

INSTITUTIONAL OPPORTUNITIES AND BARRIERS TO CLIMATE ADAPTATION

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ABSTRACT: This paper uses a case study of drought adaptation in North and South Carolina to examine the ways in which institutions enable or impede climate change adaptation. Institutions shape the decision-making context and how water resources stakeholders perceive climate risks (e.g. drought) and consider adaptation options. In the Carolinas drought management strategies have expanded from local, structural, and supply-oriented solutions to include a range of activities that require new institutions or institutional change. Such activities include non-structural methods of securing supply, demand management, drought response planning, and the development of management structures that include diverse stakeholders in drought decision-making. The study reveals how institutional change has entailed not only the modification of formal rules that govern drought management but also the adoption of new water management practices and shifts in how the vulnerability of the region's water resources is perceived and discussed. Refining understanding of the various ways in which institutions shape decisions can help illuminate the institutional barriers and limits to adaptation. For example, measures to modify formal legal structures should also consider where and how those adaptations require concomitant changes to the informal rules and taken-for-granted assumptions that shape water management. This case study suggests that recognizing institutional interactions – and their outcomes – is an essential component of adaptation efforts.

KEY TERMS: institutions, adaptation, drought, climate risks

INTRODUCTION

The purpose of this paper is to examine the ways in which institutions shape society's ability to cope with, adapt to, and manage climate risks. It applies insights from a case study of drought adaptation in the Carolinas to begin to address climate adaptation research needs. Recent, record-breaking droughts (1998-2002, 2007-2008) have combined with population growth, increasing demand for water to serve both social and environmental needs, and development and land use changes to stress water quantity and quality. In addition, climate change is expected to place additional pressures on the Southeast's water resources. Changes in annual and seasonal precipitation patterns are projected to affect the timing and amount of water availability and increase flooding and drought risks (Karl et al. 2009). The region's experience with severe drought has triggered a range of adaptations and provides an opportunity to consider how institutional opportunities and barriers will affect future adaptation to a changing and more variable climate.

CLIMATE ADAPTATION AND INSTITUTIONAL RESEARCH NEEDS

Across the United States, increasing awareness of potential climate change impacts has stimulated interest in adaptation to climate, as well as other natural- and human-induced, stresses (Moser 2009). Adaptation refers to "...a process, action or outcome in a system in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity." (Smit and Wandel 2006, 282) Suggested climate adaptations for the water resources sector include securing supply through infrastructure improvements, conservation and efficiency programs, water reuse, changes to reservoir operations, modification of water rights, and land use policy changes to better protect water quality (see NRC 2010, pages 74-77). Despite the abundance of recommended strategies and tools, decision makers and the scientific community possess limited knowledge about climate change adaptation (Moser 2009, NRC 2010). For example, many proposed adaptation strategies are general and do not address the actual costs and feasibility of specific approaches (Moser 2009, 2010). Second, many proposals make simplistic "...assumptions that developed nations like the U.S. face relatively low vulnerability and possess high capacity to address climate change." (Moser 2009, 2; Adger and Barnett 2009) On the contrary, barriers to adaptation exist within and across federal, state, local levels and encompass a wide range of factors – financial, technological, social, political, institutional, or cultural.

Moreover, it is often suggested that institutional change, new institutions, or new institutional mechanisms is necessary to support climate adaptation (NRC 2010, Moser 2009, Stakhiv and Stewart 2010). However, such suggestions do not necessarily make clear what is meant by "institution" or "institutional change." Institution refers to the systems of rules that

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shape individual and collective behavior. Institutions may be formal (e.g. sanctioned and enforced laws, rights, constitutions, court decisions, administrative regulations, organizational arrangements) or informal (e.g. shared beliefs, routine practices, prevalent discourses and understandings) (Young 2002). Institutions operate at different jurisdictional levels (e.g. national, state, local) as well as at different decision making levels, for example at the operational level (e.g. through codes, scientific standards, professional or community practices) or at higher policy levels (e.g. general management paradigms related to efficiency, sustainability, market-based solutions) (Bakker 1999). Adaptations may entail formal institutional change, as through the implementation of new codified rules (e.g. state level drought legislation, local drought response plans). Or, adaptations may emerge gradually as individuals and organizations learn from experience, interact with other actors, and reconfigure a system's dominant norms through practice (Ostrom 1990, March and Olsen 1989, Ostrom 2008).

