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Catalyzing Change: Social Science for Water Resources Management

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Catalyzing Change: Social Science for Water Resources Management

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Managing water resources is becoming increasingly difficult as demographic, economic, institutional, technological, and climate changes manifest across the U.S. and around the world (Cosgrove and Louchs 2015). These extraordinarily complex water quality and quantity challenges facing water resource management are "wicked problems" (Gold et al. 2013). Wicked problems - those that are difficult to resolve because of complexity, uncertainty, and divergence and fragmentation in viewpoints, values, and intentions (Rittel and Webber 1973; Head 2008) - arise in numerous resource management contexts. The act of simply trying to define the problem illustrates the level of difficulty associated with resolution. For example, multiple perspectives on an issue, the level to which numerous social and natural systems are connected, and the overwhelming number of potential fixes that need to be understood to clearly define the issue make water management a wicked problem.

Historically, water problems have been regarded as requiring engineering or technological fixes. However, because most water problems are largely the result of human activity (Schultz 2011; Rockström et al. 2014), it is the social - not technical - complexity of these problems that overwhelms water management. Social factors (e.g., equity, water rights, norms, attitudes, values, beliefs, etc.) are often the primary determinants of management success or failure (Mascia et al. 2003; Floress et al. 2015). Thus, the resolution or mitigation of wicked water problems requires interdisciplinary collaboration, particularly from the social sciences, to foster new thinking, behavior, and innovative ideas for management of water resources under conditions of rapid change and uncertainty (Jury and Vaux 2005).

> *One of the anomalies of modern ecology is that it is the creation of two groups each of which seems barely aware of the existence of the other. The one studies the human community almost as if it were a separate entity, and calls its findings sociology, economics, and history. The other studies the plant and animal community, [and] comfortably relegates the hodge-podge of politics to "the liberal arts." The inevitable fusion of these two lines of thought will, perhaps, constitute the outstanding advance of the present century.* — Aldo Leopold

Despite the social complexity of water challenges, most people working in water resource management are trained in the bio-physical sciences, in turn limiting access to knowledge that could be gained from social sciences (Floress et al. 2015). Water resource professionals and the staffs of myriad water-related agencies tend to have backgrounds in engineering, hydrology, ecology, aquatic sciences, and so on. Thus, agencies and organizations may not have the necessary skills to effectively address the human dimensions of water resource management (Sexton et al. 2013). Many lack the capacity to deal with the social complexity and interdependencies of current water

resource management. "The management of water resources is currently undergoing a paradigm shift toward a more integrated and participatory management style" (Pahl-Wostl et al. 2007, p. 1) in order to address "complex interdependencies, human behavior and social institutions" (Pahl-Wostl et al. 2012, p. 25). Future water management will require new and continuous learning, new patterns of behavior, and innovative thinking (Uhl-Bien et al. 2007; Berry 2017). This requires that water resource managers develop the capacity to catalyze change and advance innovative solutions within integrated and participatory management approaches.

Since most wicked water resource problems are caused by or concern human behavior, leaders in water resource management must understand and be capable of changing behavior to solve them (Schultz 2011; Faruqi 2012). Development of essential skills to catalyze change or respond to external catalysts (e.g. Prokopy et al. 2014) is paramount. Catalyzing change begins with new knowledge and readiness to change. The ability to create and transfer new knowledge is a foundational skill to effect change in others, communities, or policy (Schultz 2002; Kaiser and Fuhrer 2003).

> *Human behavior flows from three main sources: desire, emotion, and knowledge* — Plato

However, those involved in water resource management must also be able to motivate change in others, develop the ability to assist others in sustaining the behavior change, and recognize and support the practice of the behavior change (Beer et al. 2016). They must facilitate others engagement with new concepts in the context of their own lives, critical reflection, and reinforcement for the new behavior to become enduring (Bandura 1977; Argyris and Schon 1978; Mezirow 1997).

> *For the environment after all is where we all meet; where we have a mutual interest; it is one thing that all of us share. It is not only a mirror of ourselves, but a focusing lens on what we can become* — Lady Bird Johnson

To change behaviors, we have to understand how to train leaders in social science skills and evaluating success. This special issue uses case studies to demonstrate how social science concepts, theories, and methods are used to catalyze change across a range of water resource management issues and geographic scales. Supporting water management programs with information from the social sciences provides a framework for program design, implementation, and evaluation necessary for resolving wicked problems.

Through a series of case studies predominantly from the Midwestern United States, this issue provides those involved with water management - or students learning about it - a resource useful for understanding how social science research can help them achieve desired outcomes more effectively. The case studies range from using applied gaming to expand knowledge of water issues to evaluating statewide water leadership programs, and each includes practical applications and impacts related to using specific social science approaches (Table 1). Together, the cases accentuate the need for partnerships between social scientists and practitioners.

Burbach and Reimers-Hild use leadership theory to develop catalysts of change in a comprehensive water leadership academy in Nebraska. They describe how future water leadership programs must evolve to meet the increasing challenges facing water management. They use pre- and post-program skills assessment and other program evaluation methods to demonstrate how a process-based curriculum with developmental experiences can affect behavior change in participants. This article demonstrates how the social sciences can guide the construction, conduct, and assessment of a water leaders development program.

In the following article, Bonnell et al. used interviews with watershed professionals to develop a framework of effective watershed leadership that has three categories of skills: technical, administrative, and social. The results from these interviews inform understanding of collaborative watershed management in general. More specifically these results are used to improve programming in the Ohio Watershed Leadership Academy.

Kaufman et al. demonstrate how they used a mixed methods research approach to explore and explain eco-leadership in the context of community organizations that have the potential to engage in community watershed protection efforts. They

demonstrate the value of both quantitative and qualitative strands to enrich our understanding of eco-leadership.

Moving away from leadership-related research, Bathke et al. describe the utility of applied games for public participation and expanding systems thinking regarding resource management issues. Within the context of an agricultural watershed, the authors develop, implement, and evaluate a Multi-Hazard Tournament requiring participants to collaboratively adapt to flooding, droughts, and water quality changes that stem from climate extremes. They show how the game improved participants' knowledge of issues and potential actions; knowledge of and opportunities for collaboration with other participants; and feelings of empowerment to put their new knowledge and skills to work when making decisions.

Table 1. Overview of Articles in Special Issue.

Article Authors	State	Stakeholders, program, or process studied	Theoretical or Conceptual Framework	Data Collection Methods	Data Analysis Methods
Burbach & Reimers-Hild	Nebraska	Formal water leadership program	McCauley et al. (2010) model of leadership development	Pre-/post- skills assessments; program evaluation	Statistical analysis; difference in means
Bonnell et al.	Ohio	Watershed professionals	Collaborative watershed management	Interviews	Coding, categorizing, and theme searching of interview transcripts
Kaufman et al.	Virginia	Community organizations	Eco-leadership	Surveys and focus groups	Descriptive and correlational statistics; coding of qualitative data; crossover tracks analysis
Bathke et al.	Minnesota/ Iowa	Diverse participants in serious game	Applied gaming	Pre-surveys, surveys immediately after event; surveys 3 months after event	Primarily qualitative assessment of change
Bentlage et al.	Indiana	Riparian landowners; river recreationists	Community based social marketing	Pre-/post- surveys (in-person and mail); stakeholder input session	Statistical analysis; difference in means
Church et al.	Indiana	Collaborative watershed management project	Formative, process and summative evaluation	Pre-/post- surveys; interviews; participant observation	Statistical analysis: difference in means; qualitative coding
Floress et al.	Wisconsin	Lake and water management policies; policy networks	Community capacity; good governance	Semi-structured interviews; policy documents; web survey	Policy content analysis; thematic interview coding

Bentlage et al. describe how they developed a community-based social marketing campaign to influence the awareness, attitudes, and behaviors of riparian landowners and recreational users of a river in northwestern Indiana. Focusing on the role of freshwater mussels and their dependence on clean water, this social marketing campaign was informed by in-person and mail baseline surveys and a stakeholder input session. At the completion of the campaign, surveys were again used to evaluate overall success. This article illustrates how social science data can be used both before and after an outreach campaign.

A comprehensive evaluation of a collaborative watershed management process in North Central Indiana is presented by Church et al. Ongoing efforts to encourage farmers to adopt conservation practices in the predominantly agricultural Beargrass Watershed were enhanced in 2014 with an infusion of monetary and technical support to the local Soil and Water Conservation District. They discuss how surveys and interviews conducted at the beginning of this process helped to inform the subsequent messaging of practices to farmers and how participant observation during the outreach stage of the project was used to continue to refine messaging. Finally, they discuss how end-of-project surveys and interviews were used to evaluate the effectiveness of the watershed process.

Floress et al. describe an investigation of good water governance principles to support managing Lake Wausau, an impounded lake on the Wisconsin River. Intended to support the work of local leaders and resource management professionals, they used policy content analysis, semi-structured interviews, and a web-based survey to assess the extent to which the system of governance was transparent, effective, equitable, accountable, and appropriately scaled. They discuss barriers to and opportunities for a more effective system of governance, along with suggestions for projects considering similar endeavors.

Complex water resource management requires interdisciplinary collaboration. Those involved in water resource management are increasingly called upon to incorporate social science theories, concepts, and methods into their practice to solve wicked water problems involving human behaviors and institutions. It is our hope that the cases in this special issue highlight some of the ways in which social science has contributed to more effective water programs.

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References

Argyris, C. and D. Schon. 1978. *Organizational Learning: A Theory of Action Perspective*. Addison-Wesley, London, U.K.

Bandura, A. 1977. *Social Learning Theory*. Prentice Hall, Englewood Cliffs, NJ.

Beer, M., M. Finnström, and D. Schrader. 2016. Why leadership training fails—and what to do about it. *Harvard Business Review* 94(10): 50-57.

Berry, D. 2017. Encouraging local environmental innovation. *Solutions* 8(2): Article 3.

Cosgrove, W.J. and D.P. Loucks. 2015. Water management: Current and future challenges and research directions. *Water Resources Research* 51: 4823-4839.

Faruqi, M. 2012. Embracing complexity to enable change. In: *Environmental Leadership: A Reference Handbook*, Vol. 2, D. Rigling Gallagher, N. Christiansen, and P. Andrews (Eds.). Sage, Thousand Oaks, CA.

Floress, K., K. Akamani, K.E. Halvorsen, A.T. Kozich, and M. Davenport. 2015. The role of social science in successfully implementing watershed management strategies. *Journal of Contemporary Water Research and Education* 154: 85-105.

Gold, A., D. Parker, R. Waskom, J. Dobrowolski, M. O'Neill, P. Groffman, et al. 2013. Advancing water resource management in agricultural, rural, and urbanizing watersheds. Why land-grant universities matter. *Journal of Soil and Water Conservation* 68(4): 337-348.

Jury, W.A. and H. Vaux. 2005. The role of science in solving the world's emerging water problems. *Proceedings of the National Academy of Sciences* 102: 15715-15720.

Head, B.W. 2008. Wicked problems in public policy. *Public Policy* 3: 101-118.

Kaiser, F. and U. Fuhrer. 2003. Ecological behavior's dependency on different forms of knowledge. *Applied Psychology: An International Review* 52: 598-613.

Mascia, M.B., J.P. Brosius, T.A. Dobson, B.C. Forbes, L. Horowitz, M.A. McKean, and N.J. Turner. 2003. Conservation and the social sciences. *Conservation Biology* 17(3): 649-650.

Mezirow, J. 1997. Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education* 74: 5-12.

Pahl-Wostl, C., L. Lebel, C. Knieper, and E. Nikitina. 2012. From applying panaceas to mastering complexity: Towards adaptive governance in river basins. *Environmental Science and Policy* 23: 24-34.

Pahl-Wostl, C., J. Sendzimir, P. Jeffrey, J. Aerts, G. Berkamp, and K. Cross. 2007. Managing change toward adaptive water management through social learning. *Ecology & Society* 12(2): 30.

Prokopy, L.S., N. Mullendore, K. Brasier, and K. Floress. 2014. A typology of catalyst events for collaborative watershed management in the United States. *Society and Natural Resources* 27(11): 1177-1191.

Rittel, H.W. and M.M. Webber. 1973. Dilemmas in a general theory of planning. *Policy Sciences* 4(2): 155-169.

Rockström, J., M. Falkenmark, T. Allan, C. Folke, L. Gordon, A. Jägerskog, et al. 2014. The unfolding water drama in the anthropocene: Towards a resilience-based perspective on water for global sustainability. *Ecohydrology* 7: 1249-1261.

Schultz, P.W. 2002. Knowledge, education, and household recycling: Examining the knowledge-deficit model of behavior change. In: *Education, Information, and Voluntary Measures in Environmental Protection*, T. Dietz and P. Stern (Eds.). National Academy of Sciences, Washington, D.C.

Schultz, P.W. 2011. Conservation means behavior. *Conservation Biology* 25: 1080-1083.

Sexton, N.R., K.M. Leong, B.F. Milley, M.M. Clarke, T.L. Teel, M.A. Chase, and A.M. Dietsch. 2013. The state of human dimensions capacity for natural resource management: Needs, knowledge, and resources. *The George Wright Forum* 30(2): 142-153.

Uhl-Bien, M., R. Marion, and B. McKelvey. 2007. Complexity leadership theory: Shifting leadership from the industrial age to the knowledge era. *Leadership Quarterly* 18: 298-318.

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Developing Water Leaders as Catalysts for Change: The Nebraska Water Leaders Academy

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Abstract: Managing water resources is increasingly complex and dynamic. Sustaining freshwater ecosystem services in the face of increasing challenges and emerging threats is a supreme leadership challenge. Leadership development program designers should look to social science theories and methods to prepare leaders to catalyze the change necessary to meet future challenges. This paper provides evidence that a new generation of water leaders is needed; and correspondingly, there is a need for new leadership development programs. The Nebraska Water Leaders Academy and its evaluation is presented as a case study of a successful program training leaders in social science-based skills in order to produce catalysts of change. The Academy is theoretically grounded in transformational leadership, champions of innovation, civic capacity, and entrepreneurial leadership. The Academy employs a process-based curriculum with developmental experiences that includes key components of assessment, challenge, and support. Formative assessment provides constructive feedback from participants and guides the development of future sessions and curriculum. Summative assessment is used to gauge participants' leadership knowledge, skills, and behaviors, and evaluate the instructional methods used in the Academy. Results of pre- and post-Academy assessments of participants from both the participants' and raters' perspectives indicate statistically significant increases in transformational leadership behaviors, champion of innovation behaviors, civic capacity, entrepreneurial leadership behavior, awareness of Nebraska water issues, and engagement with Nebraska water issues.

Keywords: *water management, leadership development, process-based curriculum, assessment, catalysts of change*

Managing water resources is extremely challenging. Considerations include resource variability, changeable weather patterns, and technological advances, as well as evolving socioeconomic, policy, and regulatory factors. Unprecedented additional challenges, however, are emerging from the processes of climate change, increasing weather variability, accelerating demand for freshwater, aging infrastructure, fiscal constraints, environmental degradation, and declining water tables and stream flows (Pittock et al. 2008; Pahl-Wostl et al. 2013; Cosgrove and Loucks 2015). Problems posed to water managers are complex, non-linear, full of uncertainty, and open-ended (e.g., Tosey and Robinson 2002; Higgs and Rowland 2005; Gilley et al. 2009; Faruqi 2012). Sustaining freshwater ecosystem services in the face of these emerging threats is widely recognized as a supreme leadership challenge facing society (Millenium Ecosystem Assessment 2005; Rockström et al. 2009; Pittock et al. 2013).

This paper demonstrates how social science theories and methods are used to train leaders to catalyze change and provides an example of evaluating success. First, the case is made for a new generation of water leaders. Evidence presented shows that new leaders with a dynamic skill set are needed to meet future water management challenges. Correspondingly, the demand for

novel and evolutionary leadership development programs is presented. Foremost, the Nebraska Water Leaders Academy and its evaluation is presented as an example of a successful program training leaders in social science-based skills in order to produce catalysts of change.

Background

The Need for New Water Leaders

Emerging water management challenges demand knowledgeable and skilled leaders with abilities beyond technical expertise (Morton and Brown 2011; Lincklaen Arriëns and When de Montalvo 2013; Burbach et al. 2015). They require leaders who can guide, manage, and facilitate the changes necessary to address them. The Resilience Alliance (2010) argues that in order to increase a natural system's "resilience to disturbance and its capacity to adapt to change" resource managers must take "into account social and ecological influences at multiple scales, incorporate continuous change, and acknowledge a level of uncertainty" (p. 4). Folke et al. (2010) contend that transformational change is necessary to enable resilience in social-ecological systems, and this "transformational change often involves shifts in social network configurations, patterns of interactions among actors including leadership and political and power relations, and associated organizational and institutional arrangements" (para. 15). McIntosh and Taylor (2013) assert that "leadership is needed to initiate and drive change, enable innovation (both incremental and radical), build shared visions for a more sustainable water future, and deliver these visions through aligning resources and building commitment to collective success" (p. 46). Exceptional leadership is critical to the success of change efforts (Higgs and Rowland 2005). Thus, building leadership capacity is required to drive the necessary change to meet future water management challenges (Redekop 2010; Brasier et al. 2011; Morton et al. 2011; Pahl-Wostl et al. 2011b; Taylor et al. 2012).

Future water leaders must be catalysts of change while also preparing others to deal with continuous challenges and opportunities. Leaders will also need to catalyze change in many ways. As catalysts, they will not only need to lead incremental and transitional changes that involve merely fine-tuning the status quo but rather they will also need to lead discontinuous changes or paradigm shifts that involve redefining values, purposes, attitudes, and beliefs. These types of changes will frequently require different organizational strategies, structures, and management practices as well as cultural shifts (e.g., Burke and Litwin 1992; Cacioppe 2000; Tosey and Robinson 2002; Gilley et al. 2009). Leaders will need to create new systems and then institutionalize the new approaches in response to changing conditions (Kotter 1995). Leaders will need to help others make sense of and give meaning to events during times of great change (Weick 1995; Winch and Maytorena 2009; Combe and Carrington 2015) by organizing and turning circumstances into understandable frameworks that provide springboards for action (Weick et al. 2005).

Entrepreneurial individuals are needed to keep up with societal changes and globalization that continues to evolve at an increasingly rapid pace (O'Connor and Fiol 2002; Neuborne 2003), and foster a global mindset in organizations and communities by supporting innovation, change, and risk-taking while also valuing social responsibility (Reimers-Hild and King 2009). Future water leaders will also need to be good problem solvers if they are going to be catalysts of change (Gordon and Berry 2006; Heifetz et al. 2009); and manage not only conflict that has always been a part of water management, but also conflict that arises in a fashion and form not seen before as a consequence of increasingly diverse societies (Day 2000; Day and Halpin 2004; Benn et al. 2006; Dunphy et al. 2007; Taylor 2009; Pahl-Wostl et al. 2011a). Indeed, future water leaders must navigate more holistic, multidisciplinary, and participatory approaches to water management and governance (UNDESA 2014; Singh et al. 2019).

The Need for New Water-related Leadership Development Programs

Water-related leadership development programs are needed that prepare participants to be catalysts of change and to lead others through change (Burbach et al. 2015; Pradhananga et al. 2019). Traditional models of leadership development may be inadequate to develop catalysts of change

(Rost 1993; Allen et al. 2006). Many leadership development models are based on executive and management "command and control" models (Dietz and Stern 2002) in which leaders work toward specific goals, arbitrate among competing interests, enhance leader-follower competency, or develop competitive advantage (Berry and Gordon 1993; McCallum and O'Connell 2008; Mabey 2013). According to Faruqi (2012), traditional environmental leadership frameworks reflect a "mechanistic view of nature-human relations" (p. 776) where "human and natural systems are viewed as separate from each other" (p. 777) and "leaders are viewed as controllers who are expected to direct followers toward prescribed and often predetermined future states through a planned and efficient change management process" (p 776).

Historically, the foundation of most environment-related leadership development programs is the knowledge or information deficit model (Bak 2001; Sturgis and Allum 2004). This model is based on the premise that increasing participant environmental and leadership knowledge will cause behavior change and development of new abilities and skills. Knowledge forms the foundation upon which leadership development programs influence change; and knowledge is necessary for environmental and leadership behavior change (Kollmus and Agyeman 2002; Schultz 2002; Kaiser and Fuhrer 2003; Monroe 2003). Moreover, different forms of environmental knowledge must be considered in order to effect pro-environmental behavior change (Kaiser and Fuhrer 2003; Diaz-Siefer et al. 2015). Likewise, knowledge is necessary for developing the ability to effect change in others, communities, or policy (Gordon and Berry 2006). However, research has shown that, while knowledge is often correlated to behavior, increasing knowledge alone does not typically result in lasting behavior change (Barling et al. 1996; Schultz 2002; Abrahamse et al. 2005; Steg and Vlek 2009; Yukl 2013). It is generally not enough to know what to do. One must also be motivated to change, have the ability and skill to sustain the behavior change, and practice (Beer et al. 2016). People need active engagement with the concepts in the context of their own lives, critical reflection, and reinforcement to 'set' the new behavior (Bandura 1977; Argyris and Schon 1978; Mezirow 1997; Beer et al. 2016).

