Building Upon Common-Pool Resource Theory to Explore Success in Transitioning Water Management Institutions

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BUILDING UPON COMMON-POOL RESOURCE THEORY TO EXPLORE SUCCESS IN TRANSITIONING WATER MANAGEMENT INSTITUTIONS

By

Christina M. Hoffman

A DISSERTATION

Presented to the Faculty of
The Graduate College at the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Doctor of Philosophy

Major: Natural Resource Sciences

Under the Supervision of Professors Sandra B. Zellmer and Ann Bleed

Lincoln, Nebraska

April, 2013
BUILDING UPON COMMON-POOL RESOURCE THEORY TO EXPLORE SUCCESS IN TRANSITIONING WATER MANAGEMENT INSTITUTIONS

Christina M. Hoffman, PhD
University of Nebraska, 2013

Advisors: Sandra B. Zellmer and Ann Bleed

Nebraska, like many regions around the world, is faced with the challenge of adapting to a new era in water management. Increasing demands for water resources, mounting concerns over threatened and endangered species, and obligations to abide by interstate water allocation agreements have motivated Nebraska to revisit traditional water management approaches. However, although Nebraska’s water management institutions have undergone much change, little research exists on the influence these changes have had on the ability of water institutions to successfully manage water allocations. This research (1) qualitatively explores the perspectives and experiences of stakeholders in the overappropriated region of the Platte River Basin (PRB), Nebraska, to gain an in-depth understanding of how the current water management system is working, (2) develops and implements a survey instrument to quantitatively measure and assess how well the newly devised management system is working as seen by water users in the PRB, (3) generates a comprehensive assessment into the characteristics that either promote or impede successful water management within the basin, and (4) uses Nebraska’s complex water resource governance system to build upon established principles of successful common-pool resource governance. This research provides information necessary to continue to improve management efforts within the basin and throughout the State, and serves as a fundamental baseline assessment from which to
measure improvements moving forward. Improving resource managers’ ability to learn about and better understand the implications of management approaches and policies can lead to more successful water resource institutions.
DEDICATION

For my family and friends who have given me much love and support throughout this endeavor.
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**PUBLICATION INFORMATION**

This Dissertation is written in a nontraditional style. Chapters two and three are written to be stand-alone publishable articles. Therefore, since this study follows a mixed-methods research approach, there is repetition in the background information provided in each of these chapters. For publication purposes, Dr. Mark Burbach and Dr. Lisa Pennisi will be listed as co-authors of these chapters for their contributions in developing the research methodologies and their numerous reviews of article drafts. Also relevant to this Dissertation is the following law review article: Hoffman, C. and Zellmer, S. (*Forthcoming June 2013*). Integration and Adaptability: Assessing Institutional Ability for Adaptive Water Resources Management. *Nebraska Law Review* 91:4, 302-360.
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CHAPTER 1: INTRODUCTION

Water, which is critical to all life, is a finite common-pool resource that transcends political boundaries. Water is also variable in quantity and quality across time and space; and in many areas demand for water is outstripping supply. Today, a changing climate, mounting demands for freshwater resources, declining water tables and stream flows, aging infrastructure, and species decline are challenges that institutions across the globe are tasked with addressing. Given these conditions, it is essential to develop water resource institutions that are capable of addressing these challenges. Institutions are vital for the successful management of water resources because they are the link that governs the relationship between social and natural systems (Kramer et al. 2013; Dolšak and Ostrom 2003). Institutions are characterized by both the formal and informal practices that structure human interactions, including established rules, laws, organizational entities, norms and codes of conduct (Armitage et al. 2007).

It is becoming apparent that many institutions devised to manage water resources as they existed in the past are ill equipped to address the challenges that today are inherent to water resources management (Hearne 2007; NRC 2001; Gillian and Brown 1997). Furthermore, knowledge about how existing water resource institutions might be modified and improved is scarce (NRC 2001; Miller et al. 1997), as is information on the effectiveness or the ineffectiveness of different institutional prescriptions towards more adaptive governance (Huitema et al. 2009). While the real measure of the success of any water management institution depends on how well the institution manages the resource over the long term, waiting decades to see the results of management actions is not an effective or wise strategy. Waiting decades to see if management goals and objectives
have been met eliminates any potential to learn from management actions and prohibits improvements and necessary adaptations. Making wise decisions today requires methodologies and initiatives that yield a more immediate determination of whether an institution is working. One way to assess whether or not an institution is working, at least in the short term, is to determine whether the people impacted by the institution believe the institution is achieving its management goals. In the minds of stakeholders, the success of an institution often depends on whether that institution measures up to the expectation of what the institution should do. Politically, at least in a democracy, an institution is unlikely to survive over the long-term if the majority of stakeholders feel the institution is not accomplishing its intended goals and objectives.

Moreover, stakeholder opinions and perspectives will continue to become increasingly important in water management decisions. Sabatier et al. (2005) describe a “quiet revolution” that is occurring in water management institutions within the United States; the emergence of a new and collaborative water management approach in which decision-making involves face-to-face negotiations among a variety of stakeholders. Evolving away from traditional top-down, agency-dominated approaches in addressing water management problems to a more collaborative approach involves “negotiations and problem solving among a variety of governmental and non-governmental stakeholders” (p. 4). As a result, new ways and methodologies that seek to interpret, measure, and assess stakeholder perspectives are imperative to better evaluating institutional success.

This research has four major goals. The first is to develop and implement a survey instrument to measure how well Nebraska’s current water management system is working; the term “working” refers to how well stakeholders perceive Nebraska’s current
management institutions to be performing, based on a list of institutional success criteria established in this research. Second, by assessing a new and unique water management system in an over-appropriated river basin in Nebraska, it is hoped that this research will add to our understanding of the principles that characterize successful common-pool resource management institutions in a large, complex setting. Third, this research will assess the potential for success of a new and unique institutional framework for water management that could be a model to be used by others. Finally, the research will generate insight into the characteristics that either promote or impede successful water resource management within the basin.

Nebraska, like many regions around the world, is faced with the challenge of adapting to a new era in water management. Increasing demands for water resources, increased use of groundwater, emerging conflicts between water users, mounting concerns over threatened and endangered species, and obligations to abide by interstate water allocation agreements have motivated Nebraska to revisit traditional approaches toward water management within the State. Consequently, Nebraska’s water institutions have undergone significant changes over the past several decades. More than forty years ago, the State changed from a system of State control over all water resources to a system of state control over surface water and local control over groundwater. Most recently, the State adopted a more integrated management system of shared state and local control where surface water and groundwater are hydrologically connected. This recently developed governance structure, which is unique to Nebraska, takes a new and innovative approach to how water resources are managed within the State.
Innovation in rules is often a trial-and-error process that usually requires more than one round to “get the rules right” (Ostrom 1998; Ostrom 1990). As Lee (1993) explains, management strategies and policies are experiments. If we are to learn from such experiments, we need to assess how well these newly devised water management institutions are working. However, very little research exists on how well the current water management system within Nebraska is actually working. Furthermore, waiting decades to determine if the new institutional arrangement is going to be successful is not a luxury the State can afford; more immediate ways to measure success need to be developed so that water resource managers and policy makers can implement adjustments to ensure long-term success.

One theoretical basis from which to pursue such research is through the lens of established principles of successful common-pool resource governance. Elinor Ostrom (1990) defined several characteristics or “principles” descriptive of local communities that developed successful management institutions that allow individuals to achieve long-term productive outcomes in managing common-pool resources. Common-pool resources (CPRs), such as water, have two defining characteristics: 1) it is difficult to exclude beneficiaries from using the resource, and 2) use of the resource by one person or group reduces resource availability for others (Poteete et al. 2010). Ostrom outlined eight design principles characteristic of institutions successful in governing CPRs, including: 1) clearly defined boundaries, 2) congruence between appropriation and provision rules and local conditions, 3) collective-choice arrangements, 4) monitoring, 5) graduated sanctions, 6) conflict-resolution mechanisms, 7) minimal recognition of rights to organize, and 8) nested enterprises (p. 90).
These principles share overlap with similar research efforts conducted by other researchers (Pomeroy and McConney 2007; Acheson 2006; Agrawal 2001). For example, in comparing CRP research conducted by Ostrom (1990), Wade (1988), and Baland and Jean-Philippe (2001), Agrawal identifies clearly-defined boundaries, locally devised access and management rules, ease in enforcement of rules, graduated sanctions, accountability of monitors to users, and local control as examples where such overlap occurs. Further, in their review of research into the conditions attributable to successful fisheries management, Pomeroy and McConney (2007) reveal clearly defined boundaries, benefits that outweigh costs, strong partnerships, community involvement in the decision-making process, monitoring, and effective enforcement mechanisms as important components of success.

Ostrom’s principles are well established for localized resources (Dietz et al. 2003), are well known (Folke et al. 2007), and provide a valuable framework for assessing more complex resource management systems (Anderies et al. 2004). However, as Ostrom’s principles were derived from relatively simple, localized resource systems, research is still needed regarding how to effectively apply these principles to more complex resources systems, and to regional and global resources (Dietz et al. 2003). For example, “case studies suggest that we cannot focus on one level of governance but need to balance the various levels of governance equally in order to maintain robustness of social-ecological systems” (Janssen 2006, p. 131). Berkes (2007) posits that since social systems are multilevel, perspectives from each level are likely different. This suggests that institutional practices might be perceived differently between the different levels of governance and within the community itself. Therefore, a multilevel assessment of both
state and local institutions might be more appropriate for assessing the ability of water management institutions to address water management issues of the 21st century.

Basurto and Ostrom (2009) state that there is a need for traditional common-pool resource theory to “move beyond the argument that each resource system, and the people that use it, is unique” (p. 38). While recognizing that resource systems do possess unique characteristics, they assert the need for common-pool resource theory to move “towards a more diagnostic approach to CPR management” in an effort to build upon cross-case commonalities that can serve as the basis for “theoretical analysis, explanations, and diagnosis” (p. 38).

This case study uses both qualitative and quantitative data collection efforts to take a closer look at how Nebraska’s newly devised integrated management system is working as seen through the eyes of stakeholders living and working in the basin. Gaining insight into how well stakeholders feel the water management system in Nebraska is working is an essential indicator of the potential for success that these newly devised institutional arrangements hold. Although efforts towards integrated management planning are relatively new within the State, an in-depth look at how the system is working as perceived by stakeholders can inform water managers and policy makers as to areas where the system is performing well while also drawing attention to aspects of the system that need improvement. Further, this research builds upon CPR theory by 1) investigating the characteristics stakeholders feel necessary to the successful management of a complex, large-scale water resource system, and 2) operationalizing these characteristics, which build on Ostrom’s established Design Principles, to quantitatively measure success within a large-scale, complex water resource system. Accordingly, there
is much to be gained in taking an in-depth look at how Nebraska’s transitioning water management system is working as viewed by stakeholders.

Research Questions

This mixed methods research study looks at how well Nebraska’s water management institutions are working within the overappropriated portion of the Platte River Basin, Nebraska. In fulfilling this purpose, this research addresses the following questions:

Qualitative Research Question:

1. What institutional characteristics do stakeholders in the overappropriated portion of the Platte River Basin, Nebraska think are necessary for the successful management of water resources?
2. How well do stakeholders perceive the water management system in the overappropriated portion of the Platte River Basin, Nebraska to be working?

Quantitative Research Questions:

3. Based on the assumption that Ostrom’s principles are indicative of successful water management institutions, can Ostrom’s eight Design Principles, combined with the characteristics discovered in Research Question 1, be operationalized through the creation of a survey tool to quantitatively measure how well Nebraska’s water management system is working in the overappropriated portion of the Platte River Basin, Nebraska as seen by stakeholders?
4. Using the diagnostic survey instrument developed in Research Question 3, to what degree do water users feel the characteristics descriptive of successful water management are being met within the over-appropriated portion of the Platte River Basin, Nebraska?

Gap Analysis:

5. Using the both qualitative and quantitative data previously generated, how well is the current water management system working in the over-appropriated portion of the Platte River Basin?

6. What recommendations can be made to promote successful water management in the basin in coming years?

Research Site

This case study takes a closer look at how a newly developed management system is working within the boundaries of five local natural resources districts (NRDs) along the Platte River in Nebraska. These NRDs are located in the western half of Nebraska, west of the 100th meridian. This imaginary line delineates the drier portion of the state from its eastern counterpart, where rainfall in much more plentiful (Wilhite and Hubbard 1998). This study will focus on the portions of the Platte River Basin designated as over-appropriated by the Nebraska Department of Natural Resources (DNR) on September 15, 2004, which includes the following NRDs: the North Platte NRD, the South Platte NRD, the Twin Platte NRD, the Central Platte NRD, and the Tri-Basin NRD (see Figure 1). The term over-appropriated is used to describe a basin where existing uses of water exceed the available supply of water, resulting in the expected declines of both
surface and groundwater resources in the designated area (DNR 2005). Hereafter, the overappropriated portion of the Platte River Basin will be referred to as the Platte River Basin (PRB).

Figure 1.1. Natural resources districts within Nebraska. The circle indicates the case study area which includes the overappropriated portion of the Platte River Basin, Nebraska (the North Platte NRD, the South Platte NRD, the Twin Platte NRD, the Central Platte NRD, and the Tri-Basin NRD).

Methodology

This research is designed as a mixed methods study. Mixed methods research is a type of research that combines elements of qualitative and quantitative research approaches for the purposes of breadth and depth of understanding and corroboration (Johnson et al. 2007). Specifically, this study adopts the exploratory sequential design format, a two-phase format where the research first explores the topic through a qualitative study and then uses the data collected to inform the second, quantitative phase of the study. As described in Creswell and Plano Clark (2011), the four main steps in this process are as follows:
1. Design and implement the qualitative strand
2. Use strategies to build on the qualitative results
3. Design and implement the quantitative strand
4. Interpret the connected results

The purpose of this exploratory sequential design is to first qualitatively explore with a small sample and then to determine if the qualitative findings generalize to a large sample. The first phase of the study is a qualitative exploration of the water management system within the PRB looking at 1) how well stakeholders perceive the water management system in the PRB to be working; and 2) what characteristics stakeholders in the PRB think are necessary for the successful management of water resources. Interview data were collected by conducting 35 semi-structured interviews with a diversity of stakeholders within the study region including representatives from local, state, and federal water-related agencies, upstream and downstream surface-water appropriators, groundwater users, irrigation districts, and municipal, hydroelectric, industrial, and recreational interests within the basin.

Themes from these data, in addition to the use of established success criteria (Ostrom 1990), were then developed into a diagnostic survey instrument to quantitatively explore stakeholder views of Nebraska’s current water management system. Survey data were collected from 345 water users living within the boundaries of the PRB NRDs to better assess the characteristics that either promote or impede the successful management of water as a common-pool resource. The final phase of this mixed-methods study was an in-depth review of how well the current water management system is working, using both the qualitative and quantitative data collected. Chapter 2 of this Dissertation reports the
qualitative phase of this study; Chapter 3 reports the quantitative survey portion and provides an in-depth review of how well the water management system is working based on qualitative and quantitative findings; and Chapter 4 concludes the study with an overview of research findings.
LITERATURE CITED


CHAPTER 2: A CASE STUDY EXPLORING INTEGRATED WATER MANAGEMENT IN THE OVERAPPROPRIATED PORTION OF THE PLATTE RIVER BASIN, NEBRASKA AS PERCEIVED BY STAKEHOLDERS

ABSTRACT

Mounting demands and escalating conflict over limited fresh water resources are making the water management challenges of the 21st century greater than ever before. In an effort to address these challenges, Nebraska’s water institutions have undergone significant change, taking a new and innovative approach to water resources management. This case study identifies characteristics stakeholders view as vital to building and maintaining successful water management institutions for the overappropriated Platte River Basin in Nebraska. The characteristics identified are then used as a proxy to qualitatively assess how well stakeholders believe Nebraska’s current water management institutions are working in the basin. Analysis of 35 in-depth interviews reveals that characteristics of successful management institutions include an ability to influence rules, clearly defined water-use rules, equity, flexibility, funding, integration, leadership, local control, proactive planning, and trust. Although challenges remain, stakeholders as a whole believe Nebraska’s current water management approach is moving the State towards greater institutional success.
Introduction

Water, which is critical to all life, is a finite common-pool resource that transcends political boundaries. Water is also variable in quantity and quality across time and space; and in many areas demand for water is outstripping supply. Institutions are vital for the successful management of common-pool resources, such as water, as they are the link that governs the relationship between the social and the natural systems (Kramer et al. 2013; Dolšak and Ostrom 2003). Institutions are characterized by both the formal and informal practices that structure human interactions, including established rules, laws, organizational entities, norms and codes of conduct (Armitage et al. 2007).

