \begin{cases} = p\left(\ln[WTP] \geq \ln[B_{10}]\right) \\ = p\left(\mathbf{x}_i'\boldsymbol{\beta} + \varepsilon_i \geq \ln[B_{10}]\right) \\ = p\left(\varepsilon_i \geq \ln[B_{10}] - \mathbf{x}_i'\boldsymbol{\beta}\right) \\ = p\left(\varepsilon_i\left(\frac{1}{\sigma}\right) \geq \left\{\ln[B_{10}] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right)\right) \\ = \Phi\left(\left\{\ln[B_{10}] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right)\right) \\ = 1 - \Phi\left(\left\{\mathbf{x}_i'\boldsymbol{\beta} - \ln[B_{10}]\left(\frac{1}{\sigma}\right)\right\}\right) \end{cases}, \tag{2}$$

where B_{10} indicates the highest bid, $\boldsymbol{\beta}$ is the estimated coefficient, σ is the standard error, and Φ is the standard normal CDF. For respondents who accept the $10.00 bid, the true willingness

to pay is bounded between \$10.00 and infinity, because the actual willingness to pay is an unspecified amount above the given highest bound.

To derive the likelihood function for a respondent whose willingness to pay is less than the highest bid, or somewhere between two of the given bounds, it is necessary to consider both the upper and lower bounds:

$$(3) \qquad p(\text{“yes” to } B_j) \begin{cases} = p\left(\ln[B_j] \le \ln[WTP_i] < \ln[B_{j+1}]\right) \\ = p\left(\ln[B_j] \le \mathbf{x}_i'\boldsymbol{\beta} + \varepsilon_i < \ln[B_{j+1}]\right) \\ = p\left(\ln[B_j] - \mathbf{x}_i'\boldsymbol{\beta} \le \varepsilon_i < \ln[B_{j+1}] - \mathbf{x}_i'\boldsymbol{\beta}\right) \\ = p\left(\left\{\ln[B_j] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right) < \varepsilon_i\left(\frac{1}{\sigma}\right) < \left\{\ln[B_{j+1}] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right)\right) \\ = \Phi\left(\left\{\ln[B_{j+1}] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right)\right) - \Phi\left(\left\{\ln[B_j] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right)\right) \end{cases},$$

where B_j is the offered bid, σ is the standard error, and Φ is the standard normal CDF.

Equation (4) sums the individual likelihood functions over all i responses:

$$(4) \qquad \mathrm{L} = \sum_{i=1}^{I} \ln\left[\Phi\left(\left\{\ln[B_{j+1}] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right)\right) - \Phi\left(\left\{\ln[B_j] - \mathbf{x}_i'\boldsymbol{\beta}\right\}\left(\frac{1}{\sigma}\right)\right)\right].$$

To estimate WTP for each respondent, the following function was used:

$$(5) \qquad WTP_i = \exp\left(\mathbf{x}_i\boldsymbol{\beta} + 0.5\sigma\right),$$

where σ is the estimated standard error of the log-likelihood function at its maximum. (Because sigma could be estimated as a negative value, for this equation sigma was first squared to ensure all positive values, and then the square root was taken.) The model generates a vector of individual estimated WTP for all n respondents, which was then used to calculate mean and median WTP for the entire sample.

Two models were estimated to evaluate the impact of uncertain decision choices. Model I does not allow for uncertain responses and incorporates only those bids in which a respondent indicated “definitely yes.” Model II allows for uncertain responses by incorporating bids in which the respondent indicated “probably yes” or “definitely yes.”