Likewise, developing effective leaders with the ability to catalyze change and influence others requires building a set of competencies more than a body of knowledge alone (Boyatzis 1982; Bandura 1986; Arthur et al. 2003). Knowledge-only programs often result in small, short-term change or minimal ability to influence others (Feser et al. 2017). Often, leadership development requires more than knowledge to change values, beliefs, and attitudes (Roberts 2008). Changing values, beliefs, and attitudes requires a long-term perspective and reinforcement that accounts for social and cultural influences (e.g., Lewin 1947; McKenzie-Mohr 2000; Clayton and Opotow 2003; Dietz et al. 2005).

Water-related leadership development programs may also be short, one-time workshops where participants learn about environmental issues and leadership skills; and participants may even be motivated to implement change (DeVenney 2009; Petrie 2013). If a program is long-term, participants may meet at a series of stand-alone workshops where environmental and/or leadership information is shared. In more advanced cases, earlier knowledge may be built upon. However, in none of these cases would they get "the ongoing follow-up to solidify new thinking and behaviors into new habits" (Petrie 2013, p. 4).

Leadership Development as a Process

Leadership development programs founded on a process-based curriculum with a systematic approach that consider the unique contextual needs of the individual are much more likely to cause lasting change in behavior or leadership abilities (e.g., Brown and Posner 2001; Byrne and Rees 2006; Whitney and D'Andrea 2007; Ritch and Mengel 2009; McCauley et al. 2010; Day et al. 2014). Leadership development requires a variety of developmental experiences, as well as the ability and opportunity to learn from those experiences (Newman et al. 2007; Popper and Mayseless 2007; Ely et al. 2010; McCauley et al. 2010). And as mentioned earlier, active engagement with leadership concepts and water issues in the context of participants' own lives, critical reflection, and reinforcement is necessary to set the new behaviors. The leader development process will

most likely succeed in instances where individuals have solid developmental experiences that provide robust opportunities to learn (Hughes et al. 2012). First-hand experiences that activate emotional circuits in the brain result in improved learning and retention of that learning as changed behavior (Brown and Brown 2012; Waller et al. 2014). In a meta-analysis of creativity training programs, Scott et al. (2004) found that well-designed programs typically induce gains in performance; moreover, more successful programs were likely to focus on development of cognitive skills and the heuristics involved in skill application, and use realistic exercises appropriate for the context.

As a process, developing leaders takes time and practice to cultivate new knowledge, skills, abilities, and lasting behavior change (McCauley et al. 2010; Day et al. 2014; Beer et al. 2016). Maxwell (1998) states, "leadership develops daily, not in a day" (p. 21). According to Maxwell, the process entails learning, application, and adjustment. Day and colleagues (Day et al. 2014; Day and Dragoni 2015) promote experiences, interventions, and interactions as part of the development process. McCauley et al. (2010) state that leadership development involves developmental experiences that include three key components: assessment, challenge, and support (Figure 1). Taylor and McIntosh (2012) and Addor et al. (2005) demonstrate how a process-based water leadership development program incorporates assessment, challenge, and support to create agents of change.

It is not safe to assume that current water-related leadership development programs are designed to produce the catalysts of change necessary to address emerging water management challenges. Burbach et al. (2015), for instance, reviewed 30 water-related leadership development programs and found only four that used curriculum grounded in evidence-based theory and that used a variety of developmental experiences incorporating assessment, challenge, and support.

The Nebraska Water Leaders Academy

The Nebraska Water Leaders Academy (from here on referred to as the Academy) has operated since 2011. The Academy employs a process-based curriculum with developmental experiences and opportunities to learn from the experiences following the McCauley et al. (2010) model to develop Nebraska's future water leaders, cause lasting change in their leadership abilities, and provide them the skills and abilities to influence change in others.

The objectives of the Academy are:

- Develop scientific, social, and political knowledge about water and related natural resources.
- Provide training materials, professional presentations, and experiential learning activities that instill sound and accurate information about efficient, economic, and beneficial uses of Nebraska's water resources.
- Develop and enhance critical thinking and leadership skills through process-based educational activities.
- Encourage and assist participants toward active involvement in water policy issues at all levels.

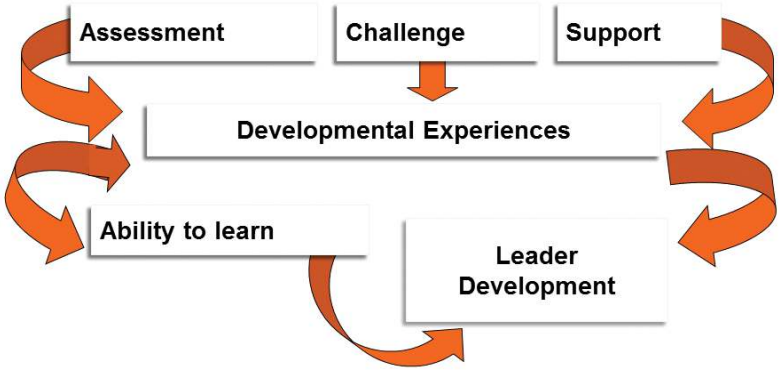

Figure 1. The McCauley et al. (2010) model of leadership development.

- Integrate multi-disciplinary educational and leadership programs to provide life-long leaders in water resources management.
- Challenge traditional paradigms about water resources and facilitate creative solutions to water-resources issues.

The Nebraska State Irrigation Association and its Executive Director, Lee Orton, created the Academy and established the nonprofit Water Futures Partnership-Nebraska to support Academy funding. The Academy is a year-long program consisting of six two-day sessions. There are three curricular components of the Academy: leadership, policy/law, and natural resources. Dr. Mark Burbach and Dr. Connie Reimers-Hild developed the leadership component of the Academy with contributions from qualified faculty and staff at the University of Nebraska-Lincoln (UNL). The water policy/law and natural resource curriculum are addressed by leading experts in their respective fields from UNL; federal, state, and local agencies; non-government organizations; and other associations. Early to mid-career professionals from diverse fields with a desire to impact change are the target audience. As of January 2019, a total of 120 participants in eight classes (i.e., cohorts) from across Nebraska with a wide range of professional, geographic, and water resources backgrounds have completed the Academy.

Formal assessment is accomplished through pre- and post-Academy assessments of participants' knowledge, skills, and abilities associated with the foundational leadership theories – transformational leadership, champions of innovation, civic capacity, and entrepreneurial leadership – as well as their awareness of and engagement in water issues in Nebraska. The pre- and post-assessments ask participants and others to rate participants on their leadership knowledge, abilities, and skills. Reliable and validated instruments are used in the pre- and post-assessments. Assessment is also conducted as part of each Academy session's evaluation process. Participants are asked to gauge the change in their knowledge and skills on leadership topics from before and after each session. At the conclusion of each session, participants are also asked open-ended questions about their experience with the material covered.

Challenge comes in the form of discussions in which participants are asked to respectfully challenge material covered by instructors; and in return, instructors challenge participants' paradigms. Participants are also asked to respectfully challenge each other's reasoning. Role play, scenarios, and games are used to challenge participants' assumptions or put themselves in another's shoes. Participants also have homework assignments and work on a team project.

Support starts with providing a safe and secure learning environment in which participants feel free to speak and share ideas (Beer et al. 2016). When it comes to sharing personal thoughts and opinions, the Academy follows the philosophy of "what happens in the Academy stays in the Academy." Feedback from assessments is provided to participants, but only cumulative results are shared. Participants listen to each other's stories of struggles and conflicts with water-related issues. They are encouraged to share strategies for coping. Accomplishments are celebrated. Participants develop professional and personal relationships with each other and Academy personnel. Furthermore, participants broaden their professional networks by connecting with presenters and others associated with the Academy. News and information are shared through newsletters, Facebook, and other media.

In addition to the developmental experiences through assessment, challenge, and support, the Academy provides field trips to learn first-hand about water issues across Nebraska and to make leadership challenges more tangible. The field trips have specific learning objectives and time is provided for participants to reflect and share what they learned. Teams are expected to identify and design a project over the course of the year-long Academy and present their final project to the Academy at the last session. Team construction is intentionally diverse based on a personality assessment, gender, age, profession/background, and region of the state represented.

Enhancing the ability to learn comes through participants recognizing they need new behaviors, skills, or abilities to lead the change necessary to address the emerging challenges of water management. Enhancing the ability to learn also comes through the participants sharing their

expectations of the Academy. The Academy asks participants to reflect upon their current strengths and weaknesses and their own learning process. The Academy also shares expectations with participants. Expectations include completing pre- and post-assessments; accepting responsibility for their own development; actively engaging with presenters, organizers, and each other; respecting one another's prior experiences and viewpoints; taking advantage of the opportunities offered; completing session evaluations; and completing homework. The Academy shares with participants the program curriculum prior to the first session, as well as agendas and other curricular information before each session.

Theoretical Foundation of the Nebraska Water Leaders Academy Curriculum

While the Academy follows the McCauley et al. (2010) model of leadership development to meet its curricular objectives, the subjects that comprise its curriculum are transformational leadership, champions of innovation, civic capacity, and entrepreneurial leadership. Transformational leadership theory suggests leaders can influence others to achieve change in any organization, at any level (Burns 1978; Bass 1990). Transformational leaders encourage and facilitate innovation, creativity, critical examination, and adaptive change (Moynihan et al. 2014). According to Bass and Avolio (1985, 1990), transformational leaders: 1) have high standards of moral, ethical, and personal conduct as well as gain respect, trust, and confidence from others; 2) increase optimism and enthusiasm and provide a strong vision for the future; 3) challenge norms, encourage a new look at old methods/problems, foster creative thinking, and stress re-examination of assumptions underlying problems; and 4) diagnose the needs and capabilities of others, delegate and coach, and attend to the personal development of others.

The Academy is also based on Howell et al. (2005) champions of innovation model. Champions of water management innovation are change agents promoting a philosophy of sustainable water management (Taylor 2009). Champions play a critical role in driving environmental change at multiple levels; from the project level through organizations and broader institutions (Olsson et al. 2006; Penning-Rowsell et al. 2006; Brouwer and Biermann 2011). Champions have a strong personal commitment to the environmental change they promote (Schon 1963; Markham et al. 1991). Effective champions convey confidence and enthusiasm about the innovation, enlist the support and involvement of key stakeholders, and persist in the face of adversity (Howell 2005).

Sun and Anderson's (2012) civic capacity model is another grounding framework for the Academy. Civic capacity is "the combination of interest and motivation to be engaged in public service and the ability to foster collaborations through the use of one's social connections and through the pragmatic use of processes and structures" (Sun and Anderson 2012, p. 317). Water leaders have a keen interest and motivation for civic engagement and the ability to successfully guide multi-sector collaborations (Crosby and Bryson 2010; Morse 2010; Silvia and McGuire 2010) and develop collaborative partnerships (Margerum and Robinson 2015). In order for the change that leaders initiate to be successful, the outcome must be socially acceptable in addition to bio-physically possible and economically feasible (Allan et al. 2008).

The Academy curriculum is also grounded in Renko et al.'s (2015) entrepreneurial leadership concept. An entrepreneurial individual is an innovative person who is open to change and recognizes and pursues opportunities irrespective of existing resources, such as time, money, personal support, and/or technology. Entrepreneurs are characterized as innovative people that convert problems into opportunities and whose ideas inspire others while serving as catalysts of change (Drucker 1985). Entrepreneurial individuals, who may or may not start a business, are critical to the success of communities and organizations, because they are innovators who proactively move ideas forward. In addition, it takes entrepreneurial leadership to foster a culture of sustainable innovation characterized by entrepreneurial actions and behaviors (Reimers-Hild and King 2009). Entrepreneurial leaders are noted for their ability to develop a compelling vision, recognize opportunities where others do not, operate in a highly unpredictable atmosphere, influence others (both followers and a larger constituency), absorb

uncertainty and risk, build commitment, and overcome barriers (Renko et al. 2015).

The Academy also introduces participants to the Meyers-Briggs model of personality type (Jung 1971; Myers and Myers 1995), conflict management (Delli Priscoli and Wolf 2009), work motivation (Leonard et al. 1999), and adaptive management (Holling 1978; Walters 1986). These elements of the Academy contribute to increased self-awareness and self-efficacy (Hannah et al. 2008; Day et al. 2009; Ashley and Reiter-Palmon 2012), and current best practices in resource management; however, these facets of leadership are not assessed by the Academy.

Program Evaluation

Program evaluation is an essential component of the Academy because it assesses the development of participants' leadership knowledge, skills, and abilities; evaluates the instructional methods used in the Academy; provides constructive feedback from participants; and guides the development of future sessions and curriculum (Ely et al. 2010; Day et al. 2014). The evaluation is both summative (i.e., assessing the outcomes of the program) and formative (i.e., improving program development and implementation) in order to empirically advance leadership practices. The evaluation process consists of individual session evaluations and an empirical analysis using a pre- and post-Academy leadership assessment (Figure 2). While the session evaluations and participant feedback are briefly discussed below, the primary component of the evaluation is the pre- and post-Academy assessment that is described in detail below.

The session evaluations gauge participants' change in knowledge levels related to leadership, water policy/law, and natural resource issues covered in each session. Participants also provide subjective feedback concerning the major knowledge they gained from the session, a summary of the session experience, and other important takeaways they want to share with the Academy planners. The session evaluations include a post-session quiz in the form of a word game to gauge participants' knowledge of material covered in the session. Post-field trip guided discussions are linked to field trip learning objectives. Evaluations are used by session planners to modify and adjust future sessions, particularly with regard to topics and presenters. Likewise, feedback from participants is used to evaluate participant needs, and may result in adjustments to future sessions. Periodically, alumni are surveyed on a variety of topics related to performance and future directions of the Academy.

The empirical analysis is conducted to measure the participants' change in leadership knowledge, skills, abilities, and behaviors from the beginning to the end of the Academy. This evaluation component provides a gauge of the cumulative effect of the Academy on participants and the overall effectiveness of the Academy curriculum. The objective is to explore research-based leadership knowledge, skills, and abilities associated with increasing leadership capacity. Participants' change in awareness of, and engagement with, water issues in Nebraska is also assessed. This analysis is on-going. The latest pre- and post-Academy assessment is further described below.

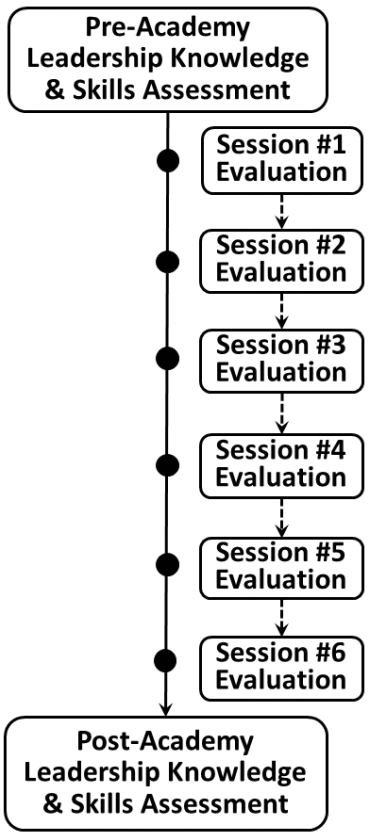

Figure 2. Flow chart of the Nebraska Water Leaders Academy program evaluation.

Assessment of the Nebraska Water Leaders Academy

Objective one of the pre- and post-Academy assessment was to determine any significant change in participants' leadership behaviors after the Academy from participants' perspectives. A series of paired-samples *t*-tests were conducted to compare the cumulative Academy participants' pre- and post-Academy leadership behaviors. A paired-samples *t*-test is used to compare two population means where you have two samples in which observations in one sample can be paired with observations in the other sample (i.e., Academy participants before and after).

One hundred eighteen of the 120 total Academy participants have completed the pre- and post-Academy assessment of transformational leadership abilities, champion of innovation behaviors, civic capacity, entrepreneurial leadership, and Nebraska water issues awareness and engagement. Twenty-six females and 92 males have completed the pre- and post-assessment (27 females and 93 males have completed the Academy). The participants' average age was 38.4 with a range of 21 to 61. Civic Capacity was assessed for the first time in 2016; thus, 54 Academy participants (42 males, 12 females) have completed the pre- and post-Academy assessment of civic capacity.

Objective two of the pre- and post-Academy assessment was to determine any significant change in participants' leadership behaviors after the Academy from raters' perspectives. A series of independent samples *t*-tests were conducted to compare the cumulative Academy participants' pre- and post-Academy leadership behaviors from raters' perspectives. An independent samples *t*-test is used to determine statistically significant difference between the means in two unrelated groups (i.e. anonymous raters before and after). Two hundred sixty-one raters have completed pre-Academy assessments and 244 raters have completed post-Academy assessments.

Procedures. A research-based questionnaire composed of previously validated items was employed to assess changes in leadership behaviors among participants over the course of the Academy. The survey is administered online using Qualtrics™ software with the assistance of a trained graduate assistant from the UNL. The UNL Institutional Review Board (IRB) approved the research prior to beginning the study. The IRB continues to review and approve the research protocol on an annual basis.

Academy participants were notified of the online questionnaire three weeks prior to the first Academy session in January and given instructions on completing the questionnaire. The process is repeated three weeks prior to the final session in November (objective one). Participants were also asked to invite others with whom they have a professional relationship to rate their leadership behaviors (objective two). Participants send raters an e-mail invitation that includes the link to the online questionnaire. The only modification to the questionnaire was that the items were written from an observer's perspective. All IRB protocols are followed to ensure anonymity of participants and raters.

Measures. The online questionnaire consisted of four research-based leadership assessments. The first assessment consisted of 36 items from the Multi-factor Leadership Questionnaire (MLQ-5, Bass and Avolio 1995) intended to evaluate transformational leadership styles - *Idealized Influence*, *Inspirational Motivation, Intellectual Stimulation, Individualized Consideration.*

The second assessment is a modified Champions of Innovation scale developed by Howell et al. (2005). It is a 14-item, five-point Likert-type scale that measures characteristics of champions of innovation. The scale was modified by eliminating one or two items from each of the three subscales for a total of 10 items. The constructs' three subscales are: *enthusiasm and confidence in what innovation can do*, *persisting under adversity*, and *getting the right people involved*.

A third assessment measures characteristics of civic capacity. The civic capacity scale was developed by Cramer (2015). Nine items of the five-point Likert-type scale were used. Civic capacity is "the combination of interest and motivation to be engaged in public service and the ability to foster collaborations through the use of one's social connections and through the pragmatic use of processes and structures" (Sun and Anderson 2012, p. 317). Civic capacity is

composed of the following subscales - *Civic Drive, Civic Connections*, and *Civic Pragmatism*.

A fourth assessment measures participants' tendencies for entrepreneurial leadership. Five items are used to measure entrepreneurial leadership following the Renko et al. (2015) conceptualization.

The questionnaire also includes items to measure participants' knowledge and behavior related to Nebraska water issues. The knowledge and behavior scale is an eight-item, five-point Likert-type scale that measures *awareness* of water issues in Nebraska and *engagement* in water issues in Nebraska. An example of awareness is: "I am aware of the major water issues confronting Nebraska." An example item for engagement is: "I am actively engaged in Nebraska water policy issues."

The internal reliability (Cronbach's alpha) for all the scales ranged from 0.70 to 0.95. Nunnally and Bernstein (1994) concluded that acceptable minimum reliability for measurement scales should be 0.70; and the measures meet this standard.

Results

Participants' Perspective (Objective One)

There has been a statistically significant increase in the participants' total transformational leadership behaviors from pre- to post-Academy from the participants' perspective (Table 1). Additionally, all four transformational leadership behaviors from pre- to post-Academy showed a significant increase. There has also been a significant increase in participants' total innovation behaviors from pre- to post-Academy, as well as all three champions of innovation behaviors from pre- to post-Academy. Participants' awareness of, and engagement in, Nebraska policy water issues has increased significantly from pre- to post-Academy (Table 1). There has been a significant increase in entrepreneurial leadership in participants from pre- to post-Academy.

Civic Capacity was assessed for the first time in 2016. Thus, cumulative results for civic capacity represent three Academy classes. There was a significant increase in participants' civic capacity from pre- to post-Academy (Table 1). The past three classes of Academy participants have also demonstrated a significant increase in all three dimensions of civic capacity from pre- to post-Academy.

Raters' Perspective (Objective Two)

There has been a statistically significant increase in participants' total transformational leadership behaviors as well as all four subscales of transformational leadership behavior from pre- to post-Academy from the raters' perspective (Table 2). Participants' total champion of innovation behaviors has increased significantly from pre- to post-Academy from the raters' perspective, as well as all three champion of innovation dimensions.

Academy participants' awareness of, and engagement in, Nebraska water policy issues has increased significantly from pre- to post-Academy from the raters' perspective (Table 2). There has also been a significant increase in Academy participants' entrepreneurial leadership from pre- to post-Academy from the raters' perspective.

Additionally, a significant increase was revealed in the past three classes of Academy participants' civic capacity from pre- to post-Academy from the raters' perspective (Table 2). These three classes of Academy participants have also demonstrated a significant increase in all three dimensions of civic capacity from pre- to post-Academy.

