Managing Water in Western North Carolina: Decision-Maker Perceptions and Policy Implementation

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Abstract

Western North Carolina is water rich, with high annual rainfall and historically low population. Therefore, water management has traditionally not been a significant policy issue. Recent droughts and high population growth, however, have stressed many water supply systems. To deal effectively with these stresses, new policies and management practices have been initiated, prompted by both state mandates and local pressure. As pressures are likely to continue, there is a need to under-stand what motivates policy development and what processes decision makers use when creating water management policies and programs. Previous research finds that decision makers are apt to base decisions on perceptions, personal beliefs and historical practice rather than on relevant water data. In this study, survey results are used to understand how decision-maker perceptions about water availability, growth, and environmental concerns correlate with water allocation and conservation policies. Results indicate that respondents are only moderately concerned about water availability and drought is the primary concern, rather than population growth. Few of these decision makers have implemented water education programs, but many have implemented drought-related conservation programs. Environmental concerns related to water management are quite low among all respondents.

Kristan Cockerill, Christopher Badurek, & Robin Hale (2014) "Managing Water in Western North Carolina: Decision-Maker Perceptions and Policy Implementation" *Environmental Practice* volume 16 issue 2 pp. 94-101 Version of Record Available from www.researchgate.net

Population growth, climate change, and recent droughts are beginning to increase attention toward water quantity issues, even in the historically humid Southeast. As Feldman (2009) notes, the idea that "western water problems mostly revolved around inadequate water quantity while humid areas' problems were related to water quality, is no longer a valid distinction, if it ever was." In western North Carolina, the population is growing rapidly, with some counties experiencing up to a 20% increase in population between 2000 and 2010 [United States (US) Census Bureau, 2010]. Droughts in 2002–2003, 2007–2008, and 2010 reduced the available water supply temporarily throughout the region (Hagevik and Badurek, 2011). Increased population and a decrease in available water have stressed many water supply systems in this region. To deal effectively with these stresses, many new policies and management practices have been initiated, prompted by both state mandates and local pressure. Water management has generally not been well documented throughout the region nor understood by those outside the decision-making process. Therefore, there is a need to understand the drivers of these policies and what influences decision makers when creating policies or programs. Because population continues to grow and climate change is increasing the uncertainty surrounding water supplies in this region, this study sought to better understand (a) how decision makers perceive their water supply; (b) the perceived relationships among water supply, growth, and environmental impacts; and (c) how these perceptions correlate with policies for distributing (allocating) water and establishing conservation or education programs.

Previous Work

Historically, finding a new water supply has been a favored water management practice, as this has allowed water management to remain largely invisible to the general public—water is simply always available (Gleick, 2002;

Larson, Gustafson, and Hirt, 2009). These *supply-side* approaches are top–down, relying on controlling water to supply a sufficient volume through infrastructure. The emphasis on supply-side management has contributed to prevalent disconnects among water demand, land use, development, and ecological needs. Much recent literature emphasizes a need to shift to *demand-side* management, which would use a bottom–up method and encourage consumer responsibility for efficient water use (Butler and Memon, 2006; Stakhiv, 1998; Zetland, 2011). In general, suggested management options are not technological in nature, nor do they require a better understanding of hydrologic processes or ecological needs; rather, they address gaps in social organization, political processes, and call for paradigmatic shifts (Fane and Turner, 2010). Despite the academic recognition that this shift is potentially beneficial, especially in light of climate change, the demand-side approach has not been widely adopted in water management. The existing literature, therefore, also calls for further research relevant to understanding why certain water policies are chosen (Agnew, 2011; Falkenmark, 2004; Olmstead and Stavins, 2009; Viviroli et al., 2011).