Most of the water management institutions existing today were developed to meet the water demands that society faced in decades of the past. In the western United States, water management institutions were first developed in the late 19th century and focused almost exclusively on governance of surface water resources. Realizing the limitations of this approach, during the 20th century, a handful of western states made changes to water management institutions to address increasing use of ground water, to integrate the management of surface water and groundwater, and to provide water for environmental purposes. These amendments in management structures and policies have significantly impacted the way that water has been managed, but little research exists on the effectiveness of these changes.

The demands of the 21st century are bringing new challenges including a changing climate, mounting demands for freshwater resources, declining water tables and stream flows, aging infrastructure, escalating concerns over threatened and endangered species, and obligations to abide by transboundary water allocation agreements. Several
researchers have questioned whether these 20th century institutions can meet the challenges of the 21st century and some have concluded that many institutions devised to manage water resources as they existed in the past are ill equipped to address the challenges that today are inherent to water resources management (Dovers and Hezri 2010; Gillian and Brown 1997; NRC 2001).

In looking towards the future of water management, Sabatier et al. (2005), describe one promising approach now emerging in the realm of water management. This is a new and collaborative approach in which decision-making involves face-to-face negotiations among a variety of stakeholders including both governmental and non-governmental stakeholders. Contrary to past, top-down, agency-dominated approaches, stakeholders’ participation and perspectives are an inherent component of this collaborative decision-making process.

In this collaborative management approach, how stakeholders perceive the effectiveness of water management institutions is a vitally important question. In the minds of stakeholders, the success of an institution often depends on whether that institution measures up to the expectation of what the institution should do. Politically, at least in a democracy, an institution is unlikely to survive over the long term if the majority of stakeholders feel the institution in not accomplishing its intended goals and objectives.

The purpose of this study is to examine Nebraska’s newly adapted water management system to see how stakeholders feel the current water management institutions are meeting expectations and institutional goals. This qualitative case study will first identify the characteristics that stakeholders within the overappropriated portion
of the Platte River Basin (subsequently referred to as the PRB) see as vital to successful management of the State’s water resources. Secondly, the success characteristics identified by stakeholders are used as a proxy to qualitatively assess how well stakeholders believe Nebraska’s current water management institutions are working. This study will not only inform current water resource managers within Nebraska, but will inform others states that are looking to integrate local control into water resources management in an effort to better address current and future water resources challenges.

The Case: The Platte River Basin, Nebraska

Originating in the eastern Rocky Mountains, the Platte River is formed by the juncture of the North Platte and South Platte rivers which enter Nebraska’s arid western boundary from the bordering States of Wyoming and Colorado, respectively. The main stem of the Platte River is formed near North Platte, Nebraska, and continues approximately 500 kilometers east towards Iowa before emptying into the Missouri River just east of Plattsmouth, Nebraska. As it exists today, the Platte River and its tributaries are a heavily engineered river system, composed of numerous large-scale dams, reservoirs, water diversions, and storage projects (Freeman 2010). Such works are essential to ensuring delivery of water to users, especially because precipitation varies both annually as well as spatially across the basin. Further, timely and reliable deliveries of water resources are vital for the basin’s economy, which is largely supported by irrigated agriculture (Freeman 2010; Lamphear 2006).

Although Nebraska is considered to be a State rich in surface and groundwater resources, a significant portion of Nebraska’s rivers are either fully or overappropriated (DNR 2009). Declared overappropriated in 2004, declining flows within the PRB are a
significant concern, especially since the area provides important habitat for the endangered least tern, whooping crane, and the threatened piping plover. Moreover, in addition to water needs for irrigation and species protection, water resources within the PRB are valued for municipal water supply, hydropower production, industrial uses, and recreation.

Nebraska’s water management institutions, first put in place in 1895 for the primary purpose of administering surface water, remained relatively unchanged until the middle of the 20th century. However, over the past several decades, these institutions have undergone substantial changes as the State attempted to streamline government, develop a more integrated basin-wide water management framework, and address conflicts between surface water and groundwater users. In 1972 Nebraska consolidated 154 special purpose districts into 23 locally managed Natural Resources Districts (NRDs), charged with broad responsibilities over natural resources related issues, including the legal authority to manage local groundwater resources. In the 1980’s Nebraska, for the first time, legally acknowledged the relationship between surface and groundwater and, in 2004, Nebraska passed Legislative Bill (LB) 962, which established a more proactive approach to managing the State’s hydrologically connected surface water and groundwater resources through a system of integrated management planning.

Under LB962, if basins are found to be either fully or overappropriated, the local NRD and State Department of Natural Resources (DNR) are required to work together in developing integrated water management plans (IMPs) with the goal of sustaining a balance between basin supplies and uses so that economic viability, as well as social and environmental health, safety, and welfare of the affected area can be maintained for both
the near and long term (*Neb. Rev. Stat.* 46-715). The term overappropriated is used to describe a basin where existing uses of water exceed the available supply of water, resulting in anticipated declines of both surface and groundwater resources in the designated area (DNR 2005). Nebraska’s unique governance structure, takes a new and innovative approach towards more local and integrated water resources management.

The overappropriated portion of the PRB consists of five NRDs: North Platte NRD; South Platte NRD; Central Platte NRD; Twin Platte NRD; and Tri-Basin NRD. The overappropriated portion of the PRB was selected as the focus of this case study for several reasons: 1) since the basin was designated as overappropriated, the local NRDs and State DNR are legally required to develop IMPs, and therefore analysis of this basin will provide data on how this effort towards integration is working; 2) information on how water management efforts might be improved within the region could prove invaluable to the $320 million collaborative tri-state/Federal threatened and endangered species recovery program ongoing within the study region; and 3) the study region exhibits a number of water management challenges common to other basins, including increasing demands on limited supplies of water resources and a diversity of stakeholders and interest groups with often conflicting agendas.

Qualitative Data Collection Methodology

Qualitative inquiry was selected for this research study because it allows the experiences, attitudes and opinions of participants to be heard in meaningful ways. The explorative nature of qualitative research affords an in-depth inquiry of a bounded system through a broad and less restrictive design than quantitative research allows (Bickman and Rog 1998). Specifically, a case study research approach was used because it allows
the investigator to explore a bounded system, engaging in detailed data collection involving multiple sources of information over time. In-depth analysis of data provides a thorough case description and development of case-based themes (Creswell 2007).

Data-collection efforts within the PRB included 35 semi-structured interviews of stakeholders in the basin - 33 in-person and two by telephone - ranging from 30 to 90 minutes and a review of relevant documents (i.e. Integrated Management Plans and newspaper articles) (see interview protocol and questions in the Appendix of this article). In this work, the term “stakeholder” refers to individuals or groups with an interest or claim in how water resources within the PRB are used and/or managed, including both governmental and non-governmental institutions, individuals, and communities (Armitage et al. 2007). Interviewees, who are kept anonymous, were selected through purposeful sampling, a technique used to select individuals for study, because they can “purposefully inform an understanding of the research problem and central phenomenon in the study” (Creswell 2007, p. 125). Maximum variation sampling was used for this study, because it solicits information from a sample of people representing a wide range of interests and experiences related to the phenomenon of interest. Interviewees represented a diversity of local, state, and federal water-related agencies, upstream and downstream surface-water appropriators, groundwater users, irrigation districts, and municipal, hydroelectric, industrial, and recreational interests within the basin.

Although there is no pre-defined number for the quantity of interviews that should be conducted in a qualitative case study, samples must be “large enough to assure that most or all of the perceptions that might be important are uncovered” while avoiding overly large samples that become “repetitive and, eventually, superfluous” (Mason 2010,
Introduction section, para. 2). Thus, the concept of saturation, which is the point when no new information is being introduced (Glaser and Strauss 1967), was used to determine sample size.

Interviews were recorded, transcribed verbatim, and subsequently coded and analyzed to search for emerging themes descriptive of successful water management institutions. MAXqda software was used to store and organize the large amounts of transcribed data; however, all themes were manually-coded by the researcher. As recommended by Yin (2009), data analysis consisted of examining, categorizing, and tabulating data in search of emerging themes and empirically based conclusions. Initial exploration of the data involved reading each interview in its entirely several times. Memos were typed in the margin of the interviews noting key concepts, ideas, and short phrases revealed in the data (Creswell 2007). A typological coding methodology was employed which requires the researcher to sort data into typological categories in order to discover patterns and develop themes (Hatch 2002). Codes were then compared across all interview data to search for overlapping trends in meaning and redundancy. Both methodological triangulation (using more than one data-collection method, such as interviews, newspaper articles, and management plans) and member checking (presenting draft materials to interviewees for verification) were used to establish validity.

Themes / Results

Data analysis reveals that stakeholders view an ability to influence rules, clearly defined water-use rules, equity, flexibility, funding, integration, leadership, local control, proactive planning, and trust as vital characteristics (i.e. criteria) of successful water management institutions. The following section describes each of these 11 themes, and,
to the extent possible, the stakeholders own words and phrases are retained and incorporated into the descriptions to provide a more vivid and realistic picture of how well interviewees think Nebraska’s water management institutions are working.

**Ability to Influence Rules**

There was near consensus among interviewees that stakeholders should play an important role in shaping water management decisions. Stakeholders believe they should have opportunities to influence rules through meaningful and ongoing participation that is inclusive of all interests. However, throughout the interview process, a number of stakeholders questioned their ability to influence water management rules during the IMP process. Representatives from the environmental community voiced concern that they do not always have a seat at the table. Moreover, stakeholders from both environmental and surface water communities mentioned that even if they do manage to get a seat at the table, they are not really decision makers in the process as the final decision on the IMPs are left to the NRD and DNR; and because there are “no requirements for them [the NRD or DNR] to listen,” they feel their concerns are not heeded. Furthermore, as one municipal water representative discussed, having a seat at the table can be rather intimidating when you are in a room dominated by irrigation interests, which makes many less influential interests think twice before they subject themselves to such a scenario.

Within Nebraska, the newly devised IMP process, laid out in LB962, aims to facilitate stakeholder involvement by requiring consultation with a diversity of stakeholders as identified by either the DNR or NRDs (*Neb. Rev. Stat.* §46-715(5)(b)). Prior to LB962, interaction between surface and groundwater managers and users was
less prevalent. Consequently, many interviewees agree the IMP process is “a step in the right direction” and has the potential to facilitate increased and more diverse stakeholder involvement in the decision-making process.

Nonetheless, several interviewees feel the process could do more, not only to increase participation from all concerned stakeholders, but by continuing to provide opportunities for water users to voice concerns and work together after the IMP is in place. As a prominent Nebraska farmer and NRD board member stated, once the IMP is adopted, “there is no follow-up…to find out if anything is going on”. He noted one exception: an annual public meeting between the five overappropriated Platte River NRDs and the DNR mandated by LB962. Although valuable, he believes this meeting is viewed more as an opportunity to report on current projects and updates versus a venue to engage in face-to-face collaboration.

*Clearly Defined Water-Use Rules*

Water users must have a clear understanding of water-use rules and how the rules apply to them as a water user. Rules need to be sufficiently detailed and defined, and it is important that users are aware of why the rules were devised. As one farmer explained, “I can work with it [water-use rules] if I know what the rules are.” Once users have an understanding of the rules and comprehend why such policies were developed, they not only seem to be more accepting of the regulations, but feel better equipped to participate in shaping water-use rules moving forward.

Each of the five overappropriated Platte River Basin NRDs has had an IMP in place since 2009. By design, the legislated IMP framework is rather vague, so that NRDs can “fill in the details because of their unique location.” This model allows IMPs to be
tailored to the specific needs and interests of the district, a characteristic that is greatly valued by many water users in Nebraska. However, stakeholders are still adapting to the novel framework and how the recent changes impact them as a water-user. As one interviewee reflected, “I think the concept with the recent legislation was good, but we haven’t fully developed the hows…it is still piecemeal and it is not uniform.” Several interviewees attributed this challenge to the complexity of integrating management of surface and groundwater resources governed by very different legal doctrines - the State employs the doctrine of prior appropriation to manage surface water and the NRDs use the laws of reasonable use and correlative rights to govern groundwater - as well as to a lack of knowledge when it comes to understanding surface and groundwater connections. Consequently, some stakeholders admitted they are still trying to figure out the current management framework. Nevertheless, they feel NRDs are facilitating the transition by communicating valuable water-related information and guidance on water-use rules to users.

Equity

Despite differences in how people use and value water, it is essential that all water users are treated fairly. Equity spans a diversity of criteria but requires that stakeholders feel they are being treated fairly in their ability to use water and in their ability to participate in discussions about how water is managed.

When it comes to who is able to use water and for what purpose, environmental interests voiced concerns that consumptive water users (i.e. irrigators and industrial users) “get a heavier weight than wildlife.” One representative from an environmental state agency lamented that people wishing to divert water for irrigation simply have to go
down to the State DNR and “10 dollars later you have a permit.” However, he claimed that in order to secure water to protect wildlife “we have to do very intensive [and expensive] scientific studies…just to protect public resources.” In contrast, one farmer and NRD board member questioned the need to “have so much water running down [the river]…for a bird”, especially since the basis of Nebraska’s economy is supported by irrigation.

Questions of equity also arose when discussing who holds the power in making water-use decisions, what interests are represented in the decision-making process, and where the responsibility lies in solving water quantity problems. Within Nebraska, groundwater-irrigated acres largely outnumber surface water-irrigated acres, which cause some people to believe that “decision-making power” is skewed in favor of groundwater interests. Further, authority over groundwater resources lies with NRDs that are governed by a board of directors. Numerous interviewees mentioned that NRD boards are “dominated by agricultural interests” and therefore are not representative of the diversity of interests that exist within the basin. There is apprehension that NRD board members have a “vested interest” in how groundwater is managed since many of the directors are groundwater irrigators themselves. Further, in developing solutions to reduce water use within the basin, and in efforts to address threatened and endangered species concerns, surface-water interests often feel that they have to “feed the losses that somebody else created.” As one interviewee explained, “we strictly look to surface water people to solve those [environmental] problems…there is no direct federal hook to get at groundwater.”

Interviews revealed that there are a number of deep-seated equity issues existing within the basin, many of which developed long before IMP efforts began. Since water is
valued for diverse often competing uses, rules on who is able to use water, for what purposes, and in what quantities often bring about questions of equity. Although it is unlikely that equity concerns over water will ever disappear from the basin, many stakeholders believe the IMP process is helping address such issues by bringing water users and managers together. By working together, stakeholders within the basin are building relationships and trust which many believe will empower them to better address equity issues in the future.

**Flexibility**

Although water users value certainty when it comes to using water, stakeholders believe water institutions must be able to adapt to changing conditions, have the freedom to develop and implement innovative solutions, and learn from new information. Within the PRB, stakeholders emphasized that flexibility is needed to manage the different physical and hydrologic conditions existing between districts.