The Leadership Experience of Academy Alumni

The Academy also conducts formal interviews of alumni to gauge their involvement in water policy issues. There is substantial evidence from post-Academy interviews that alumni are becoming engaged as water leaders impacting water-related issues at the local, state, regional, and national levels. Several alumni have been elected to Natural Resources Districts boards of directors, the primary groundwater management and regulatory agency in Nebraska. Other examples of leadership include alumni serving as a Special Advisor to the Secretary of the U.S. Department of Agriculture, two Nebraska Natural Resource Commissioners, a Nebraska Environmental Trust board member, a city council member, a coordinator for a state senator, and several foundation board members.

Others are now active in local water basin boards, planning boards, religious boards, community organizations, and service clubs. All alumni interviewed and those updating their

alumni profile with the Academy have advanced within their jobs, crediting the Academy for giving them the skills, confidence, and experience needed to advance. Many alumni volunteer in local and community organizations, schools, and religious groups. One Academy alumnus is working on a team designing and facilitating transboundary water cooperation between Afghanistan, Tajikistan, and Pakistan with funding from the U.S. Institute of Peace. One Academy alumnus, a groundwater management engineer, teaches a course at the University of Nebraska-Omaha on geography and water resources using knowledge and experience gained from his participation in the Academy. Finally, one Academy alumnus is preparing to run for the state legislature in the next election.

Discussion

Unprecedented water management challenges require new leaders with skills based in the social sciences, in addition to technical skills; and new or modified leadership development programs are needed to master these skills. The Nebraska Water Leaders Academy provides a case study of a leadership development program grounded in social science theories and methods to prepare leaders to catalyze change. The Academy also provides an example of how to evaluate a leadership development program. The Academy is successfully building the leadership capacity of future water leaders by enabling them to drive the change necessary to address emerging water management challenges. Results of the empirical analysis

Table 1. Results of paired samples *t*-tests comparing cumulative participants' transformational leadership behavior before and after the Academy (N = 118).

	Pre-Academy		Post-Academy						
	M	**SD**	**M**	**SD**	**Diff.**	**t**	**df**	**Sig.**	**Cohen's d**
Transform. Leadership	2.75	0.46	3.06	0.38	0.31	10.97	117	0.000*	0.73
Idealized Influence	2.69	0.49	3.00	0.41	0.31	8.68	117	0.000*	0.69
Inspirational Motivation	2.74	0.60	3.07	0.51	0.33	8.40	117	0.000*	0.59
Intellectual Stimulation	2.74	0.59	3.10	0.50	0.36	9.59	117	0.000*	0.66
Individual Consideration	2.84	0.54	3.10	0.39	0.26	6.77	117	0.000*	0.55
Champion of Innovation	3.01	0.49	3.29	0.39	0.28	9.29	117	0.000*	0.63
Enthusiasm and Confidence in Innovation	2.95	0.65	3.25	0.50	0.30	7.15	117	0.000*	0.52
Persistence under Adversity	2.97	0.55	3.24	0.46	0.27	6.92	117	0.000*	0.53
Get Right People Involved	3.10	0.59	3.37	0.51	0.27	7.28	117	0.000*	0.49
Water Issue Awareness	2.84	0.74	3.46	0.50	0.62	9.88	117	0.000*	0.98
Water Issue Engagement	2.59	0.86	3.14	0.66	0.55	8.94	117	0.000*	0.72
*Civic Capacity***	2.39	0.73	2.88	0.56	0.49	7.59	53	0.000*	0.75
Drive	2.48	0.89	2.86	0.72	0.38	5.26	53	0.000*	0.47
Connections	2.51	0.80	3.11	0.58	0.60	7.58	53	0.000*	0.86
Pragmatism	2.17	0.83	2.66	0.69	0.49	5.80	53	0.000*	0.64
Entrepreneurial Leadership	2.68	0.72	3.02	0.60	0.34	7.32	117	0.000*	0.51

* $p < 0.001$; ** N = 54

Table 2. Results of independent samples *t*-tests comparing cumulative raters' perspectives of participants' transformational leadership behaviors before and after the Academy.

	N	M	SD	t	df	Sig.	Cohen's d
Transform. Leadership – Pre-Academy	312	3.01	0.52	6.75	587	0.000*	0.57
Transform. Leadership – Post-Academy	277	3.29	0.44				
Idealized Influence – Pre-Academy	312	3.03	0.55	6.31	587	0.000*	0.52
Idealized Influence – Post-Academy	277	3.29	0.44				
Inspirational Motivation – Pre-Academy	312	3.07	0.59	5.39	587	0.000*	0.44
Inspirational Motivation – Post-Academy	277	3.31	0.49				
Intellectual Stimulation – Pre-Academy	312	2.96	0.59	6.54	587	0.000*	0.55
Intellectual Stimulation – Post-Academy	277	3.26	0.50				
Individual Consideration – Pre-Academy	312	2.99	0.61	5.41	587	0.000*	0.44
Individual Consideration – Post-Academy	277	3.22	0.52				
Champion of Innovation – Pre-Academy	311	3.20	0.48	7.50	586	0.000*	0.61
Champion of Innovation – Post-Academy	277	3.48	0.43				
Enthusiasm & Confidence – Pre-Academy	311	3.10	0.62	5.77	586	0.000*	0.47
Enthusiasm & Confidence – Post-Academy	277	3.37	0.53				
Persistence – Pre-Academy	311	3.24	0.51	6.28	586	0.000*	0.51
Persistence – Post-Academy	277	3.50	0.50				
Right People Involved – Pre-Academy	311	3.27	0.51	7.87	586	0.000*	0.66
Right People Involved – Post-Academy	277	3.58	0.43				
Water Issue Awareness – Pre-Academy	312	3.26	0.62	6.98	587	0.000*	0.57
Water Issue Awareness – Post-Academy	277	3.58	0.49				
Water Issue Engagement – Pre-Academy	312	3.05	0.75	7.05	587	0.000*	0.57
Water Issue Engagement – Post-Academy	277	3.44	0.60				
Civic Capacity – Pre-Academy	157	3.02	0.60	5.13	291	0.000*	0.62
Civic Capacity – Post-Academy	136	3.38	0.57				
Drive – Pre-Academy	157	3.02	0.66	4.40	291	0.000*	0.54
Drive – Post-Academy	136	3.37	0.63				
Connections – Pre-Academy	157	3.02	0.64	5.41	291	0.000*	0.64
Connections – Post-Academy	136	3.41	0.58				
Pragmatism – Pre-Academy	157	3.01	0.62	4.72	291	0.000*	0.58
Pragmatism – Post-Academy	136	3.35	0.58				
Entrepreneurial Leadership – Pre-Academy	261	3.12	0.60	4.43	503	0.000*	0.39
Entrepreneurial Leadership – Post-Academy	244	3.36	0.62				

* $p < 0.001$

of the Academy from participants' and raters' perspectives demonstrate a statistically significant increase in Academy participants' transformational leadership behaviors, champion of innovation behaviors, civic capacity, entrepreneurial leadership behavior, awareness of Nebraska water issues, and engagement with Nebraska water issues. Feedback from alumni demonstrates that they are positioning themselves to be catalysts of change in water issues at local, state, regional, national, and even international levels.

Conclusion

Emerging challenges to water management are adding to what has always been a difficult, complex task for communities and states. Future water leaders must be capable of leading change and preparing others for change. Leadership development program designers must look to the social sciences and social science theories in creating leadership development programs to produce catalysts of change to sustain freshwater ecosystem services. By using a theoretically-based foundation and employing a process-based curriculum involving developmental experiences that include assessment, challenge, and support, these leadership development programs are more likely to produce the necessary catalysts of change.

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References

Abrahamse, W., L. Steg, C. Vlek, and T. Rothengatter. 2005. A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology* 25: 273-291.

Addor, M., T. Cobb, E. Dukes, M. Ellerbrock, and L. Smutko. 2005. Linking theory to practice: A theory of change model of the Natural Resources Leadership Institute. *Conflict Resolution Quarterly* 23(2): 203-223.

Allan, C., A. Curtis, G. Stankey, and B. Shindler. 2008. Adaptive management and watersheds: A social science perspective. *Journal of the American Water Resources Association* 44(1): 166-174.

Allen, K.E., J. Bordas, G.R. Hickman, L.R. Matusak, G.J. Sorenson, and K.J. Whitmire. 2006. Leadership in the twenty-first century. *IEEE Engineering Management Review* 34: 60-67.

Antonakis, J., B.J. Avolio, and N. Sivasubramaniam. 2003. Context and leadership: An examination of the nine-factor full-range leadership theory using the Multifactor Leadership Questionnaire. *Leadership Quarterly* 14: 261-295.

Argyris, C. and D. Schon. 1978. *Organizational Learning: A Theory of Action Perspective*. Addison-Wesley, London, UK.

Arthur, W., Jr., W. Bennett, W., Jr., P.S. Edens, and S.T.

Bell. 2003. Effectiveness of training in organizations: A meta-analysis of design and evaluation features. *Journal of Applied Psychology* 88: 234-245.

Ashley, G.C. and R. Reiter-Palmon. 2012. Self-awareness and the evolution of leaders: The need for a better measure of self-awareness. *Journal of Behavioral & Applied Management* 14(1): 2-17.

Bak, H.-J. 2001. Education and public attitudes toward science: Implications for the "Deficit Model" of education and support for science and technology. *Social Science Quarterly* 82: 779-795.

Bandura, A. 1977. *Social Learning Theory*. Prentice Hall, Englewood Cliffs, NJ.

Bandura, A. 1986. *Social Foundations of Thought and Action: A Social Cognitive Theory*. Prentice Hall, Englewood Cliffs, NJ.

Barling, J., T. Weber, and E. Kelloway. 1996. Effects of transformational leadership training on attitudinal and financial outcomes: A field experiment. *Journal of Applied Psychology* 81: 827-832.

Bass, B.M. 1985. *Leadership and Performance Beyond Expectations*. Free Press, New York, NY.

Bass, B.M. 1990. From transactional to transformational leadership: Learning to share the vision. *Organizational Dynamics* 18(3): 19-31.

Bass, B.M. and R. Bass. 2008. *The Bass Handbook of Leadership: Theory, Research, and Managerial Applications.* 4th edition. Free Press, New York, NY.

Bass, B.M. and B.J. Avolio. 1990. Developing transformational leadership: 1992 and beyond. *Journal of European Industrial Training* 14: 21-27.

Bass, B.M. and B.J. Avolio. 1995. *Multifactor Leadership Questionnaire*. Mind Garden, Redwood City, CA.

Beer, M., M. Finnström, and D. Schrader. 2016. Why leadership training fails—And what to do about it. *Harvard Business Review* 94(10): 50-57.

Benn, S., D. Dunphy, and A. Griffiths. 2006. Enabling change for corporate sustainability: An integrated perspective. *Australasian Journal of Environmental Management* 13: 156-165.

Berry, J.K. and J.C. Gordon. (Eds.). 1993. *Environmental Leadership: Developing Effective Skills and Styles*. Island Press, Washington, D.C.

Boyatzis, R.E. 1982. *The Competent Manager: A Model for Effective Performance*. Wiley, New York, NY.

Brasier, K.J., B. Lee, R. Stedman, and J. Weigle. 2011. Local champions speak out: Pennsylvania's Community Watershed Organizations. In: *Pathways for Getting to Better Water Quality: The Citizen Effect*, L.W. Morton and S.S. Brown (Eds.). Springer, New York, NY, pp. 133-144.

Brouwer, S. and F. Biermann. 2011. Towards adaptive management: Examining the strategies of policy entrepreneurs in Dutch water management. *Ecology and Society* 16(4): 5.

Brown, P. and V. Brown. 2012. *Neuropsychology for Coaches – Understanding the Basics*. McGraw-Hill, Maidenhead, UK.

Burbach, M.E., K. Floress, and E.K. Kaufman. 2015. Are water-related leadership development programs designed to be effective? An exploratory study. *Journal of Leadership Education* 14(1): 107-123.

Burke, W.W. and G.H. Litwin. 1992. A causal model of organizational performance and change. *Journal of Management* 18: 523-545.

Burns, J.M. 1978. *Leadership*. Harper & Row, New York, NY.

By, R.T. 2005. Organisational change management: A critical review. *Journal of Change Management* 5: 369-380.

Byrne, J.C. and R.T. Rees. 2006. *The Successful Leadership Development Program: How to Build It and How to Keep It Going*. Pfeiffer, San Francisco, CA.

Cacioppe, R. 2000. Creating spirit at work: Re-visioning organization development and leadership - Part II. *Leadership & Organization Development Journal* 21(2): 110-119.

Clayton, S. and S. Opotow. (Eds.). 2003. *Identity and the Natural Environment: The Psychological Significance of Nature*. MIT Press, Cambridge, MA.

Combe I.A. and D. Carrington. 2015. Leaders' sensemaking under crises: Emerging cognitive consensus over time within management teams. *Leadership Quarterly* 26: 307-322.

Cosgrove, W.J. and D.P. Loucks. 2015. Water management: Current and future challenges and research directions. *Water Resources Research* 51: 4823-4839.

Cramer, J.S. 2015. Civic capacity and integrative public leadership: A case study of the Nebraska Water Leaders Academy. Thesis, University of Nebraska-Lincoln, Lincoln, Nebraska.

Crosby, B.C. and J.M. Bryson. 2010. Integrative leadership and the creation and maintenance of cross-sector collaboration. *Leadership Quarterly* 21: 211-230.

Day, D.V. 2000. Leadership development: A review in context. *Leadership Quarterly* 11: 581-613.

Day, D. and L. Dragoni. 2015. Leadership development: An outcome-oriented review based on time and levels of analyses. *The Annual Review of Organizational Psychology and Organizational Behavior* 2(3): 1-24.

Day, D.V., J.W. Fleenor, L.E. Atwater, R.E. Sturm, and R.A. McKee. 2014. Advances in leader and leadership development: A review of 25 years of research and theory. *Leadership Quarterly* 25: 63-82.

Day, D.V. and S.M. Halpin. 2004. Growing leaders for tomorrow: An introduction. In: *Leadership Development for Transforming Organizations: Growing Leaders for Tomorrow*, D.V. Day, S.J. Zaccaro, and S.M. Halpin (Eds.). Lawrence Erlbaum, Mahwah, NJ, pp. 3-22.

Day, D., M. Harrison, and S. Halpin. 2009. *An Integrative Approach to Leader Development. Connecting Adult Development, Identity and Expertise*. Taylor & Francis, New York, NY.

Delli Priscoli, J. and A.T. Wolf. 2009. *Managing and Transforming Water Conflicts*. Cambridge University Press, Cambridge, MA.

DeVenney, M. 2009. *Leadership: Making the Critical Investment*. Bluteau DeVenney & Company, Halifax, Nova Scotia.

Díaz-Siefer, P., A. Neaman, E. Salgado, J.L. Celis-Diez, and S. Otto. 2015. Human-environment system knowledge: A correlate of pro-environmental behavior. *Sustainability* 7: 15510-15526.

Dietz, T., A. Fitzgerald, and R. Shwom. 2005. Environmental values. *Annual Review of Environmental Resources* 30: 335-372.

Dietz, T. and P.C. Stern (Eds.). 2002. Exploring new tools for environmental protection. In: *New Tools for Environmental Protection: Education, Information, and Voluntary Measures*. National Academy Press, Washington, D.C., pp. 3-15.

Donaldson, S.I. and E.J. Grant-Vallone. 2002. Understanding self-report bias on organizational behavior research. *Journal of Business and Psychology* 17(2): 245-260.

Drucker, P.F. 1985. *Innovation and Entrepreneurship*. Harper Collins, New York, NY.

Dunphy, D., A. Griffiths, and S. Benn. 2007. *Organizational Change for Corporate Sustainability: A Guide for Leaders and Change Agents of the Future*. 2nd edition. Routledge, London, UK.

Ely, K., L.A. Boyce, J.K. Nelson, S.J. Zaccaro, G. Hernez-Broome, and W. Whyman. 2010. Evaluating leadership coaching: A review and integrated framework. *Leadership Quarterly* 21(4): 585-599.

Faruqi, M. 2012. Embracing complexity to enable change. In: *Environmental Leadership: A Reference Handbook*, D. Rigling Gallagher, N. Christiansen, and P. Andrews (Eds.). Sage, Thousand Oaks, CA, pp. 772-781.

Feser, C., N. Nielsen, and M. Rennie. 2017. What's missing in leadership development? *McKinsey Quarterly* 2017(3): 20-24.

Folke, C., S.R. Carpenter, B. Walker, M. Scheffer, T. Chapin, and J. Rockström. 2010. Resilience thinking: Integrating resilience, adaptability and transformability. *Ecology and Society* 15(4): 20.

Gilley, A., H.S. McMillan, and J.W. Gilley. 2009. Organizational change and characteristics of leadership effectiveness. *Journal of Leadership & Organizational Studies* 16(1): 38-47.

Gordon, J.C. and J.K. Berry. 2006. *Environmental Leadership Equals Essential Leadership: Redefining Who Leads and How*. Yale University Press, New Haven, CT.

Hannah, S.T., B.J. Avolio, F. Luthans, and P.D. Harms. 2008. Leadership efficacy: Review and future directions. *Leadership Quarterly* 19: 669-692.

Heifetz, R., A. Grashow, and M. Linsky. 2009. *The Practice of Adaptive Leadership*. Harvard Business Press, Boston, MA.

Higgs, M. and R. Rowland. 2005. All changes great and small: Exploring approaches to change and its leadership. *Journal of Change Management* 5(2): 121-151.

Holling, C.S. 1978. *Adaptive Environmental Assessment and Management*. John Wiley and Sons, Chichester, UK.

Howell, J.M. 2005. The right stuff: Identifying and developing effective champions of innovation. *Academy of Management Executive* 19: 108-119.

Howell, J.M. C.M. Shea, and C.A. Higgins. 2005. Champions of product innovations: Defining, developing and validating a measure of champion behavior. *Journal of Business Venturing* 20: 641-661.

Hughes, R.L., R.C. Ginnett, and G.J. Curphy. 2009. *Leadership: Enhancing the Lessons of Experience.* 5th edition. McGraw-Hill, New York, NY.

Jung, C.G. 1971. *Psychological Types*. Princeton University Press, Princeton, NJ.

Kaiser, F. and U. Fuhrer. 2003. Ecological behavior's dependency on different forms of knowledge.

Applied Psychology: An International Review 52: 598-613.

Kaplan, A. 1964. *The Conduct of Inquiry: Methodology for Behavioral Science*. Thomas Y. Crowell, New York, NY.

Kollmuss, A. and J. Agyeman. 2002. Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research* 8: 239-260.

Kotter, J.P. 1995. Leading change: Why transformation efforts fail. *Harvard Business Review* 73(2): 59-67.

Leonard, N.H., L.L. Beauvais, and R.W. Scholl. 1999. Work motivation: The incorporation of self-concept-based processes. *Human Relations* 52: 969-998.

Lewin, K. 1947. Frontiers in group dynamics: Concepts, method and reality in social science, social equilibria and social change. *Human Relations* 1(1): 5-41.

Lincklaen Arriëns, W. and U. Wehn de Montalvo. 2013. Exploring water leadership. *Water Policy* 15(Suppl.2): 15-41.

Mabey, C. 2013. Leadership development in organizations: Multiple discourses and diverse practice. *International Journal of Management Reviews* 15: 359-380.

Margerum, R.D. and C.J. Robinson. 2015. Collaborative partnerships and the challenges for sustainable water management. *Current Opinion in Environmental Sustainability* 12: 53-58.

Markham, S., S. Green, and R. Basu. 1991. Champions and antagonists: Relationships with R&D project characteristics and management. *Journal of Engineering and Technology Management* 8: 217-242.

Maxwell, J. 1998. *The 21 Irrefutable Laws of Leadership: Follow Them and People Will Follow You*. Thomas Nelson, Inc., Nashville, TN.

McCallum, S. and D. O'Connell. 2008. Social capital and leadership development. *Leadership and Organizational Development Journal* 30: 152-166.

McCauley, C.D., E. Van Velsor, and M.N. Ruderman (Eds.). 2010. Introduction: Our viewpoint of leadership development. In: *The Center for Creative Leadership Handbook of Leadership Development*. Wiley, San Francisco, CA, pp. 1-26.

McIntosh, B.S. and A. Taylor. 2013. Developing t-shaped water professionals: Reflections on a framework for building capacity for innovation through collaboration, learning and leadership. *Water Policy* 15: 42-60.

McKenzie-Mohr, D. 2000. Promoting sustainable behavior: An introduction to community-based social marketing. *Journal of Social Issues* 56: 543-554.

Mezirow, J. 1997. Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education 74*: 5-12.

Millennium Ecosystem Assessment. 2005. *Ecosystems and Human Well-Being: Synthesis*. Island Press and World Resources Institute, Washington, D.C.

Monroe, M. 2003. Two avenues of encouraging conservation behaviors. *Human and Ecology Review, Society for Human Ecology* 10(2): 113-125.

Morse, R.S. 2010. Integrative public leadership: Catalyzing collaboration to create public value. *Leadership Quarterly* 21: 231-245.