Results and Discussion

Willingness-to-Pay Influencers

Both the model without uncertainty (Model I) and with uncertainty (Model II) included the variables described in table 2. As shown, the variable *Shopper* indicates a respondent is the primary shopper for landscaping/gardening materials in the household. This variable was included as an indicator of respondent awareness of actual pricing and plant characteristics. We would expect a more informed shopper to have a positive WTP. The *Price_Origin* variable denotes a respondent’s ranking of his or her preference for price versus product origin, measured on a scale from 1–10, where 1 indicates that price is all-important when

Table 2. MLE Variable Definitions and Statistics

Variable	Definition	Mean	Std. Dev.	Min.	Max.
Shopper	1 = respondent is primary shopper for landscaping/gardening supplies in household	0.844	0.364	0	1
Price_Origin	Rank of importance of price of plant vs. origin of plant: 1–10 scale, where 1 = price strictly important, and 10 = origin strictly important	3.474	2.612	1	10
*Drought*1	1 = respondent ranked drought resistance as a more important characteristic (rank of 1 or 2)	0.758	0.429	0	1
*Natural*1	1 = respondent ranked natural appearance as a more important characteristic (rank of 1 or 2)	0.602	0.491	0	1
Income_Hi	1 = respondent's annual household income is ≥ $60,000	0.469	0.500	0	1
Age_Lo	1 = respondent is 18–44 years old	0.232	0.423	0	1
*V*2	1 = respondent completed survey version 2	0.194	0.397	0	1
*V*3	1 = respondent completed survey version 3	0.152	0.340	0	1
*V*4	1 = respondent completed survey version 4	0.175	0.381	0	1
*V*5	1 = respondent completed survey version 5	0.190	0.393	0	1

purchasing plants and 10 indicates that plant origin is all-important. A respondent with a higher ranking for plant origin is predicted to have a higher WTP.

The variables *Drought*1 and *Natural*1 were based on plant attribute rankings. They reflect a respondent's ranking (first or second) of the two attributes. *Drought*1 denotes that a respondent believes drought resistance is a more important characteristic of native plants, and *Natural*1 indicates a respondent believes natural appearance is a more important characteristic of native plants. These two variables represent homeowners' preferences for beneficial plant attributes and are expected to have a positive influence on WTP.

The variable *Income_Hi* indicates that a respondent's annual household income is $60,000 (median) or above. The *Age_Lo* variable denotes a respondent is between the ages of 18 and 44. The income and age variables were coded in this manner for ease of comparing our results to studies in which consumers with preferences for labeled and certified products have higher income levels and tend to be younger (see Loureiro, McCluskey, and Mittelhammer, 2002; Loureiro, 2003; Grannis and Thilmany, 2002). Finally, the variables *V*2 through *V*5 represent survey versions. The only differentiating feature between versions was the bid order. Version effects would indicate the presence of starting-point bias.

The estimation results presented in table 3 show that the variables *Price_Origin* and *Drought*1 are significant and positive in both models.[4] These findings suggest that the more importance a respondent places on the origin of native plants, the more likely he/she is to pay a premium for local "origin-certified" native plants. This likelihood may be caused by respondents' perceptions that locally produced plants are hardier, have a higher probability of survival, or generate a positive impact on local producers. Such support has been noted in the literature (Umberger et al., 2009). Plant origin was considered important in the purchasing decision by 14.3% of survey respondents, as shown in table 1.

The result for drought resistance reveals homeowners would be willing to pay more for "certified" locally grown native plants. This finding is perhaps motivated by homeowner desire to reduce plant replacement costs, as well as water costs and watering frequency.

[4] The models were estimated using Matlab. The program code is available from the authors upon request.

Table 3. MLE Estimation Results

	MLE Model I: Without Uncertainty		MLE Model II: With Uncertainty	
Variable	Coefficient	Std. Error	Coefficient	Std. Error
Constant	−2.950***	0.646	−3.281***	0.421
Shopper	−0.308	0.537	0.702*	0.333
Price_Origin	0.206**	0.084	0.132**	0.057
*Drought*1	1.133***	0.343	0.694**	0.299
*Natural*1	−0.404	0.346	0.806**	0.257
Income_Hi	0.037	0.376	0.703**	0.248
Age_Lo	−0.032	0.401	0.446	0.322
*V*2	1.275**	0.525	0.116	0.344
*V*3	0.355	0.494	0.126	0.396
*V*4	0.899	0.512	−0.012	0.419
*V*5	0.293	0.523	−0.670	0.380
Number of Respondents	250		250	
Log-Likelihood Statistic	−386.6		−397.4	

Note: Single, double, and triple asterisks (*,**,***) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

In Model I (without uncertainty), the variable *V*2 is also significant and positive. This survey version had an initial bid of $5.50, which respondents may have found reasonable and thus provided a preferable starting point. Since none of the version variables were significant in Model II (with uncertainty), it may also be possible that when respondents are allowed to express uncertainty in acceptance of their bids, issues typically related to version effects (such as anchoring) may not be as strong.