There is recognition throughout the basin that balance is needed between short-term certainty and a long-term commitment to be more adaptable to change. Many see IMPs as offering more flexible water management strategies best suited to local needs. Through the IMP process, each NRD can pursue management options best tailored to local needs and can select from a suite of groundwater control options. For example, interviews revealed that both the South Platte and North Platte NRDs have opted to implement allocations as a mechanism to limit groundwater use in designated areas. Instead of having a set allocation over a one-year period, they have increased flexibility to the irrigator by expanding the allocation period. For instance, allocations in the North Platte are set at 56 acre-inches over a four-year period. Since, “you never know how
much water nature is going to give you” more flexible allocation arrangements allow irrigators to carry water over from one year to the next or the ability to use more water early on, depending on how they plan their crop practices. Other NRDs, like the Twin Platte and Central Platte, have chosen to pursue different groundwater control options, instead focusing on efforts to reduce irrigated acres.

In efforts to reduce water use within the basin, some believe NRDs have too much flexibility, and as a result, can implement less effective groundwater control mechanisms that do not achieve the objectives of the IMP. Further, numerous interviewees noted that devising more flexible arrangements to manage surface water resources can be challenging, especially in an overappropriated basin where little to no unappropriated water exists. Despite differing views, most agree that as long as the goals of the IMP are being met, there can be some flexibility in how they get there. As one interviewee eloquently stated, maintaining flexibility and adaptability to changing conditions and values is vital for, “the problems that we have today may not be the problems that we have tomorrow.”

Funding

Stakeholders believe that water management efforts can be extremely costly, and therefore, having a secure and stable funding source is essential. As spoken by one water manager, “the biggest solution that we need is where the funding is going to come from.” Many stakeholders mentioned the challenges of finding financial resources to fund water projects, research needs, and staff. Implementing IMPs and maintaining a knowledgeable, technical staff to manage water resources requires consistent funding. If allocations are pursued as a groundwater control mechanism, installing flow meters and ongoing
monitoring can be an expensive endeavor. However, as one NRD manager stated, “if you are not going to regulate, you need money for other projects.”

Fortunately, in a time when state and federal funds are becoming less certain, NRDs, as a political subdivision of the State, have local, but capped, taxing authority to support management efforts. One NRD manager explained that his district is funded “about half from property tax, another 25% from various state funds, and the remaining fourth in state and federal grants.” The property tax taxes irrigated acres at a higher rate than non-irrigated lands and “has been very important” in funding NRD projects. According to one semi-retired farmer, “Most of the work that the NRDs have done in the last 37 years would not have been accomplished any other way.”

However, there are fears within the basin that decertifying acres – which means that land can no longer be irrigated - will harm counties, local government, and schools. Irrigation means higher land valuations and more money coming into the county, yet with fewer irrigated acres and no more new drilling, there is an artificial cap on expansion. Moreover, when it comes to funding, not all NRDs have the same resource base. One manager explained that while Central Platte NRD has approximately 2 million irrigated acres, another NRD has around 335,000 acres and fewer irrigated acres means “the tax dollars aren’t here for us.”

A number of water users and NRD managers favor economic development (i.e. increasing irrigated acres) to bring in tax dollars; however, one interviewee made the case that he “wanted something that is sustainable, and economic growth is not good growth if it can’t be sustained over time.” Further, as another stakeholder pointed out, “raising tax dollars…is not a popular move with the public.” One manager described that although the
district might recognize there is a problem, “their board [which is publically elected] won’t allow them to have the funds to do what they need to do, because it would require raising taxes.” Although not everyone likes the idea of tax increases, one interviewee proclaimed that “at least people can see how projects are implemented at the local level.”

Moving beyond groundwater districts, funding also poses challenges for irrigation districts. Within the basin, most surface-water rights are held by irrigation districts, which maintain water-delivery infrastructure and are responsible for distributing water to contracted irrigators. As with NRDs, the resource base of irrigation districts varies depending on the number of customers they have. As one farmer described, “mom and pop irrigation districts have been living a hand and mouth existence for decades.” In efforts to avoid irrigation district fees, many surface-water users have converted to groundwater, decreasing the customer base of irrigation districts. This in turn brings the irrigation district’s fees up, resulting in the loss of customers and an overall “downward spiral” of the district.

Alternatively, IMP efforts are bringing surface and groundwater interests together and enhancing opportunities for collaboration and joint projects that leverage funding. Such up-front initiatives are crucial, for as one interviewee emphasized, “it takes a lot more money to backtrack than it does to be proactive.”

Integration

Integrated water resources management is needed across political boundaries and between differing legal and administrative systems. The actions of upstream surface-water users, whether in bordering states or upstream counties, affect downstream users, just as groundwater pumping can affect neighboring surface-water users. As one farmer
articulated “the darn problem is the river is a flowing resource…it goes across multiple NRDs and to be effective they need to be working in harmony with one another and that just doesn’t always happen.”

Within Nebraska, barriers to integration stem from the disparate legal doctrines governing water use, maintaining separate agencies to manage surface and groundwater, and the independent nature and mindset of water-users throughout the basin. As one stakeholder reasoned, upholding significantly different approaches to priorities in water-use, as well as different management authorities, “make it very difficult to manage the water resources.” One NRD board member explained that current challenges are “a reflection of our history with independent NRDs, and we just haven’t evolved to understand that we’ve got to look broader than the individual NRDs in some cases.” We are still managing as individuals, “with different goals, objectives, and methodologies.” One stakeholder proclaimed that “LB962 was an attempt to…get away from this old mindset that you could pump groundwater and it wouldn’t have an influence on surface water.”

The process of moving towards more integrated water resources management is not an easy or quick transition. Nonetheless, many stakeholders feel NRDs have done a great deal to develop and build relationships with local water users. As one groundwater user stated, “I really appreciate the relationships that we have with our water management agency, because we feel that we are a part of a team out here.” With the creation of integrated management, joint planning efforts now have the ability to expand relationships beyond individual NRDs to bring together surface and groundwater users across the basin. As one resource manager acknowledged, the IMP process is in its
“infancy” but “entities are learning to communicate.” However, one stakeholder advised that in order to facilitate the communication process “we have to stop using the word ‘or’ and start using the word ‘and’…we have to have water for irrigation and endangered species.”

Knowledge

Building successful water management institutions requires an understanding of the resource system being managed. Knowledge is reflected in staff expertise, available technology, data collection and monitoring programs, education and awareness programs, and an ability to learn. As one stakeholder admitted, Nebraska’s past failure to recognize the connection between surface and groundwater was a “huge problem”, both for water managers and in efforts to integrate science into the decision-making process.

However, the legal recognition of surface-groundwater connections and new efforts towards integrated management planning facilitates Nebraska’s capacity to learn and build water-related knowledge. At the state level, the DNR’s Integrated Management Division has greatly expanded. When the program first started in 2004, the division had a staff of three people, whereas today they are a division of 14 engineers, scientists, and planners. The State’s technical skills and knowledge of water administration, both within the IMP division and throughout the agency, serve as a valuable resource for local NRDs.

One challenge can be the lack of technical capacity at the local level; a sometimes unavoidable issue in districts with limited funding. Concern was raised that although the legislature has delegated some very technical responsibilities to NRDs, such as groundwater management, many NRDs lack the “technical competence” to successfully manage the resource. As one resource manager revealed, NRD staff and board members
often lack “the professional background and capability of actually doing significant, meaningful engineering or watershed hydrologic analysis.” This can put NRDs at a huge disadvantage in executing the job they were tasked with and can serve as a barrier in communicating technical information between state and local staff.

One important collaborative initiative that is supporting decision makers at all levels is the Cooperative Hydrology Study (COHYST), a combined effort between the DNR, NRDs, Nebraska Game and Parks Commission, Central Nebraska Public Power and Irrigation District, and Nebraska Public Power District aimed at improving the hydrological and geological conditions of the basin. Many stakeholders spoke of this research effort as an important mechanism for improving the hydrological and geological understanding of the PRB. Data collection and monitoring efforts also inform water management decisions. Although relatively few NRDs require meters to monitor groundwater use, one NRD manager revealed that meters have “turned into a positive” as they not only improve knowledge of water use but provide a wealth of data to support management decisions.

Further, many spoke of a “smart farmer revolution,” where the agricultural community has embraced new technologies that conserve water, such as soil monitoring, moisture sensors, flow meters, and increased use of weather stations and climate data. As one farmer explained, “the way we use and interface with water has changed over time” in part because the cost of being wasteful is being accounted for much more thoroughly than in the past. Consequently, technology, the ability to leverage resources between agencies, and increased opportunities for inter-agency learning are all improving water-management knowledge within the basin. Although there is still much knowledge to be
gained, one insightful stakeholder rationalized that “learning and adjusting policy into the future is where successful management evolves.”

**Leadership**

As described by stakeholders, leadership at all levels must be able to make difficult choices that are in the best interest of society as a whole, using sound science and withstanding political pressures. Good leadership provides overarching goals and direction to its constituents, is open, and is willing to be a part of the decision-making process for the long run.

When asked whether or not Nebraska’s water management institutions possess good leadership, many interviewees feel this is an area in which the State struggles. As one NRD board member described, “we really haven’t been in a position where we’ve had to manage water too aggressively until just recently.” As a result, “I think we are still finding our way…NRDs are still struggling with the concept of, they do have to shut people off from time to time…DNR still struggles with the notion that they have to explain what they do.”

Throughout the basin, many stakeholders believe the State needs to “look at the big picture” in managing water resources and should do a better job of setting overarching goals and objectives, perhaps in the form of a state water plan. One stakeholder recommended that “the State should set the policy and the overall direction and then the NRDs can implement it locally,” similar to how the U.S. Environmental Protection Agency implements the Clean Water Act (CWA). CWA standards are based on what is good for the whole nation and then implemented locally by each state.
Numerous stakeholders emphasized that although they do not want the State “dictating” what should be done, the State does have a responsibility to set some overlying goals. Additionally, some surface water users feel that the State, as the regulator of surface water resources, should represent their interests. There is a feeling among surface water users that they have been “left out of the equation” in the planning process due a lack of overarching representation from the State. While interviewees seemed to think groundwater interests are adequately represented through local NRDs, the State DNR claims a more neutral position when it comes to representing water interests. As one DNR employee framed it, when it comes to the IMP process “we are a state agency, we don’t really have a dog in the fight…we are just trying to provide resources and try to provide a path forward.”

Stakeholders also feel leaders should have the “political fortitude” to make tough decisions based on science and in the best overall interests of the constituents they serve. Numerous interviewees spoke of the enormous political pressures that exist on water managers at both the state and local level. As one resource manager described, at the state level, the agency head is appointed by the Governor and “if the Governor so chooses, he can exert tremendous political pressure [on the DNR].” Political pressure also exists for NRD board members, who often must make decisions that in many cases are not only very adverse to themselves but to friends and neighbors. As one manager stated, “it is pretty tough to shut off somebody’s well and then see them in the grocery store a day later.”

According to interviewees, good leadership must also acknowledge “key uncertainties” exist when it comes to managing water resources. Management needs to
recognize that wrong decisions will be made and that management should learn from their mistakes. Leaders within Nebraska’s water management agencies are not always good at saying they were wrong. As one farmer asserted, leaders often feel it is “more important to protect your position.” However, an ability to learn is a key criterion in building successful management institutions.

Local Control

Local control of groundwater resources is strongly supported throughout the PRB, which means there is also strong support for NRDs. Many Nebraskans are proud of the local NRD system, for it is “the only one in the United States” and as such touts a new and innovative way to address water management issues. One farmer declares that locally tailored management districts can better address the diverse water resource challenges associated with the “completely different climate, as well as different geology and hydrology” that exists from one end of the State to the other.

A number of stakeholders purported local control has fostered the development of “innovative solutions” that would not be possible if management was imposed from the State. Local expertise and firsthand knowledge of the resource not only allows management strategies to be customized to the issues at hand but can more quickly and effectively address problems if they arise. Further, many feel the level of water management activity taking place at the local level is much greater since the creation of NRDs. Proponents of local control emphasized NRD’s ability to interact with stakeholders on a regular and more personable basis. As one farmer affirmed, “the NRD is close to the constituents it serves.”
Despite the accolades the NRD system often receives, many claimed that having a board of directors composed primarily of groundwater irrigators charged with managing groundwater use is a direct conflict of interest and one of the main “shortcomings” of the NRD system. However, a former State water manager reasoned this scenario is “not that different than the City Council setting taxes.” Recognizing this regularly stated criticism, one NRD board member retorted that although there are hard choices to make, “if we don’t do something locally, it will be done for us on a statewide basis.” Many advocates of local control feel that State control is not a viable option.

Proactive Planning

As described by interviewees, proactive planning entails actively addressing long-term concerns and issues in the current planning process. Overall, stakeholders seem to feel that water resource institutions within the State are not very proactive. IMPs are only mandatory for basins designated as fully and overappropriated, and, as a result, are essentially addressing problems that already exist. As one interviewee phrased it, “it is called overappropriated for a reason…the proactive part is kind-of out the window at that point.”

Currently, IMPs focus mainly on the short-term goal of reducing water use to more sustainable levels. As one State water manager described, while there are goals looking more long term, at this point “we haven’t been as engaged in that aspect of the process.” Most agree the effort is in its infancy and for the IMP process to be properly tested, “it needs to have a chance to avoid the problems or manage through the problems and not just have to solve the problems.”
Stakeholders also attributed the lack of proactive planning to the “shortsightedness” of elected officials, who as one interviewee described, prefer “short-term rewards…as opposed to looking down the road and saying how is this going to impact our children.” One stakeholder raised the concern that, “we are making decisions for water policy right now that are going to have implications twenty or forty years out and…there is not very much concern looking that far out.” Another challenge is that many management actions seem to be reactive, not proactive. As one farmer described, “every crisis ends when it rains or when it stops, depending on how you look at it.” Many agree there is a need to rethink water infrastructure and water use over the long-term.

Despite these challenges, stakeholders feel the IMP process is a step in the right direction. One farmer commented that he wished “we would have started looking at water quality and quantity issues with perhaps more stringent controls earlier than 2004.” There is hope within the PRB that other basins learn from their experiences and avoid an overappropriated status. Although not mandatory, basins without a fully or overappropriated status do have the opportunity to pursue a voluntary IMP and several NRDs are doing just that. One State water manager believes this is a “positive step” towards avoiding a fully or overappropriated status.

Trust

Trust is a foundational component in building successful water management institutions. Stakeholders agree that in order to solve water management issues, managers and users must first establish relationships based upon respect and trust. However, there is a history of mistrust between the State DNR and local NRDs. As one farmer and NRD board member described, “when everything started out [the creation of NRDs], there was
a great deal of suspicion, distress, and dislike between the NRDs and DNR” for the local water users feared the State would try and impose regulations that were not in their best interest,

Fortunately, the IMP process has done a great deal to alleviate some of the mistrust between State and local water management agencies, as well as between the constituents they serve. As one resource manager explained, the IMP process has “forced them to establish relationships and have a greater knowledge about one another,” and this has really helped. While the majority of stakeholders feel it will take time to build relationships based on trust, one State water manager already sees this happening; “we are developing greater trust with the NRDs…especially the ones that we are interfacing with on a regular basis.” He admitted that the level of trust with a local government agency versus a State agency is different; while the State spends a lot of time building trust with the local agencies, the local agencies build relationships by going “directly to the public.” One interviewee described the relationships that NRDs have with groundwater users as built “across the table [and]…on trust and confidence.”

Stakeholders stressed the importance of “process” in building trust. Interviewees felt that in taking the time to go through the IMP process properly, in an inclusive and meaningful way, public acceptance is improved. Conversely, dictating what needs to be done does little to build trust and threatens acceptance of the management process.