One reason that there has not been a wholesale shift in management approaches is that decision makers are not actively seeking and/or using pertinent information about future issues regarding their water supply. There is ample evidence that water managers in the Southeast, and elsewhere, do not routinely seek or use climate or drought forecast data (Bolson et al., 2013; Feldman and Ingram, 2009; Kirchhoff, 2010; Lowrey, Ray, and Webb, 2009; O'Connor et al., 2005; Rayner, Lach, and Ingram, 2005). A possible reason for not consulting these relevant data is a lack of concern about the future water supply. In a 2010 survey, only 28% of Florida water utility personnel reported that they expect climate change to affect their water supplies seriously (Rajbhanary et al., 2010). A survey of water managers in Georgia, Florida, and Alabama found moderate concern about water system vulnerability to climate change (Bolson et al., 2013). Stroup (2011), however, does find that decision makers, even in humid regions, may be beginning to recognize that variable and changing climate will affect their water resources.

Driving decisions about water management are perceptions that the decision makers hold about their water supply and any perceived risk to that supply. Perceptions about the world around us influence the way all people make decisions—both personal and professional. Perceptions about risk, value, urgency, conflict, and emotions all play important roles in decision making (Shafir, 2007). Research on decision making in the political and public policy world has found that decisions are often based on soft knowledge or perception rather than scientific data. Caplan (1976) interviewed federal decision makers representing a wide range of departments and found that even when given scientific information, the decision makers would disregard that information if it conflicted with their individual perceptions of reality. A solid body of literature from across diverse disciplines documents that decision making is often influenced more strongly by preexisting beliefs than by the immediate conditions (Cockerill, in press; Harris, 1994; Kaiser and Fuhrer, 2003; Labianca, Gray, and Brass, 2000; MacLean, 2008; Shepherd and Kay, 2012). Further, perceptions have been shown to be more influential in decision making for local rather than global decisions (Shafir, 2007).

More specifically, Freeman (2000) argues that two types of knowledge are used in water management: generalizable knowledge and location-specific knowledge. The former is often based on scientific understanding, whereas the latter is based on perceptions and cultural influences. For successful water management, the two must work together. A study of consumers, decision makers, and scientists in Phoenix, Arizona, found very different perceptions about water management among the three groups. While all were concerned about drought and water shortages, each group blamed shortages on different causes: consumers blame other consumers for using too much water, scientists blame weak regulations, and all three groups blame nature—that is, drought. By blaming drought, policy makers are less likely to create conservation-based policies that encourage water use behavior changes (Larson et al., 2009).

Study Area

This study focuses on a 22-county region, dominated by the Appalachian Mountains, in western North Carolina. Western North Carolina receives 40–50 inches of rain per year. Global climate change models have predicted a wide range of future scenarios in North Carolina, including both increases and decreases in precipitation (Cowell and Urban, 2010). While it is uncertain how much drought frequency and intensity will increase, they are not expected to decrease (State Climate Office of North Carolina, 2012).

Despite recent growth trends, this region is still quite rural, with only about 1,000,000 permanent residents. The most populous city has about 85,000 inhabitants (US Census Bureau, 2010). Tourism is prevalent, and western North Carolina has a relatively high number of seasonal homes (20.5%) compared to the remainder of North Carolina (13.7%).