Morton, L.W. and S.S. Brown. 2011. *Pathways for Getting to Better Water Quality: The Citizen Effect*. Springer, New York, NY.

Morton, L.W., T. Selfa, and T.A. Becerra. 2011. Shared leadership for watershed management. In: *Pathways for Getting to Better Water Quality: The Citizen Effect*, L.W. Morton and S.S. Brown (Eds.). Springer, New York, NY, pp. 29-39.

Moynihan, D.P., S.K. Pandey, and B.E. Wright. 2014. Transformational leadership in the public sector: Empirical evidence of its effects. In: *Public Administration Reformation: Market Demand from Public Organizations*, Y.K. Dwivedi, M.A. Shareef, S.K. Pandey, and V. Kumar (Eds.). Routledge, New York, NY, pp. 87-104.

Myers, I.B. and P. Myers. 1995. *Gifts Differing: Understanding Personality Type*. Davies-Black Publishing, Mountain View, CA.

Neuborne, E. 2003. Bright ideas. *Sales and Marketing Management* 155(8): 26-30.

Newman, P., B.L. Bruyere, and A. Beh. 2007. Service-learning and natural resource leadership. *Journal of Experiential Education* 30: 54-69.

Nunnally, J.C. and I.H. Bernstein. 1994. *Psychometric Theory.* 3rd edition. McGraw-Hill, New York, NY.

O'Connor, E.J. and C.M. Fiol. 2002. Mindful over mindless: Learning to think like an entrepreneur. *The Physician Executive* 28(4): 18-23.

Olsson, P., L.H Gunderson, S.R. Carpenter, P. Ryan, L. Lebel, C. Folke, and C.S. Holling. 2006. Shooting the rapids: Navigating transitions to adaptive governance of social-ecological systems. *Ecology and Society* 11(1): 1-21.

Pahl-Wostl, C., K. Conca, A. Kramer, J. Maestu, and

F. Schmidt. 2013. Missing links in global water governance: A processes-oriented analysis. *Ecology and Society* 18(2): 33.

Pahl-Wostl, C., P. Jeffrey, N. Isendahl, M. Brugnach. 2011a. Maturing the new water management paradigm: Progressing from aspiration to practice. *Water Resource Management* 25: 837-856.

Pahl-Wostl, C., C. Nilsson, J. Gupta, and K. Tockner. 2011b. Societal learning needed to face the water challenge. *Ambio* 40: 549-553.

Penning-Rowsell, E., C. Johnson, and S. Tunstall. 2006. 'Signals' from pre-crisis discourse: Lessons from UK flooding for global environmental policy change? *Global Environmental Change* 16: 323-339.

Petrie, N. 2013. *Vertical Leadership Development – Part 1: Developing Leaders for a Complex World*. Center for Creative Leadership, Greensboro, NC.

Pittock, J., L. Hanson, and R. Abell. 2008. Running dry: Freshwater biodiversity, protected areas and climate change. *Biodiversity* 9(3 & 4): 30-38.

Pittock, J., K. Hussey, and S. McGlennon. 2013. Australian climate, energy and water policies: Conflicts and synergies. *Australian Geographer* 44(1): 3-22.

Popper, M. and O. Mayseless. 2007. The building blocks of leadership development: A psychological conceptual framework. *Leadership & Organizational Development* 28: 664-668.

Pradhananga, A., M. Davenport, and E. Green. 2019. Cultural narratives on constraints to community engagement in urban water restoration. *Journal of Contemporary Water Research & Education* 166: 79-94.

Redekop, B.W. (Ed.). 2010. *Leadership for Environmental Sustainability*. Routledge, New York, NY.

Reimers-Hild, C.I. and J.W. King. 2009. Six questions for entrepreneurial leadership and innovation in distance education. *Online Journal of Distance Learning Administration* 12(4). Available at: http://www.westga.edu/~distance/ojdla/winter124/reimers-hild124.html. Accessed July 16, 2019.

Renko, M., A. El Tarabishy, A. Carsrud, and M. Brannback. 2015. Understanding and measuring entrepreneurial leadership. *Journal of Small Business Management* 53(1): 54-74.

Ritch, S. and T. Mengel. 2009. Guiding questions: Guidelines for leadership education programs. *Journal of Leadership Education* 8(1): 216-227.

Roberts, C. 2008. Developing future leaders: The role of reflection in the classroom. *Journal of Leadership Education* 7: 116-130.

Rockström J., W. Steffen, K. Noone, A. Persson, F.S. Chapin, E.F. Lambin, T.M. Lenton, M. Scheffer, C. Folke, H.J. Schellnhuber, B. Nykvist, C.A. de Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Constanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corell, V.J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J.A. Foley. 2009. A safe operating space for humanity. *Nature* 461: 472-475.

Rost, J.C. 1993. Leadership development in the new millennium. *The Journal of Leadership Studies* 1: 92-110.

Schultz, P.W. 2002. Knowledge, education, and household recycling: Examining the knowledge-deficit model of behavior change. In: *Education, Information, and Voluntary Measures in Environmental Protection*, T. Dietz and P. Stern (Eds.). National Academy of Sciences, Washington, D.C., pp. 67-82.

Schon, D. 1963. Champions for radical new inventions. *Harvard Business Review* 41(2): 77-86.

Scott, G.M., L.E. Leritz, and M.D. Mumford. 2004. The effectiveness of creativity training: A meta-analysis. *Creativity Research Journal* 16: 361-388.

Singh A., D. Saha, and A.C. Tyagi (Eds.). 2019. Emerging issues in water resources management: Challenges and prospects. In: *Water Governance: Challenges and Prospects*. Springer, Singapore.

Silvia, C. and M. McGuire. 2010. Leading public sector networks: An empirical examination of integrative leadership behaviors. *Leadership Quarterly* 21: 264-277.

Steg, L. and C. Vlek. 2009. Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology* 29: 309-317.

Sturgis, P. and N. Allum. 2004. Science in society: Re-evaluating the deficit model of public attitudes. *Public Understanding of Science* 13(1): 55-74.

Sun, P. and M. Anderson. 2012. Civic capacity: Building on transformational leadership to explain successful integrative public leadership. *Leadership Quarterly* 23(3): 309-323.

Taylor, A. 2009. Sustainable urban water management: Understanding and fostering champions of change. *Water Science and Technology* 59: 883-891.

Taylor, A., C. Cocklin, and R. Brown. 2012. Fostering environmental champions: A process to build their capacity to drive change. *Journal of Environmental Management* 98: 84-97.

Taylor, A. and B. McIntosh. 2012. Building leadership capacity to drive change: Lessons from a new program. In: *Proceedings of the Enviro 2012 Conference*. July 24-26, 2012, Adelaide, South Australia, pp. 1-17.

Tosey, P. and G. Robinson. 2002. When change is no longer enough: What do we mean by "transformation" in organizational change work? *The TQM Magazine* 14(2): 100-109.

United Nations Department of Economic and Social Affairs (UNDESA). 2014. *International Decade for Action 'Water for Life' 2005-2015*. Available at: https://www.un.org/waterforlifedecade/iwrm.shtml. Accessed July 16, 2019.

Wacker, J. 1998. A definition of theory: Research guidelines for different theory-building research methods in operations management. *Journal of Operations Management* 16: 361-385.

Waller. L., M. Reitz, E. Poole, and A. Muir. 2014. *The Neuroscience of Leadership Development: Preparing through Experience*. *Ashridge Business School Report,* Berkhamsted, UK, *p. 23.*

Walters, C.J. 1986. *Adaptive Management of Renewable Resources*. Macmillan, New York, NY.

Wang, G., I.S. Oh, S.H. Courtright, and A.E. Colbert. 2011. Transformational leadership and performance across criteria and levels: A meta-analytic review of 25 years of research. *Group & Organization Management* 36: 223-270.

Weick, K.E. 1995. *Sensemaking in Organizations*. Sage, Thousand Oaks, CA.

Weick, K.E., K.M. Sutcliffe, and D. Obstfeld. 2005. Organizing and the process of sensemaking. *Organization Science* 16: 409-421.

Whitney, R. and L.M. D'Andrea. 2007. The process of becoming a leader: An individual identity model. *Vistas Online Journal*. Available at: http://counselingoutfitters.com/vistas/vistas07/Whitney.htm.

Winch, G.M. and E. Maytorena. 2009. Making good sense: Assessing the quality of risky decision-making. *Organization Studies* 30: 181-203.

Yukl, G. 2012. *Leadership in Organizations.* 8th edition. Prentice Hall, Englewood Cliffs, NJ.

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The Watershed Leader as a Catalyst for Change

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Abstract: This paper describes a research project that collected information about the leadership characteristics of successful watershed coordinators in Ohio. We interviewed a total of twenty watershed coordinators who had successfully completed nonpoint source (NPS) management projects and asked them to discuss their perceptions of what made them and others like them successful. We organized the attributes identified into three themes (social, technical and administrative). Of these, social attributes like strong communication skills were considered to be the most critical for getting NPS projects completed, though technical and administrative attributes were also important. We discuss how these findings might be applied in evaluating and training watershed coordinators, and consider possible avenues for further research.

Keywords: *watershed training, core competencies, nonpoint source (NPS) management, watershed leadership, collaborative watershed management*

In 2013, the Ohio Environmental Protection Agency (OEPA) approached Ohio State University Extension (OSU Extension) about conducting a research project. They wanted to better understand why some watershed coordinators had been more effective than others at implementing nonpoint source pollution management projects (NPS projects) that grew out of collaborative watershed plans. In particular, OEPA staff wanted to know if there were certain characteristics or approaches that effective coordinators had in common so that OSU Extension and other educational institutions could create professional development programs to increase the capacity of less successful watershed coordinators.

At that time, Ohio was fertile ground for an inquiry into the role of watershed coordinators in watershed plan implementation. Approximately 13 years earlier, the Ohio state legislature had approved funding for a new collaborative initiative involving OEPA, the Ohio Department of Natural Resources (ODNR) and OSU Extension. The goal was to support existing and facilitate new watershed management projects and programs at the local level. ODNR created a grant program to provide funding to watershed groups and local governmental agencies to hire full-time watershed coordinators. These new coordinators would oversee development and implementation of watershed management plans to address sources of NPS pollution. Recipients of grant funds were required to demonstrate how they would engage key stakeholders in both planning and implementation. This grant program created new watershed coordinator and related positions at a variety of agencies and organizations in Ohio. Twelve years after the initial watershed coordinator grants were awarded, many watershed plans had been developed and endorsed by OEPA and ODNR and were being implemented.

Effective Watershed Leadership

Collaborative watershed management is promoted and supported by many state and federal agencies as an effective strategy for addressing nonpoint sources of surface water pollution (National Research Council 1999; Leach and Pelkey 2001; Sabatier, Focht et al. 2005). Effective collaborative watershed management involves:

- Engaging key stakeholders in defining problems and negotiating solutions, leading to greater buy-in and higher levels of implementation (Sabatier, Focht et al. 2005; Morton 2011).
- Building social capital,[1] in particular by expanding and strengthening social networks and trust between stakeholders (Sabatier, Leach, et al. 2005; Floress et al. 2011; Morton 2011).
- Integrating scientific and local knowledge (Daniels and Walker 2001; Sabatier, Weible and Ficker 2005; Morton and Brown 2011).
- Coordinating and targeting resources to critical areas to reduce duplication of effort and increase return on investment (i.e., environmental outcomes relative to resources invested) (Morton and McGuire 2011).

In their book *Swimming Upstream: Collaborative Approaches to Watershed Management*, Sabatier, Focht et al. (2005) offer a conceptual framework for understanding collaborative watershed management (Figure 1). The framework identifies 12 factors believed to influence watershed outcomes and their relationship to each other. The watershed leader serves as the coordinator, director, or facilitator of the 'Institution for collaborative watershed management' (watershed collaborative), which provides the structure and function for the collaborative **Process**. The watershed collaborative produces **Policy Outputs** (plans and projects) and influences the **Civic Community**, which consists of six factors: human capital, social capital, political efficacy, trust, legitimacy, and collective action beliefs. Changes in the civic community and policy outcomes lead to **Watershed Outcomes**. In this model, the watershed collaborative plays a central role in engaging and building capacity within the civic community to achieve policy outputs and watershed outcomes.

Perhaps because collaborative approaches, by definition, require shared leadership among multiple stakeholders, research has tended to focus on identifying the attributes of successful watershed *groups* rather than identifying attributes of successful *individual leaders*. However, a literature review by Leach and Pelkey (2001) identified participation by an effective leader, coordinator, or facilitator as second in importance only to adequate funding as a key factor in the success of collaborative watershed management efforts. Another study of collective action in fisheries found that the presence of one effective leader, defined as an "individual with entrepreneurial skills, highly motivated, respected as a local leader and making a personal commitment to the co-management implementation process," increased positive outcomes in fishery management (Gutiérrez et al. 2011, 387-8).

Another tendency in this area of research is to focus on watershed *planning* with little attention to influence of specific leadership qualities on the successful *implementation* of watershed plans. As a result, our understanding of effective leadership characteristics for plan implementation is relatively limited. Interestingly, some studies of watershed partnerships (Leach and Pelkey 2001; Mandarano and Paulsen 2011) have found very weak linkages between key social outcomes associated with effective planning (e.g., increased trust, social and human capital, and learning) and environmental outcomes (e.g., stream restoration and protection projects). Mandarano and Paulsen (2011, 1310) call for more research into "the presence and influence of collaborative behaviors that facilitate the development and implementation of site specific projects.

Purpose

The purpose of this study was to identify the leadership characteristics and behaviors of watershed coordinators who successfully implemented NPS projects in Ohio. We were interested in answering the following specific research questions:

- What characteristics of watershed coordinators are most critical to successful watershed plan implementation?
- Which behaviors by watershed coordinators are critical during the process of implementing watershed protection and restoration projects?

[1]Putnam (1995, 67) defines social capital as "features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit."

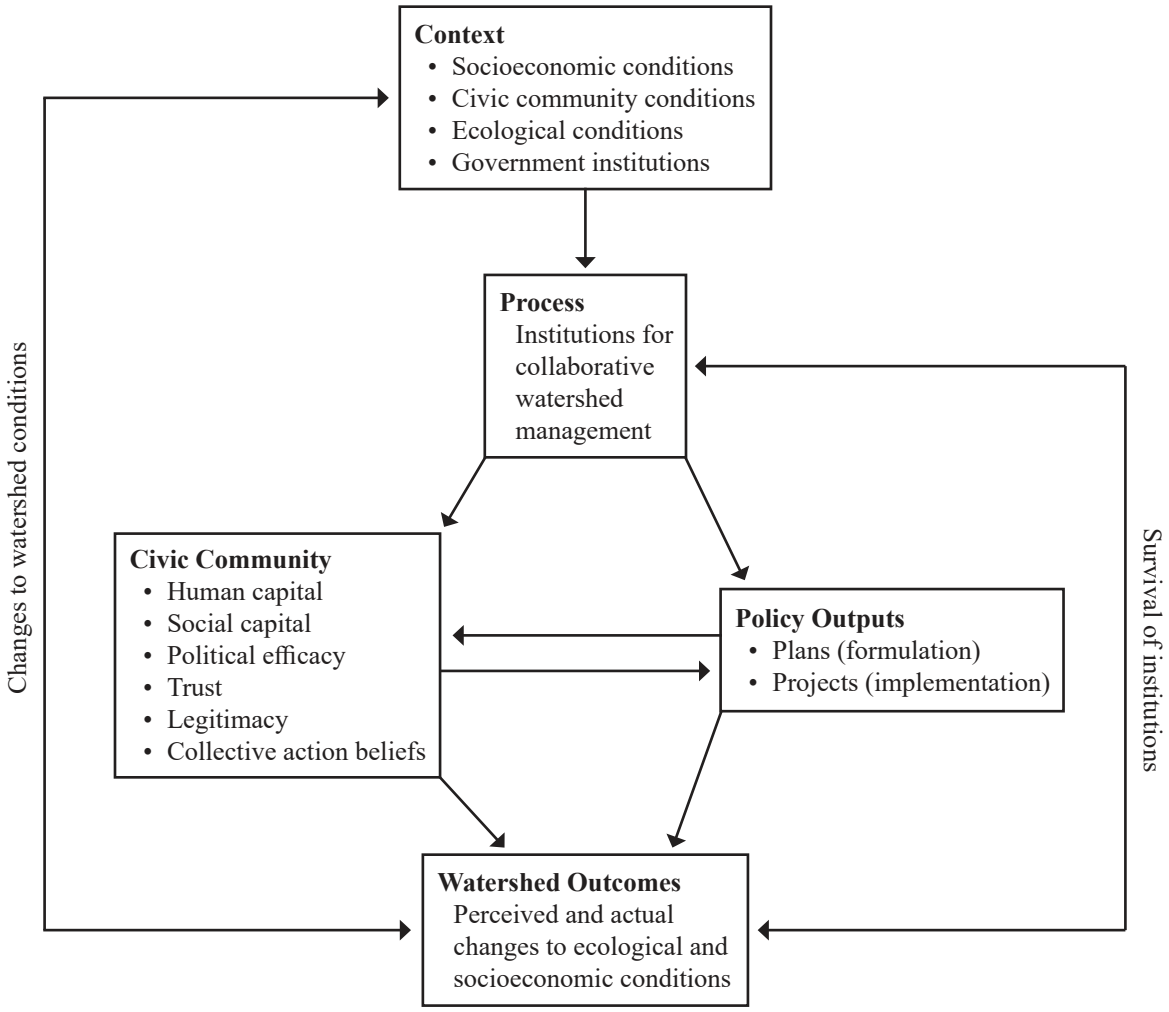

Figure 1. A dynamic framework for watershed management. Reproduced from Sabatier, Focht et al. 2005, 14.

- What role(s) does the watershed coordinator play in the broader context of collaborative watershed management, specifically in implementing NPS management projects?

Methods

As noted earlier, much of the research on watershed leadership has focused on understanding the characteristics and processes of watershed *groups* while little research has been conducted on the characteristics and behaviors of *individual leaders*. In cases where understanding of the phenomenon of interest is still immature, an exploratory, qualitative research design is most appropriate (Creswell 1994). In quantitative research, the researcher determines which variables will be measured prior to making any observations and then looks for evidence of relationships between the pre-selected variables. In qualitative research, variables of interest are not predetermined but instead emerge from the observations through inductive analysis. That is, the researcher observes the phenomenon and then looks for evidence of relationships based on the observations. Qualitative research can inform quantitative research as variables of interest are identified. Qualitative research design should not be confused with qualitative research methods. A qualitative research design refers not only to the methods used but also to the researchers' overall approach to the study. Data collection methods

commonly associated with qualitative research such as interviews, observations, and document analysis can also be used with quantitative research designs.

Participant Recruitment

The NPS Program Coordinator in the Division of Surface Water at OEPA provided an initial list of five potential interviewees who had successfully completed NPS management projects while implementing an endorsed watershed action plan. The list included watershed coordinators and agency staff who worked directly with them. A chain referral sampling approach (Morgan 2008), also commonly referred to as 'snowball sampling,' was used to identify additional possible participants by asking each interviewee to identify a watershed coordinator they considered to be successful at implementing NPS management projects from watershed action plans. The chain referral or snowball sampling approach is most useful when you do not have a clearly defined group or list from which to select your participants. For this study, there was no existing list of 'effective watershed coordinators' so we consulted with our study participants to identify other successful coordinators. In all, 20 individuals were contacted and all 20 agreed to be interviewed.

Interview Questions

We created an interview guide to ensure consistency in the interviews. Questions were open-ended with some optional follow-up questions. There were 15 total questions covering the following topics:

- Demographics (name, position title, employer).
- Professional history (educational background, relevant work experience, current role).
- Definition of successful watershed plan implementation. (The purpose of this line of questioning was to understand how interviewees defined successful implementation rather than imposing a definition or set of criteria for defining success.)
- Description of a successful watershed plan implementation project. (Here, we asked participants to recall a specific NPS project that they led and provide as much detail as possible about how the project unfolded and what factors influenced the success of the project.)
- Interviewee's role in a successful watershed implementation project.
- Description of other collaborators' roles.
- Critical skill areas for successful watershed plan implementation.
- Other comments.

Data Analysis

The interviews, which ranged in duration from approximately 45 minutes to 90 minutes, were audio recorded and transcribed. Text from the transcripts was coded in the NVivo 10 software program. The authors used the three-step process of coding, categorizing, and theme searching recommended by Glesne (1999). Initially, several interview transcripts were coded separately by two researchers to identify characteristics, behaviors, and roles of effective leaders. These initial codes were compared and reconciled to create an organizing structure for coding the remaining interviews. All remaining transcripts were coded by a single researcher. Once the coding was completed, all three researchers worked collaboratively to identify categories, themes, and relationships among themes.

Results

This section includes a brief overview of the demographics of the interviewees (Table 1) and results from the analysis of the interview data. The results include a framework of knowledge/skills associated with effective watershed leadership followed by a more in-depth description of the various factors identified in the framework and how they relate to each other.