Conclusions

Data analysis reveals that the majority of interviewees feel that an ability to influence rules, clearly defined water-use rules, equity, flexibility, funding, integration, leadership, local control, proactive planning, and trust are fundamental themes in building
successful management institutions. Elinor Ostrom, a Nobel Prize winner in Economics, looked extensively at the characteristics that promote successful local natural resource management institutions (Ostrom, 1990). Ostrom’s work reveals many similarities with the success characteristics identified in this research, such as an ability to influence rules, local control, nested enterprises (integration), and clearly defined water-use rules. Her work also revealed that communication, a way to develop trust, and the sense of sharing a common future all shape a community’s ability to develop successful management institutions. Communication and the importance of building a shared future were also mentioned as important underlying factors of successful water management institutions during interviews; however, these characteristics did not emerge as standalone themes.

However, extensive review of interview data revealed the degree to which stakeholders believe Nebraska’s state and local water management institutions possess these characteristics varies. Many stakeholders value the current system because they value local control. As they see it, the existence of NRDs increases knowledge of local conditions, strengthens collaboration at the local level, and maintains a valuable taxing authority to fund district projects. Further, the movement toward IMPs has generally increased stakeholders’ ability to influence rules, facilitated integration between State and local water management agencies, and served as an arena to build trust between water users and agency personnel. Integrated management planning has also worked to incorporate flexibility into the management system and to foster shared learning and knowledge. However, with all of the recent changes in water management, the water-use rules sometimes seem blurred and not always clearly defined. Moreover, Nebraska’s current water management system still struggles with equity, integration, leadership, and
proactive planning. The divided nature of the current system, which maintains different agencies to manage often connected resources, as well as existing tension between various types of water users, appears to impede trust between both stakeholders and managers, making it difficult for stakeholders to share a common future that encompasses the entire basin and the resource as a whole.

Nonetheless, while a number of water management challenges continue to persist within the basin, there is a collective belief among stakeholders that newly devised integrated management efforts are building more successful water management institutions within the State. As complexity and uncertainty surrounding water resources continues to mount, it is imperative to better understand the role these concepts play in working towards more successful water management institutions. Such research will not only inform current resource managers within Nebraska but will provide valuable insight for other states and regions facing similar water resources challenges.
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CHAPTER 3: A MIXED METHODS APPROACH TO ASSESSING SUCCESS IN TRANSITIONING WATER MANAGEMENT INSTITUTIONS: A CASE STUDY OF THE PLATTE RIVER BASIN, NEBRASKA

ABSTRACT

To address increasing conflicts between surface and groundwater users, the State of Nebraska has adopted a more localized and integrated approach in managing water resources. Integrated approaches offer promise in better managing connected water resources within the State; however, little review of the potential benefits and/or challenges of these actions has been conducted. This case study uses both qualitative and quantitative data collection efforts to take an in-depth look at how this newly devised management system is working through the eyes of stakeholders living and working in the basin. By combining qualitative and quantitative techniques, a greater understanding of the results can be achieved. Interestingly, the results demonstrate that stakeholders in the basin had a set of characteristics in mind that they believed were important to good governance. Based on a review of the literature, these characteristics were similar in many ways to those determined important in other academic studies. In addition, the methodology effectively identifies what stakeholders viewed as strengths of Nebraska’s new governance system and suggested areas where there is room for improvement. This methodology could be a valuable tool when used regularly to do interim assessments of water management institutions in the context of adaptive management.
Introduction

Competition for freshwater resources is greater now than ever before. Escalating demands for water resources to support food production for a growing global population, mounting concerns over water for wildlife and ecosystem health, and availability of adequate water resources to meet basic human needs are some of the many water-supply challenges facing the world today. In response to these persistent and rising environmental challenges, a shift is occurring in how water resources are managed. Throughout Canada, the United Kingdom, and the United States, environmental management efforts are increasingly being delivered at more localized levels (Allan and Curtis 2005). Sabatier et al. (2005) characterize this shift as a new approach to water resources management – one that moves beyond traditional top-down management approaches towards a more collaborative approach involving face-to-face negotiations among a variety of governmental and non-governmental stakeholders. Many researchers and practitioners believe a collaborative, more integrated management approach is essential in addressing the complexity of water management challenges that now exist (Armitage et al. 2007; Sabatier et al. 2005).

Within Nebraska, increasing demands for water resources, emerging conflicts between water users, mounting concerns over threatened and endangered species, and obligations to abide by interstate water allocation agreements have motivated the State to revisit traditional approaches toward water management. Consequently, Nebraska’s water institutions have undergone significant change over the past several decades, evolving from a system of state controlled water resources to a system of divided state and local control, and finally, in certain situations, to a more integrated system of shared state and
local control. This recently developed governance structure, which is unique to Nebraska, takes a new and innovative approach to how water resources are managed. However, while more localized and integrated water management approaches offer promise in better managing interconnected water resources, little review of how the current system is actually working exists.

Importantly, as new institutional arrangements are devised to manage water resources, including both the formal and informal practices that govern human interactions (Armitage et al. 2007), efforts are required to assess the effectiveness of these novel arrangements. Innovation in rules is often a trial-and-error process that usually requires more than one round to get the rules right (Ostrom 1998; Ostrom 1990). As Lee (1993) explains, management strategies and policies are experiments. Consequently, in conducting such experiments, it is essential to learn from institutional change to ensure water managers and policy makers are getting the rules right.

In looking at the history of successful and unsuccessful institutions, a “scholarly consensus” is emerging on the conditions most likely to lead to successful common-pool resources (CPR) management (Ostrom et al. 1999, p. 281). CPRs, such as water, are described as resources in which exclusion of beneficiaries is difficult and exploitation by one resource user reduces the availability for others (Ostrom et al. 1994). Ostrom (1990) and other researchers have suggested key criteria descriptive of institutions successful in managing CPRs.

Ostrom’s list of eight design principles, or “essential elements,” for successful CPR management include 1) clearly defined boundaries, 2) congruence between appropriation and provision rules and local conditions, 3) collective-choice arrangements,
4) monitoring, 5) graduated sanctions, 6) conflict-resolution mechanisms, 7) minimal recognition of rights to organize, and 8) nested enterprises (p. 90). Other common-pool theorists have found similar principles that demonstrate considerable overlap with Ostrom’s work (Agrawal 2001). Wade (1988), for example, found fourteen conditions that facilitate the successful management of CPRs, based on his work looking at irrigation districts in South Indian villages. Further, Baland and Platteau (1996) compiled a list of conditions for successful CPR management based on an extensive review of empirical CPR management studies. Agrawal (2001) notes that while the characteristics developed by Ostrom, Wade, and Baland and Jean-Philippe are categorized differently; much overlap exists in the established characteristics themselves. Clearly-defined boundaries, locally devised access and management rules, ease in enforcement of rules, graduated sanctions, accountability of monitors to users, and local control are several examples where such overlap occurs (Agrawal 2001). Further, in their review of research into the conditions attributable to successful fisheries management, Pomeroy and McConney (2007) reveal clearly defined boundaries, benefits that outweigh costs, strong partnerships, community involvement in the decision-making process, monitoring, and effective enforcement mechanisms as important components of success.

Ostrom’s design principles, which share overlap with other CPR research efforts, are well known (Folke et al. 2007) and provide a valuable resource that can be used to assess sustainable commons (Berkes 2007; Ostrom 1999). However, the current knowledge base for assessing institutional success is most strongly established for small-scale ecologies and institutions where long time-series studies on many successes and failures exist (Dietz et al. 2003). While these principles are nonetheless well established
as a result of empirical studies and appear to be applicable at larger scales (Anderies et al. 2004; Dietz et al. 2003), there is a need to develop diagnostic methods to identify combinations of variables that affect the incentives and actions of actors under diverse, and arguably more complex, large-scale governance systems (Ostrom 2007). Increasing populations, consumption, and advancing technologies for resource use (Dietz et al. 2002), combined with changing markets and state policies (Agrawal 2001), continually influence management efforts and outcomes, prompting a need to revisit the characteristics that drive institutional success.

In this research, Ostrom’s established principles for successful CPR management are used as a starting point to assess how well water resources management is working in Nebraska as seen through the eyes of stakeholders. Specifically, this research builds upon Ostrom’s eight design principles to take an in-depth look at how the novel integrated institutional arrangements are working in a large, overappropriated river basin in Nebraska – the Platte River Basin. The term overappropriated is used to describe a basin where existing uses of water exceed the available supply of water, resulting in expected declines of both surface and groundwater resources in the designated area (DNR 2005). This case study used in-depth qualitative interviews to 1) generate insight into the characteristics stakeholders within the region believe are vital to the successful management of water resources and 2) explore whether water users believe the current system is effective. Building upon this research, a quantitative survey tool was designed and employed to survey the wider water-user population within the basin. Combining both qualitative and quantitative data generates a more robust and in-depth understanding of characteristics that either promote or impede successful water resource management
within the Platte River Basin, Nebraska. This diagnostic analysis provides valuable stakeholder insight into how Nebraska’s new and innovative integrated management system is working, while also establishing a baseline from which to measure institutional improvements moving forward. This research also contributes to the current body of CPR knowledge that seeks to better understand how established principles can be applied to assess more complex resource management institutions.

Case Study: The Overappropriated Portion of the Platte River Basin, Nebraska

Nebraska is considered a state that is rich in both surface water and groundwater resources. However, many of the State’s rivers are either fully or over-appropriated (DNR 2009). In an effort to address declining water resources and escalating conflicts between surface and groundwater resource users, Nebraska has adopted a more localized and integrated approach in managing interconnected surface water and groundwater resources. One of the most substantial of these changes has been the creation of local management districts – Natural Resources Districts (NRDs) – charged with diverse natural-resource related management responsibilities, including the management of groundwater resources within their respective district. NRDs are governed by a locally elected board of directors. More recently, the State implemented Integrated Management Planning to better manage interconnected surface and groundwater resources. This effort brings together local NRDs charged with managing groundwater and the State agency – the Nebraska Department of Natural Resources (DNR) – with authority over surface water resources. Prior to this initiative, surface water and groundwater resources were managed as separate resources.
This study focuses on how these efforts are working in the overappropriated portion of the Platte River Basin (subsequently referred to as the PRB), which consists of five NRDs: North Platte; South Platte; Central Platte; Twin Platte; and Tri-Basin. Integrated management planning efforts are relatively new within the State with each of the five PRB NRDs implementing their first Integrated Management Plans (IMPs) in 2009. While the effort is still in its infancy, an analysis of stakeholders’ perspectives on how the system is working can provide valuable feedback to managers and policy makers interested in reviewing progress and challenges to date.

Methodology

This section describes the methods used to study how well stakeholders think PRB water management institutions are working. The research design included a seven-step process of qualitative and quantitative data collection and analyses.

Step 1 - Defining the Construct

A list of criteria descriptive of successful water resources management were derived from two main sources: 1) Elinor Ostrom’s eight design principles (Ostrom 1990), and 2) analysis of 35 stakeholder interviews conducted within the PRB (see Table 3.1). In-depth semi-structured interviews were used to gain insight into the characteristics that stakeholders felt important in successfully managing water resources in the PRB and to explore how well water users believe the current system is working. Interviewees were selected using maximum variation sampling to solicit perspectives from a wide range of interests and experiences related to water resources management within the basin. Interviews included representatives from local, state, and federal water-related agencies, upstream and downstream surface-water appropriators, groundwater users, irrigation
districts, and municipal, hydroelectric, industrial, and recreational interests within the basin. Interviews ranged in duration from 30 to 90 minutes and were conducted both in person (33 interviews) and by telephone (2 interviews). Interviews were recorded, transcribed verbatim, and subsequently coded and analyzed using MAXqda software to search for emerging themes descriptive of characteristics stakeholders felt important to successfully managing the basins water resources.

Data analysis of the interviews, combined with Ostrom’s eight design principles (Ostrom 1990), resulted in a list of fifteen criteria descriptive of successful water management institutions: 1) an ability to influence rules, 2) clearly defined water-use rules, 3) conflict resolution mechanisms, 4) benefits that outweigh costs, 5) enforcement, 6) equity, 7) flexibility, 8) funding, 9) integration, 10) knowledge, 11) leadership, 12) local control, 13) monitoring, 14) proactive planning, and 15) trust (see Table 3.1).

Step 2 – Item Development

The fifteen established success criteria were then operationalized and incorporated into a self-administered survey. Initially, five to six items were developed for each criterion (i.e. success characteristic) using data garnered in qualitative interviews and from a literature review of the relevant success criteria. Items were developed using an 8-point Likert scale, with zero representing non-agreement and seven representing strong agreement, with a number assigned to each choice. Lietz (2010), in a review of questionnaire design, recommended Likert scales range from five to eight response options, numerical scales be unipolar with matching written labels only as anchors at both ends of the scale, and all numerical scale delineations be labeled. While there is debate about whether or not written middle alternatives should be included in question response
options, the middle alternative was not explicitly provided in this survey to avoid losing information about the direction some people lean (Converse and Presser 1986). All questions were positively worded, as negatively worded statements are not recommended (Belson 1981; Foddy 1993) because they are less reliable than positively worded items (O’Muircheartaigh et al. 2000). Additionally, demographic questions were incorporated at the end of the survey, which is recommended to avoid causing feelings of lost anonymity among respondents (Lietz 2010).

Cognitive interviews, also referred to as intense individual interviews, were conducted to test for item comprehension, wording, visual design, and navigation problems in the initial version of the survey tool. The cognitive interview process aims to find out how well respondents comprehend questions and performs the response task by asking the interviewee to read the survey questions aloud and then explain their thought process as they answer each question (Fowler 1995). Five cognitive interviews were conducted with faculty members and advanced PhD students in the School of Natural Resources at the University of Nebraska-Lincoln.

Step 3 – Face Validity

As recommended by DeVellis (2003), a panel of judges with expertise in the content area were asked to review the revised survey tool to provide feedback on 1) the relevancy of each item to the phenomenon being measured, 2) the clarity of each item, 3) any items that might need to be re-worded, and 4) criteria that require further items to better capture the characteristic being measured. Seven persons with specialized knowledge in the field of water resources management reviewed the survey tool,
including two water management practitioners, three faculty members and two advanced PhD students in the School of Natural Resources at the University of Nebraska-Lincoln.

*Step 4 – Q-Sort Methodology*

The Q-sort method is a cost-effective, straightforward, and powerful method used to assess the reliability and construct validity of questionnaires in a pre-testing stage (Nahm et al. 2002; Thomas and Watson 2002). The method tests item agreement and fit in order to form the basis for assessing construct validity and to improve the reliability of the constructs (Nahm et al. 2002). As described by Thomas and Watson (2002), Q-sort methodology provides a means to conduct an in-depth study of small sample populations and is backed by a well-developed theoretical literature. The method offers researchers the benefits of small sample sizes and does not require random selection of participants (Thomas and Watson 2002; Brown 1980). The primary goal of Q-sort methodology is to uncover patterns of thought as opposed to a focus on numerical distributions among the larger population (Valenta and Wigger 1997).

Q-sort methodology traditionally involves selecting judges who first sort survey items into corresponding groups for each criterion. The items are typically written on cards and sorted into piles. During the second stage, items that are considered weak or that are categorized incorrectly are reworded or thrown out in an effort to improve item agreement among judges. For this research, a modified Q-sort method was developed and applied (see Q-Sort Methodology Pre-Test Survey in the Appendix of this article). To facilitate online application of the method, a Q-sort pre-survey test was developed. The survey randomly listed each of the 58 survey items and provided an alphabetical bank of the fifteen criteria at the top of each survey page. Next to each item was an 8-point
Likert-scale. The Q-sort pre-survey instructions first asked each participant to select the principle that best relates to each item and then, using the Likert-scale, rank how well each statement fits with the principle selected. The pre-test survey was emailed to a pre-selected group of water users and management experts within Nebraska. In total, 33 pre-test surveys were completed. Items were kept if 1) the correct criterion was filled in to the corresponding statement at least 80% of the time, and 2) the statement received a mean “goodness of fit” score of at least 5.6, or 80%, on the 8-point scale. Based on the results of the Q-sort, the highest scoring three to four items meeting these conditions were retained for each criterion for a total of 47 remaining items.

