Willingness to Pay for Water Availability in Northwest Arkansas

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Introduction

Urban systems are tightly linked to surrounding ecosystems, making such urban areas a major component of environmental change. Urbanization is now the dominant demographic trend globally (Vitousek, 1994) and it is thus important to understand the human attitudes and perceptions which shape the behaviors that directly influence environmental change (Pickett, et al. 2001).
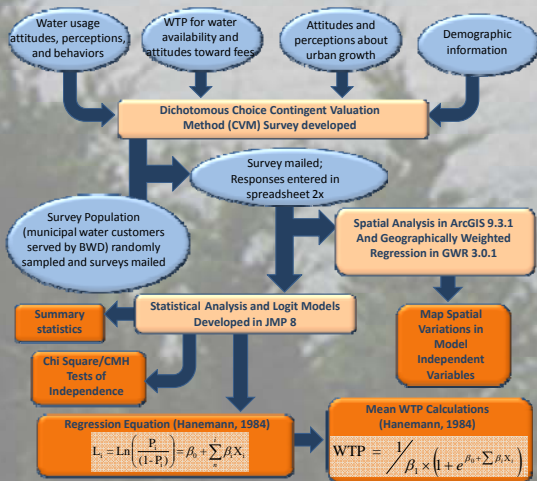
Two decades of rapid urban growth and a trend toward increasing per capita water consumption has left water providers in Northwest Arkansas concerned about their ability to meet future demand. Beaver Water District (BWD) is the largest of four regional water providers that draw from Beaver Lake, the only regional source of potable water. BWD supplies 62% of the population, but studies estimate that BWD will exhaust its allocation as early as 2031 based on growth projections (Carollo Engineers, 2006).

Growth and water consumption patterns are well understood, but we lack understanding of the priorities and attitudes that shape these patterns. Residential water use accounts for over half of demand, but there is little emphasis placed on conservation or water resource protection in the face of rapid urbanization. Further complicating the situation is the highly variable hydrologic regime of Beaver Lake's source, the White River (Cleaveland and Stahle, 1989) and management of multiple competing uses for the water. Can we be assured of a stable, reliable water supply to meet future demand, or will water availability and deliverability prove to be the critical limiting factor in continued urbanization and population growth in the region?
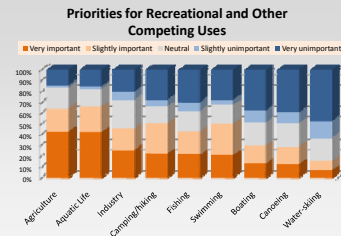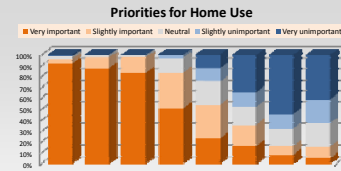
Objectives

- Ascertain stated priorities for water use in the region
- Assess the attitudes and perceptions that influence willingness-to-pay and conservation behaviors
- Estimate mean willingness-to-pay for a reliable water supply at the regional and local scale
- Examine spatial variation in attitudes and perceptions

Methods

Regression Equation (Hanemann, 1984)

$$L_i = Ln\left(\frac{P_i}{(1-P_i)}\right) = \beta_o + \sum_x \beta_x X_i$$

Mean WTP Calculations (Hanemann, 1984)

$$WTP = \frac{1}{\beta_1} \times \ln\left(1 + e^{\beta_o + \sum_x \beta_x X_i}\right)$$

Priorities for Water Use

Priorities for Home Use

Legend: Very important, Slightly important, Neutral, Slightly unimportant, Very unimportant

Categories: Drinking, Bathing, Cooking, Housecleaning, Outdoor Watering, Vegetable Gardens, Swimming Pools, Washing Cars

City	Surveys Mailed	Surveys Returned	Response Rate
Bentonville	286	51	17.8%
Fayetteville	552	122	22.1%
Rogers	441	84	19.0%
Springdale	636	112	17.6%
Total	**1,915**	**369**	**19.3%**

Priorities for Recreational and Other Competing Uses

Legend: Very important, Slightly important, Neutral, Slightly unimportant, Very unimportant

Categories: Agriculture, Aquatic Life, Industry, Camping/hiking, Fishing, Swimming, Boating, Canoeing, Water-skiing

Relationships to Demographic Measures

- Home owners more likely to rank water for drinking, cooking, outdoor watering, and washing cars at home "important"

- Women and respondents > 45 yrs of age more likely to rank water for housecleaning "important"

- Respondents with incomes >$40,000 more likely to rank water for outdoor watering "important"

- Respondents < 45 yrs of age more likely to rank recreational uses (boating, fishing, hiking, camping, etc.) "important"

- Respondents > 45 yrs of age more likely to rank water for industrial uses "important"

Logit Models & Mean Willingness to Pay

Expected Independent Variables

- Bid Amount
- Education
- Income
- Attitudes towards Fees
  - I am happy to pay fees our water resource managers feel are appropriate
  - I can't afford to pay a higher fee
  - New residents should bear the cost of additional demands for water
- Attitudes toward Growth
  - I feel I have personally benefitted from economic growth in the region