Five of the participants provided technical and program support to multiple watershed projects and leaders (four of the five were state or federal agency employees and one was a university employee). The remaining 15 participants played a leadership role with a single watershed group or initiative. Participants represented a diversity of geographic regions in Ohio (NE, NW, SE, and SW),

Table 1. Participant demographics.

	Number of Participants
Position Title	
Watershed Coordinator	7
Program/Project Manager	4
Executive Director	4
Board Member	2
Other*	3
Education Level	
PhD	1
Master's	12
Bachelor's	7
Degree Major/Area of Study	
Environmental sciences/studies	6
Natural resources management	6
Natural sciences	4
Agriculture	1
Regional planning	1
Other	2
Employer	
Local/county agency (including soil and water conservation districts)	7
Nonprofit organization	3
State/federal agency	4
Watershed organization	3
University	3

basins (Lake Erie and Ohio River), and landscapes (agricultural, urban, and mixed). Although they had different titles (e.g., watershed coordinator, executive director, program manager), throughout this document we use the term 'watershed coordinator' to refer to individuals with primary responsibility for leading collaborative watershed planning and implementation.

Framework of Effective Watershed Leadership

After coding and analyzing the interview data to identify themes, we developed the following framework for watershed leadership. The framework consists of three categories and nine subcategories of attributes (Table 2).

Social Attributes. By far, the attributes most frequently mentioned by study participants as critical to implementation of NPS projects involved communication, education, and interpersonal and group dynamics. The participants suggested that building and maintaining trusting relationships was a vital role of the watershed leader not only during planning but also to achieve implementation of priority projects. Building and nurturing trusting relationships requires effective communication with multiple stakeholders in order to build effective teams, muster political and financial support, communicate the value of proposed projects to funders and potential partners, and hold collaborators accountable for their commitments. The following quotations from interviews are examples of statements coded to Social Attributes:

> *"[The watershed coordinator] has to be someone who feels totally comfortable reaching out, not waiting for people to call her or him, but making phone calls, sending out emails, and more importantly, going out into the community, shaking peoples' hands, looking people in the eye, so really strong people-engaging skills."*

> *"No matter what your background is, you still have to be able to communicate to people and build relationships to do nonpoint source projects because, like I said before, it's all voluntary."*

> *"I'm a facilitator. I bring the right people to the table. It's incumbent upon me to know who those people are, to gauge people's skill sets. I assemble the right team to make each project happen."*

> *"I think what is most helpful is interpersonal skills and being able to communicate either scientific information or land information in a way that resonates with our members – not only our fellow agencies and organizations, but also to residents, townships and trustees, and community councils."*

> *"Ultimately, getting something implemented depends on successfully*

Table 2. Attributes of effective watershed leaders.

Attribute Categories	Attribute Subcategories
Social	Communication and education
	Interpersonal and group dynamics
	Community dynamics
	Political dynamics
Technical	Tools and techniques
	Specialized knowledge base
	Systems thinking/problem-solving/analytical skills
Administrative	Project management
	Grant-writing and management

navigating the power structures of local communities, [which] can be very weird. It's important, and I think it's a skill that is gained by experience."

Technical Attributes. NPS project implementation often requires a high level of technical expertise, but rather than taking on the technical aspects themselves, watershed coordinators talked about assembling teams of experts that had the appropriate knowledge and skills. For example, two interviewees said:

"Well, I'd say what I have is that I'm a leader. I'm a facilitator. I bring the right people to the table. It's incumbent upon me to know who those people are, to gauge people's skill sets. I assemble the right team to make each project happen."

"A watershed coordinator/leader does not need to be a technical expert. He or she needs access to the technical experts within the community."

Nevertheless, several interviewees pointed to the value of having a certain level of technical knowledge and expertise in order to prioritize projects, communicate with project teams, and understand and communicate information about the projects to key stakeholders, as in these examples:

"I have a technical background in this general area of water, water resources and ecology, which allows me to be able to speak the language, understand the language and even more importantly, be able to interpret the technical aspects into non-technical language for the decision-makers who are typically not biologists and not watershed specialists."

"I think having any kind of science background is helpful so that you can analytically look at things and understand what the problems are from a natural resource standpoint."

Technical knowledge and expertise allowed the watershed coordinator to participate effectively in conversations with technical experts about project details, to convene and work with a team of experts, and to serve as an intermediary between the experts and key stakeholders who may not have had the same expertise but were critical to getting the project completed.

Administrative Attributes. Watershed coordinators in Ohio are often the only full-time staff dedicated to overseeing implementation of watershed plans. As a result, they are frequently required to handle a wide range of administrative tasks including grant writing, grant administration, and project management. These types of administrative and management skills are rarely mentioned in the collaborative watershed leadership literature but in interviews with study participants, project management and the ability to acquire and

administer grants to fund NPS projects were common themes. For example, one interviewee said:

> *"Grant-writing is pretty important. The funding for these types of projects isn't given to you. You have to seek and find it. Having the ability to write grants and to find funding to do your implementation is very critical."*

NPS projects can be costly, often running into tens or hundreds of thousands of dollars for assessments, permitting, design, construction, and post-project monitoring. Very few watershed initiatives can undertake such projects without external funding and the task of seeking out and acquiring funding through competitive grants frequently falls on the shoulders of the watershed coordinator. NPS projects may require the watershed coordinator to build partnerships with multiple stakeholders, including landowners, potential funders, cost-share and in-kind service providers, and citizen activists in order to put together a viable grant proposal. Once a project is funded, the watershed coordinator often acts as the primary grant administrator and project manager which typically entails ensuring that contractors produce deliverables on time and on budget, communicating with and reporting to funders and stakeholders, and assuring that cost-share and in-kind service providers fulfill commitments.

Discussion

The model of the effective watershed leader that emerges from the literature review and our Ohio interview data is an individual with a relatively high level of technical knowledge who is particularly skilled at building, maintaining, and utilizing social capital through effective communication. In other words, the successful watershed coordinator must build relationships with individuals and organizations that are influential in the community and can provide access to resources.

It may be helpful to look at the role of the watershed leader in the context of Sabatier, Focht et al.'s (2005) previously discussed conceptual framework. The watershed coordinators in this study all acted as the formal leader for their respective watershed collaborative. Based on the interview data, watershed coordinators who were successful at getting NPS projects completed were highly effective at utilizing and mobilizing the civic community. They were able to identify and assemble ad hoc teams of experts (human capital) to identify and design potential projects. They increased trust and strengthened networks by working and communicating with diverse stakeholder groups. Successful watershed coordinators learned who had power and influence over key stakeholders and resources, and they built relationships with those individuals and organizations in order to garner support for or avoid opposition to NPS projects (political efficacy).

Researchers in the field of social capital distinguish between bonding and bridging social capital. Bonding social capital is created when individuals form relationships with others who are like them in some important way (e.g., employees of the same organization) and bridging social capital is created when individuals form relationships with others who are unlike them in some important way (Putnam 2007). This study found that effective watershed leaders increase bridging social capital in their watersheds by building partnerships between stakeholder groups that may have very different and even conflicting missions and by facilitating communication between subject matter experts on one hand and lay decision-makers on the other.

Attributes of Effective Watershed Coordinators

Attributes identified under the 'social' category were considered to be the most critical for getting NPS projects completed, though technical and administrative attributes were also considered essential. Watershed coordinators must utilize existing social networks, build new networks through partnerships with other organizations, and assemble ad hoc teams of experts tailored to the requirements of each project. Effective watershed coordinators pay attention to local politics and work with or around influential opinion leaders and decision-makers. They are skilled communicators capable of connecting with diverse stakeholders, conveying sometimes complex technical information, and identifying shared interests.

Technical knowledge and skills (e.g., systems thinking, problem-solving) were sometimes mentioned as being directly applicable to NPS

project planning and implementation, but participants also frequently mentioned the value of technical knowledge for communicating with experts who are more directly involved in project planning and implementation. Being able to 'talk the talk' gave the coordinators a certain level of legitimacy with technical experts so that they could influence how NPS projects were prioritized and executed. Watershed coordinators also used their communication and education skills to translate complex technical information about NPS projects for lay audiences, including key decision-makers and stakeholders, to acquire needed permissions or resources.

Many NPS projects require external funding and effective watershed coordinators are skilled at preparing grant applications. Once an NPS project is underway, watershed coordinators often play the role of project manager, fulfilling grant reporting requirements and ensuring that contractors and partner organizations meet deadlines and specifications. These administrative responsibilities are rarely mentioned in the watershed leadership literature but participants in this study identified grant writing and project management as essential skills. Administrative knowledge and skills may be overlooked in part because of the strong bias toward project planning rather than project implementation among scholars of collaborative watershed management.

Conclusions

The watershed coordinators interviewed for this study perceived that they had a significant role to play as catalysts for change in collaborative watershed management. They were skilled communicators and educators, they understood and worked effectively with the local social as well as ecological systems, and they utilized and integrated a diverse range of technical, social, and administrative knowledge and skills to implement NPS projects. The skills and strategies required for collaborative watershed planning (building social capital, facilitating communication and shared decision-making, promoting a shared vision) appear to transfer to the implementation phase but must be adapted and focused to meet the particular context of a given NPS project.

Application of Findings

The findings from this study have applications for collaborative watershed institutions, funding agencies, and organizations that provide professional development and support to watershed coordinators. The framework for watershed leadership that emerged could serve as a starting point for collaborative watershed institutions to develop criteria for hiring and evaluating watershed coordinators. Funding agencies may also consider using this framework to evaluate the capacity of watershed coordinators and watershed institutions to effectively implement NPS projects *before* providing funding for those projects.

Organizations that provide professional development opportunities can also apply the findings from this study to their programs. Authors of this report direct the Ohio Watershed Academy, a professional development program for watershed leaders, and we made significant revisions to the curriculum for that program as a result of the study findings. In particular, new modules on water policy and government agency roles were added to the curriculum to address gaps in the discussion of political dynamics. In addition, assignments were revised to emphasize systems thinking and analytical skills. The overall structure of the course was also reorganized to provide more balance among the three categories of watershed leader attributes (technical, administrative, and social) that emerged from the study.

Implications for Further Research

While this study does provide some insight into the knowledge and skills required by watershed coordinators to implement NPS projects, it raises more questions than it answers. Some possible questions for future research include:

- How does the role of the watershed coordinator compare to other watershed leaders (e.g., members of advisory boards and boards of directors)?
- How does the role of the watershed coordinator change when transitioning from planning to implementation?
- Does the role of watershed coordinator vary in different political or geographical

contexts? For example, do watershed coordinators require different skill sets in western watersheds where there tend to be more entrenched conflicts between resource users (e.g., logging and ranching versus salmon fisheries and wildlife)?

- What is the relationship between the capacity of a watershed coordinator and collaborative watershed management outcomes? What other social and environmental contextual factors (e.g., relative levels of social capital, level of environmental degradation, socio-economic conditions) influence watershed coordinator effectiveness?

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References

Creswell, J.W. 1994. *Research Design: Qualitative and Quantitative Approaches*. SAGE Publishing, Thousand Oaks, CA.

Daniels, S.E. and G.B. Walker. 2001. *Working through Environmental Conflict: The Collaborative Learning Approach.* Praeger, Westport, CT.

Floress, K., L.S. Prokopy, and S.B. Allred. 2011. It's who you know: Social capital, social networks, and watershed groups. *Society & Natural Resources* 24(9): 871-886. Available at: https://doi.org/10.1080/08941920903493926. Accessed June 24, 2019.

Glesne, C. 1999. *Becoming Qualitative Researchers: An Introduction*. Longman, New York, NY.

Gutiérrez, N.L., R. Hilborn, and O. Defeo. 2011. Leadership, social capital and incentives promote successful fisheries. *Nature* 470(7334): 386-389. Available at: https://doi.org/10.1038/nature09689. Accessed June 24, 2019.

Leach, W.D. and N.W. Pelkey. 2001. Making watershed partnerships work: A review of the empirical literature. *Journal of Water Resources Planning and Management* 127(6): 378-385. Available at: https://doi.org/10.1061/(ASCE)0733-9496(2001)127:6(378). Accessed June 24, 2019.

Mandarano, L. and K. Paulsen. 2011. Governance capacity in collaborative watershed partnerships: Evidence from the Philadelphia region. *Journal of Environmental Planning and Management* 54(10): 1293-1313. Available at: https://doi.org/10.1080/09640568.2011.572694. Accessed June 24, 2019.

Morgan, D.L. 2008. *The SAGE Encyclopedia of Qualitative Research Methods*. SAGE Publishing, Thousand Oaks, CA, pp. 816-817. Available at: http://dx.doi.org/10.4135/9781412963909. Accessed June 24, 2019.

Morton, L.W. 2011. Citizen involvement. In: *Pathways for Getting to Better Water Quality: The Citizen Effect*, L.W. Morton, and S.S. Brown (Eds.). Springer, New York, NY, pp. 15-28. Available at: https://doi.org/10.1007/978-1-4419-7282-8_2. Accessed June 24, 2019.

Morton, L.W. and S.S. Brown. (Eds.). 2011. Pathways to better water quality. In: *Pathways for Getting to Better Water Quality: The Citizen Effect*. Springer, New York, NY, pp. 3-14. Available at: https://doi.org/10.1007/978-1-4419-7282-8. Accessed June 24, 2019.

Morton, L.W. and J. McGuire. 2011. Getting to performance-based outcomes at the watershed

level. In: *Pathways for Getting to Better Water Quality: The Citizen Effect*, L.W. Morton and S.S. Brown (Eds.). New York, NY, pp. 181-196. Available at: https://doi.org/10.1007/978-1-4419-7282-8_15. Accessed June 24, 2019.

National Research Council. 1999. *New Strategies for America's Watersheds.* National Academy Press, Washington, D.C. Available at: https://doi.org/10.17226/6020. Accessed June 24, 2019.

Putnam, R.D. 1995. Bowling alone: America's declining social capital. *Journal of Democracy* 6: 65-78. Available at: https://doi.org/10.1353/jod.1995.0002. Accessed June 24, 2019.

Putnam, R.D. 2007. *E. pluribus unum*: Diversity and community in the twenty-first century. The 2006 Johan Skytte Prize Lecture. *Scandinavian Political Studies* 30(2): 137-174. Available at: https://doi.org/10.1111/j.1467-9477.2007.00176.x. Accessed June 24, 2019.

Sabatier, P.A., W. Focht, M. Lubell, Z. Trachtenberg, A. Vedlitz, and M. Matlock. (Eds.). 2005. Collaborative approaches to watershed management. In: *Swimming Upstream: Collaborative Approaches to Watershed Management*. MIT Press, Cambridge, MA, pp. 3-21.

Sabatier, P.A., W.D. Leach, M. Lubell, and N. Pelkey. 2005. Theoretical frameworks explaining partnership success. In: *Swimming Upstream: Collaborative Approaches to Watershed Management*, P.A. Sabatier, W. Focht, M. Lubell, Z. Trachtenberg, A. Vedlitz, and M. Matlock (Eds.). MIT Press, Cambridge, MA, pp. 173-199.

Sabatier, P.A., C. Weible, and J. Ficker. 2005. Eras of watershed management in the United States: Implications for collaborative watershed approaches. In*: Swimming Upstream: Collaborative Approaches to Watershed Management*, P.A. Sabatier, W. Focht, M. Lubell, Z. Trachtenberg, A. Vedlitz, and M. Matlock (Eds.). MIT Press, Cambridge, MA, pp. 23-52.

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Understanding the Nature of Eco-Leadership: A Mixed Methods Study of Leadership in Community Organizations

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Abstract: The purpose of this study was to explore and explain eco-leadership in practice, specifically among community groups in Virginia's New River Valley. This paper describes relationships between community groups' leadership style and other factors while also highlighting an intricate mixed method design that ultimately led to a deep, rich understanding of these relationships. There were five research objectives: (1) Characterize the community groups' leadership culture; (2) Assess each group's cohesiveness; (3) Assess the groups' community project involvement; (4) Determine if relationships exist between the variables; and (5) Highlight the role of mixed methods in the emergence of findings. The study has implications for carrying forward the concept of eco-leadership in research and practice.

Keywords: *civic groups, transformational leadership, crossover tracks analysis, group cohesion, small group processes*

The nature of leadership is changing: The challenges are becoming more complex, there is a greater reliance on interdependent work, and leadership is increasingly being viewed as a collective process (Avolio et al. 2009). There is a growing need for high-quality leadership development programs in support of those who work in water resource management, and it is important to ground those programs in evidence-based theory (Burbach et al. 2015). The complex, multi-level nature of leadership makes it an important phenomenon for consideration, but the socially constructed process of leadership makes it a challenge to study (Stentz et al. 2012). Community watersheds are an ideal context for investigating collaborative leadership because the rise of nonpoint source pollution has created a broad base of stakeholders with little hierarchy and accountability (Morton and Brown 2011). Approximately 4,000 locally-based organizations are involved in community watershed protection efforts across the United States (Grumbles n.d.). However, little is known about how such organizations operate and what factors are critical for their success. The study reported in this chapter helps address that by investigating community groups in Virginia's New River Valley, uncovering the relationship between leadership and other factors that impact their potential for success.

Community Leadership as a Context for Research

As government programs shrink and less money is available for community services, community-based organizations are becoming pivotal actors in addressing local needs. To meet these challenges, approaches to leadership are also changing (Figure 1). Leadership is increasingly viewed not as the effect of an individual, but rather as a collective process

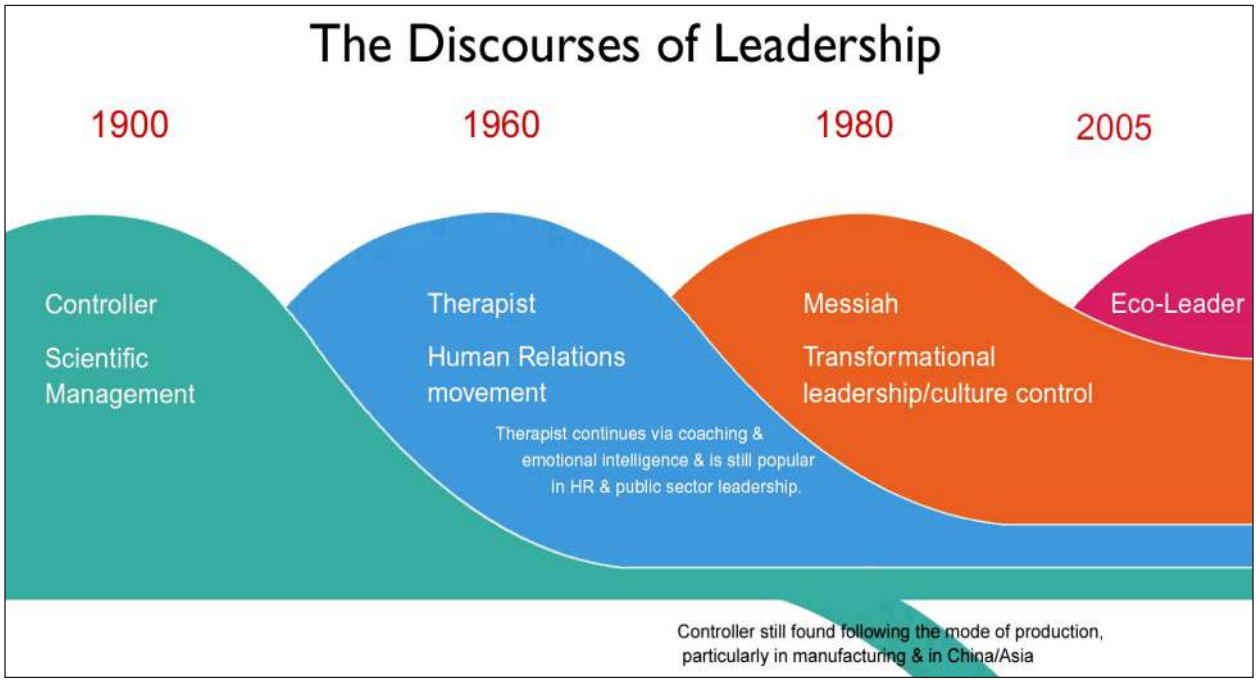

Figure 1. The Discourses of Leadership (Western 2008, 82). Reprinted from *Leadership: A Critical Text*, by S. Western, 2008, London: SAGE. Copyright 2008 by SAGE publishing. Reprinted with permission.

(Avolio et al. 2009). An emerging leadership discourse—eco-leadership—aligns directly with many community groups' efforts to establish and strengthen community viability, and supports public leaders' need to address wicked problems through community engagement (Redekop 2010).

In the early 2000s, Western (2008) popularized the term "eco-leadership." The "eco" prefix does not necessarily refer to the natural environment or any environmental cause. Rather, eco-leadership derives its leadership metaphor from the field of ecology and contends that each organization is nested in larger ecosystems, such as society, economy, and the natural environment (Wielkiewicz and Stelzner 2010). Rather than focusing on leader-created change, eco-leadership focuses on "a reciprocal relationship between leadership and its environment. It decenters individuals and challenges centralized power, claiming that by creating the right culture and conditions, leadership will emerge in plural forms and unexpected places" (Western 2010, 36).