Further, items were limited to three to four items per criterion in an effort to increase the survey response rate and avoid survey fatigue. Surveys that appear short and easy to fill out reduce the perceived costs of responding (Dillman et al. 2009) and research has shown that longer questionnaires achieve slightly lower response rates (Herberlein and Baumgartner 1978). Moreover, Herzog and Bachman (1981) demonstrated a “fatigue effect” among respondents who were given self-administered surveys with large sets of questions in the same format. Their research revealed that toward the end of such question sets, respondents tended to check the same alternative no matter what the question.

Step 5 - Survey Implementation

The targeted survey population included both surface water and groundwater users within the PRB. Within Nebraska, surface water and groundwater are administered under two separate systems, and as a result, two main sources were used to obtain the survey sample population. A list of 14,939 groundwater users within the study region was
obtained using a publically available list of registered groundwater wells, along with associated mailing addresses, maintained by the DNR (DNR databank online 2012b).

Obtaining a list of surface water users within the study region was not straightforward. While a list of surface water permits holders is publically available from the DNR, oftentimes large irrigation and/or canal companies hold the permit, therefore making it more difficult to identify the number of individual users with water rights. Such overarching entities are often unable and/or unwilling to release information relating to individual water users. Consequently, to best capture surface water user perspectives, a publically available list of the Board of Directors from all irrigation and canal companies within the study region was obtained. To be elected to the Board of Directors, an individual must be a water user. This list was combined with the list of individual surface water right holders maintained by the DNR (not including irrigation and canal companies) to generate a list of 386 surface water user addresses.

Since the available list of surface water users was significantly smaller than the list of groundwater users, the entire population of surface water users was included in the survey population, along with a simple random sample of the 14,939 groundwater users. Simple random sampling allows every member of the sample list an equal chance of being selected, and it is the most common type of sampling used for self-administered surveys (Dillman et al. 2009). Since many water users use both surface and groundwater resources, duplicate addresses were eliminated from the population prior to generating the random sample. While a random sample of the entire population of both surface water and groundwater users would be optimal, the selected procedure was deemed the best alternative.
The sample size was determined using the methodology outlined in Dillman et al. (2009, pages 56-57). Using a .05 margin of error, a 95% confidence level, and an 80/20 split for responses (descriptive of how varied the population is with respect to the characteristics of interest), the completed sample size required was approximately 243 groundwater users and 153 surface water respondents. In an effort to achieve these survey response numbers without excessively increasing costs, the initial random sample of groundwater users was tripled and then combined with the entire list of 386 surface water users for initial mailing of 1115 survey pieces. A second round of 500 survey pieces, drawing from the random sample of groundwater users, was sent out approximately 1 month later to boost response numbers.

The self-administered, anonymous mail survey was implemented following selected procedures recommended by Dillman et al. (2009). Mailed survey packets included a cover letter, 2-page survey (see Water Management Survey in the Appendix of this article), and stamped return envelope. One week after the initial survey mailing, a reminder post card was send thanking respondents who had already sent in the survey and reminding those who had not, to do so right away. As discussed by Dillman et al. (2009), sending a reminder postcard has been shown to improve response rates by between 7 and 12 percentage points.

Step 6 - Scale Item Reliability

Once survey responses were complied, a scale item analysis was performed on the survey data to ensure that items formed an internally consistent scale – that items measure the same construct. As described by Spector (1992), internal consistency among a set of items suggests they are indicators of the same underlying construct or that they
share a common variance. Item analysis requires a sample size of approximately 100 to 200 respondents; this survey data has 338 respondents.

In choosing which items to retain, Spector (1992) recommends retaining items with the highest item remainder coefficients (corrected item-total correlation) but notes that this is often a balance between retaining coefficients above a set criterion (e.g. 0.4) and retaining a certain number of items. Field (2009) suggests that corrected item-total correlations should be greater than 0.3. Scale item reliability analysis reveals that all items are above 0.4 (see Table 3.2).

Cronbach’s alpha is a measure of the internal consistency of the scale, which directly corresponds to both the number of items and their magnitude of intercorrelation (Spector 1992). A widely accepted rule of thumb is that alpha should be above 0.7 to demonstrate internal consistency (Nunnally 1978). All items had high reliabilities with Cronbach’s $\alpha \geq 0.7$ (see Table 3.2). Based on these results, it was decided that all items should be retained.

**Step 7 – Survey Summary Statistics**

Respondents were asked to rank each survey item using an 8-point Likert scale. The higher respondents ranked items – i.e. the more strongly they agreed with item statements on a scale of 0 to 7 – the more successfully users perceive the system to be working. Respondents ranking items a “7” strongly agree the current water management system is working very well with regard to the criterion being tested. A ranking of “3” or “4” reveal stakeholders feel the system is working relatively well but could be improved, and a ranking of “2” or less indicates that the system would benefit from improvement. Respondents ranking items a “0” feel that the system is not working at all.
Index scores for categories were formed by averaging responses for items across each category. For example, in the survey tool there are 3 items that measure “proactive planning”. The three items were added together and averaged to get the average score for “proactive planning”. If the survey respondent answered less than the total number of items for a particular criterion, an average of the entered scores was taken. Once average criterion scores were obtained for each survey, those scores were added together and averaged to produce an overall score for each of the fifteen water management survey criterion (see Table 3.3).

Quantitative Survey Responses

In total, 1615 surveys were mailed, and 338 completed surveys were returned, generating a response rate of 21.0% (see Table 3.4). While this response rate is similar to the response rate other agricultural-related surveys conducted in Nebraska (Sheeder and Lynne 2011) and the United States (Peterson et al. 2012) have obtained, the lower the response rate, the higher the likelihood of response bias or nonresponse error (Draugalis et al. 2008). Response bias refers to survey respondents being somehow different from the non-respondents and therefore not representative of the target population (Draugalis et al. 2008), while nonresponse error results when the respondents who returned the survey differ in attitudes, beliefs, or characteristics on the items of interest from those who did return the survey (Dillman et al. 2009). Currently, there are no agreed-upon standards for acceptable response rates (Fowler 2002). Moreover, response rates alone do not determine whether survey results are “good”, as it is still possible for a survey with a very low response rate to adequately represent the survey population (Dillman et al. 2009).
Implementation for this survey followed sample size methodology recommended by Dillman et al., using a .05 margin of error, a 95% confidence level, and an 80/20 split for responses (2009, pages 56-57). The completed sample size required was approximately 243 groundwater users and 153 surface water respondents, for a total of 396 responses. In total, 338 responses were obtained; 143 from groundwater users, 18 from surface water users, and 171 from both surface and groundwater users (6 declined to answer) (see Table 3.4). The main challenge faced during survey implementation was a lack of access to surface water users’ addresses. This limits the survey’s ability to accurately reflect the opinions of those who solely use surface water. It is, however, important to note that people who rely solely on surface water within Nebraska are proportionally much lower than those who use groundwater or those who use both surface and groundwater. While water use statistics for the study area alone are not readily available, according to the U.S. Geological Survey (2005), groundwater withdrawals in Nebraska account for approximately sixty-one percent of the total water withdrawals in the state, while surface water accounts for thirty-nine percent. Moreover, in looking solely at consumptive water uses – water that is removed from available supplies without return to the water resource system – eighty-five percent of all water withdrawals in the state are from groundwater versus only fifteen percent from surface water. Further, groundwater irrigated agriculture represents approximately ninety-three percent of the State’s groundwater withdrawals and surface water irrigated agriculture represents twenty-four percent. For this survey, there were a total of 319 responses from people who use groundwater or both groundwater and surface water, and eighty-five percent of all respondents indicated they use water for irrigation. Although it would have
been optimal to obtain a higher response rate, particularly from surface water users, survey results are still largely representative of the water user population within the study region.

Qualitative and Quantitative Results

This analysis assesses the general question of how well water users in the PRB think Nebraska’s current water management system is working, using both quantitative and qualitative data collection. Interviews were conducted with a wide range of stakeholders within the PRB, while survey data were focused on surface water and groundwater right holders – subsequently referred to as water users. Consequently, qualitative interview data include a more diverse range of perspectives. With this in mind, qualitative and quantitative data were reviewed in tandem, revealing that for the majority of criteria both methods indicated similar trends in stakeholders’ beliefs of how well management efforts are working. However, for a number of criteria, results differ somewhat. In both cases, qualitative interview data further inform survey data, allowing perspectives to be explained in ways that numbers alone cannot.

Ability to Influence Rules

Survey and interview responses both indicated that many stakeholders in the PRB perceive that they have a limited ability to influence water-use rules. The majority of survey respondents ranked this criterion a “2” on the survey scale (Table 3.3). Further, when splitting the responses into either disagrees (rankings of “0” to “3”) or agree categories (rankings of “4” to “7”), only 28.7% of respondents think the system is working well with regard to their ability to influence rules, while 71.3% do not. Moreover, 10% of respondents ranked their ability to influence rules as “0”, indicating
they have no ability to influence water use rules under the current system. In-depth interviews with the wider stakeholder group corroborate these attitudes. Interviews reveal that stakeholders, including municipal, environmental and surface water interests, think they have a limited ability to influence the decision-making process, do not always have a seat at the table, and can feel intimidated by water user interests that they believe hold more weight (i.e. the belief that consumptive water uses hold more weight than environmental or municipal interests, etc.). Moreover, even when they do have opportunities to participate, numerous stakeholders asserted that their views are not always considered when the final decision is made.

*Clearly Defined Water-Use Rules*

Quantitative survey findings show that, overall, water users feel that water-use rules are clearly defined. The majority of respondents ranked this criteria a “4”, while when split into agrees and disagrees categories, 68% of respondents agree the system is clear in this regard, and 32% do not. Interview results display a similar trend. While some interviewees mentioned that the IMP framework is too vague, many stakeholders commented that this is, in fact, one of the benefits of the current system, because it allows NRDs to customize plans to best meet local needs. Further, interviewees feel NRD’s play a vital role in communicating information and guidance on water-use rules to users. NRD’s serve as a valuable resource stakeholders can turn to if they have water-related questions or concerns.

*Conflict Resolution*

The majority of survey respondents indicated that the current management system is performing moderately well in devising adequate conflict resolution mechanisms to
manage water, as seen by the majority response rate of “3”. When divided into agree and disagree categories, water users are relatively split, with 46.2% indicating agreement that the system is working well and 53.8% feeling that it is not working well. While conflict resolution did not evolve as a theme of successful management from stakeholder interviews, the criteria is one of Ostrom’s 8 Design Principles. Since sharp differences often exist in how people use and value resources, conflict is inherent in environmental choices (Dietz et al. 2003). Consequently, regular access to low cost, rapid conflict resolution mechanisms is needed to mediate conflicts over the misinterpretation of rules of use (Anderies et al. 2004; Ostrom 1990). Stakeholders did mention that if the DNR does not feel a local NRD is implementing and enforcing rules under their IMP, they can raise their concerns with the Integrated Water Review Board – a board appointed by the Governor to resolve the dispute. However, to date this mechanism has not been used.

Costs and Benefits

Costs and benefits were the highest ranked criteria, with a mean criteria ranking of 4.8. The majority of respondents, 26.1%, ranked this criterion a “6”; when split into agree and disagree categories, 84.9% of respondents indicated agreement that the benefits they get from using water outweigh their costs. While costs and benefits did not arise as a theme in interview data, Elinor Ostrom listed this criterion as one of her eight Design Principles, recognizing that costs accrued in managing CPRs should be in line with the benefits received (1990). Several stakeholders did mention that while there is a cost associated with using, or not using, water for irrigation, there is not currently a cost associated with taking water out of the river or for associated ecosystem goods and
services. Further, while water is a relatively inexpensive resource in many respects, stakeholders think it is a very expensive resource from a conservation standpoint.

**Enforcement**

The majority of water users surveyed think the current water management system is working relatively well when it comes to enforcing water-use rules, as indicated by a majority ranking of “4”. When divided into agree and disagree categories, 68% of water users agree the system is working well when it comes to enforcement while 34% do not. Although enforcement did not emerge as a theme characteristic of successful water management among interviewees, Ostrom (1998) describes graduated sanctions in enforcing water rules, as a close to universal characteristic in robust CPR institutions and incorporated the concept in her list of Design Principles (Ostrom 1998). Graduated sanctions are important, because they maintain a sense of fairness by allowing flexible punishment (Anderies et al. 2004). While enforcement was not extensively discussed during interviews, several interviewees commented that penalties for not abiding by water-use rules can range from a slap on the wrist to not being able to irrigate anymore, with various monetary fines and penalties possible in-between.

**Equity**

Survey responses indicated that water users were roughly divided in how well they think the current water management system is working with respect to equity, as 47.6% of respondents agree that the system is working while 52.4% do not. The majority of respondents ranked this criterion a “3”, while 5.9% ranked it a “0”. Surveyed water users were somewhat split on this criterion, but interviewees representing the wider stakeholder group voiced concerns that the current system is not always equitable when it
comes to who holds the power over water management decisions, what interests are represented during the decision-making process, and where the responsibility lies in solving water quantity problems. Within the basin, feelings of inequity are deep-rooted and have historical connotations; however, many interviewees indicate that the IMP process is facilitating dialogue and bringing people together, which is building trust amongst stakeholders.

Flexibility

The majority of survey respondents (31.7% or 107 people) believe that the current water management system is working relatively well when it comes to flexibility, as indicated by the majority response ranking of “4”. When looking at the responses in either agree or disagree format, respondents are roughly divided with 55% agreeing the system is working well and 45% indicating is not working well. Interviewees explained that having a flexible water management system is imperative to address diverse physical and hydrological conditions across the basin. Moreover, they think flexibility is vital to address changing conditions and improving management strategies moving forward. Many interviewees discussed the value of the current IMP framework, which affords NRDs flexibility in tailoring management plans to best address local concerns and conditions. However, several stakeholders mentioned there is little flexibility in surface water use, which is governed by the law of prior appropriation – a first in time first in right system. They reason that in an overappropriated basin, there is little flexibility when there is no new water available for use.

Funding
Surveyed water users indicated that Nebraska’s water management system is working relatively well in terms of being sufficiently funded; the majority of respondents, 31.7%, ranked this criterion a “4,” and 74.9% indicated agreement that the system is working well. Interviews revealed a somewhat different scenario. While numerous stakeholders believe that a beneficial characteristic of the NRD system is its taxing authority, albeit an authority with limits, many interviewees think funding is a primary challenge in managing water resources. Secure and continuing funding is essential to finance water projects, maintain staff, monitor resources, and fund new programs, like IMPs. While NRDs taxing authority helps, in addition to state and federal funding sources, several stakeholders commented that taxing their way out of problems is not the ultimate answer. Nonetheless, as state and local agencies begin to work together through IMP initiatives, increased opportunities to leverage funding offer promise.

Integration

Interview and survey data revealed that stakeholders believe the water management system is working relatively well in terms of integration. The majority of survey respondents ranked this criterion a “4” on the survey scale, while when split, 47.3% agree the system is well integrated, and 52.6% do not. Notably, 5.0% think the current water management system is not at all integrated. Challenges to integration, as discussed by interviewees, arise out of Nebraska’s bifurcated legal systems for managing surface and groundwater, from maintaining different management agencies to govern often interconnected water resources, and from the independent mind-set of Nebraska water users. Despite these challenges, which are largely a reflection of Nebraska’s water
management history, interviewees think the IMPs process is helping to overcome barriers by bringing agencies and stakeholders together in the planning process.