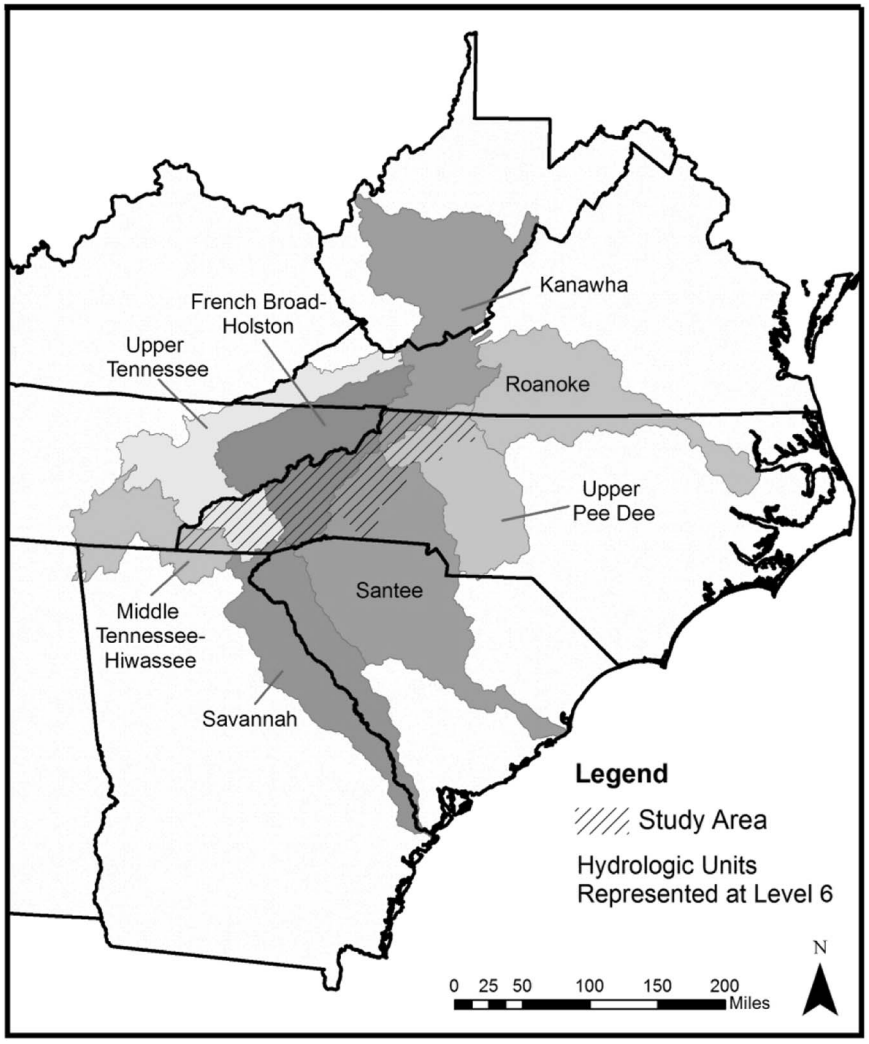

Figure 1. The study area is a 22-county region in western North Carolina, which includes the headwaters for eight watersheds.

Western North Carolina contains the headwaters for eight large watersheds (see Figure 1). Water supply in western North Carolina comes from a combination of groundwater and surface water. Because of the steep, complex topography of the area, few potential dam sites remain, so most of the surface water supply is taken directly from run of the river intakes (High Country Council of Governments, 2010).

As noted, this region has experienced serious droughts several times since 2000. The drought of 2002 set many records. During this time, more than 200 municipalities across North Carolina put water restrictions in place. The drought of 2007 was worse than the drought of 2002; in fact, it was the worst since 1895. During the 2007 drought, the North Carolina Division of Water Resources identified 30 municipalities at risk for running out of water, several of which were in western North Carolina (High Country Council of Governments, 2010).

Method

Web-based Snap Surveys (http://www.snapsurveys.com/) was used to collect data about water management practices, growth, and perceptions surrounding water supply and growth in western North Carolina. The survey included 31 primary questions, several of which included a follow-up. Respondents were asked to answer up to 43 questions. The survey was organized into five sections: general questions about respondents and their community, questions about development and growth, questions about water

availability, and questions regarding policies and programs. The survey data were downloaded from Snap Surveys and imported into SPSS (Statistical Package for the Social Sciences). The methods are similar to those used in other studies examining the perceptions of decision makers in water resource management (Caplan, 1976; Larson et al., 2009; White, Corley, and White, 2008).