Within the smaller context of organizations and communities, eco-leadership is characterized by shared leadership, collective decision-making, collaboration of group activities, and grassroots organizing (Western 2008). This new eco-leadership approach may benefit community organizations because a larger number of stakeholders—including minority stakeholders—can have a stronger voice, creating the potential for both better decisions and greater commitment to those decisions by group members (Allen et al. 1999). The eco-leadership approach has the potential to create more sustainable and equitable group dynamics and may enhance a group's ability to be productive (Cletzer and Kaufman 2018; Western 2018).

Although eco-leadership discourse has drawn the interest of leadership scholars, empirical research studies investigating eco-leadership are limited. "The vast majority of published work relies on a conceptual approach rather than an empirical one" (San Martin-Rodriguez et al. 2005, 133). This may be due in part to the complexities associated with assessing group-level problem solving. In an eco-leadership approach, it is the whole team that creates a direction, solves a problem, and plans for the future; yet it is more difficult to study the whole team than an individual leader (Western 2008). Accordingly, the study highlighted in this chapter investigates shared leadership within six different community organizations established to serve Virginia's New River Valley.

New Eco-leadership Paradigm Related to Other Group Dynamics

Prior to emergence of the eco-leadership discourse, scholars who study groups working in collaborative, interdependent ways found several associated concepts. Group cohesion is thought to be particularly important (Kubeš 1998). Similarly, shared leadership traits are often present (Avolio et al. 2003). Therefore, in this study, along with the eco-leadership framework proposed by Western (2008), we considered measurements of, and discussions about, group cohesion and shared leadership.

Group Cohesion. Group cohesion can be thought of as the "glue," or interpersonal bonds, that hold a group together (Carron and Brawley 2012). This is particularly important for performance when the group's task requires high levels of interaction, coordination, and interdependence (Kubeš 1998). According to Treadwell et al. (2001), "members of highly cohesive groups mutually accept each other's ideas, contribute equally to problem solving, and are not likely to be adversely affected by the power and status structures within the group" (p. 4). Accordingly, it is important to consider a number of ways to assess group cohesion: consistency between group and individual goals, decision-making style, group communication, member retention, and stated vulnerability among members (Treadwell et al. 2001).

Shared Leadership. Seibert and colleagues (2003) suggest important limitations on the potential for a single individual to carry strong leadership for a group and instead detail various ways groups share leadership. Their models point to groups that are "unified," "unified with isolates," "polarized," and structured as "multiple coalitions." Further, research by Pearce et al. (2004) suggests shared leadership is a more powerful predictor of group performance than individual leadership, particularly in not-for-profit settings. Unfortunately, "when focusing on leadership in teams, most authors have examined the behavior of an individual appointed leader as opposed to the leadership exhibited by all members of the team" (Avolio et al. 2003, 144). Therefore, more research is needed to assess shared leadership in the group governance process (Bass and Avolio 1996).

The Value of Mixed Methods Approaches

A highly complex phenomenon such as leadership is challenging to study and requires "a broadly conceived approach" (Wren 1995). A mixed methods approach has the potential to simultaneously address a range of exploratory and confirmatory questions and can provide strong inferences about the phenomenon being studied (Teddlie and Tashakkori 2009). A mixed method design can provide deeper understanding of existing leadership theory by combining quantitative approaches (e.g., surveys), which serve to provide opportunities to analyze existing leadership theory, with qualitative approaches (e.g., interviews), which "can support new discoveries within the realm of existing leadership theory" (Stentz et al. 2012, 1174).

Though growing in popularity, mixed methods studies are still uncommon in the study of leadership (Klenke 2008). One literature review of the popular leadership journal, *Leadership Quarterly*, found that only 15 mixed methods journal articles were published during the 22-year period between 1990 and 2012 (Stentz et al. 2012). However, articles on the topics of leadership and management featuring a mixed methods approach were considered significantly more influential based on their impact scores, indicating added value by the mixed methods design (Molina-Azorin 2011). There is a clear need for greater use of a mixed methods approach to the study of the complex phenomenon of leadership to help catalyze change for water resource protection and restoration. A mixed methods approach helps researchers to: (a) create a framework for triangulation when assessing findings, (b) yield more complete understanding, (c) increase the validity of results, and (d) examine the phenomenon within a contextual understanding provided by multiple perspectives (Greene 2007; Teddlie and Tashakkori 2009; Creswell and Plano Clark 2011).

Purposes and Objectives

The purpose of this study was to explore and explain eco-leadership in practice, specifically among community groups in Virginia's New River Valley. This study describes relationships between community groups' leadership style and other

factors while also highlighting an intricate mixed method design that ultimately led to a deep, rich understanding of these relationships. There were five research objectives:

1. Characterize the community groups' leadership culture;
2. Assess each group's cohesiveness;
3. Assess the groups' community project involvement;
4. Determine if relationships exist between the variables; and
5. Highlight the role of mixed methods in the emergence of findings.

Methods

In order to investigate the phenomenon described in the research objectives, we used a mixed methods exploratory design with parallel data collection and sequential data analysis (Figure 2).

For this study, we integrated the data at the point of analysis, which enhanced our understanding of what was learned from both the quantitative and qualitative data (Greene et al. 2001; Mertens 2010). Our approach was a crossover tracks analysis, where the results from one method are clustered, summarized, or transformed and integrated with the other method (Greene et al. 2001). Some scholars speak of crossover tracks analysis studies as being ones that either "quantitize" qualitative data or "qualitize" quantitative data. Because new software programs can analyze qualitative data in a quantitative fashion, and vice versa, crossover tracks analysis is becoming a new trend (Small 2011, 70).

Quantitative Strand

Study Population. The general criteria for selection of participant organizations included: (a) holding regular face-to-face meetings; (b) self-identifying as a civic, social, or service group; and (c) serving Virginia's New River Valley. We developed a list of 91 community-based organizations by searching online resources. Community groups were contacted by phone, and those expressing interest received a follow-up email with an information packet, including examples of survey instruments. Based on willingness and availability, a convenience sample of six organizations with 92 individual participants continued in the study. Although the groups varied in their involvement with environmental issues and water resources projects, all of them held the potential for catalyzing change in these areas.

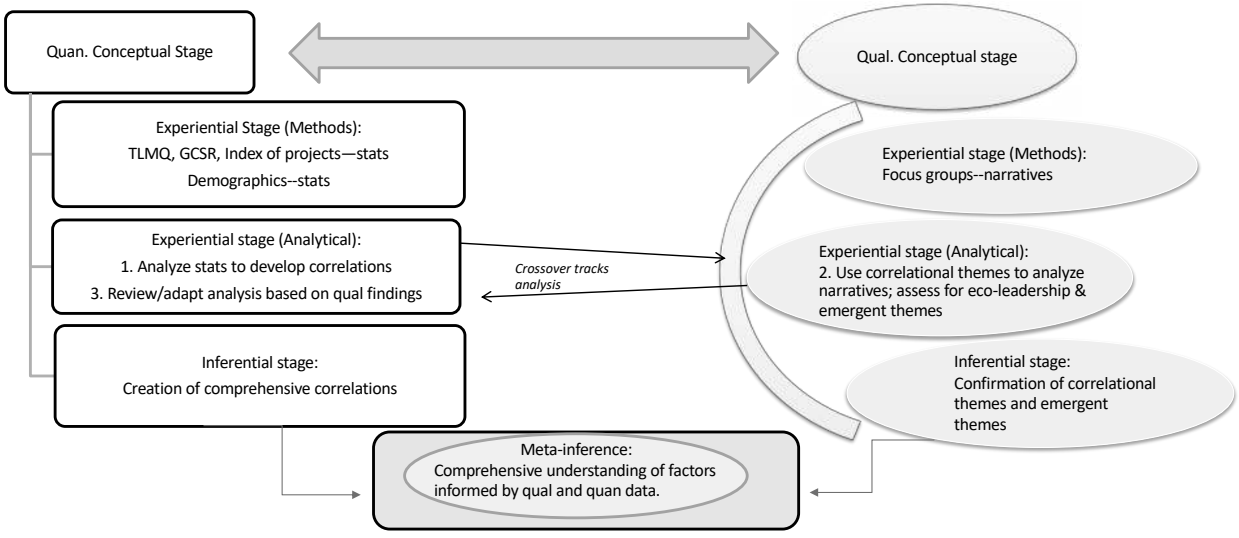

Figure 2. Schematic of mixed methods research protocol used. Mixing occurs during the analysis and inference stages. Quantitative data are analyzed first and inform qualitative analysis. Emergent themes from qualitative analysis further inform a secondary quantitative analysis. Meta-inference is developed from this stance. Note: "Quan" = quantitative and "Qual" = quantitative.

We used simple descriptive statistics to determine the demographic make-up of the sample, including gender, age, race, years of service, and level of education. Of 92 total individual respondents, 84 provided sufficient data for analysis: 61% were male (n=50), and 39% were female (n=34). Ages of participants ranged from 19 to 91 years, with a mean age of 62. Respondents reported being 82% white (n=69), 14% black (n=12), 2% Asian (n=2), and 1% Hispanic (n=1). Education levels varied with 35% (n=29) holding a doctorate or professional degree, 27% (n=23) with a master's degree, 13% (n=11) with a bachelor's degree, 4% (n=4) with an associate's degree, and 19% (n=16) with "some college or less."

Instruments. We used two standardized instruments to collect quantitative data: (a) Group Cohesion Scale – Revised (GCS-R) and, (b) Team Multifactor Leadership Questionnaire (TMLQ). The GCS-R is a 25-item questionnaire designed to assess group cohesion in terms of interaction and communication among group members, member retention, decision making, vulnerability among group members, and consistency between group and individual goals (Treadwell et al. 2001). The TMLQ is a 48-item questionnaire designed to assess shared transformational leadership in the form of group level leadership style (Gronn 2008).

In addition to the standardized instruments, we created a demographic survey to collect basic stakeholder information, such as age, gender, occupation, and level of education. This survey also collected information related to the group's involvement in community projects, which is represented in the project index score (Figure 3) and served as the dependent variable for the study. This instrument provides a gauge as to whether the community groups are able to mobilize and work on some of the challenging concerns of the area, affording us a simple indicator of their productivity. When individuals asked for clarification on the reference to "environmental protection or restoration," we encouraged them to define it as broadly as they felt comfortable.

Data Collection. The research team attended regular or special meetings of participant organizations. We discussed the study, obtained consent, and administered the questionnaires. After each group finished the quantitative segment, we compiled their group level scores and shared these during a face-to-face meeting with the subject community organization.

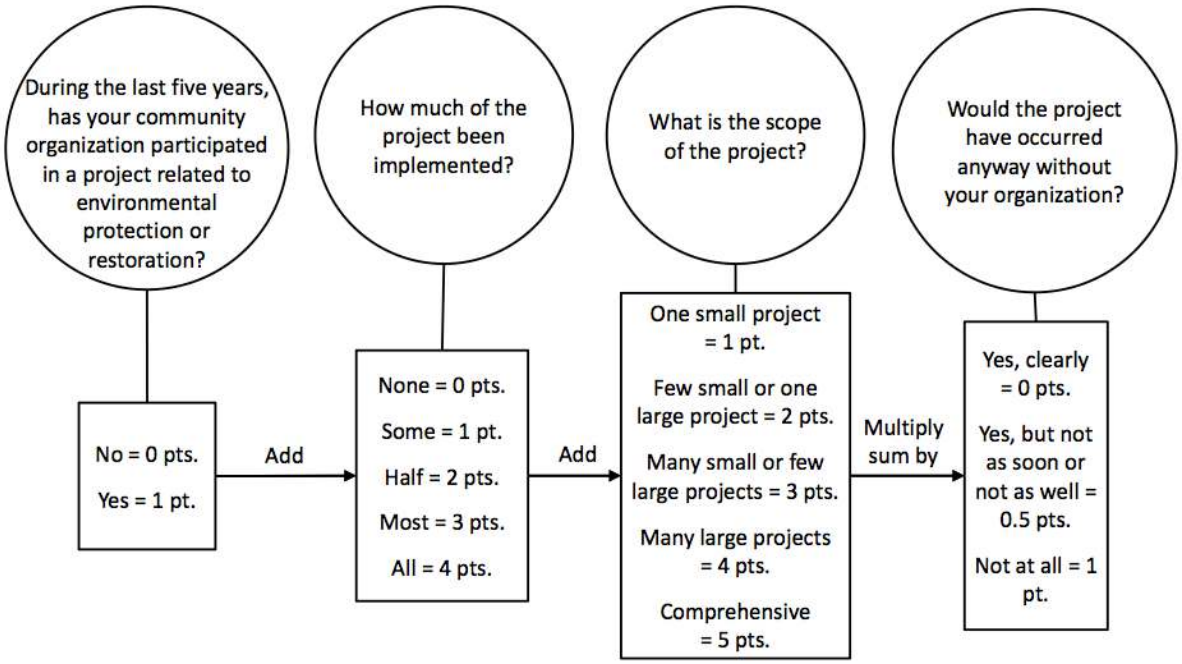

Figure 3. Index of restoration projects (Leach and Sabatier, 2005, 241 Figure 8.2). Adapted from *Are Trust and Social Capital the Keys to Success?* by W. D. Leach & P. A. Sabatier, 2005, Cambridge, MA: MIT Press.

Analysis. Following the quantitative data collection, we calculated group-level composite scores for all independent and control variables. Using statistical analysis software, we identified descriptive statistics and investigated relationships between variables. We noted several correlations, which we qualitized (operationalized verbally to reflect a theme) to reflect the terms of the related theories. These initial findings were then used during analysis of qualitative data (Greene et al. 2001; Hsieh and Shannon 2005; Mertens 2010).

Qualitative Strand

Participants. All groups were invited to participate in a more in-depth investigation through focus group interviews. General criteria for selection included a willingness and ability to provide thick, rich descriptions of experiences with their respective community groups. We conducted focus group sessions with four of the participating community groups. Group sizes ranged from four to seven participants. Focus group sessions were held at times and locations convenient for participants, and each participant was offered compensation for their time.

Instruments. Focus group sessions followed a semi-structured, open-ended format to allow participants to respond in their own words. The focus group protocol concentrated the conversation on how leadership emerged within the group, how the group addresses challenges with the group exchange structure, and types of community involvement they promoted. Some of the questions asked included:

- How would you describe the leadership style within your organization?
- What words would an outsider use to describe your organization in terms of leader to member connections?
- How does the group generally go about deciding what projects to work toward?
- We are curious about a time when there was conflict in the organization. Can you relate that experience in terms of how leadership did or did not function?

During focus group sessions, two researchers were present; one acted as facilitator and the other as note taker. In order to reduce the potential for bias, we rotated duties during the sessions. We captured interview data with a digital audio recorder. Researchers debriefed with each other immediately following each session's closure in order to capture their combined field notes and perceptions.

Analysis. Following the qualitative data collection, we enlisted a professional transcription company to transcribe the audio files verbatim. We established codes based on the statistical correlations and the themes identified in the literature. We coded for evidence of eco-leadership constructs, group cohesion, and shared transformational leadership, as measured through key aspects of the TMLQ: idealized attributes (build trust), idealized behaviors (act with integrity), individualized consideration (coach and develop people), and inspirational motivation (encourage others) (Table 1).

As stated by Rabiee (2004), "one of the tasks here is not only to make sense of the individual quotes, but also to be imaginative and analytical enough to see the relationship between the quotes, and the links between the data as a whole" (p. 658). In doing so, we became aware that, although analysis of the qualitative data corroborated some quantitative findings, it also paradoxically confounded initial findings. For example, the quantitative data did not show a correlation between group cohesion and other variables. Therefore, our initial thought was that group cohesion was not imperative to group functionality. However, the qualitative analysis showed group cohesion and eco-leadership constructs often co-occurred. From this vantage, group cohesion appeared as an important aspect of group functionality. This led us to quantitize the qualitative data. Specifically, we counted the number of times a particular code occurred and used those code counts to create a matrix of the numerical findings for each construct. With this new analysis in mind, we reviewed the original statistical outputs.

Thereafter, crossover tracks analysis was applied in the opposite direction and the quantitative data were further investigated through this new lens. In this final step, we re-analyzed group-level scores for group cohesion and four aspects of the TMLQ, and we juxtaposed this with eco-leadership code counts. That allowed us to organize the findings into an overall conclusion (i.e., meta-inference),

Table 1. Deductive codes used with qualitative data analysis in a study of eco-leadership and community organizations.

Parent Code	Sub-codes
Eco-leadership Constructs	Collective decision making, collaboration of group activities, shared leadership at group level, and grassroots organizing
Group Cohesion	Feeling of unity and consistency between group and individual goals, desire to spend time together, problem solving as group effort, despite tensions members stick together
Idealized Attributes	Instill pride in association with each other, go beyond self-interests, display extraordinary competence, behave so as to build respect for one another, display confidence in one another
Idealized Behaviors	Emphasize importance of being committed to beliefs; display conviction in their core ideals, beliefs, and values; talk about need for trust; emphasize importance of collective sense of mission; clarify the central purpose underlying mission
Individualized Consideration	Listen attentively to other's concerns, focus on developing each other's strengths; spend time teaching/coaching each other; treat each as individuals with different needs, abilities, and aspirations
Inspirational Motivation	Sets high standards, envision exciting new possibilities, talk optimistically about future, talk enthusiastically about our work, articulate a compelling vision

benefitting from a perspective that considered both strands of data and their relationship to one another.

Results

Understanding the Leadership Culture of Community Groups

The leadership culture of the community groups in our study was first assessed by the (TMLQ), followed by analysis from focus groups, and then re-assessed by re-analyzing the survey data based upon emergent findings. Correlational statistics indicate groups' behavior aligned with the "Transformational Leadership" paradigm, as measured by the TMLQ (Table 2). Respondents reported alignment with four of the transformational leadership constructs: **idealized attributes**, **idealized behaviors**, **individualized consideration**, and **inspirational motivation**. Additionally, we noted a statistically significant relationship between idealized attributes and inspirational motivation and community project involvement. At that point, with all quantitative results analyzed, we projected that groups exhibiting certain characteristics of transformational leadership (i.e., idealized attributes and inspirational motivation) may have a greater ability to complete projects than groups that do not exhibit these characteristics. Further, we surmised that group cohesion was not as significant a characteristic.

During coding of qualitative data, examples of the TMLQ constructs were present. In this section, we highlight a few participant quotes related to those constructs. Examples of **idealized attributes** were revealed in this passage between two respondents:

> Person 1: "*The thing what strikes me is, when you talk about leadership, I don't think there's a hell of a lot of training that needs to be done, because I think you basically try to bring in people who have that experience. As I look around the group, hell, every one of them could do any of the work*."

Table 2. Correlations, means, and standard deviations of variables hypothesized as related to community project involvement.

	Measure	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1	Community Project Involvement	2.25	2.60												
2	Group Cohesion	3.21	0.26	0.193*											
3	Idealized Attributes	3.27	0.51	0.283*	0.596**										
4	Idealized Behaviors	2.95	0.63	0.049*	0.443**	0.532**									
5	Inspirational Motivation	3.19	0.59	0.257*	0.507**	0.650**	0.690**								
6	Intellectual Stimulation	2.49	0.63	0.007*	0.080**	0.394**	0.518**	0.562**							
7	Individualized Consideration	2.81	0.64	0.192*	0.619**	0.702**	0.651**	0.741**	0.459**						
8	Transformational Leadership	2.94	0.49	0.185*	0.540**	0.783**	0.834**	0.888**	0.724**	0.867**					
9	Contingent Reward	2.88	0.66	0.192*	0.353**	0.455**	0.577**	0.579**	0.543**	0.506**	0.652**				
10	Management-by-Exception: Active	1.17	0.78	-0.082*	-0.376**	-0.306**	-0.245**	-0.298**	0.076**	-0.288**	-0.253**	-0.064**			
11	Management-by-Exception: Passive	1.04	0.69	-0.092*	-0.474**	-0.428**	-0.429**	-0.480**	-0.141**	-0.466**	-0.471**	-0.312**	0.619**		
12	Laissez-faire	1.10	0.67	-0.084*	-0.350**	-0.410**	-0.416**	-0.451**	-0.253**	-0.455**	-0.483**	-0.372**	0.545**	0.627**	
13	Extra Effort	2.99	0.74	0.241*	0.458**	0.602**	0.602**	0.821**	0.597**	0.682**	0.807**	0.579**	-0.218**	-0.373**	-0.453**

Note: *p<0.05, **p<0.01

Person 2: *"Sure. We're business [people]. We're professionals. We're people who have to lead and organize life; and in order to get anything accomplished, we have to get it organized. And everybody's in agreement with that."*

Evidence of **idealized behaviors** was demonstrated in all groups. A great example is the following quote:

"*I agree that there is a lot of drive, and it's not just a group of individuals meeting with and just filling space for the sake of saying that there is a functional [group name] in [region]. I mean you can tell by the meetings how passionate folks are…."*

Further, quotes revolving around **individualized consideration** manifested in response to the prompt: "What words would an outsider use to describe your organization in terms of leader to member connections?" One participant stated:

"For me, I think encouraging and innovative. The way I think of that — I can think of many people; but [member's name] in particular, he is so creative about thinking how to motivate people and how to bring people in. And when I became president, he just took it on to be my mentor. He said, 'You might want to think about this,' or 'Sometimes people really appreciate if this happens.' He would suggest; he would encourage. He wouldn't tell you 'Do this. Make this. Do this. You're doing this wrong.' He's the example that comes straight to mind, but it wasn't just him that did that, everybody helped somebody who was new in a position."