Knowledge

Water users reported relatively strong agreement that sufficient knowledge exists to successfully manage surface and groundwater resources, as the majority of water users ranked knowledge a “5” on the survey scale. When divided into agree and disagree categories, 65.7% of respondents think the system is working well when it comes to knowledge, while 34.3% do not. Conversely, while interviewees acknowledge that water-related knowledge is constantly advancing, they believe much uncertainty remains, specifically in relations to groundwater and surface water interactions. Within Nebraska, the connection between surface water and groundwater was not legally acknowledged until 1996. Moving forward from this recognition, it takes time to develop technical tools, to learn, and to educate stakeholders when there are problems to solve.

Leadership

According to survey responses, 54.7% of water users agree and 45.3% disagree that Nebraska’s current water management institutions possess good leadership, with the majority of respondents ranking this criterion a “4”, or working relatively well. Interviews, however, revealed that leadership in water management is one area where the State struggles. The diversity of stakeholders raised concern that management efforts often do not look at the big picture when it comes to managing water. While water is a flowing resource that transcends boundaries, water resource management is often segmented, fails to set overarching goals, and is heavily influenced by political pressures.
Despite these challenges, interviewees nonetheless deem good leadership as essential to more comprehensively and effectively managing the State’s wealth of water resources.

**Local Control**

The majority of survey respondents think the current system is performing moderately well, or a ranking of “3”, when it comes to implementing locally devised rules for water management. When split into agree/disagree categories, 53.7% agree this success criteria is working well, while 43.7% do not. Interviews revealed that many stakeholders are strong supporters of local control and of Nebraska’s innovative management system, which they believe allows districts to tailor management strategies to specific needs and bridge gaps between State agencies and local water users. However, a number of interviewees also voiced concern with the current system and the fact that NRD Boards are dominated by agricultural interests, which are not necessarily representative of the diversity of stakeholder views within the basin. Consequently, while interviewees generally showed strong support for local control, there is concern that locally devised rules do not fully consider the range of stakeholder interests.

**Monitoring**

Survey data revealed management efforts are working relatively well when it comes to monitoring water resources. The majority response was a “4” on the survey scale, with 66.3% of respondents agreeing that monitoring efforts are working well. While monitoring did not arise as a success criterion among stakeholders in the PRB, field studies have shown that monitoring is a vital characteristic in maintaining robust and successful CRP institutions (Ostrom 1998). Interviews did, however, reveal that throughout the PRB water-use monitoring practices vary considerably. A few NRDs
require meters, while most do not; other monitoring efforts by agencies involve annual or semi-annual low-level infrared photography used to ensure that farmers are complying with established limits on irrigating land. While interviews revealed many differences in opinion regarding monitoring, and more specifically towards water-use meters, several stakeholders discussed how metering within their NRD has become a positive for both water managers and users by increasing water-use knowledge. Actual facts, as they see it, are much more informative in substantiating management actions than rhetoric.

**Proactive Planning**

The majority of water users agree that the current management system is working relatively well when it comes to proactive planning, with 26.6% ranking this criterion a “4”. Furthermore, 62.4% of respondents agree that the current management system is proactive, whereas 37.6% do not. On the other hand, the wider stakeholder group generally thinks water resource institutions within the State are not very proactive. As reasoned by interviewees, IMPs are only mandatory for basins that are declared fully or overappropriated and as a result are more reactive than proactive. Current efforts, while in their infancy, are heavily focused on the short-term goals of reducing water use rather than proactively planning to avoid future problems.

**Trust**

Water users are roughly split in how much they trust water management institutions within Nebraska. Survey results show that 52.8% of water users trust the current water management system, whereas 47.8 do not. The majority of respondents, or 22%, ranked this criterion a “4” on the survey scale, while, notably 5.6% of respondents indicated that they have no trust, a ranking of “0”, in the current system. Similar to
survey results, interviews indicated that the wider stakeholder group also has mixed feeling when it comes to how much they trust the current system. Interviewees discussed a history of mistrust between State and local agencies, arising in part out of local fears that the State would come impose regulations not in their best interests. Limitations in stakeholders’ ability to influence the rules, either by not having a seat at the table, or feelings that their concerns are not legitimately considered also foster mistrust within the current system. However, many recognize that IMP efforts are working to alleviate some of this mistrust by forging better relationships between stakeholders throughout the basin.

Discussion and Recommendations

An important limitation of the quantitative component of this study is that there is no benchmark from which to measure improvement or progress towards success. This raises two important points. First, this study demonstrates the value in assessing system performance, which can provide vital benchmarks and opportunities from which to learn. Secondly, this highlights the utility of using qualitative data to inform quantitative data. Qualitative data incorporate indispensable local and institutional knowledge that can help to explain quantitative data results.

For example, in this research both qualitative and quantitative data revealed that on average, Nebraska’s current water management system is working relatively well, although there are several areas where the system can be further improved. Qualitative interviews revealed that while the current management system is not perfect, significant progress towards more integrated management to date has improved how well the system is working. As revealed by stakeholder interviews, IMP efforts facilitate increased integration between State and local water management agencies, serve as an arena to
foster communication and build trust, and enhance opportunities to influence water-use rules. Furthermore, stakeholders believe that local control enables water managers more flexibility in developing management plans best tailored to local needs and concerns, stimulates innovative management strategies, and bridges the gaps between water users and State agencies. However, in continuing to work toward more successful management institutions, the data collected in this research allude to several areas where the current management system can be further improved. Recommendations for continued improvement include: 1) ensure all stakeholder interests are represented; 2) provide increased opportunities to participate; and 3) work towards more holistic and proactive water management.

Ensure all Stakeholder Interests are Represented

Survey results indicate that water users are relatively split on how equitably they feel they are treated under the current management system. In-depth interviews representative of the larger stakeholder population reveal an even greater level of concern when it comes to how equitable the current system is. As revealed in interviews, problems with equity are diverse, deeply rooted in the history of water resources management within the State, and not easily solved.

Symes et al. (1999) review of fairness in water allocation lists some of the most important aspects of fairness of the allocation process as being: 1) management of water for future generations; 2) water as a public good and therefore being managed as such; 3) the rights of the environment; and 4) how efficiently water is being used. In order to ensure that the diversity of views and values related to water allocation are represented, a
necessary first step is arguably to ensure that all stakeholder interests are represented in the decision-making process.

Although the current IMP process does require consultation with broad stakeholder interests throughout the basin as identified by either the DNR or NRD (Neb Rev Stat §46-715(5)(b)), many interviewees, specifically those representative of environmental and surface water interests, feel they do not always have a seat at the table when important water management decisions are being made. Many also think the NRD Board of Directors is dominated by agricultural interests and therefore not representative of the diversity of stakeholder concerns within the basin.

If stakeholder interests are not represented in the decision-making process, there remains limited opportunity to reconcile differences up front. By their very nature, participatory processes are meant to establish common ground and trust between participants and facilitate a better understanding of diverse stakeholder views (Stringer et al. 2006). Face-to-face interactions and communication have been repeatedly shown to increase the levels of cooperation achieved (Ostrom 1998), while also building trust and reciprocity between individuals and groups (Reed 2008; Dietz et al. 2003; Ostrom 1998). While ensuring representation of water interests will by no means alleviate all equity issues within the basin, it is a necessary starting point in recognizing and reconciling diverse and often conflicting water interests.

*Increased Opportunities to Participate*

Both survey results and in-person interviews suggest that stakeholders in the PRB feel they have a limited ability to influence water-use rules. However, both stakeholder interviews and Ostrom’s Design Principle agree that stakeholders must genuinely believe
that, at least to a certain extent, they have the power to meaningfully influence water-use rules. As Parkins and Mitchell (2005) note, the public will not maintain an active interest in the planning processes without hope of influencing a decision or given situation.

Reed (2008) recommends that stakeholders can be empowered through participation by: 1) ensuring that participants have the power to really influence the decision, and 2) ensuring that participants have the technical capability to engage effectively with the decision. Stakeholders must be able to voice their concerns and engage in discussions shaping water-use rules, and their concerns must be legitimately considered. Moreover, an educational component is sometimes necessary to ensure that stakeholders understand, at least at a basic level, the technical aspects being considered in support of various management decisions.

Interviews also indicated that stakeholders want increased opportunities to voice issues and concerns after IMPs are established. Currently, there is one annual meeting between PRB NRDs and the DNR where stakeholders come together in the form of a public meeting. Interviewees described this gathering as more of an opportunity to report on current projects, rather than engage in meaningful dialogue about IMP progress, issues, and/or concerns. In order to facilitate increased opportunities to engage in meaningful participation, the format of this meeting could be restructured to promote more engaged learning and face-to-face discussion on management effectiveness to date, highlighting and devising strategies for continued improvements. Lastly, it is argued to be most effective, stakeholder participation must be institutionalized (Reed 2008). Creating an organizational culture where stakeholder input and feedback are encouraged and
incorporated into the decision-making process can improve strides towards more successful water resources management.

More Proactive and Holistic Water Management

Within Nebraska, IMPs are required only if a basin is designated as fully or overappropriated. This methodology, as reasoned by numerous stakeholders, is a reactive, not proactive, approach to water resources management. By the time the water resources within a given area are deemed fully and/or overappropriated, many options for more proactive management have already been foreclosed. At this point, water resources managers are trying to decipher how to best fix the problem of unsustainable water-use, instead of trying to avoid the situation from the onset.

While not mandatory, NRDs not currently designated as fully or overappropriated do have the option of pursuing voluntary IMPs. To date, ten NRDs have implemented mandated IMPs, including one overarching basin-wide plan for the PRB (DNR 2013), and another five are working towards voluntary IMPs (DNR 2012a). However, that leaves eight NRDs without current plans to implement or work towards IMPs. Under Nebraska’s current water management system, this means that NRDs manage groundwater resources and the State DNR manages surface water resources, with little to no effort towards integrated planning.

The IMP process offers a valuable opportunity to build relationships between stakeholders, facilitate shared learning, and proactively discuss water management challenges and/or potential issues before they become a problem. Further, increased interaction and communication between local and State water management agencies can build trust and reciprocity (Ostrom 1998) and can stimulate innovative solutions and
strategies geared at better managing water resources. During interviews, several stakeholders mentioned wishing efforts focused on collectively managing water resources had started prior to 2004 (when LB962 was passed) in order to avoid the problems now faced. However, stakeholders also hope the PRB can serve as an example to other basins by encouraging them to avoid a similar situation. Water, as a flowing and interconnected resource, should be managed as such. Therefore, the current management system should move beyond voluntary IMPs for individual NRDs towards IMPs for all NRDs as well as overarching basin-wide plans for the larger watersheds. Increased integration and a heightened focus on more comprehensive water resources management will help the State move beyond a system of individual NRDs and closer toward shared methodologies, goals, and objectives.

Conclusion

Without follow-up and investigation, resource managers and policy makers cannot be sure as to whether they have gotten the rules right. This research provides much needed information that can be used to continue to improve management efforts within the PRB and throughout the State and serve as a fundamental baseline assessment from which to measure improvements moving forward. Moreover, this research methodology can be used by water resource managers and policy makers, within and beyond Nebraska, as an assessment tool to qualitatively and quantitatively inform efforts toward more integrated and adaptive management approaches. Improving resource managers’ ability to learn about and better understand the implications of management approaches and policies can lead to more successful water resource institutions.
Within the basin, stakeholders agree that movement towards more integrated management planning efforts is an important first step in building successful water management institutions within Nebraska. Overall, interviewees feel the right tools exist within the State to successfully manage water and now it is a matter of putting these tools into action. However, there is little doubt that this change will take time. Interviewees recognize that it has taken significant effort and resources to get to where there are today and that change will not happen overnight. Having a baseline assessment for how well the current management system is working will be a key indicator in determining success moving forward.
Table 3.1. Characteristics Promoting Successful Water Management

<table>
<thead>
<tr>
<th>Management Characteristic</th>
<th>Characteristic Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to Influence Rules*^</td>
<td>An ability to influence rules through meaningful and ongoing participation inclusive of all stakeholder interests</td>
</tr>
<tr>
<td>Clearly Defined Water-Use Rules *^</td>
<td>Water users must have a clear understanding of what the water-use rules are and how the rules apply</td>
</tr>
<tr>
<td>Conflict Resolution^</td>
<td>Mechanisms must be put in place to resolve conflicts between water users.</td>
</tr>
<tr>
<td>Costs and Benefits^</td>
<td>Costs accrued in managing water resources should be in line with benefits.</td>
</tr>
<tr>
<td>Enforcement^</td>
<td>Water users who violate rules should face graduated sanctions, reflective of the number of violations committed and seriousness of the offense.</td>
</tr>
<tr>
<td>Equity*</td>
<td>Despite differences in how people use and value water, it is essential that all water users feel they are treated fairly.</td>
</tr>
<tr>
<td>Flexibility*</td>
<td>Water institutions must be able to adapt to changing conditions, have the freedom to develop and implement innovative solutions, and learn from new information.</td>
</tr>
<tr>
<td>Funding*</td>
<td>A stable and sufficient funding source is essential in developing and sustaining water management programs, projects, and staff.</td>
</tr>
<tr>
<td>Integration*^</td>
<td>Integration refers to the connectedness of water management institutions, both vertically and horizontally, as well as to the connectedness of legislation and legal doctrines devised to govern water resources.</td>
</tr>
<tr>
<td>Knowledge*</td>
<td>Successful water management involves understanding the resource system being managed. Knowledge is reflected in staff expertise, technology, data monitoring programs, education and awareness programs, and an ability to learn.</td>
</tr>
<tr>
<td>Leadership*</td>
<td>Good leadership involves making difficult choices that are in the best interest of society as a whole, providing overarching direction to constituents, and a willingness to be a part of the long-term decision-making process.</td>
</tr>
<tr>
<td>Local Control*^</td>
<td>The ability to develop local solutions targeted at the specific circumstances of a particular district or region.</td>
</tr>
<tr>
<td>Monitoring^</td>
<td>Monitoring mechanisms are in place so that the status of the resource, as well as people’s behavior in using the resource, is known and can be appropriately addressed.</td>
</tr>
<tr>
<td>Proactive Planning*</td>
<td>Proactive planning involves actively addressing long-term concerns and issues in the current planning process.</td>
</tr>
<tr>
<td>Trust*</td>
<td>Building and establishing relationships so that there is a greater level of communication, confidence, and acceptance in water management actions and initiatives.</td>
</tr>
</tbody>
</table>

*Denotes characteristics derived from in-depth qualitative interviews

^Denotes Ostrom’s eight Design Principles (Ostrom 1990)
Table 3.2. Scale Item Reliability Analysis

<table>
<thead>
<tr>
<th>Survey Items</th>
<th>Item-Total Statistics</th>
<th>Reliability Statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Corrected Item-Total Correlation</td>
<td>Cronbach’s Alpha if item deleted</td>
</tr>
<tr>
<td><strong>Ability to Influence Rules</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q7</td>
<td>0.683</td>
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</tr>
<tr>
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<tr>
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<td>.829</td>
</tr>
<tr>
<td>Q29</td>
<td>.674</td>
<td>.662</td>
</tr>
<tr>
<td>Q30</td>
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<td>.622</td>
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<tr>
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<td>Q2</td>
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<tr>
<td>Q18</td>
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<td>Q39</td>
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<td><strong>Flexibility</strong></td>
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<tr>
<td>Q11</td>
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<td>Q45</td>
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</tr>
<tr>
<td>Q4</td>
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<td>0.806</td>
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<td>Survey Items</td>
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<td>Reliability Statistics</td>
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<td>Corrected Item-Total Correlation</td>
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<td>Q38</td>
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<td>Q19</td>
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<td>Q32</td>
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<td>Q41</td>
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Table 3.3. Overall Distribution and Summary Statistics for “Successful Water Management in the PRB, NE” Survey Criteria. The majority ranking for each criterion is in bold.