Many researchers and practitioners recommend that adaptation research is needed to improve understanding of context-specific climate vulnerabilities and the effectiveness and feasibility of recommended adaptation options (Moser 2009, NRC 2010, Adger and Barnett 2009). Knowledge about the local and regional nature of adaptive capacity – a system's characteristics and set of resources which enable that system to cope with and/or adapt to climate-related hazards and other stressors – will also enhance efforts to build societal capacity and implement various adaptation efforts (Smit and Wandel 2006). This paper aims to contribute to this research agenda by showing how refined thinking about institutions can help to inform adaptation planning processes and improve understanding of how institutions contribute to adaptive capacity.

THE CASE STUDY

Methods

The author used several methods to obtain information about drought impacts, adaptations, and adaptive capacity. The research was conducted from May 2007 to November 2008, a period of extreme drought conditions. The author conducted 46 semi-structured interviews with representatives from federal agencies, state agencies, non-governmental organizations, community groups, and industry and 43 structured phone interviews with public water system managers and other local officials. Interview questions focused on drought impacts, adaptations made in response to drought events, the factors that enabled or constrained adaptations, and other stresses affecting water- and drought management decisions. The onset of drought in spring 2007 triggered basin- and state-level drought response meetings and conference calls which continued regularly throughout the data collection period. The author attended and observed 61 meetings and conference calls. Long-term observation of drought management meetings provided an invaluable opportunity to observe the adaptation process as stakeholders discussed and debated the successes, and unanticipated consequences, of previous adaptations (i.e. after the 1998-2002 drought). Finally, documents provided supplementary information about water- and drought management.

Drought in the Carolinas

Although the Carolinas normally receive ample annual precipitation, the region is not immune to drought risks. The two states experience interannual variability, as well as seasonal variations, in precipitation, and yet water resource managers, communities, and state agencies were ill-prepared for the record-breaking drought that lasted from 1998-2002. Beginning in 1998, many areas in the Carolinas experienced several years of below-normal precipitation before river and reservoir levels reached critical lows in summer 2002. Precipitation deficits over the four-year period were among the largest ever recorded. This cumulative shortfall resulted in record lows for stream flows, ground water levels, and reservoir storage (Weaver 2005, SC DNR 2003). In 2007-2008 the Carolinas experienced another "drought of record." This drought's rapid and intense onset in summer 2007 was exacerbated by above-average temperatures. North Carolina experienced the driest year on record and a record number of days above 90°F. South Carolina experienced its 5th driest year on record in 2007 (NC DMAC 2008). Below-average rainfall persisted throughout 2008, and streamflow-, reservoir-, and groundwater levels failed to recover as they normally would through the winter and spring months.

The 1998-2002 event exposed the limits of the prevailing strategies to manage drought risks. In the Carolinas, drought adaptations and decision making processes have evolved within a riparian water rights system. Few statutes or regulations govern water use, and as in other southeastern states, state-level water supply management has been typified by a "hands-off approach to water allocation." (Moreau and Hatch 2008, 2) As a result water systems and municipalities have been responsible for drought planning, with limited engagement by other actors. The underlying assumption was that the Carolinas had plenty of water and that droughts represented temporary supply-demand imbalances. Drought planning has been based on local experiences and historical climate records. Structural solutions were used to minimize drought risks, prevent service disruptions, and lessen the impacts of climate variability on water customers. Consequently, many systems were not prepared for the cumulative effects of long-term drought and growing societal demands. At the state level, only a skeletal structure for state agency involvement in drought response and monitoring existed. At the basin level, drought

response plans for hydropower dam operations were either outdated or non-existent. Reservoir management plans generally placed few constraints on hydro-operations, set low minimum reservoir levels and release requirements for the operators (i.e. utilities, industries, and the Army Corps of Engineers). Rapidly declining water supplies in the Yadkin-Pee Dee River necessitated emergency meetings between dam operators, NC and SC state agencies, and water users to manage the limited resource during the drought.

LINKING INSTITUTIONS AND DROUGHT ADAPTATIONS

The events described above triggered efforts to reduce vulnerabilities and improve capacity to manage water resources more effectively during future droughts. Adaptations enacted from 1998-2008 have transformed the drought- and water management arena in several fundamental ways. These changes include 1) the diversification of strategies and tools, namely drought response planning and measures to manage customer demand, 2) the increasing formalization of drought preparedness and response, and 3) increasing engagement by a wide range of stakeholders in drought decision-making. The following sections discuss these shifts in water- and drought management, highlighting the different ways in which institutions influence adaptation decisions and how institutions have played an integral role in simultaneously facilitating and constraining adaptation processes.