Inspirational motivation inferences were peppered throughout the focus groups. Here is an example:

"It's been a good year. I mean we were very successful in what we do; and, since next year is another election year, we're gonna do what we did this year, hopefully on a wider scale and also hopefully we can have at least another… at least another one project going and possibly two for next year."

The focus groups imparted insights about eco-leadership within these groups, which was not possible with the quantitative questionnaire. Regarding the **leadership culture** of the groups, the following quote from the focus groups represents the general experience and expectations:

"Our leadership style is very informal in a way. I think there's a great deal of respect, because people sort of rotate through the divisions anyway. But there's a great deal of respect for the fact that everybody is a volunteer. I think that's very important as a volunteer organization that you respect that. If you try to push too much as a volunteer, like you're saying, 'I think they will push back.'"

The **shared approach to leadership** is reflected in the following quotes:

"Any of the activities that we are involved in, we don't necessarily initiate; the idea comes from members on the committee."

"I think that part of our conflict resolution, our management style, is because there is no hierarchy."

The group scores from the TMLQ, as well as the number of eco-leadership construct excerpts from the focus groups, varied considerably (Table 3).

During the secondary review of the quantitative data, we noticed the group with the lowest TMLQ scores (m=2.65) also had the lowest group cohesion score (m=73.6). However, that group's expression of eco-leadership was higher than the other groups in terms of both code counts (n=41) and ratio (64%). We wondered what this meant for a description of their leadership culture. Delving deeper, we considered the rank order of a group's transformational leadership constructs (e.g., higher on inspirational motivation and lower on individual consideration) may provide insight into how they experience transformational leadership. Therefore, there may be subtle and nuanced alignments between transformational leadership and eco-leadership, and we may expect the same with group cohesion.

Understanding Group Cohesion within the Community Groups

We assessed participants' group cohesion with the GCS-R, followed by analysis of the focus group data. While there is no consensus among scholars about what amount of cohesion is good or where exactly the scale tips into either disorganization or cliquish behaviors, we hypothesize the mean rating

Table 3. Group level scores of constructs in a study on eco-leadership and community.

Group	Group Cohesion	TMLQ	Idealized Attributes	Idealized Behaviors	Individualized Consideration	Inspirational Motivation	Eco-leadership
A	73.6	2.65	2.8	2.5	2.4	3.0	41/64 = 64.06%
B	80.8	2.9	3.3	3.0	2.8	3.2	27/43 = 62.79%
C	81.3	3.12	3.4	3.0	3.1	3.3	36/54 = 66.67%
D	82.3	3.18	3.5	3.1	3.0	3.5	48/95 = 50.53%
E	79.1	2.94	3.2	3.0	2.9	3.1	No data
F	80.4	3.03	3.4	3.1	3.3	3.3	No data
G	84.8	2.86	3.2	2.9	3.1	3.0	No data

of our groups reflects a fairly high level of 'social glue.' The thick, rich data from the focus groups allowed for exploration of what these scores mean to the participating groups.

All groups spoke in varying ways about their desire to be part of their organization. Many stated that, despite controversy, they coalesce around the group's mission and goals. Further, there was ample evidence from the focus groups that problem solving was seen as a group effort and people feel they have the ability to give input into making an organization their own. Members shared:

"I feel attracted to this group. I am proud of the fact that we are active in the community in so many different ways, and I'm glad to be a part of it, and I want to continue to be a part of it. I mean it motivates me to get here."

"It's fun to come to meetings just because of the people who are there, the camaraderie. If I didn't come for any other reason, it would be for that."

"I was thinking it was funny how much the fact that we're a civic organization, but also social, and how much the fact that we eat together may affect how we feel about each other."

While we observed a high level of group cohesion in the focus group data, it is somewhat confounding that examples of anti-cohesive behaviors were also seen. Some groups spoke of controversies that ripped their organizations apart, or feeling that the group is not working in unison. For example, one narrative positions this as a provocative dilemma:

"Even though you have to make a decision, I find a lot of tear—there's a lot of torn in the committee when it comes down to it, because everybody's passionate about what it is that they stand firm on. I mean you saw some of it right now when it comes down to the scholarship. We are very passionate about… where our opinion is with that. Our opinion means a lot, and we have to meet our opinion… But what happens is when it comes down to that final decision, it's based on a vote and not so much compromise and that is what keeps—in my opinion—what keeps the group at a standstill, no form of movement because we can't get… off our own soapboxes or we can't compromise."

Reflecting on the quantitative data again, in regards to group cohesion, we find no clear indication of what was transpiring within the groups. The range of group level cohesion was a rather small range. Paradoxically, the group with the lowest cohesion score had the lowest TMLQ score

and the group with the highest cohesion score had the next to lowest TMLQ score. When comparing the scores to the eco-leadership construct, none of the relationships stayed consistent. Although group cohesion is present and actively discussed within these groups, the findings are confounding. To better understand the relationship between group cohesion, transformational leadership, and eco-leadership would require open-ended interviews and participant observation periods.

Assessing Participating Groups' Community Project Involvement

Practitioners generally assume group cohesion is necessary in order for a group to be productive, and that idea carries into the eco-leadership discourse. In this study, we wanted to further assess if community project involvement related to aspects of eco-leadership principles. To assess participating groups' community involvement, we used a previously published instrument, Leach and Sabatier's (2005) Index of Restoration Projects, and we also asked questions about this topic during the focus groups. On the Index of Restoration Projects, respondents' reporting ranged from 0.00 to 8.00, with a mean of 2.25. For comparison, when used to assess 47 U.S. based environmentally oriented groups' work on four separate occasions, Leach and Sabatier (2005) found the highest score to be 18 out of 40 (45%). Since none of our research groups have environmental protection or restoration as part of their mission statement, we surmise the exhibited mean of 2.25 out of 10 possible points (22.5%) indicates a fairly remarkable level of productivity for something that is not central to their mission. We use this index as a snapshot of their potentiality.

During the focus group interviews, participants spoke freely about various projects with which they have been involved. Through the qualitative inquiry, we found groups were likely to engage with social issues revolving around disability, food scarcity, homelessness, humane animal care, literacy, poverty, race, small town quality of life enhancement, youth education, etc. The qualitative data were rich in instances where participants spoke optimistically and enthusiastically about their projects and their projects' futures. Participants' experiences are represented in the following quotes:

> *"And so, I do a lot of stuff in the community, and that's one of the reasons why I come to this group is so I can help facilitate getting this group connected to what's outside."*
>
> *"I think that kind of in general we tend to say, 'Let's give it a try and see how it goes.'"*

A great example of optimism for a project is captured in a narrative about a younger organization member who proposed an idea:

> *"He has an idea that he is all excited about, and I know he's going to have the support of the whole organization, not just our committee…. And this is what he wants to get with us and have us involved in; and I can see where that's going to happen."*

Relationship between Leadership Culture, Group Cohesiveness, and Project Involvement

One of the main objectives of this study was to determine if a relationship exists between leadership culture, group cohesion, and community project involvement. Table 2 points to statistical findings. However, it was imperative that both the qualitative and quantitative data contribute to our understanding. During the analysis, each type of data was transformed in ways that allowed for integration to occur.

In considering statistical correlations between aspects of transformational leadership and community project involvement, we found a weak-to-moderate relationship between idealized attributes and community project involvement and a second weak-to-moderate relationship between inspirational motivation and community project involvement. Group cohesion was not statistically related to community project involvement.

We noted a correlation between transformational leadership and group cohesion. Pulling apart the transformational leadership aspects, we noted significant relationships between group cohesion and idealized attributes, inspirational motivation, and individualized consideration. Lesser, but still significant, was the relationship with idealized behaviors.

In regard to the eco-leadership constructs assessed via the focus group data, the quantification of data (Table 4) show the code co-occurrence. We note an associative coding between eco-leadership

Table 4. Co-occurrence of qualitative codes in a study of eco-leadership and community organizations. The shading represents the three main parent codes: eco-leadership (and its subcodes), group cohesion, and the TMLQ aspects for which we coded. The last column and the bottom row are also shaded to call attention to the totals counts.

	Eco-leadership, Overall and Sub-codes						Transformational Leadership			
	Eco-leadership constructs	**Collaboration of group activities**	**Collective decision making**	**Grassroots organization**	**Group level shared leadership**	**Group cohesion**	**Idealized attributes**	**Individualized consideration**	**Inspirational motivation**	**Totals**
Eco-leadership constructs		57	68	45	39	62	33	14	28	**346**
Collaboration of group activities	57		10	17	10	18	11	5	17	**145**
Collective decision making	68	10		19	10	37	15	9	9	**177**
Grassroots organization	45	17	19		12	10	8	4	9	**124**
Group level shared leadership	39	10	10	12		15	10	4	5	**105**
Group Cohesion	62	18	37	10	15		35	15	38	**230**
Idealized attributes	33	11	15	8	10	35		14	12	**138**
Individualized consideration	14	5	9	4	4	15	14		1	**66**
Inspirational motivation	28	17	9	9	5	38	12	1		**119**
Totals	**346**	**145**	**177**	**124**	**105**	**230**	**138**	**66**	**119**	

Note: The table allows for interpretation by looking across the rows or down the columns.

constructs and group cohesion. For example, out of the 346 eco-leadership codes, 62 of those were also coded for cohesion (approximately 18%). This is much higher than any of the TMLQ factors.

Emergent Findings: Role of Conflict in Eco-Leadership

Like any ecosystem, a community group has many connecting parts. Even though the group is still functioning, creating programs, having social events, and generally doing the organization's work, small tensions may mount and cause conflict. Each of the participating groups in the focus groups spoke of inner group dynamics and how they manage conflict.

The eco-leadership discourse references collective decision making, TMLQ includes individualized consideration (i.e., treating each other as individuals with different needs, abilities, and aspirations, etc.), and group cohesion includes the ability to stick together despite tensions. We found the comments from participants illuminated these constructs in ways a quantitative instrument never could. For example, one group discussed an emotional conflict that arose among the members and their efforts to create a listening environment that allowed for group decision making. Three members explained:

Person 1: *"Well I would say without a doubt people were satisfied with the process that was used."*

Person 2: *"It got things out in the open, which had been, you know, back in the background."*

Person 3: *"But the people who had very strong convictions, either to the right or to the left, didn't change their convictions. They might of… but everybody felt the process was fair."*

Despite evidence of conciliatory and consensus making practices, the analysis piqued our interest with statements from participants regarding instances of conflict that caused members to feel hurt, retreat from active participation, and occasionally leave the group. Digging deeper into these stories, we found collective decision making was not easy when the emotional stakes were high (i.e., when the group's ideals, beliefs, or values were at the center of the debate). However, the appearance of shared leadership at the group level, along with idealized attributes and individualized consideration, created an environment that fostered group cohesion (the desire to work it out and stick it out). One participant shared:

"So sometimes the discussions get a little bit intense; but if we can sit through it, we see a perspective that we didn't have when we came in because we're so focused. So, the perspectives bring the balance that's necessary. Sometimes I think we maybe should meet twice a month [laughs] until we get through a lot of the details, because we're increasing our activity and so we have more things to discuss."

Conclusions and Implications

This study breaks ground by applying mixed methods research to the emerging eco-leadership theory. To date, publications on eco-leadership have been primarily theoretical in nature. Little information exists on how eco-leadership manifests in community settings. Additionally, no one has adequately explained how this new type of leadership culture influences or is influenced by group cohesion. Further, there is a lack of empirical evidence regarding how this new type of leadership culture may affect community engagement. This study empirically examined community groups, investigating the occurrence of eco-leadership in practice by analyzing the relationships between their leadership cultures, cohesiveness, and community project involvement.

Although a limitation of this pilot study is the small sample population and the fairly homogenous demographics of participants, the insights produced are still helpful in carrying knowledge of eco-leadership in practice forward (Figure 4). Through our meta-inference of both quantitative and qualitative data we conclude the following for our study population:

- Eco-leadership characteristics exist in all these groups. The construct of collective decision making appeared the most often, followed by collaboration of group activities, grassroots organization, and, lastly, group-level shared leadership.
- There appears to be an association between eco-leadership traits and group cohesion.

- Transformational Leadership factors correlate with group involvement in community projects, indicating groups engaging in transformational leadership practices may be more productive.
- Although group cohesion was not statistically correlated to community project involvement, we found a qualitative relationship between a group's desire to work together and its pride and enthusiasm about the group's projects.
- The role of conflict should not be denied when seeking to understand how community groups function. In this case, some groups mentioned the ability to effectively manage conflict, but all shared examples of when conflict damaged their cohesion and productivity.

While the findings of this study are not generalizable, the lessons learned have important implications for practitioners and researchers alike. This study points to further expansion of the eco-leadership discourse, particularly related to civic organization leadership and involvement. Beyond incorporating eco-leadership principles into curricula, we encourage leadership studies professionals to consider innovative mixed methods research procedures, due to the potential for greater insight.

Even though leadership education programs are adapting to the new, more collaborative nature of leadership, a lack of research and validated models has limited the scholarly and curricular support for such changes (Leigh et al. 2010). The exploratory nature of this study points to questions for further investigation:

- Are the ways in which scholars look for group cohesion too broad? If the construct needs to be finessed, would aspects of transformational leadership apply? Can mixed methods practices improve our understanding of how these relate, or not?
- Are these community groups unique in their display of eco-leadership constructs, or would similar results be found in other localities?
- What can leadership educators do to better support and promote the principles associated with effective eco-leadership?
- How can groups best manage conflict in a way that is productive?

We encourage others to join us in conducting research that helps answer these questions.

Insight from the Mixed Methods Process

We approached this research with a desire to expand the repertoire of current leadership studies' research methods by mixing qualitative and quantitative data collection methods, analysis, and inferences. What can we learn about using a mixed methods study to look into such complex

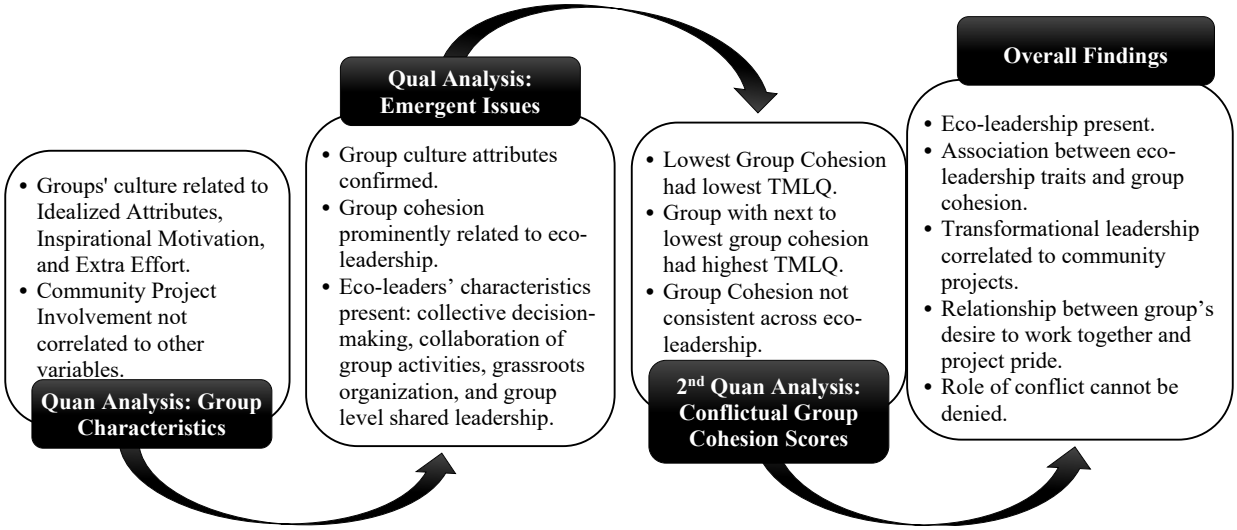

Figure 4. Summary of findings at each stage of analysis. The black boxes and arrows show the stages taken during this process. Inside the box are the key points found at each stage which moved the research forward.

small group dynamics? Our research design was a mixed methods explanatory design with parallel data collection, sequential data analysis using crossover tracks analysis. It has been argued that mixed methods approaches are more comprehensive (i.e., they include different aspects and perspectives) and hence yield results which provide more insight and deeper understandings of an issue (Greene et al. 2005).

Our belief was this would ultimately lead to a deep, rich understanding of the relationships we sought to study in a way a single strand of data could not. In going through this process, our initial quantitative data analysis showed some surprising results. Our findings did not show a statistically significant correlation between group cohesion and group productivity. This caused us to question if group cohesion was really necessary, despite literature on the topic that suggests it is vital. Many community leadership programs emphasize group cohesion and spend ample time training on how to achieve this elusive "social glue." We initially believed our findings might shine new light on this practice.

However, as we delved into the qualitative data, a different story began to emerge. The participants spoke eloquently of group cohesion traits (e.g., feeling of unity/togetherness, problem solving as a group effort, and sticking together despite tensions). Roughly 30% of the qualitative excerpts were coded for group cohesion. Further, since eco-leadership constructs were being explored through the qualitative data only, we were acutely aware of the many excerpts being coded for these eco-leadership constructs. This caused us to think of the quantitative data in a different way. Revisiting the quantitative data, we re-analyzed the data and compared them to the eco-leadership constructs, which enabled us to see the data from multiple angles and report more holistically about the nature of eco-leadership within these groups. We hope others benefit from our experience and pursue additional practical opportunities for gleaning valuable insights from mixed methods research.

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References

Allen, K.E., S.P. Stelzner, and R.M. Wielkiewicz. 1999. The ecology of leadership: Adapting to the challenges of a changing world. *Journal of Leadership & Organizational Studies* 5(2): 62-82. DOI: 10.1177/107179199900500207.

Avolio, B.J., N. Sivasbramaniam, W.D. Murry, D. Jung, and J.W. Garger. 2003. Assessing shared leadership: Development and preliminary validation of a team multifactor leadership questionnaire. In: *Shared Leadership: Reframing the Hows and Whys of Leadership*, C.L. Pearce and J.A. Conger (Eds.). SAGE Publishing, Thousand Oaks, California, pp. 143-172. DOI: 10.4135/9781452229539.n7.

Avolio, B.J., F.O. Walumbwa, and T.J. Weber. 2009. Leadership: Current theories, research, and future directions. *Annual Review of Psychology* 60(1): 421-449. DOI: 10.1146/annurev.psych.60.110707.163621.

Bass, B. and B.J. Avolio. 1996. *Team Multifactor Leadership Questionnaire*. Mind Garden, Menlo Park, California. Available at: https://www.mindgarden.com/149-team-multifactor-leadership-questionnaire. Accessed July 1, 2019.

Burbach, M.K., K. Floress, and E.K. Kaufman. 2015. Are water-related leadership development programs designed to be effective: An exploratory study. *Journal of Leadership Education* 14(1): 107-123. DOI: 10.12806/V14/I1/R7.

Carron, A.V. and L.R Brawley. 2012. Cohesion: Conceptual and measurement issues. *Small Group Research* 43: 726-743. DOI: 10.1177/1046496412468072.

Cletzer, D.A. and E.K. Kaufman. 2018. Eco-leadership, complexity science, and 21st century organizations: A theoretical and empirical analysis. In: *Innovation in Environmental Leadership: Critical Perspectives*, B.W. Redekop, D. Rigling Gallagher, and R. Satterwhite (Eds.). Routledge, New York, NY, pp. 80-96.

Creswell, J.W. and V.L. Plano Clark. *Designing and Conducting Mixed Methods Research*. SAGE Publishing, Thousand Oaks, California.

Greene, J.C. 2007. *Mixed Methods in Social Inquiry*. John Wiley & Sons, San Francisco, CA.

Greene, J.C., L. Benjamin, and L. Goodyear. 2001. The merits of mixing methods in evaluation. *Evaluation* 7(1): 25-44. DOI: 10.1177/13563890122209504.

Greene, J.C., H. Kreider, and E. Mayer. 2005. Combining qualitative and quantitative methods in social inquiry. In: *Research Methods in the Social Sciences*, B. Somekh and C. Lewin (Eds.). SAGE Publishing, London, United Kingdom, pp. 274-281.

Gronn, P. 2008. The future of distributed leadership. *Journal of Educational Administration* 46(2): 141-158. DOI: 10.1108/09578230810863235.

Grumbles, B.H. n.d. Building Livable Communities Starts with a Watershed Address. Washington, D.C., United States Environmental Protection Agency. Available at: http://wren.palwv.org/documents/BuildingLivableCommunities-Grumbles.pdf. Accessed July 1, 2019.

Hsieh, H.F. and S.E Shannon. 2005. Three approaches to qualitative content analysis. *Qualitative Health Research* 15: 1277-1288. DOI: 10.1177/1049732305276687.

Klenke, K. 2008. *Qualitative Research in the Study of Leadership*. Emerald Group Publishing, United Kingdom.

