POSSIBLE REASONS AND RESULTS OF A HYPOTHETICAL PRICE INCREASE OF WATER IN THE ATLANTA METROPOLITAN AREA

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Abstract. Price changes can significantly affect water consumption. A survey was over a six month period of twelve small cities in the Atlanta metropolitan area for a hypothetical situation whether residents would be willing to pay a 20 percent price increase in drought conditions to keep their lawn green or to wash their cars. Results suggest that residents in the north Atlanta metropolitan area were more willing to pay this price increase as opposed to residents in the south Atlanta metropolitan area.

INTRODUCTION

The Atlanta metropolitan area is one of the fastest growing regions in the United States. Since 1960, its population has grown from over 1 million to approximately 2.7 million in 1995. It is predicted by the year 2010 the Atlanta region will employ almost 2.3 million people, and have a regional population of almost 3.7 million people (Atlanta Regional commission, 1991).

This area receives approximately eighty percent of its water supply from the Chattahoochee/Lake Lanier system (U.S. Congress, 1991). There are other sources of water throughout the Atlanta area, such as groundwater supplies, but these sources cannot sustain large populations.

Lake Lanier and Buford Dam were designated to serve several purposes. These included water supply for the Atlanta metropolitan area, hydropower, and recreation. If they could be operated solely as a source of water supply, then concerns over the Atlanta region's water supply needs would be nonexistent (Hopkins, 1983). Since the Atlanta region receives over 101.6 cm of rainfall a year, supply is not usually a problem, although effective management can be (U.S. Congress, 1991). A general characteristic of this water supply systems that heavily depend on surface water is that they can be endangered by severe droughts.

Because of Atlanta's rapid growth, planning and careful management of water have new urgency. Studies have been conducted throughout this country and others on the factors that affect water consumption (Shukri, 1985; Al-Monmani, 1987). These studies either use a time-series or cross-sectional approach. The former involves the study of one system over a certain period. This approach is effective in analysis of temporal variation patterns of water use. As opposed to the temporal based time-series approach, the cross-sectional approach examines spatial variation patterns using data for a variety of water systems at a given point in time (Shukri, 1985). The data used in this latter approach typically includes factors that change over the geographic landscape such as socioeconomic and housing variables. Previous research has found relations between water use and the before mentioned variables (Gardner and Schick, 1964 and Headley, 1963). Other studies have found that the water price can affect water consumption patterns over time (Gottlieb, 1963).

METHODOLOGY

To analyze the effect of the socioeconomic factor on water consumption at the individual household level in the Atlanta metropolitan area a questionnaire was designed (Table 1). Twelve cities in the Atlanta area were picked to survey (Figure 1). These twelve cities were chosen to analyze the differences between the north and south Atlanta metropolitan area. Question 1 of the survey was asked to ascertain whether the respondent lived in a house. The analysis was focused on those who lived in either a house or alternative housing unit (i.e., mobile home or condominium). Since apartments lack lawns, respondents that lived in apartments were excluded from the survey. Questions 2,3, and 4 were asked to determine the number of automobiles in the household and the frequency with which they washed their automobiles and watered their lawns. Question 5 was the average monthly amount of the respondents' water bill. Question 6 allowed for one of the reasons this survey was conducted: to see how respondents reacted to hypothetical price changes in their water bill. Question 7 through 12 were related to socioeconomic factors. The last question was concerned with conservation measures, including low-flow showerheads, ultra-low flow toilets, and xeroscaping of drought tolerant plants.

A total of 200 surveys were planned. The number of surveys for each city was determined by the percentage of households in

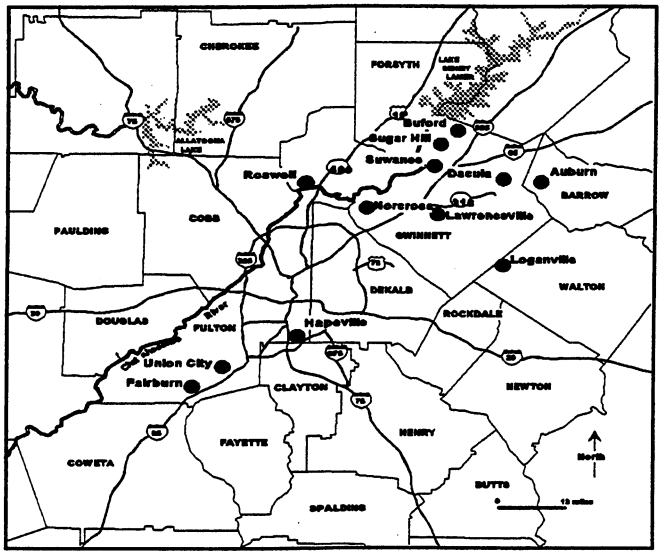

Figure 1:Water systems used in article.

