



Water does not flow up hill: determinants of willingness to pay for water conservation measures in the mountains of western North Carolina[☆]



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ARTICLE INFO

Article history:

Received 29 July 2015

Revised 28 September 2015

Accepted 5 October 2015

Available online 10 November 2015

Keywords:

Water conservation

Contingent valuation

Willingness-to-pay

Averting behavior

Demand side management

ABSTRACT

Even in historically water-rich areas, population growth and drought put pressure on water supplies. Understanding public attitudes about water management and, especially water conservation, may become increasingly salient as even humid regions attempt to shift to demand side management. Using the contingent valuation method we estimate the willingness to pay for water conservation measures. Our analysis finds that younger individuals, individuals with higher education and higher income are more likely to say they are willing to pay for these measures. We also find that valuations depend on how the water source is managed. People who are on municipal water or a shared well are willing to pay more for public water conservation measures than individuals who have their own well or access to a spring. In addition we find that older individuals and respondents who have ancestors in the area are less willing to pay for water conservation methods. Lastly, using bivariate probit analysis that focuses on averting behavior and our contingent valuation question, we find that there are some unmeasured characteristics of respondents that make them more likely to participate in private averting behavior and increase their willingness to pay for public water conservation measures.

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“We never know the worth of water till the well is dry” – Thomas Fuller, Gnomologia, 1732

1. Introduction

With an average of 50 inches of rain per year and several feet of snow, water quantity concerns may seem unfounded in the mountains of western North Carolina. Increasing population coupled with recent droughts, however, has put pressure on regional water supplies. Several counties throughout western North Carolina experienced double-digit growth rates between 2000 and 2010, and droughts in 2002–2003, 2007–2008, and 2010 temporarily reduced the available supply throughout the region. In 2007, towns in the region enforced drought measures. For example, in Blowing Rock (pop 1200) in Watauga County, restaurants were required to use disposable tableware to avoid running dishwashers. To effectively deal

with these stresses on water supply new policies and practices have been initiated, prompted by both state mandates and local pressure. One response has been to seek new supply sources. Throughout the region several towns have either secured a new source since the 2007 drought or are in the process of obtaining a new source. Municipalities have also implemented conservation programs. For example, Boone (pop 17,000)¹, the largest town in the study area, began its “Every Drop Counts” program in 2005, which includes offering free water-conserving showerheads and water leak audits. In 2011, the town implemented a toilet rebate program to reimburse businesses and home-owners who replaced high water use toilets with models that use less water.

The growing demand for water in western North Carolina and potential for drought suggests it is important to understand the extent to which residents support water conservation efforts. A 2011 survey in the U.S. of state conservation measures revealed that all states have room for improvement, and North Carolina specifically was granted a ‘C’ for its conservation efforts (Christiansen et al., 2012). North Carolina is a humid state and conservation has not been a priority; however, there is growing recognition among

[☆] A University Research Council Grant from Appalachian State University provided funds for the survey conducted for this paper. The views expressed in this paper are the authors. The authors would like to thank John Whitehead and three anonymous referees for their comments.

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¹ In addition to approximately 16,000 students attending university.

scholars that the past is not a prologue for the future (Milly et al., 2008). Even in humid regions that have historically had ample water supplies, demand side management (e.g. conserving and improving efficiency) offers a more cost-effective approach than seeking new water supplies (supply side management) and must be part of any water management portfolio (Hoffner, 2008; Butler and Memon, 2005).

In our project, we developed survey questions to ascertain self-reported conservation behaviors as well as a contingent valuation scenario to assess willingness to pay for household and public water conservation measures. The contingent valuation scenario was based on conservation measures that could be included in a holistic demand side management strategy; they also represent practices that have been promoted in this region and so are familiar to the general public. Our survey area covers Ashe and Watauga counties in northwestern North Carolina. These counties offer insights into a rural, but growing area² where a large proportion of the population relies on individual wells or springs as their water source. These counties also offer a comparative look at public attitudes conditional on water source as Watauga County has a greater proportion of its population served by a municipal supply than Ashe County. Furthermore, regional studies are highly relevant for assessing attitudes about water management and conservation because much water management, especially in humid regions that rely on riparian management systems, happens at the household and local government level rather than at the state or national level.

Our two primary objectives in this paper are (i) to use the contingent valuation (CV) method to estimate households' willingness to pay for publically funded conservation efforts that would be paid for via a one-time tax and (ii) to compare conservation behaviors of households who use different water sources (i.e., municipal, individual well, spring, or shared well). Section 2 discusses the related literature; Section 3 describes our survey and provides descriptive data from the sample; Section 4 discusses households' private conservation (or averting) behaviors; Sections 5 and 6 discuss the contingent valuation scenario and results, and Section 7 provides conclusions.