The target audience included decision makers in 11 counties in western North Carolina. E-mail addresses for all elected officials, managers, utility personnel, and planners were collected through the High Country Council of Government and the Land of Sky Regional Council. The individuals in these positions are, collectively, responsible for making water management decisions and/or making decisions that influence water supply use. Ultimately, elected officials have the authority for determining how water is allocated and otherwise managed within their jurisdiction. These individuals, however, rely on guidance from planners, managers, and, if their jurisdiction includes a water utility, then utility personnel are routinely included in the decision-making process.

Managers are typically responsible for implementing the decisions made by the elected bodies and hence are assumed to be familiar with the social, political, and legal implications of water management decisions. The planners generate the plans for land use and economic growth management, which directly and indirectly impact water resources and drive demand. In jurisdictions with water utilities, those personnel have the day-to-day responsibility for managing water supplies and are often a key source of information about water for the planners, managers, and elected officials. Additionally, utility personnel are often responsible for community education about water and for managing water conservation programs. In this region, there are planners, managers, and elected officials who do not have any direct water management responsibilities because water users in their jurisdiction rely entirely on self-supplied sources, usually from groundwater. There are still, of course, impacts on the physical supply from these individual users, as well as from land use and economic development decisions within these communities.

We e-mailed the project description, a personal invitation to participate in the survey, and a survey link to all 347 decision makers in November 2011, but 55 e-mails bounced, leaving a total potential respondent group of 292 individuals. Two reminder e-mails were sent, and the survey was closed in January 2012. The survey returned 85 responses representing 22 counties and more than 40 municipalities throughout western North Carolina. The survey link had been forwarded to individuals not on the original e-mail list, which explains the increased geographic area. Of the respondents, 17 were from outside of the original targeted study area. Assuming these 17 were the only people forwarded the survey, then the response rate is between 23% (based on the original list) and 28% (based on forwarded respondents). Table 1 shows the representativeness of the sample.

Table 1. Categories of decision-maker respondents

Decision-maker category	292 Total potential respondents	85 Actual respondents
Elected	178 (61%)	32 (38%)
Managers	33 (11%)	26 (31%)
Planners	27 (9%)	8 (9%)
Utility	51 (17%)	13 (15%)
Other	3 (1%)	6 (7%)

Results

To understand relationships among decision-maker perceptions and actual water management policies, we asked decision makers whether they had each of the following: a formal policy for how water was allocated to users, any education programs, and any conservation programs. Half of the respondents reported that their community does have a formal allocation policy, and half reported that their community does not. A majority of respondents said that their community has a conservation program, although most of these programs apply only during drought, as mandated by the state. Only 19% of the decision makers reported having any water education campaigns or programs in their community (Figure 2). Almost one third reported that they did not know whether their community has implemented an education program.

The survey included questions asking respondents about their level of concern for potential issues such as drought, population growth, and regulations to influence water availability in their community (Table 2). Drought was the greatest concern, with half of respondents saying that they were "very concerned" that drought might limit their water availability. Decision makers were then most concerned that state or federal regulations might limit their access to water. Because of the region's reliance on second homes and recreation tourism for its economic livelihood, it is not

surprising that decision makers did not express concern that population growth or second-home ownership might limit the water supply.

The survey also asked respondents to rank the influence of seven criteria on their community's decision-making process for allocating water to new users (Table 3). The ability for the existing infrastructure to support new use was easily the most influential criterion, followed by economic concerns and the potential for drought as most influential in allocation decisions.

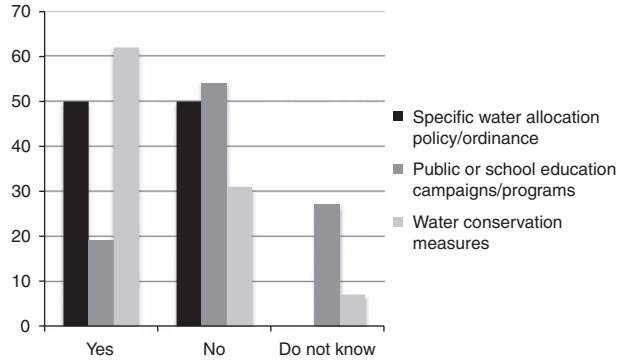

Figure 2. Results from survey questions about whether a community has specific water management programs or policies.