Table 1. Water-Use Questionnaire

1. ***Do you live in an apartment or in a house?***
   ___house ____apartment
2. ***Do you have any automobiles in your household?***
   If so how many?
3. ***Do you wash your automobiles at your house?***
   ___once a week ___every other week ___once a month
4. ***Do you water your lawn?***
   ___once a week ___every other week ___once a month
   ___every other month ___never
5. ***How much is water bill a month?***
   ___10-20 ___20-30 ___30-40 ___40-50 ___more than 50
6. ***In a drought, would you be willing to pay a 20% increase in your water bill to keep your lawn green or to was your car(s)?***
   a 40% increase? a 100% increase?
7. ***How big is your lot?***
   ___less than .25 acre ___.25-.50 ___.50-1 ___greater than 1 acre
8. ***What is the range of your property value?***
   __less than 100,000 __100,000-150,000 __150,000-200,000
   __greater than 200,000
9. ***How many bedrooms are in your house? How many bathrooms?***
10. ***How old is your house?***
    ___less than 5 years ___5-10 ___10-20 ___greater than 20 years
11. ***How many people live in your house?***
12. ***How many people aged 10-19 live in your house?***
13. ***Do you use any conservation measures?***
    low flow showerheads?
    ultra low flow toilet?
    xerophytes in landscaping?

each city to the total number of households in the entire study area:

$$N_i=H_i*200/\Sigma H_i$$

Where N_i is the number of surveys for the city ; H_i is the number of households in the city, and ΣH_i is the sum of the households in all the cities.

The 1995 residential phone book of the Atlanta metropolitan area was used to identify households to survey. The first page of the phone book was chosen as the arbitrary starting point for each city. For example, the city of Auburn was identified form the abbreviations of town names. The first number with this town's abbreviations was selected to call. After this was done, every other number for Auburn was then selected to call. I would then turn back to the first page of the phone book after all of the calls for a city were completed and start with the next city. If the occupants of the household were not there or if there was a busy signal, then I would move on to the next selected phone number.

For all of the questions, except question 5, the answers were coded 1 through 5 according to coding rules established by Fielding(1993). The amount of water used for each surveyed household, question 5, was calculated by subtracting the amount charged or the first 2500-3000 gallons for each city. The marginal or block price was then used to convert the remainder into gallons consumed; this figure was then added to the number of gallons, 2500-3000, representing the amount subtracted from the average monthly bill. Spearman's rank correlation was used to determine the relationship between the average monthly household water use and the other coded questions because this non-parametric correlation can handle data at the nominal or ordinal scale (Silk,1979). Correlations were performed for all of the individual systems, except Suwanee, as well as all surveys combined. Suwanee was excluded because only one survey was conducted for this water system.

ANALYSIS

In general, respondents' in the north Atlanta metropolitan area are much more willing to pay for a price increase. The reasons for this become more apparent after examining the results of the other survey questions. Overall, more respondents in the north Atlanta metropolitan area water their lawns once a week to every other week then in the south metropolitan area, while there is a high percentage of the respondents in the south that never water their lawns. Most respondents in the south water their lawns once a month or once every other month. Although lawn watering is more frequent in the north Atlanta metropolitan area, this is not the trend for the frequency of washing automobiles. There is not a definite pattern for automobile washing in the north Atlanta metropolitan area. Most people tend to wash their cars at least once every other month although a high number of respondents never wash their cars. However, results from question 2 indicate that respondents in the south Atlanta metropolitan area own fewer automobiles than respondents in the north metropolitan area. It might be inferred that if respondents have fewer automobiles, then they may wash their cars more frequently, but for the cities overall, less water is used in car washing.

Owning more automobiles would generally indicate a higher economic status. This is supported by the answers to the other questions. From question 7 lot size is greater in the north Atlanta metropolitan area than in the south metropolitan area.

Again this clear distinction between north and south Atlanta is evident for question 8 and 9, regarding property value and the number of bedrooms. Most houses in the survey have property values less than $150,000 and fewer bedrooms in the south metropolitan area. This seems to support findings from question

7. Lost size can be considered to be directly proportional to property value.

After the preliminary examination to detect geographical patterns was done, a statistical analysis was conducted on the survey results. Nineteen of the two hundred surveys were thrown out because they were not on the public water supply system. Interestingly, when Spearman's rank correlation analysis was performed on all of the surveys combined, several significant relationships were found.