2. Related literature

Policy makers promoting residential demand side management can benefit from better understanding public attitudes and behavior regarding conservation and technological efficiency. This includes understanding household valuations of specific water supply management approaches. The CV method has long been used in assessing water-related concerns. Early CV research linked the requirements of the Clean Water Act with water recreation (Binkley and Hanemann, 1978; Carson and Mitchell, 1993). There is a subsequent body of work associating river health and drinking water quality (Desvousges, Smith, and Fisher, 1987; Bliem and Getzner, 2012). The Safe Drinking Water Act prompted use of CV studies to meet cost-benefit analysis requirements (Whitehead and Van Houten, 1997), and there has been some attention to protecting groundwater that serves drinking water supplies (Crocker, Forster, and Shogren, 1991). In high-income countries, however, there has been little assessment of willingness to pay (WTP) for water delivered to a household, likely because regulations ensure a high quality household water supply. The available research does show that individuals who perceive that they do have high quality drinking water have a lower WTP to improve the quality (Tanellari et al., 2015; Beaumais et al., 2014). There has been growing attention to linking risk perception about drinking water quality,

especially related to specific contaminants, and WTP to address those perceived risks. As might be expected, higher perceived risk is tied to higher WTP for clean-up or improvements in the water supply infrastructure (Tanellari et al., 2015).

More relevant to our focus on water quantity, there is a growing body of literature on WTP and water security, including developing resilience during drought conditions. Hensher, Shore, and Train (2006) illustrate that households' willingness to pay for reliability may depend on the 'historical context and expectations of shortages'. Their survey employs stated choice experiments using households in Canberra, Australia at a time when the area was experiencing mandatory restrictions. They found that WTP to avoid moderate water restrictions was not very high because people perceived the restrictions to be a reasonable method to reduce wasteful water use. Respondents viewed restrictions that allowed for some daily (or every other day) watering or that were in place for short periods as statistically equivalent to no restrictions. Households were willing to pay to avoid more serious restrictions, however. The Canberra study found households would pay approximately 31% of their annual water bill to go from a high level of restriction (e.g. banning most outdoor water use) to no restrictions. Households were also willing to pay to reduce restrictions from once every 10 years to once every 20. A similar study of Aurora, Colorado households found a higher willingness to pay based on a CV survey to reduce restrictions from one in 10 years to one in 30 years (Howe and Smith, 1994).

In putting the CV/WTP literature into context with general attitudinal research about water quantity (i.e., supply security or reliability) as opposed to quality, we find that in the US, studies are more prevalent in western states (e.g., Griffin and Mjelde, 2000; Howe and Smith, 1994; Salvaggio et al., 2014) than in the southeast. In general, there is a dearth of information relevant to public attitudes about water quantity concerns and conservation behavior in humid climates. In separate studies, Florida and Georgia residents were found to be more concerned with water quality than water quantity (Lamm, 2013; Responsive Management, 2003). Furthermore, Georgia residents perceived conservation to be salient only when it is directly tied to localized, community issues (Responsive Management, 2003). Even following the 2007 drought, Evans et al. (2011) found that the Georgia public was divided on whether they felt water quantity was a problem for their community.

In other regions, studies have shown that behavior related to conservation is complex and a variety of factors motivate people to conserve (e.g., attempting to stem a perceived environmental threat, participating in socially desirable behavior, and responding to price changes) or not conserve (e.g. exercising a perceived right to use as much water as desired) (Gilg and Barr, 2006). Renwick and Archibald (1998) looked at the distributional effects of price and non-price demand side management policies in Santa Barbara County, California during drought conditions and showed that demand reduction associated with management policies depends on household attributes including income and lot size (i.e., landscaping). Pricing policies impacted low income households more than high income households, while quantity targets had a larger impact in lower density areas where more landscaped area was maintained. Renwick and Archibald (1998) note the importance of understanding the composition (socioeconomic and structural/technological) of households to predict the quantitative and distributional impacts of demand side management policies.

Our research demonstrates the additional importance of understanding the effect of water source on households' attitudes and willingness to support demand side management as a conservation method. Our CV scenario differs from previous literature related to water quantity in that it is directly related to demand side conservation as opposed to improving reliability (which typically involves supply side measures) or avoiding water restrictions.

² Using Census data, NC's population grew approximately 18% between 2000 and 2010. Ashe County grew at a more modest 12%, but Watauga's population grew almost 20%.

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