Diversification of Drought Management Strategies

Local water systems and communities have diversified their drought management approach in several ways. First, water system managers report developing and implementing drought response plans. Drought response planning involves the adoption of formal mechanisms to monitor and manage water resources during drought. Important components of a drought response plan include management triggers, response actions such as water use restrictions, enforcement mechanisms, local ordinances, and communication protocols and networks. State legislation in both states requires local drought response plans, although there are no substantial enforcement mechanisms or penalties that ensure that water systems and communities write and implement plans. A second change is the introduction of demand management tools to influence water demand and customer behaviors. Tools include education programs, metering system upgrades (to monitor and manage water use), efficiency initiatives and incentives, and rate and fee increases. While some demand management tools represent best practices for the industry (e.g. the EPA WaterSense program), other changes have required that managers and local officials demonstrate a shift in thinking about water provision services and evolving assumptions that customers should be unaffected by drought events. Rather, water customers should be expected to reduce water use and contribute to conservation efforts.

Despite these changes, securing supply remains the predominant approach to drought preparedness on the local level. Managers report taking additional measures to secure backup supplies, diversify water sources, conduct leakage detection programs, and upgrade infrastructure and/or water treatment and delivery processes. Water managers are supplementing the engineering approach with non-structural tools, e.g. purchase contracts with other systems or consolidation, merging, or regionalization of systems. However, these actions rely on engineering and technical expertise and occur within the existing institutional structures and “normal” practices. Institutional research provides insights into why the adoption of new strategies and tools may be a difficult undertaking. Institutions represent and reinforce the predominant water management paradigms and create a particular decision-making context which affects how actors perceive risks, formulate solutions, and implement drought adaptation options (Pulwarty et al. 2005). The water management tends to be conservative, relying on proven tools and localized, personal experience and expertise to manage risks (Rayner et al. 2005; Lemos 2008). The persistence of existing, well-established operating procedures, routines, industry best practices, and ways of thinking may limit the adoption of new adaptation strategies and tools (Young 2008; Moser 2009). Also, managers may not perceive a need to adopt new tools (e.g. drought response plans, demand management) if their water system has adequate capacity to manage current risks.

Increasing Formalization of Drought Response and Preparedness

As noted above, rules, protocols, and routines create consistent preferences and approaches to decision-making (March 1994), and may hinder the willingness to change. However, organizations and institutions must continually adapt in order to face problems that old structures and knowledge systems cannot adequately address. The formalization of drought response and preparedness has addressed a need for a more structured decision-making approach at various decision-making levels. On the state-level legislation has not only required local drought response plans but also directed state agencies to take a more proactive role in drought preparedness and response. The North Carolina Division of Water Resources and the South Carolina State Climatology Office, Department of Natural Resources, are the lead state agencies. They have enhanced drought response by improving drought-related data and monitoring tools and by providing technical assistance to water

systems. On the basin level, drought response protocols were developed through the Federal Energy Regulatory Commission (FERC) relicensing processes. These processes began in 2003 in the Catawba-Wateree and Yadkin-Pee Dee Basins, both shared by NC and SC. Since licenses are set for 30- to 50-year terms, this process provided a unique opportunity to incorporate lessons from 1998-2002 into the formal operating plans of the projects. The new drought response plans prescribe conservative operations to sustain water supplies and adequate downstream flows for multiple needs and users.

While the adaptations listed above entailed purposeful change to formal rules, lessons from the case study suggest that acceptance of formal rules may require a concomitant adoption of new practices, routines, and ways of thinking. Although the 2007-2008 drought was unexpected and unwelcome, this event did provide an opportunity for water managers to implement and test the measures developed in response to the 1998-2002 event. In some instances, the new strategies created additional management challenges or exposed new types of vulnerabilities. As water managers and decision-makers gained additional experience and learned new lessons about managing drought conditions and impacts, they made adjustments and enacted new adaptations. For example, many managers report that their systems increased water rates and fees to cover revenue losses that resulted from implementation of water restrictions and declines in water consumption. In 2008 the North Carolina state legislature passed more stringent requirements for local response. These actions reveal a central concern that developed during the 2007-2008 drought, namely the disconnect between state requirements and expectations for drought response (i.e. water conservation) and well-established local practices. These issues also demonstrate how high transaction costs and other disincentives may impede institutional change and adaptations (Young 2008, Barnett and O'Neill 2009). Many disincentives to implementing drought response plans and water conservation measures exist at the local level. Because water systems are set up to sell water at low prices, any unplanned drop in demand can produce revenue losses and significant financial impacts for that system. The willingness to implement drought response plans (and water use restrictions) was often dependent on the existence of rate structures that ensured adequate revenue when water sales decreased. Systems that had already invested in large-scale fixed infrastructure expressed concerns about the financial and political costs of embarking on new approach. Public perceptions that water restrictions unfairly targets certain users and sectors (landscapers, nurseries, car washes, pools) and other systems of water regulation (e.g. water quality) also constrained the implementation of adaptation actions.