We also asked respondents to rank six potential benefits from implementing a conservation program (Table 4). While infrastructure was the primary criterion for allocating water, most decision makers were less likely to see conservation as a means to reduce infrastructure needs.

Perhaps most relevant to environmental professionals is the low level of concern and attention that these decision makers grant to the relationship between water management

Table 4. Survey item: Please rank from 1 to 6, with 1 being the most beneficial to 6 being the least beneficial, these potential benefits from implementing a conservation program

Results (no.)	Mean rank	Mode
Lengthen life span of water supply (78)	2.10	1 (49%)
Reduce threat from drought (75)	2.35	1 (48%)
Reduce infrastructure needs (75)	2.72	1 (28%)
Improve environmental conditions (76)	3.20	4 (34%)
Provide ecosystem services (75)	4.09	5 (48%)

Table 2. Survey question: How concerned are you about the potential for each of the following to reduce the amount of water available to your community?

Results (no.)	Not at all	Somewhat	Very
Drought (84)	3 (4%)	39 (46%)	42 (50%)
State regulations (83)	17 (20%)	40 (48%)	26 (31%)
Federal regulations (82)	15 (18%)	45 (55%)	22 (27%)
General population growth (84)	26 (31%)	48 (57%)	10 (12%)
Housing development for full time residents (84)	33 (39%)	41 (49%)	10 (12%)
Second-home development (83)	36 (43%)	39 (47%)	8 (10%)
Tourism (82)	35 (73%)	41 (50%)	6 (7%)

Table 3. Survey item: Please rank from 1 to 7, with 1 as the most important and 7 as the least important, the following in terms of their influence on your community's decision-making process for allocating water to new users

Results (no.)	Mean rank	Mode
Ability of infrastructure to support new use (70)	2.44	2 (37%)
Potential for economic benefits to the community (69)	3.04	1 (29%)
Potential for drought (75)	3.07	1 (35%)
Compliance with state regulations (70)	3.44	1 (27%)
Ability to sustain the supply for the long term (72)	3.44	1 (25%)
Environmental concerns (71)	3.52	4 (20%)

Table 5. Respondent concern for drought to reduce the available water supply cross-referenced with implemented water management measures

Water management measures	Concerned that drought will reduce available supply:	15 Yes	46 No	23 Do not know
Education programs*	Not at all	0	2	9
	Somewhat	67	52	22
	Very	33	46	70
Conservation measures*	Not at all	0	12	0
	Somewhat	40	58	60
	Very	60	31	40
Allocation policies	Not at all	2	5	0
	Somewhat	48	45	0
	Very	50	50	0

*$p \leq 0.05$.

Table 6. Relationship between the presence of allocation policy, education, or conservation programs and perceptions of drought: mean score from ranked list reported

Water management measure		Potential for drought to influence allocation decisions† (no.)	Reduce threat from drought as benefit of conservation program†† (no.)
Allocation policies	Yes	3.43* (40)	2.39 (38)
	No	2.66 (35)	2.30 (37)
Education programs	Yes	2.92 (13)	1.77 (13)
	No	3.07 (42)	2.30 (43)
	Do not know	3.15 (20)	2.84 (19)
Conservation measures	Yes	2.51** (49)	1.98* (49)
	No	4.10 (21)	2.71 (21)
	Do not know	4.20 (5)	4.40 (5)

*$p \leq 0.1$, ** $p \leq 0.01$. †Scale 1–7, with 1 being most influential, ††Scale 1–6, with 1 being most important.

and environmental impacts. As shown in Tables 3 and 4, environmental concerns were ranked lowest in their influence on water allocation decisions, improved environmental conditions ranked second lowest as a benefit to implementing a conservation program, and providing ecosystem services was perceived to be the least beneficial reason to implement a conservation program. Respondents whose communities do not have formal allocation policies or conservation programs ranked environmental concerns more highly than did those who have these measures in place, and these relationships are significant.