In Model II (with uncertainty), the variables *Shopper*, *Natural*1, and *Income_Hi* were significant and positive. In the case of "natural" appearance, the supportive rationale is parallel to that of drought resistance and consistent with the literature (see Spinti, Hilaire, and Vanleeuwen, 2004; Hurd, 2006). The result for *Shopper* may be due to the primary shopper's increased knowledge of the enhanced benefits of locally produced native plants. Additionally, homeowners with higher disposable incomes (*Income_Hi*) are more likely to pay a premium for certified locally grown plants. This result is consistent with the literature, which suggests consumers with a higher disposable income tend to focus more on product attributes and differentiation (Tronstad et al., 2005).

Willingness-to-Pay Estimates

As reported in table 4, the mean estimated WTP for Model I was $5.39 and $5.71 for Model II. Thus, Nevada homeowners are willing to pay premiums of $0.39 to $0.71 (or 7.8% and 14.2% over the base price, respectively) for a certified "NevadaGrown" one-gallon native plant. The majority of the previous research on origin-labeled products has centered on food items, which are not easily compared to the plant products used in this study. However, our results fall into the wide range of previous WTP estimates for labeled food products of

Table 4. WTP Results for Model I and Model II

Model	Median WTP	Mean WTP	Standard Error
Model I: Without Uncertainty	$5.25	$5.39	$0.07
Model II: With Uncertainty	$5.55	$5.71	$0.12

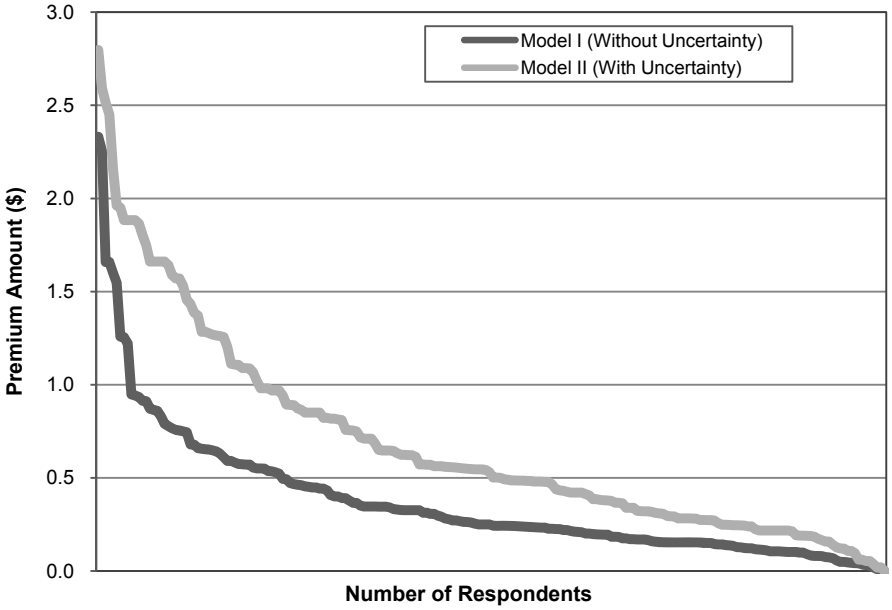

Figure 1. Distribution of WTP for Models I and II

2.5% for U.S. chicken breasts and pork chops (Loureiro and Umberger, 2005) to 58% for U.S. certified steak (Loureiro and Umberger, 2003), and are very comparable to the premiums found for U.S. steak and hamburger at 11% and 24%, respectively (Umberger et al., 2003). For our sample, it seems that given the ability to purchase a certified locally grown native plant, homeowners would be willing to pay a premium. WTP distributions are provided in figure 1.