Question 1 suggests that water consumption decreases for mobile homes, trailers, duplexes, or others (Table 2). This appears logical for outdoor consumption since these types of housing units typically do not have their own lawns or maintenance services will often car for lawns in duplexes. The negative correlation for question 4 confirms that the more frequently a household waters its lawn, the more water is consumed. The size of the household is found to be positively correlated with water use (Table 2). This is also a rather logical relationship since the household water consumption would certainly increase as the number of people living in the household increases.

There also existed several significant correlations between socioeconomic and housing variables (Table 3). A negative correlation existed between the size of households and housing types. This is because for mobile homes, trailers, duplexes, and others fewer people tend to reside in these housing units as compared with single-family housing units. Also there are fewer bedrooms and bathrooms in theses types of housing units as compared to houses. There was also a negative correlation between lot size and housing types since single-family housing units typically have larger lots. The positive correlation between lot size and property value would also be rather logical, since the larger the lot size the higher the property value.

Another significant relationship was found between the number of bedrooms and housing types. Again this relationship confirms what had already been discovered in the survey, that is, most single-family housing units have more bedrooms than the other types. One interesting significant positive correlation was between the age of the housing units and the frequency the lawn is watered. After reviewing the surveys, it was discovered that in the systems of Hapeville, Fairburn, and Union City, houses are older, lots smaller, and the frequency of lawn watering was lower. One last logical positive correlation was between the size of households and the number of automobiles. As the number of people in the households increases so does the number of automobiles. This was supported by the surveys in all of the cities.

Spearman's rank correlation also was performed for the different water supply systems. The significant correlations and their probabilities are summarized in Table 4. Significant correlations existed only for the north Atlanta metropolitan cities of Dacula and Lawrenceville. These were between the frequency of lawn watering and water use. These correlations further support what was found concerning lawn watering, that water use in the north Atlanta metropolitan area is associated with outdoors usage.

It was found that outdoor use of water does not appear to be as prevalent in the cities of south Fulton county. One interesting note is that most of the respondents in the water system of south Fulton County were older and may not have been physically able to take care of their lawns. Another interesting significant correlation in Hapeville is that as the number of automobiles increases so does the water use. Finally significant positive correlations were found in Union City between the number of teenagers and water use. These positive correlations indicate that water use increases as the number of teenagers increases in a household. Again this indicates that water use in south Fulton County is more related to indoor use as opposed to outdoor use.

Table 2. Statistically Significant Results.

	r	∝*
Water Use(gallons) vs. Type of Housing Unit	-0.1848	0.0107
Water Use(gallons) vs. Frequency of Lawn Watering	-0.2248	0.0018
Water Use(gallons) vs. Number of People in Household	0.2411	0.0008

*Probability

Table 3. Socioeconmomic Statistically Significant Results.

	r	∝*
Type of Housing Unit vs. Number of People in Household	-0.3354	0.0000
Type of Housing Unit vs. Lot Size	-0.3354	0.0000
Lot Size vs. Property Value	0.3208	0.0000
Type of Housing Unit vs. Number of Bedrooms	-0.3520	0.0000
Age of Housing Units vs. Frequency of Lawn Watering	0.3889	0.0000
Number of People in Household vs. Number of Automobiles	0.4218	0.0000

*Probability

Table 4. Statistically Significant Results by City.

	sample size	r	∝*
Dacula			
Water Use vs. Frequency of Lawn Watering	8	-0.8437	0.0085
Lawrenceville			
Water Use vs. Frequency of Lawn Watering	25	-0.4053	0.0494
Hapeville			
Water Use vs. Frequency of Lawn Watering	12	0.6708	0.0169
Union City			
Water Use vs. Number of Teenagers	38	0.4035	0.0120

CONCLUSION

Outdoor water use was more prevalent in the north. Higher water use corresponds to higher economic conditions in this area. Indicators of higher economic conditions are larger lot sizes, higher property values, and the increased number of bedrooms would indicate housing units are larger. The higher outdoor water use is seen by the increased frequency by which respondents in the north water their lawn. Another survey result was that respondents in the north would be more willing to pay a hypothetical price increase during drought conditions to keep their lawn green. The higher economic status and increased frequency of lawn watering would explain why respondents in the north were more willing to pay this increase.

Water resource planners can better plan for the future by ascertaining there is more outdoor water use in north Atlanta. By factoring this into their calculations they can make allowances for his condition, or be prepared to put restrictions on outdoor water use during drought conditions.

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