<table>
<thead>
<tr>
<th>CRITERION</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>I do not agree</th>
<th>Distribution of Responses</th>
<th>I strongly agree</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>N</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>(%)</td>
<td>(%)</td>
<td>(%)</td>
</tr>
<tr>
<td>Ability to Influence Rules</td>
<td>338</td>
<td>2.59</td>
<td>1.56</td>
<td>33</td>
<td>52</td>
<td>91</td>
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<td>Clearly Defined Water-Use Rules</td>
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<td>1.57</td>
<td>8</td>
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<td>1.52</td>
<td>14</td>
<td>25</td>
<td>62</td>
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<tr>
<td>Costs and Benefits</td>
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<td>1.51</td>
<td>5</td>
<td>5</td>
<td>16</td>
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<tr>
<td>Enforcement</td>
<td>337</td>
<td>4.00</td>
<td>1.50</td>
<td>6</td>
<td>19</td>
<td>23</td>
</tr>
<tr>
<td>Equity</td>
<td>338</td>
<td>3.37</td>
<td>1.65</td>
<td>20</td>
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<td>50</td>
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<tr>
<td>Flexibility</td>
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<td>3.60</td>
<td>1.32</td>
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<td>48</td>
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<td>4.26</td>
<td>1.39</td>
<td>2</td>
<td>7</td>
<td>22</td>
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<td>Integration</td>
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<td>3.25</td>
<td>1.58</td>
<td>17</td>
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<td>48</td>
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<td>Knowledge</td>
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<td>Leadership</td>
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<td>3.48</td>
<td>1.66</td>
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Table 3.4. Water Management Survey Demographic Data

<table>
<thead>
<tr>
<th>Type of Water Use</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groundwater</td>
<td>143</td>
<td>42.3</td>
</tr>
<tr>
<td>Surface Water</td>
<td>18</td>
<td>5.3</td>
</tr>
<tr>
<td>Both</td>
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LITERATURE CITED


Nebraska Department of Natural Resources (DNR). 2009. Fully Appropriated and Overappropriated Surface Water in Nebraska: Determinations made by the Department of Natural Resources as of April 08, 2009. [online] URL: http://dnr.ne.gov/SurfaceWater/FullyOverAppropriatedAreaStatewide_0409.pdf


Nebraska Department of Natural Resources (DNR). 2013. Integrated Water Management – Approved Plans Webpage. [online] URL: http://dnr.ne.gov/IWM/docs/IWM_ApprovedPlans.html

Neb Rev Stat §46-715(5)(b) (Reissue 2010)


Pomeroy, R. and P. McConney. 2007. Conditions for Successful Fisheries Co-
CHAPTER 4: DISCUSSION AND CONCLUSION

Over the past several decades, Nebraska’s water management systems have undergone many significant changes. Nebraska’s water management institutions have evolved from a system of state control over all water resources to a system of state control over surface water and local control over groundwater. Most recently, the state adopted a more integrated management system of shared state and local control where surface water and groundwater are hydrologically connected. This recently developed governance structure, which is unique to Nebraska, takes a new and innovative approach to how water resources are managed within the State. However, prior to this research, little if any data existed on how well the management system was working.

Qualitative interviews reveal that the characteristics stakeholders feel as vital to the successful management of water resources corroborate common-pool resources principles for institutional success established to date. Directly asking stakeholders about the components of successful water resource management yields results similar to principles previously derived from field observations, laboratory experiments, and extensive literature reviews (Pomeroy and McConney 2007; Agrawal 2001; Wade 1998; Baland and Platteau 1996; Ostrom, E. 1990). This is an interesting and notable finding given the majority of stakeholders interviewed have little knowledge of such principles, which are largely written about in academic literature.

In using these principles to qualitatively and quantitatively assess how well Nebraska’s water management institutions are working within the overappropriated portion of the Platte River Basin, Nebraska (subsequently referred to as the PRB), this research reveals that as a whole, the current system is working relatively well. Interview
data and survey data showed similar trends in responses for many of the success criteria, including an ability to influence rules, clearly-defined water use rules, flexibility, integration, and local control. However, notable differences in views between interview and survey responses were seen for equity, funding, knowledge, leadership, proactive planning, and trust. Differences in views between the interviews and survey results are likely attributable to the populations for which the data is representative; interview data represents the wide diversity of stakeholder views within the PRB, while quantitative survey data represents only surface water and groundwater right holders within the basin.

Stakeholders generally feel that the biggest challenges the current management system face are related to their ability to influence water-use rules, equity, funding, knowledge, leadership, proactive planning, and trust. However, while interviewees recognize there are definite challenges to overcome, there is general agreement that integrated management planning is moving the State closer towards success. To remain on this path towards success, this research recommends the following opportunities for continued improvement: 1) ensure all stakeholder interests are represented; 2) provide increased opportunities to participate; and 3) work towards more holistic and proactive water management, particularly through Integrated Management Planning. These recommendations can also help to build trust and facilitate the exchange of knowledge through increased stakeholder interaction and collaboration.

This research has shown that there is much to learn from the stakeholders who are so intricately connected to the vital resources that institutions seek to govern and sustain through time. Without stakeholder buy-in to the management process, there is little hope that management institutions will be able to successfully and sustainably manage water
resources into the future. This research has shown that while quantitative survey methods provide measurable data, qualitative interview data allows stakeholder perspectives to be explained in ways that numbers alone cannot. This speaks to the value of using both qualitative and quantitative data to more robustly and comprehensively review system performance.

Further, without follow-up and investigation, resource managers and policy makers cannot be sure as to whether they have gotten the rules right. New and emerging challenges, such as increasing populations and degrading ecosystems, warrant management rules and approaches to be revisited. This research provides much needed information that can be used to continue to improve management efforts within the basin and throughout the State and serves as a fundamental baseline assessment from which to measure improvements moving forward. Moreover, this research methodology can be used by water resource managers and policy makers, within and beyond Nebraska, as an assessment tool to inform efforts towards more integrated and adaptive management approaches. Improving resource managers’ ability to learn about and better understand the implications of management approaches and policies can lead to more successful water resource institutions.

Furthermore, this research has contributed to the current body of common-pool resource knowledge that seeks to better understand how established common-pool resource principles can be applied to assess more complex resource management systems. While this research offers a good starting point from which to better assess more complex, large-scale water resource systems, additional research is needed to better understand the interdependence, as well as the associated relationships and synergies, that
exist between the various success criteria. While it is not realistic to believe that there is a single, universal prescription for successful common-pool resource management, there are basic and essential criteria that can serve to guide institutions towards success. Consequently, it is of much value to continue to build knowledge and insight into how these principles can be applied to better address common-pool resources problems in the future.
Literature Cited


APPENDIX A

Interview Participant Informed Consent
Participant Consent Form

Title of Research: Exploring Water Resources Management in Nebraska as seen by Stakeholders
Investigators: Christina Hoffman, M.S. and Cody Knutson, Ph.D.

Participation
You are being asked to participate in an interview that is being done for research purposes. The purpose of this research is to better understand water resources management within Nebraska. Interviews will be audiotaped and conducted in a private meeting room at the University of Nebraska at Lincoln, in a private conference room at interviewee's place of work, or over the telephone. In the case of telephone interviews, both interviewer and interviewee will conduct the telephone interview while in a private meeting or conference room.

You are being asked to participate in this study because you are a stakeholder in how water resources are allocated and/or managed within the state of Nebraska.

Duration
Participation in the study will consist of participating in an interview lasting 60 – 90 minutes. You may be asked to participate in a follow-up interview. This, however, will be entirely voluntary.

Risks & Benefits
There are no known risks involved in participating in this study. While there are also no specific benefits involved in your participation, this study will inform water resources management efforts within Nebraska.

Confidentiality
Your data will be kept completely confidential, and no personally identifiable information will be used in this study. You will be assigned a pseudonym that will be used in lieu of your name.

Option to Refuse or Withdraw
Your participation in this study is completely voluntary. Should you choose not to participate in this study it will have no effect upon you, your relationship with the University of Nebraska at Lincoln, or your relationship with the investigators. You may withdraw from this study at any time.
Questions
If you have any questions about this study, please contact Christina Hoffman (christina212@hotmail.com, 305-439-5145) or Dr. Cody Knutson (cknutson@unnotes.unl.edu). If you have questions about your rights as a research participant, or to report any concerns about the study, you should contact the UNL IRB office at 402-472-6965 or irb@unl.edu.

Agreement
Your signature below indicates that you agree to participate in this study. You will be provided with a copy of this informed consent form.

☐ Please check this box if you agree to have your interview audiotaped.

Your signature below indicates that you consent to participate in the above study.

_________________________________________  ________________________________
Signature of Participant                  Date

_________________________________________  ________________________________
Participant’s Name (Printed)                Date
APPENDIX B

Semi-Structured Interview Protocol
Semi-Structured Interview Protocol for:
Exploring Water Resources Management in Nebraska as seen by Stakeholders

Time of Interview:

Date:

Place:

Interviewer: Christina Hoffman

Interviewee (Pseudonym): Interviewee #

(Briefly describe the project):

This is a school research project that will explore how Nebraska’s current water resources management system is working as viewed by stakeholders. Specifically, this study will look at perceptions of how management of water allocations within the state of Nebraska are working, focusing on the overappropriated portion of the Platte River that encompasses the North Platte, South Platte, Twin Platte, Central Platte and Tri-Basin Natural Resource Districts.

This interview and all associated data will be kept confidential. I will be the sole person transcribing the data and any information incorporated into my research report will be identified by using a pseudonym.

Do you have any questions before we begin?
Questions: Interview Protocol

1. What is/has been your role in working with water resources in the Platte River Basin?

2. Can you describe the Platte River Basin?

   Probes: Groundwater resources?
   Surface water resources?
   Any changes in the resource over time?
   What is water used for?

3. Can you tell me about management of water resources as it exists in the Platte River Basin?

   Probes: How does local management of water resources work with state management of water resources?

4. Overall, how do you think the management system is working?

   Probes: Can you please explain why you feel this way?

5. “Institutions” refers to the governance structures that are in place to manage water resources. What do you think are the characteristics that describe successful water management institutions?

   Probe: Do water management institutions in Nebraska possess these characteristics?

   Probes: What are the challenges of the current management system?
   What are the benefits of the current management system?
   Do you think that other people share your opinion?
   What do you think is the future of the NRD system?

6. Is there anything else you would like to add?

7. Is there anyone else you would recommend I speak to about this topic?

(Thank the individual for participating in this interview. Assure him or her of confidentiality of responses and potential future interviews)
APPENDIX C

Q-Sort Methodology Pre-Test Survey
WATER MANAGEMENT: SURVEY PRE-TEST

PURPOSE: The purpose of this activity is to test a set of statements for a survey that will be given to water users in Nebraska. The goal of the survey will be to see how well water users in Nebraska think the current water management system is working.

INSTRUCTIONS: Please read each of the following statements. Under each statement, write the principle that best relates to the statement using the list of principles provided at the top of each page. In the column to the right, rank how well each statement fits with the principle you selected by highlighting a single number in the scale. For example, if the statement clearly fits the principle "Funding" you would write in "Funding" on the line provided and highlight "7" indicating an excellent fit. If the statement is not very clearly related to the principle you wrote in, you would highlight "1" because the statement is not a good fit with the principle. The survey will take approximately 20 minutes. Please save the changes you make to the survey and email the document to christinahoffmannarm@gmail.com. Thank you very much for your help!

<table>
<thead>
<tr>
<th>LIST OF PRINCIPLES</th>
<th>How well does the statement fit the principle?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability to Influence Rules</td>
<td>Knowledge</td>
</tr>
<tr>
<td>Conflict Resolution</td>
<td>Leadership</td>
</tr>
<tr>
<td>Costs and Benefits</td>
<td>Local Control</td>
</tr>
<tr>
<td>Enforcement</td>
<td>Monitoring</td>
</tr>
<tr>
<td>Equity</td>
<td>Proactive Planning</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Rules of Water Use</td>
</tr>
<tr>
<td>Funding</td>
<td>Trust</td>
</tr>
<tr>
<td>Integration</td>
<td></td>
</tr>
</tbody>
</table>

1. I have opportunities to directly interact in discussions with policymakers about how water resources are managed

   **Principle:**

   1 2 3 4 5 6 7

2. It is easy to identify who is in charge when it comes to making water management decisions

   **Principle:**

   1 2 3 4 5 6 7

3. The Department of Natural Resources respects local water management decisions

   **Principle:**

   1 2 3 4 5 6 7

4. Nebraska's water management system is flexible

   **Principle:**

   1 2 3 4 5 6 7

5. Water management in Nebraska is proactive

   **Principle:**

   1 2 3 4 5 6 7
<table>
<thead>
<tr>
<th>Ability to Influence Rules</th>
<th>Knowledge</th>
<th>How well does the statement fit the principle?</th>
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<td>Conflict Resolution</td>
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<td>Funding</td>
<td>Trust</td>
<td>1 = Poor Fit 7 = Excellent Fit</td>
</tr>
<tr>
<td>Integration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. The Department of Natural Resources has the technical knowledge to successfully manage surface water resources.

Principle:

7. Overall, I think there are adequate systems in place to monitor people's use of groundwater.

Principle:

8. There is excellent leadership at the local level when it comes to making decisions about how water is managed.

Principle:

9. I am able to influence rules that are put in place to manage surface water.

Principle:

10. There are adequate mechanisms put in place to resolve water conflicts between water users.

Principle:

11. The benefits I receive from using groundwater resources exceed my costs.

Principle:

12. State and local water management agencies work together to collectively manage water resources.

Principle:

13. I am treated the same as other water users.

Principle:

14. State and local water management activities are well aligned.

Principle:
<table>
<thead>
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<tr>
<td>Integration</td>
<td></td>
<td></td>
</tr>
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</table>

15. There is a high level of trust among water users
   Principle:                                                                

16. Water resource managers develop plans to address potential problems before they occur
   Principle:                                                                

17. Penalties imposed in enforcing surface water rules increase with the seriousness of the offense
   Principle:                                                                

18. Rules for managing water resources can easily be changed if needed
   Principle:                                                                

19. Overall, enough is known about how surface and groundwater interact to manage water resources successfully
   Principle:                                                                

20. Litigation is rarely needed to settle disputes between water users
    Principle:                                                                

21. There is little scientific uncertainty when it comes to managing water resources
    Principle:                                                                

22. There are sufficient enforcement mechanisms in place for managing water resources
    Principle:                                                                

23. Federal, state, and local agencies involved in water management within Nebraska do a good job of coordinating activities and responsibilities.
    Principle:                                                                

<table>
<thead>
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<th>Ability to Influence Rules</th>
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<th>How well does the statement fit the principle?</th>
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<td>Trust</td>
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</tr>
<tr>
<td>Integration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

24. Sufficient financial resources are provided to implement integrated management plans  
*Principle:*  
1 2 3 4 5 6 7

25. If a conflict arises with another water user, there are low-cost ways to work out the problem (e.g., through informal meetings with a state or local agency; by talking to fellow water users)  
*Principle:*  
1 2 3 4 5 6 7

26. The benefits of using water resources outweigh the costs of developing and managing the resource  
*Principle:*  
1 2 3 4 5 6 7

27. Nebraska’s water management system is fair  
*Principle:*  
1 2 3 4 5 6 7

28. There is a lot of flexibility when it comes to conjunctively managing surface and groundwater resources  
*Principle:*  
1 2 3 4 5 6 7

29. The costs accrued in managing water resources are in line with the benefits I receive from using water  
*Principle:*  
1 2 3 4 5 6 7

30. Natural Resources Districts have adequate financial resources to manage water resources  
*Principle:*  
1 2 3 4 5 6 7