Additionally, we show that incorporating respondent uncertainty increases WTP values. This result supports similar findings of Wang (1997), Cooper, Hanemann, and Signorello (2002), and Alberini, Boyle, and Welsh (2003). Thus, allowing for uncertain responses increases the homeowner's probability of choosing a higher bid. This finding is consistent with Ready, Whitehead, and Blomquist (1995) who show that when faced with only a dichotomous choice ("yes"/"no"), consumers tend to be more conservative (i.e., reject bids that move away from the baseline), and when faced with multiple choices, consumers have higher rates of "yes" responses ("probably yes," "likely," etc.) and higher WTP estimates.

Table 5. Marginal Effects on Significant Variables

MLE Model I: Without Uncertainty			MLE Model II: With Uncertainty		
Variable	Coefficient	Percent	Variable	Coefficient	Percent
Constant	−2.950***	−295.00	Constant	−3.281***	−328.10
Price_Origin	0.206**	20.60	*Shopper*	1.018*	101.78
*Drought*1	2.105***	210.50	*Price_Origin*	0.132**	13.20
*V*2	2.579**	257.87	*Drought*1	1.002**	100.17
			*Natural*1	1.234**	123.40
			Income_Hi	1.020**	101.98

Note: Single, double, and triple asterisks (*,**,***) denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Marginal Effects

Following Kennedy (1981), the model's estimated coefficients must be converted to marginal values when employing a lognormal parameterization.[5] The coefficients were converted using the following equation:

$$\text{Marginal Effect}\,(c) = \left[\exp(\beta_c - 0.5\,\text{var}\,\beta_c) - 1\right], \tag{6}$$

where c is the exogenous variable in question, and $\text{var}\,\beta_c$ is the estimated variance of the coefficient. Marginal effects for significant variables in both models are presented in table 5. In Model II, the marginal effects for several of the variables were similar. As shown by the positive coefficient on *Shopper*, if a respondent is the primary household shopper for landscaping and gardening supplies, WTP increases by 101.8%. The positive coefficient on *Drought*1 indicates that if a respondent considers drought resistance to be a more important attribute of native plants, his/her WTP increases by 100.2%. The positive coefficient on *Income_Hi* indicates an annual household income greater than or equal to $60,000 increases WTP by 101.9%. For every one-unit shift from an emphasis on price to an emphasis on origin, the positive coefficient on *Price_Origin* signifies that WTP increases by 13.2%. This translates to a total increase in WTP of 118.8% when moving from a complete emphasis on price to a complete emphasis on origin. The coefficient on *Natural*1 is the highest under Model II, revealing that if a respondent considers the natural appearance of native plants to be a more important attribute, WTP increases by 123.4%. Yet, fewer respondents ranked natural appearance over drought resistance as an important attribute of native plants (29.4% and 57.6%, respectively).

The marginal effects in Model I are higher than those of Model II for both *Price_Origin* and *Drought*1 (20.6% and 210.5%, respectively). These findings may confirm that the perceived benefits (plant longevity, lower water use, reduced maintenance needs, etc.) to homeowners resulting from plant origin and drought resistance play a significant role in enabling homeowners to respond to bids with "certainty." Also, the version effects attributed to the version 2 survey (*V*2) are exhibited here, as WTP increases by 257.8% if the respondent completed this version.

[5] As pointed out by Derrick (1984), the Kennedy (1981) and Halvorsen and Palmquist (1980) methods are biased in small samples, but the Kennedy estimator is preferable for practical situations due to its extremely small bias.

Summary and Conclusions

The purpose of this study was to examine homeowner propensity to purchase "origin-certified" native plant products for water-conserving residential landscaping uses. A second objective was to determine the effects of homeowner demographics, preferences for local products, and beneficial plant attributes on WTP for locally produced native plants. Data were collected through a mail survey of homeowners in Nevada and were analyzed using two maximum-likelihood estimation models, one of which allowed respondents to express uncertainty in bid responses.

While the sample size for this study was small and may not be considered representative of the full population, the stated preference data indicate Nevada homeowners would be willing to pay a premium for origin-certified native plants. Premium estimates ranged from 7.8% to 14.2% depending on the level of certainty expressed by respondents for a one-gallon certified "NevadaGrown" native plant.