Because drought was reported as the most prominent threat to a water supply, we compared that expressed concern with whether the decision maker's community had implemented education programs, conservation measures, or adopted formal allocation policies (Table 5). As might be expected, those respondents who said that they were very concerned about drought were more likely to represent communities that have conservation programs. They were not, however, more likely to have education programs. Decision-maker concern for drought to impact their water supply has a limited relationship to whether a community has a formal allocation policy.

Although the correlation is not strong, respondents with formal allocation policies do rank drought as being less influential in making actual allocation decisions than did those respondents whose communities do not have formal policies (Table 6). Additionally, respondents whose communities have conservation measures in place are much more likely to say that drought influences allocation decisions and somewhat more likely to see reducing the threat of drought as a benefit of conservation programs.

Table 7. Percent of respondents reporting perceived and expected changes in available water cross-referenced with whether the respondent's community has a conservation program

	Conservation program		
Change in available water	Yes	No	Do not know
Over the past 10 years*			
Do not know	17	27	67
Less water	40	15	17
No change	32	50	0
More water	11	8	17
Over next the 10 years			
Do not know	11	23	50
Less water	32	23	33
No change	28	27	17
More water	28	27	0

*$p \leq 0.05$.

Respondents were asked about changes in available water over the past 10 years and what they expect over the next 10 years. About 35% reported that water availability has not changed in the past 10 years, and another 25% reported that they do not know whether water availability has changed. Decision makers who reported having a conservation program perceive that less water has been available to their community over the past 10 years, and those whose community does not have a conservation program are more likely to report that there has not been any change in water availability (Table 7). Cockerill (in press) documented that these specific decision makers do not use actual flow data in determining whether water availability has changed or is predicted to change. Therefore, some decision makers might perceive that there is less water precisely because their community has implemented a conservation program rather than a perception of less water driving a need for a conservation program.

Conclusion

The data reported here suggest complex relationships among decision-maker perceptions and the presence of water management policies and programs. These survey data reflect an internal consistency among stated priorities, levels of concern, and the presence of various water management measures for decision makers in these communities. What is not entirely clear is if, how, and when the decision-maker perceptions are influencing policy and program development rather than the presence of a policy or program influencing decision-maker perceptions about water management issues. Although these decision makers do recognize the potential for drought to affect water supplies, they are much less likely to believe that human-driven use will limit their access to water. As Larson et al. (2009) noted, this perception can reduce the impetus for demand-side, conservation-based management. Despite the moderate concern expressed about their future water supply, 62% of respondents report that their community has implemented conservation measures. This, however, is not necessarily indicative of local concern because the state mandates conservation measures during drought and for most of the reporting communities that is the only conservation measure in place. Only 19% of respondents report having education programs, and this result perhaps better reflects the lack of general concern about water availability. The overall lack of attention to environmental issues as relevant to water management also suggests a general lack of concern, as well as perhaps a lack of awareness about how water management decisions relate to environmental conditions. It is interesting, however, that decision-maker attitudes about environmental issues, as well as stated perceptions about the influence of drought on making allocation decisions, do differ when a formal water allocation policy is in place. This may be because some of these decision makers perceive the formal allocation policy as addressing these concerns appropriately.

Because water supplies have historically been and largely continue to be abundant in this region, a general lack of concern is not surprising. If water quantity is not perceived to be a limitation, then short-term economic needs can continue to drive water management decisions and there is no perceived need to shift to a demand-side management approach. While water supplies are abundant, continuing to focus on economic interests and assuming water will be available may work, but as the population continues to climb in this area, these results raise questions about the ability of these communities to manage water sustainably for the long term.

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