Increasing Stakeholder Engagement in Drought Decision Making

Water management is complex, with many different actors and agencies, with varying degrees of authority to implement plans and programs, engaged in decision making. The fragmentation of water management frequently contributes to a lack of cooperation and sharing of information and resources across and within management levels (Pirie et al. 2004, Ivey et al. 2006, Ivey et al. 2004). In the Carolinas, many water management interests have overcome these barriers through drought adaptations. Drought decision-making is no longer conducted solely by individual water systems but now includes many different stakeholders (e.g. state and regional agencies, dam owners, industry, NGOs). The formal state- and basin-level plans established organizational structures to monitor and communicate drought conditions has helped to promote and formalize cooperative interactions and information-sharing among various water users. Relevant groups include the NC Drought Management Advisory Council, the SC Drought Response Committee, the Catawba-Wateree Drought Management Advisory Group, and the Yadkin-Pee Dee Drought Management Team.

As discussed above, the development of new formal structures does not always lead to full buy-in and implementation of new plans and policies. Institutions determine leadership roles and whether decision makers have the necessary financial, technical, and political support to implement adaptations (Ivey et al. 2004). Institutions may hinder or facilitate decision makers' willingness to adopt novel tools and strategies (Arnell and Delaney 2006, Wilhite 2005) or provide opportunities to develop solutions (Ostrom 1990), e.g. through processes that promote public participation, stakeholder involvement, or conflict resolution (Arnell and Delaney 2006). In the Carolinas, the FERC relicensing processes not only established new formal protocols for drought response. Information from interviewees involved in the Catawba-Wateree process suggests that social learning occurred through this process and ultimately contributed to the successful implementation of the new protocols and cooperative agreements in 2007-2008. Social learning entails collective approaches to problem-solving, learning about other stakeholder perspectives and shared interests, and developing long-term partnerships and networks to facilitate resource management (Keen et al. 2005). At the same time, the values and goals underlying institutional structures and arrangements on the local level continue to support entrenched interests and pose a barrier to collective approaches to drought management (Young 2008, Adger et al. 2009). The Catawba-Wateree drought plan requires that formal members of the management group implement pre-determined water conservation measures at the appropriate drought stage. Local officials perceive this collective approach as relinquishing their decision-making power to an external organization. Community leaders have typically used low-priced and reliable water supply as a means to promote economic development. Local business and industry pressures and lack of political commitment have posed challenges to some water system managers as they balance local interests with new priorities for basin-level water resources management.

CONCLUSIONS

This paper used a case study of drought adaptation in the Carolinas to explore the various ways in which institutions support or constrain climate adaptation processes. Studies of adaptation to existing climate risks can be a useful contribution for researchers and decision-makers striving to improve understanding of how to effectively adapt to expected future climate changes and variability. This case study demonstrates several points. First, existing and well-established institutions may pose considerable barriers to the implementation of new climate adaptation strategies and tools. Many climate and water resources researchers recognize that the concept of stationarity that guides the current system of water- and drought management may not be an appropriate guide to follow under future climate conditions (Milly et al. 2008). From an engineering perspective, water managers have been successful in managing historical climate variability (Stakhiv and Stewart 2010). Successful previous experiences and conservative approach to changing managing approaches will continue to challenge future adaptation efforts. Second, although many water managers are introducing new measures to monitor and control customer demand, a continued reliance on the securing supply as the predominant adaptation strategy to drought risks does not address the broader sustainability of current water allocation and use strategies. Other stresses such as population growth and development will interact with climate stress to place increasing pressures on the region's water resources. While both North Carolina and South Carolina are in the process of modifying water rights and allocation on the state-level, water use patterns are often influenced by local-level policies and regulations. The case study demonstrates the challenges in implementing coordinating institutional changes across different jurisdictions. Finally, the case study reveals the importance of refining how we think about institutions and the ways in which formal and informal institutions reinforce one another. In the Carolinas, new formal drought laws, decision-making processes, and organizational arrangements were implemented most effectively when there was concomitant change to the informal institutions that govern collective practices and understandings. The experiences of the Carolinas suggests that climate adaptations involving broad-scale systemic changes will require that decision-makers take advantages of opportunities (e.g. increased awareness of water resources vulnerabilities due to extreme droughts, the FERC relicensing process) to facilitate learning process that will support change to both formal and informal institutions.

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