Improved characteristics of local "origin-certified" native plants—such as natural appearance, drought resistance, and plant origin—had the most significant effect on homeowner WTP. The significance of drought resistance in both models is a positive influence on homeowner WTP. Thus, homeowners may value this attribute as a means of reducing water usage and expenditures, as well as reducing plant mortality, replacement expenditures, and maintenance efforts. Based on these findings, local native plant producers, distributors, and retailers should consider origin-certified native plants to obtain price premiums and meet consumer demands. Providing consumer information and marketing materials targeting the positive attributes of locally produced native plants may also improve market share. As homeowners develop more interest in replacing turf with xeriscape landscaping, demand for low-water-use vegetation such as native plants will likely increase.

Additionally, this study provides further evidence in the ongoing debate over bidding structures and WTP elicitation techniques by combining the multiple-bounded discrete-choice design with the option to express uncertainty. Although there is conflicting evidence as to the effect on WTP estimates from incorporating respondent uncertainty, our findings support previous research in which allowing for uncertain responses results in more accurate WTP estimates (e.g., Cooper, Hanemann, and Signorello, 2002; Alberini, Boyle, and Welsh, 2003).

The final result of this study includes information regarding version effects (anchoring). The survey used to collect our data was designed to decrease anchoring effects by using a multiple-bounded discrete-choice panel of randomly ordered bids. Although the sample size is small, the bid format did not eliminate anchoring when only certain responses were considered. However, anchoring was eliminated when uncertain responses were included in the WTP model.

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Appendix:
Selected Homeowner Survey Questions and Provided Information

Q.11. On a scale of 1–10, please rank the importance of price vs. the origin of the plants or seeds you purchase, with 1 as "price is all important," and 10 as "origin is all important." (*circle one*)

1 2 3 4 5 6 7 8 9 10

Q.15. The following is a list of four characteristics that Nevada native plants exhibit. Please rank the characteristics from most important to least important in your purchasing decision, with the rank of 1 being the most important.

Characteristic	**Rank**
1. Drought resistant	
2. Natural looking landscape	
3. Prevention of invasive weeds/plants	
4. Prevention of soil erosion	
5. Other _____	

Information Provided in Survey: "*The NevadaGrown program is a government-sponsored third-party certification program. For a producer of agricultural or food goods to be considered for NevadaGrown certification, he or she must either reside or own property in the state of Nevada. For a raw agricultural product, such as a plant, to be certified as NevadaGrown, it must be grown in the state of Nevada. Processed agricultural products, such as feed, must have at least 60% of their composition grown in Nevada. The use of the NevadaGrown logo and label are restricted to members in good standing. Certification is a cost-free process and membership is reconsidered on an annual basis.*"

Information Provided in Survey: *"Locally grown native Nevada plants and grasses are drought resistant, meaning they require less water and can sustain long periods of direct sunlight. Additionally, native Nevada species provide a more natural looking landscape, can endure the great range of temperatures common to the region, and have been shown to prevent invasive plant/weed infestation and both soil erosion and dust caused by the low water levels and high winds common to Nevada.*"

Q.16. You may purchase a native plant of one-gallon size with or without a "NevadaGrown" label. The plant without the label is priced at $5.00. In the following table, you are given ten different prices for the same native plant with the "NevadaGrown" label. For each price level, specify if you would (1) definitely not be willing, (2) probably not be willing, (3) are not sure, (4) probably be willing, or (5) definitely be willing to pay the given price.

Bid Amount	Definitely No	Probably No	Not Sure	Probably Yes	Definitely Yes
1. $10.00	1	2	3	4	5
2. $5.75	1	2	3	4	5
3. $9.00	1	2	3	4	5
4. $5.50	1	2	3	4	5
5. $6.00	1	2	3	4	5
6. $7.00	1	2	3	4	5
7. $5.25	1	2	3	4	5
8. $6.50	1	2	3	4	5
9. $5.00	1	2	3	4	5
10. $8.00	1	2	3	4	5