31. Water users can devise local rules for managing water resources  
*Principle:*  
1 2 3 4 5 6 7

32. Sufficient data and information exists to successfully manage water resources  
*Principle:*  
1 2 3 4 5 6 7
<table>
<thead>
<tr>
<th>Ability to Influence Rules</th>
<th>Knowledge</th>
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<td>Rules of Water Use</td>
</tr>
<tr>
<td>Funding</td>
<td>Trust</td>
</tr>
</tbody>
</table>

### How well does the statement fit the principle?

(please highlight a single number)

1 = Poor Fit
7 = Excellent Fit

| 33. The current water management system allows for equal representation of all water interests |
| Principle: |
| 1 2 3 4 5 6 7 |

| 34. I trust my local Natural Resources District |
| Principle: |
| 1 2 3 4 5 6 7 |

| 35. Monitoring efforts ensure people do not use more water than they are allowed to use |
| Principle: |
| 1 2 3 4 5 6 7 |

| 36. Regulations for managing water resources can be modified as new information becomes available |
| Principle: |
| 1 2 3 4 5 6 7 |

| 37. Water management agencies have the money they need to manage water resources |
| Principle: |
| 1 2 3 4 5 6 7 |

| 38. Rights to use groundwater are well defined |
| Principle: |
| 1 2 3 4 5 6 7 |

| 39. Surface and groundwater users are treated equitably |
| Principle: |
| 1 2 3 4 5 6 7 |

| 40. If I have a problem with the Nebraska Department of Natural Resources on a water resources issue, I feel that there are inexpensive avenues that I can pursue to resolve the conflict |
| Principle: |
| 1 2 3 4 5 6 7 |

| 41. Natural Resources Districts work together to collectively manage water resources |
| Principle: |
| 1 2 3 4 5 6 7 |
| Ability to Influence Rules | Knowledge | How well does the statement fit the principle?
|---------------------------|-----------|--------------------------------------------------
| Conflict Resolution       | Leadership | (Please highlight a single number)
| Costs and Benefits        | Local Control |
| Enforcement               | Monitoring |
| Equity                     | Proactive Planning |
| Flexibility                | Rules of Water Use |
| Funding                    | Trust      |
| Integration                |            | 1 = Poor Fit 7 = Excellent Fit

42. The state recognizes the importance of local control in managing water resources
   *Principle:*
   
43. State and local laws for managing water resources are well integrated
   *Principle:*
   
44. Water resources initiatives are well funded within Nebraska
   *Principle:*
   
45. I understand who must comply with rules established by the state Department of Natural Resources
   *Principle:*
   
46. Water management agencies do a good job of monitoring peoples' use of water
   *Principle:*
   
47. Water managers are working to address potential future changes in water availability and timing
   *Principle:*
   
48. I have opportunities to actively participate in discussions and/or meetings to determine how to best manage surface and groundwater resources
   *Principle:*
   
49. Sufficient monitoring systems are in place to make sure water users follow the rules
   *Principle:*
   
50. Water management agencies provide direction and guidance to water users
   *Principle:*
   
6 | Page
<table>
<thead>
<tr>
<th>Ability to Influence Rules</th>
<th>Knowledge</th>
<th>How well does the statement fit the principle?</th>
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<tbody>
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<td></td>
</tr>
<tr>
<td>Integration</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

51. Water management plans focus on meeting both short and long-term needs
   \textit{Principle}:

   1 2 3 4 5 6 7

52. I have a voice in how water resources are managed
   \textit{Principle}:

   1 2 3 4 5 6 7

53. Penalties are enforced for failing to abide by groundwater regulations
   \textit{Principle}:

   1 2 3 4 5 6 7

54. Local management plays a large role in how water is managed within Nebraska
   \textit{Principle}:

   1 2 3 4 5 6 7

55. Natural Resources Districts have great flexibility in deciding how to best manage groundwater
   \textit{Principle}:

   1 2 3 4 5 6 7

56. Water managers look after my long-term interests
   \textit{Principle}:

   1 2 3 4 5 6 7

57. I trust water managers to make good decisions when it comes to managing water resources
   \textit{Principle}:

   1 2 3 4 5 6 7

58. The state rarely challenges local water management rules
   \textit{Principle}:

   1 2 3 4 5 6 7
APPENDIX D

Water Management Survey Participant Informed Consent
May 29, 2012

Christina Hoffman
512 Hardin Hall
3310 Holdrege Street
Lincoln, NE 68583-0993

Dear Sir or Madam:

I am a student at the University of Nebraska – Lincoln and I am writing to ask for your help with my research project titled, Exploring Water Resources Management as Seen by Stakeholders in Nebraska, which looks at how water resources management is working in Nebraska. The best way to learn about how water management is working is to ask water users to share their thoughts and opinions. Your address is one of only a small number that have been randomly selected to help in this study.

Enclosed you will find a brief survey that will take approximately 15 minutes to complete. Please have an adult (19 years or older) who uses surface and/or groundwater within Nebraska fill out the survey. Your responses are voluntary and will be kept confidential. If you have any questions about this survey of water users within Nebraska, please contact Christina Hoffman (christina.hoffman@nebraskastate.edu; 402-472-8210) or Dr. Mark Rumbach (mark.rumbach@nebraskastate.edu; 402-472-8210). If you have questions about your rights as a participant, please contact the IRB office (irb@importDefault.edu; 402-472-9695).

There are no known risks involved in participating in this study. Further, while there are no specific benefits involved in your participation, this study will inform water resource management efforts within Nebraska. You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the investigators or the University of Nebraska-Lincoln. Your decision will not result in any loss of benefits to which you are otherwise entitled.

By taking the time to complete this survey, you will be helping me out a great deal and I am very grateful for your time and assistance. Once you are finished filling out the survey, please use the enclosed pre-addressed stamped envelope to return the survey to me as soon as possible. By completing the survey your consent to participate is implied. Please keep this form for your records.

I look forward to receiving your responses.

Sincerely,

Christina Hoffman
Graduate Student
University of Nebraska – Lincoln
APPENDIX E

Water Management Survey
WATER MANAGEMENT SURVEY

INSTRUCTIONS: Please read each of the following statements. For each statement, rank how much you agree with the statement. For example, if you strongly agree with a statement, circle “7”, indicating strong agreement. If you do not agree with the statement, you would circle “0”. The survey will take approximately 15 minutes to complete.

<table>
<thead>
<tr>
<th>Statement</th>
<th>I do not agree</th>
<th>I strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The Department of Natural Resources has a great deal of flexibility in deciding how to best manage surface water</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>2. I am treated the same as other water users</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>3. The costs accrued in managing water resources are in line with the benefits I receive from using water</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>4. Sufficient data and information exists to successfully manage water resources</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>5. Natural Resource Districts have adequate financial resources to manage water resources</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>6. I trust my local Natural Resource District</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>7. Water management agencies do a good job of monitoring peoples' use of water</td>
<td>0 1 2 3 4 5 6 7</td>
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<tr>
<td>8. I have a voice in how water resources are managed</td>
<td>0 1 2 3 4 5 6 7</td>
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<tr>
<td>9. I am able to influence the rules that are put in place to manage surface water</td>
<td>0 1 2 3 4 5 6 7</td>
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<tr>
<td>10. Nebraska's water management system is fair</td>
<td>0 1 2 3 4 5 6 7</td>
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</tr>
<tr>
<td>11. Water management in Nebraska is proactive</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>12. Overall, enough is known about how surface and groundwater interact to manage water resources successfully</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>13. There are adequate mechanisms in place to resolve water conflicts between water users and water managers</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>14. I have opportunities to actively participate in discussions and/or meetings to determine how to best manage surface and groundwater resources</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>15. Natural Resource Districts have great flexibility in deciding how to best manage groundwater</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>16. The benefits of using water resources outweigh the costs of developing and managing the resource</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>17. It is clear who must follow Natural Resource District rules</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>18. Penalties are enforced for failing to abide by surface water regulations</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>19. The state recognizes the importance of local control in managing water resources</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>20. Overall, I think there are adequate systems in place to monitor people's use of surface water</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>21. Local management plays a large role in how water is managed within Nebraska</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>22. State and local water management activities are well coordinated</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>23. There is a lot of flexibility when it comes to conjunctively managing surface and groundwater resources</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>24. Surface and groundwater users are treated equitably</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>25. There are adequate mechanisms in place to resolve water conflicts between water users</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
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<tr>
<td>26. Monitoring efforts ensure people do not use more water than they are allowed to use</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>27. Water resources initiatives are well funded within Nebraska</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>28. State and local laws for managing water use are well integrated</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>29. Water management plans focus on meeting long-term needs</td>
<td>0 1 2 3 4 5 6 7</td>
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</tr>
<tr>
<td>30. There is a high level of trust among water users</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>31. Rights to use groundwater are well defined</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>32. Rights to use surface water are well defined</td>
<td>0 1 2 3 4 5 6 7</td>
<td></td>
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TURN OVER →
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<th>Question</th>
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<th>7</th>
<th>N/A</th>
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<tr>
<td>33. Natural Resources Districts have the technical knowledge to...</td>
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<tr>
<td>34. Water managers are working to address potential future changes...</td>
<td>0</td>
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<tr>
<td>35. It is clear who must follow rules established by the...</td>
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<tr>
<td>36. Litigation is rarely needed to settle disputes between users...</td>
<td>0</td>
<td>1</td>
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</tr>
<tr>
<td>37. Penalties imposed in enforcing groundwater rules increase...</td>
<td>0</td>
<td>1</td>
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<td>4</td>
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<tr>
<td>38. Water users can devise local rules for managing water resources...</td>
<td>0</td>
<td>1</td>
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<td>5</td>
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<td></td>
</tr>
<tr>
<td>39. The benefits I receive from using groundwater resources exceed...</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<td>5</td>
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<td>7</td>
<td>N/A</td>
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<tr>
<td>40. Water resource managers develop plans to address potential...</td>
<td>0</td>
<td>1</td>
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<tr>
<td>41. I trust the Department of Natural Resources</td>
<td>0</td>
<td>1</td>
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<tr>
<td>42. The Department of Natural Resources has adequate financial...</td>
<td>0</td>
<td>1</td>
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<td>4</td>
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</tr>
<tr>
<td>43. Penalties are enforced for failing to abide by groundwater...</td>
<td>0</td>
<td>1</td>
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<td>4</td>
<td>5</td>
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<td></td>
</tr>
<tr>
<td>44. The benefits I receive from using surface water exceed...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>7</td>
<td>N/A</td>
</tr>
<tr>
<td>45. I am able to influence the rules that are put in place...</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<tr>
<td>46. The Department of Natural Resources has the technical...</td>
<td>0</td>
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<td></td>
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<tr>
<td>47. The current water management system allows for equal representation</td>
<td>0</td>
<td>1</td>
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</tr>
<tr>
<td>48. Federal, state, and local agencies involved in water management...</td>
<td>0</td>
<td>1</td>
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<tr>
<td>49. There is a high level of trust between local and state...</td>
<td>0</td>
<td>1</td>
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<tr>
<td>50. Penalties imposed in enforcing surface water rules increase...</td>
<td>0</td>
<td>1</td>
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<td>5</td>
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<tr>
<td>51. Overall, I think there are adequate systems in place...</td>
<td>0</td>
<td>1</td>
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<td>5</td>
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</tr>
<tr>
<td>52. The Department of Natural Resources respects local...</td>
<td>0</td>
<td>1</td>
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</tr>
<tr>
<td>53. Sufficient financial resources are provided to implement...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>54. Nebraska's water management system is flexible...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>55. If a conflict arises with another water user, there are low-cost...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<td>6</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Please circle the choice that best answers the questions below:

1. I use: only groundwater / only surface water / both surface and groundwater
2. I use both surface and groundwater but I primarily use: surface water / groundwater / N/A
3. I primarily use water for: irrigation / livestock / industrial use / Other: _______________
4. I have farmed Nebraska for: under 10 years / 11-20 years / 21-30 years / 40+ years / N/A
5. Gender: male / female
6. Age: 19-30 / 31-40 / 41-50 / 51-60 / 61-70 / 71-80 / 81+
APPENDIX F

Institutional Review Board (IRB) Documents
April 1, 2011

Christina Hoffman
School of Natural Resources
1301 Lincoln Mall #703 Lincoln, NE 68508

Cody Knatz
School of Natural Resources
823 HARH, UNL 68583-0988

IRB Number: 20110311625 EX
Project ID: 11625
Project Title: Exploring Water Resources Management as seen by Stakeholders in Nebraska.

Dear Christina:

This letter is to officially notify you of the approval of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with the institutional's Federal Wide Assurance 00002253 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as Exempt Category 2.

You are authorized to implement this study as of the Date of Final Approval: 04/01/2011.

1. The approved informed consent form has been uploaded to NUgrant (file with -Approved.pdf in the file name). Please use this form to distribute to participants. If you need to make changes to the informed consent form, please submit the revised form to the IRB for review and approval prior to using it.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim report or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality, or compromise in privacy related to the subject or others;

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you...
should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board. If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Becky R. Freeman
Becky R. Freeman, CIP
for the IRB
January 24, 2012

Christina Hoffman
School of Natural Resources
1392 Fuston Avenue, Apt. 4 San Francisco, CA 94122

Cody Knutson
School of Natural Resources
821 HARH, UNL, 68583-0988

IRB Number:
Project ID: 11625
Project Title: Exploring Water Resources Management as seen by Stakeholders in Nebraska

Dear Christina,

The Institutional Review Board for the Protection of Human Subjects has completed its review of the Request for Change in Protocol submitted to the IRB.

1. It has been approved to increase the number of participants from 30 to 40.

2. It has been approved to modify the questions and the project description in the interview protocol.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:

* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This letter constitutes official notification of the approval of the protocol change. You are therefore authorized to implement this change accordingly.

If you have any questions, please contact the IRB office at 471-6965.

Sincerely,
Becky R. Freeman, CIP
for the IRB
April 17, 2012

Christina Hoffman  
School of Natural Resources  
1392 Furston Avenue, Apt. 4 San Francisco, CA 94122

Mark Burcham  
School of Natural Resources  
512 HARR, UNL, 68583-0995

IRB Number: 20120412617 EX  
Project ID: 12617  
Project Title: Exploring Water Resources Management as seen by Stakeholders in Nebraska - Part Two Survey

Dear Christina:

This letter is to officially notify you of the certification of exemption of your project by the Institutional Review Board (IRB) for the Protection of Human Subjects. It is the Board's opinion that you have provided adequate safeguards for the rights and welfare of the participants in this study based on the information provided. Your proposal is in compliance with this institution's Federal Wide Assurance 00002255 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46) and has been classified as Exempt Category 2.

You are authorized to implement this study as of the Date of Exemption Determination: 04/17/2012.

1. The approved cover letters have been uploaded to NUgrant (files with -Approved.pdf in the file name). Please use these letters to distribute to participants. If you need to make changes to the letters, please submit the revised letters to the IRB for review and approval prior to using them.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which, in the opinion of the local investigator, was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you
should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Becky R. Freeman, CIP
for the IRB
May 17, 2012

Christina Hoffman
School of Natural Resources
1392 Farnsworth Avenue, Apt. 4 San Francisco, CA 94122

Mark Burbach
School of Natural Resources
512 HARH, UNL, 68583-0995

IRB Number:
Project ID: 12617
Project Title: Exploring Water Resources Management as seen by Stakeholders in Nebraska - Part Two Survey

Dear Christina:

The Institutional Review Board for the Protection of Human Subjects has completed its review of the Request for Change in Protocol submitted to the IRB.

1. The revised pre-test q-sort survey and the revised final survey have been approved.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This letter constitutes official notification of the approval of the protocol change. You are therefore authorized to implement this change accordingly.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,
Becky R. Freeman, CIP
for the IRB