Regional Model					
Term	Estimate	Std Error	Chi Square	Prob > Chi Sq	Effect Likelihood Ratio
Intercept	-0.722294	0.534302	1.83	0.1764	N/A
Bid Amount	0.044443	0.008058	30.42	< 0.0001	< 0.0001
Happy to Pay Fees	1.442518	0.360137	16.04	< 0.0001	< 0.0001
Can't Afford to Pay	-1.05856	0.428115	6.11	0.0134	0.0104
Pleased with Growth	1.139184	0.477182	5.70	0.017	0.0115
Support Land Use Reg.	1.123807	1.123807	4.88	0.0271	0.0179

Bentonville Model					
Term	Estimate	Std Error	Chi Square	Prob > Chi Sq	Effect Likelihood Ratio
Intercept	1.419528	1.135743	1.56	0.2113	N/A
Bid Amount	0.066114	0.027782	5.66	0.0173	0.0015
Can't Afford to Pay	-2.806277	1.210857	5.37	0.0205	0.0041

Fayetteville Model					
Term	Estimate	Std Error	Chi Square	Prob > Chi Sq	Effect Likelihood Ratio
Intercept	-0.885109	0.583934	2.30	0.1296	N/A
Bid Amount	0.038146	0.012641	9.11	0.0025	0.0003
Happy to Pay Fees	2.275119	0.580969	15.34	< 0.0001	< 0.0001
Home Ownership	-0.747232	0.405752	3.39	0.0655	0.0450

Rogers Model					
Term	Estimate	Std Error	Chi Square	Prob > Chi Sq	Effect Likelihood Ratio
Intercept	-1.597119	0.680564	5.51	0.0189	N/A
Bid Amount	0.042793	0.016598	6.65	0.0099	0.0015
Happy to Pay Fees	2.444345	0.711374	11.81	0.0006	0.0003

Springdale Model					
Term	Estimate	Std Error	Chi Square	Prob > Chi Sq	Effect Likelihood Ratio
Intercept	-2705021	0.679243	0.16	0.6905	N/A
Bid Amount	0.0543421	0.0145	14.05	0.0002	< 0.0001
Can't Afford to Pay	-1.76381	0.649179	7.38	0.0066	0.0033
Pleased with Growth	2.0097102	0.86763	5.37	0.0205	0.0107
Support Land Use Reg.	1.5330601	0.811278	3.57	0.0588	0.0420

Willing to Pay & Willing to Do

Willing to Pay Additional Fees

Yes 21.9%, No 78.1%

Attitudes Toward Fees to Preserve Water Availability

- I am happy to pay fees our water managers think are appropriate 18.7%
- I don't receive benefits from preserving the water supply 2.2%
- I can't afford to pay a higher fee 32.5%
- Good water quality is my right and it is unfair to expect me to pay for it 7.0%
- New residents should bear the costs of additional demands for water 21.8%
- Other (optional comment) 17.9%

Attitudes toward Growth

Legend: No, Yes

- Are you pleased with economic growth? No 78.8%, Yes 21.2%
- Have you personally benefitted from growth? No 40.1%, Yes 59.9%

Conservation Practices

Legend: Currently doing, Willing to do

Categories: Buy water-efficient appliances (56.4% / 30.9%), Install low-flow fixtures (49.3% / 31.7%), Limit shower lengths to 10 minutes or less (72.1% / 16.8%), Eliminate landscape irrigation or use drip irrigation (34.4% / 32.8%), Xeriscape (29.0% / 42.0%), Install a rain barrel (8.1% / 61.2%), Drain downspouts to lawn (45.5% / 33.6%), Reduce or eliminate at-home car washing (66.7% / 21.1%)

Mean WTP ($) Annually

- Global Model $72.33
- Bentonville $53.23
- Rogers $208.98
- Fayetteville $222.75
- Springdale $34.86

Mapping Spatial Variability in Parameter Coefficients
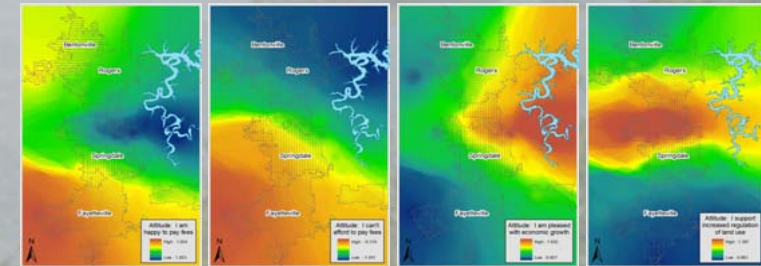
Conclusions

1. Fit of the regional logit model is not constant spatially.
2. Relative impact of the independent variables on the model varied spatially.
3. In all models, attitudes were more important than traditional demographic measures in determining willingness to pay.
4. Because water policy is often enacted at the local scale, it is essential to understand local variations in attitude in order to make sound policy decisions.

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