Kubeš, M. 1998. Adaptors and innovators in Slovakia: Cognitive style and social culture. *European Journal of Personality* 12(3): 187-198.

Leach, W.D. and P.A Sabatier. 2005. Are trust and social capital the keys to success? Watershed partnerships in California and Washington. In: *Swimming Upstream: Collaborative Approaches to Watershed Management,* P.A. Sabatier (Ed.). MIT Press, Cambridge, Massachusettes, pp. 233-258.

Leigh, J.M., E.R. Shapiro, and S.H. Penney. 2010. Developing diverse, collaborative leaders: An empirical program evaluation. *Journal of Leadership & Organizational Studies* 17(4): 370-3. DOI: 10.1177/1548051809355510.

Mertens, D.M. 2010. *Research and Evaluation in Education and Psychology: Integrating Diversity with Quantitative, Qualitative, and Mixed-methods.* SAGE Publishing, London, United Kingdom.

Molina-Azorin, J.F. 2011. The use and added value of mixed methods in management research. *Journal of Mixed Methods Research* 5(1): 7-24. DOI: 10.1177/1558689810384490.

Morton, L.W. and S.S. Brown (Eds.). 2011. *Pathways for Getting to Better Water Quality: The Citizen Effect*. Springer, New York, NY. DOI: 10.1007/978-1-4419-7282-8.

Pearce, C.L., Y. Yoo, and M. Alavi. 2004. Leadership, social work, and virtual teams: The relative influence of vertical versus shared leadership in the nonprofit sector. In: *Improving Leadership in Nonprofit Organizations*, R.E. Riggio and S.S. Orr (Eds.). Jossey-Bass, San Francisco, CA, pp. 180-203.

Rabiee, F. 2004. Focus-group interview and data analysis. *Proceedings of the Nutrition Society* 63: 655-660. DOI: 10.1079/PNS2004399.

Redekop, B.W. (Ed.). 2010. *Leadership for Environmental Sustainability*. Routledge, New York, NY.

San Martín-Rodríguez, L., M.D. Beaulieu, D. D'Amour, and M. Ferrada-Videla. 2005. The determinants of successful collaboration: A review of theoretical and empirical studies. *Journal of Interprofessional Care* 19(s1): 132-147. DOI: 10.1080/13561820500082677.

Seibert, S.E., R.T. Sparrowe, and R.C. Liden. 2003. A group exchange structure approach to leadership in groups. In: *Shared Leadership: Reframing the Hows and Whys of Leadership*, C. L. Pearce and J. A. Conger (Eds.). SAGE Publishing, Thousand Oaks, California, pp. 173-192. DOI: 10.4135/9781452229539.n8.

Small, M.L. 2011. How to conduct a mixed methods study: Recent trends in a rapidly growing literature. *Annual Review of Sociology* 37: 57-86. DOI: 10.1146/annurev.soc.012809.102657.

Stentz, J.E., V.L.P. Clark, and G.S. Matkin. 2012. Applying mixed methods to leadership research: A review of current practices. *The Leadership Quarterly* 23(6): 1173-1183. DOI: 10.1016/j.leaqua.2012.10.001.

Teddlie, C. and A. Tashakkori. 2009. *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*. SAGE Publishing, Thousand Oaks, California.

Treadwell, T., N. Lavertue, V.K. Kumar, and V. Veeraraghavan. 2001. The group cohesion scale revised: Reliability and validity. *International Journal of Action Methods* 54(1): 3-11.

Western, S. 2008. *Leadership: A Critical Text*. SAGE Publishing, Thousand Oaks, CA. DOI: 10.4135/9781446280294.

Western, S. 2010. Eco-leadership: Toward the development of a new paradigm. In: *Leadership for Environmental Sustainability*, B.W. Redekop (Ed.). Routledge, New York, NY, pp. 36-54.

Western, S. 2018. The eco-leadership paradox. In: *Innovation in Environmental Leadership: Critical Perspectives*, B.W. Redekop, D. Rigling Gallagher, and R. Satterwhite (Eds.). Routledge, New York, NY, pp. 48-60.

Wielkiewicz, R.M. and S.P. Stelzner. 2010. An Ecological perspective on leadership theory, research, and practice. In: *Leadership for Environmental Sustainability*, B.W. Redekop (Ed.). Routledge, New York, NY, pp. 17-35.

Wren, J.T. 1995. *The Leader's Companion: Insights on Leadership through the Ages.* The Free Press, New York, NY.

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Using Serious Games to Facilitate Collaborative Water Management Planning Under Climate Extremes

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Abstract: Sustainable management is a complex process that involves balancing the competing interests of the human, plant, and animal communities that depend on watershed resources. It involves developing and implementing plans, programs, and projects that sustain and enhance watershed functions while taking into account the natural, social, political, economic, and institutional factors operating within the watershed and other relevant regions. Examples of such factors include crosscutting mandates by different levels of government, conflicting objectives across sectors, and the constraints and uncertainty of the availability and accessibility of the resources within the watershed. One way to address these complexities is with public participation processes designed to share knowledge among disciplinary experts, policy-makers, and local stakeholders and provide outcomes, which inform the creation of sustainable watershed management plans. Serious games (i.e., games played for purposes other than pure entertainment) are an example of such processes. Here, we present a case study of how a serious game, called the multi-hazard tournament, was used to facilitate watershed management by promoting social learning, cross-sectoral dialogue, and stakeholder participation in the planning process.

Keywords: *water resources, drought, public participation, systems thinking, social learning*

Games are becoming increasingly popular as an alternative education and training tool, as businesses, organizations, and government entities look for innovative ways to engage individuals, train staff, and address societal challenges (Galvão et al. 2000; Michael and Chen 2006). Applications of games include the military, business, higher education, medical training, urban development, policy, natural resource management, and countless others (Cohen and Rhenman 1961; Burton 1994; Wachowicz et al. 2003; Mayer et al. 2005; Bots and Van Daalen 2007; Royse and Newton 2007; Mayer 2009; Breuer and Bente 2010; Hummel et al. 2011). The U.S. Department of Homeland Security (DHAS) promotes the use of games when managing risk and considers them to play a key role in disaster management (FEMA 2016). For instance, serious games can identify vulnerabilities and solutions for mitigation; increase preparedness by training participants, clarify roles and responsibilities, and improve interagency coordination; identify needs and capabilities during a response to a disaster; and assess the resources needed for recovery.

Games have numerous benefits that translate to water management. For example, participation in a game, as a fun activity, may make the learning process more enjoyable or may bring people to the table who would otherwise not participate (Burby 2003). Games provide a safe environment for players to learn and experiment with decisions by seeing the direct impact of those decisions through feedback mechanisms (Mayer 2009). Games can also prepare players for the real situation to which the game refers (Peters and Vissers 2004) and provide a suitable environment for improving negotiation skills, consensus building, and changing players' beliefs and attitudes (Garris et al. 2002; Rusca et al.

2012). These benefits become especially important with the fact that adults have a greater motivation to learn if the learning process is interactive (Falk 2001) and when they know the new knowledge will effectively incorporate with their real-life problems and responsibilities (Arndt and LaDue 2008).

In this paper, we use a case study of how a game, called the multi-hazard tournament (Muste et al. 2017), was used in the Cedar River Watershed in eastern Iowa to increase stakeholder participation in the planning process, foster cross-sector collaboration, build knowledge of the complexities of water management planning, and influence attitudes toward policy.

Serious Games

Games that have a designed purpose other than entertainment are called serious games (Abt 1987). Serious games focus on the transfer of game features like competition, co-operation, participants, and rules to user-centric contexts and goals. In other words, they try to help users understand a situation by thinking of it as a game rather than a real-world challenge and as players rather than competing stakeholders (Schmidt et al. 2015).

The Invitational Drought Tournament (IDT) is an example of a serious game used within the context of water management. The IDT, developed by Agriculture and Agri-food Canada (Hill et al. 2014), is a goal-oriented game designed to educate and train participants in decision-making skills around drought and water management. Part workshop and part competition, the tournament engages participants in the use of environmental data to stimulate conversations about drought in the context of a changing climate. Players work in interdisciplinary teams to develop comprehensive management strategies for minimizing environmental, social, and economic impacts of drought.

In early iterations of the tournament (AMEC 2012; Lapp 2012; AMEC 2014), teams were guided through scenarios set in a fictitious watershed that had features and characteristics similar to those that would be found in the region where the tournament was taking place. The fictional setting helped keep the game as politically and geographically neutral as possible so that players could engage in open discussion in a safe forum. Scenarios included drought characteristics (e.g., temperature, precipitation, soil moisture, etc.) as well as impacts of drought (e.g., decreased agricultural yields, increased household stress, reduced tourism, etc.).

More recently, the IDT has evolved in complexity to include multiple hazards (e.g., flood, drought, water quality) and the use of a model-based interactive decision-support system designed to support community problem-solving in selecting a watershed adaptation strategy (Muste et al. 2017). This iteration of the tournament was tested in the Cedar River Basin in eastern Iowa to assess its effectiveness in meeting objectives falling within the context of three theoretical frameworks.

Theoretical Background

The frameworks used in this case study include: public participation theory, systems thinking theory, and gaming theory.

Public Participation Theory

Public participation is the process by which public concerns, needs, and values are incorporated into the decision-making processes of governments, organizations, and corporations (Creighton 2005). The International Association for Public Participation (IAP2) defines a set of core values for making better decisions and reflecting the interests and concerns of the affected parties (IAP2 n.d.). These core values state the following:

1. The public has a right to be involved in decisions that affect their lives.
2. The public's contribution will influence the decision.
3. The public participation process will communicate the needs and interests of all participants, including the decision-makers.
4. The public participation process will seek out and facilitates the involvement of those potentially affected by a decision.
5. The public participation process will seek input from participants in designing how they will participate.
6. The public participation process will provide participants with the information they need to participate in a meaningful way.

7. The public participation process will communicate to participants how their input affected the decision.

The complexity of water resource planning and management makes it essential to bring together the right group of people and to provide them with the necessary data for making fair, efficient, and informed decisions for managing the risks caused by climate extremes. Stakeholders involved in the process should represent several aspects of social, economic, and environmental perspectives to expand options, address the most concerns possible, and create mutual understanding. Any gaps in information or perspective could lead to results that fall short of planning goals (Wall and Hayes 2016).

Public participation includes five levels of engagement (Figure 1) designed to inform, consult, involve, collaborate with, and empower the public (IAP2 n.d.; Creighton 2005). Each level includes greater engagement with the public and, correspondingly, has a greater impact. The inform stage, which has the lowest level of public impact, is a one-way flow of information designed to provide the public with the necessary background to fully understand a project or decision. In the consult stage, two-way communication begins and the public is provided an opportunity to express their views. The involve stage includes an interactive exchange of ideas throughout the project or decision-making process, though final decisions remain out of the public's hands. In the collaborate stage, the public takes an active role in the decision-making process in an effort to reach a consensus and mutually resolve issues. The highest level of public impact occurs with empowerment, which places final decision-making in the hands of the public. The higher levels of engagement also include aspects of the lower levels. For example,

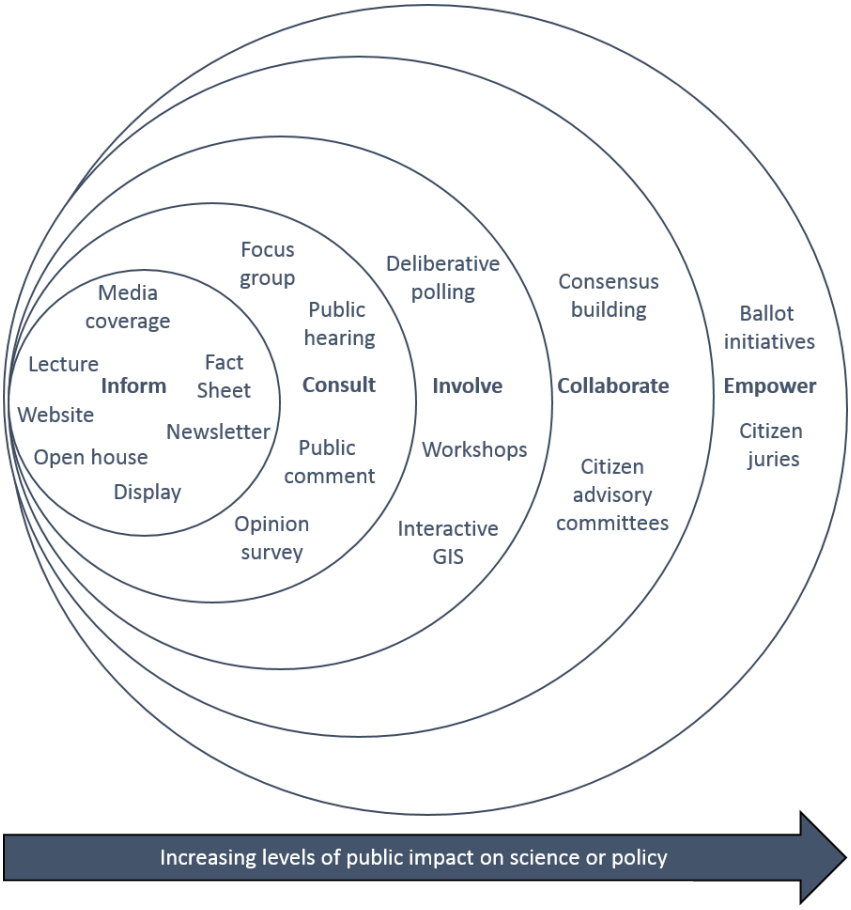

Figure 1. Levels of public participation (IAP2 n.d.; Miskowiak 2004).

the public must be informed to actively participate in collaborations or to make knowledgeable decisions. Public participation programs may include multiple levels of public participation, because of differing needs at different stages of the process and because different stakeholders will choose to engage in different ways.

Serious games such as the multi-hazard tournament meet a variety of goals in the public participation spectrum. For example, the multi-hazard tournament informs participants by providing them with an entertaining method for digesting scientific information and creates opportunities for collaboration by providing an environment in which participants can experiment with decisions under the constraints of economic, policy, and political frameworks (Hill et al. 2014). Part of the public participation process includes designing meaningful objectives and goals and providing information that can be communicated in a meaningful way. In doing so, stakeholders can see how they are affected by outcomes and organizers can assess whether or not the information and process made a significant impact in a stakeholder's decision-making.

Systems Thinking Theory

Systems thinking is a holistic approach to problem-solving that focuses on the interconnectedness and interdependencies among the different parts of a system (Behl and Ferriera 2014). It can be thought of as the ability to see the "big picture" or to recognize that "the whole is more than the sum of its parts." This approach provides opportunities to incorporate multiple perspectives, understand complex system behavior, work on problems with "fuzzy" boundaries or scopes, and to predict the impact of changes to the system (Arnold and Wade 2015).

Key components to systems thinking (Stave and Hopper 2007; Behl and Ferriera 2014; Arnold and Wade 2015) include the ability to: 1) perceive the system as a whole rather than individual parts; 2) recognize and understand feedbacks within the system; 3) understand how the behavior of the system is a function of internal structure and interactions; 4) use conceptual models to explain system behavior; and 5) understand systems at different scales.

A systems thinking approach is particularly suited to water management as managers today are expected to cope with increasing complexity and uncertainty. For instance, water managers need to account for diversity in water use, consider differing stakeholder viewpoints, understand the interconnected relationships within and between the environment and society, and discern how changes in policy affect water quantity and quality, and impact communities and ecosystems (Halbe et al. 2013; Behl and Ferriera 2014).

The multi-hazard tournament applies many of the aspects of a systems thinking approach to water management (Muste et. al. 2017). For example, interdisciplinary teams can promote social learning and help participants understand multiple perspectives for water resource management. A conceptual model of the river basin simplifies the complexity of the system to help increase understanding and a computer-based decision support system offers a way for participants to examine how feedbacks within the system relate to differing adaptation options. Finally, input from local, state, and federal entities help stakeholders understand the system at different scales. By providing players with opportunities to test potential adaptation strategies to reduce risk from extreme climate events while, at the same time, accounting for water quality issues, tournament organizers hope to move people toward a systems thinking approach (Hill et al. 2014).

Complexity and Game Theory

Game theory is the process of modeling the "conflict and cooperation between intelligent, rational decision-makers" (Myerson 2013). While this theory may have begun under the hypothesis that decision-making is well thought out and strategic, it has since evolved with the hypothesis that decision-making is, rather, "chaotic and messy" (Mayer 2009), and that straightforward programmable solutions do not always exist.

Problems in decision-making can be defined by both technical-physical and social-political complexity (Mayer 2009). Technical-physical complexity refers to complexity that arises as a result of the physical and technical entities within the system or quantifiable factors such as economics and demographics. Social-political

complexity results from competing values, needs, norms, and beliefs of stakeholders affecting and affected by policy outcomes. For example, natural resources management is frequently hampered by conflicting uses and priorities driving management decision.

Serious games now have the potential to help address and integrate technical-physical and social-political complexity (Medema et al. 2016). For example, a game can use conceptual models to simplify the complex interactions within a water management system and provide opportunities for players to test and gain insight into different adaptation strategies (Bots and van Daalen 2007; Ewen and Siebert 2016). When a game incorporates multiple players it has additional benefits of allowing players to interact, experience social learning (i.e., adjust their understanding by "walking in another's shoes"), negotiate conflict, and engage in collaborative decision-making (Bots and van Daalen 2007; Ewen and Siebert 2016; Medema et al. 2016). These types of games may provide benefits to natural resources management by creating shared knowledge, increasing understanding of the system, and leading to more effective collaborative planning (Innes and Booher 1999; Barreteau et al. 2007).

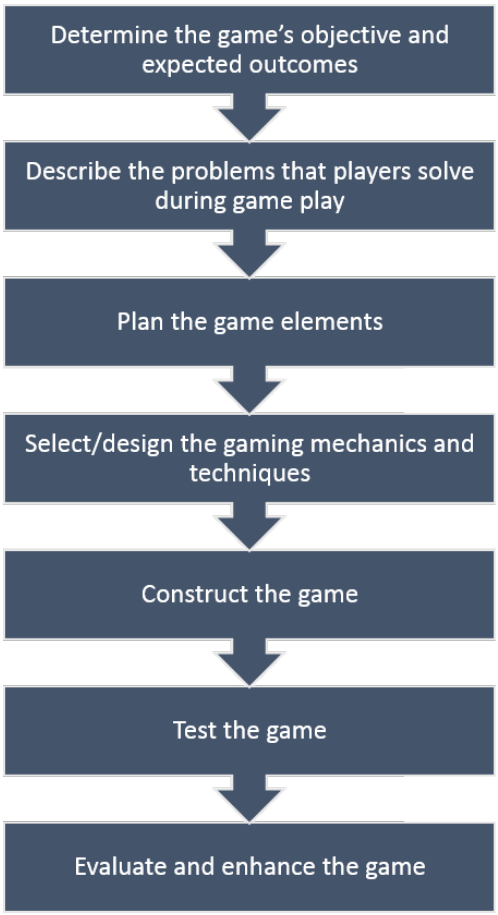

Figure 2. Basic steps to game design (Duke 1980; Smith et al. 2017).

Assessment Plan

Setting clear goals during the planning stages of a serious game (Figure 2) is essential for assessing its effectiveness within the contexts of public participation, systems thinking, and complexity and gaming theories. In the game, process outcomes can include *knowledge into action*, where the goal is to learn and apply knowledge; *action into knowledge*, where the goal is to generate new knowledge through participation in the game; or an *integration of action and knowledge*, where the goal is to make connections between the two (Koestler 2009).

In the case of the first (knowledge into action), organizers can assess whether an action, or even perceptions of an action, change before and after learning new knowledge. In the case of the second (action into knowledge), assessment includes determining whether participants changed their understanding of a topic through participation in the game. The goals of a serious game may integrate both knowledge-into-action and action-into-knowledge, where the expectation is that participants bring diverse knowledge and learn to apply their knowledge to a problem *and* generate understanding, skills, and knowledge from the experience.

A multiplayer game such as the multi-hazard tournament, adds elements of social learning which include learning new knowledge from one another, generating new knowledge from the act of working collaboratively, and working collectively to apply knowledge to a problem. In this instance, assessment may be based upon the following outcomes:

Action-to-Knowledge

- Did the players learn anything regarding the problem, information resources, or strategies?

- Did players learn or generate knowledge about strengths and weakness in existing plans, policies, or decision-making processes?
- Did players get the information that they needed to make change?

Knowledge-to-Action

- Will the players incorporate new tools or skills into future activities?
- Did or will it improve communication and coordination among player agencies and sectors? Did any new collaborations emerge?
- Do players intend to change plans, policies, or decision-making processes based on information obtained from the tournament?

Table 1 maps these outcomes to the theoretical frameworks discussed previously.

Case Study

Cedar River Watershed Overview

The multi-hazard tournament described in this case study focused on the Middle Cedar Watershed, a watershed or drainage basin that starts at the beginning of the Cedar River near Austin, Minnesota and extends southward into the city of Cedar Rapids, Iowa. The watershed spans parts of 10 counties in eastern Iowa (Figure 3) and covers approximately 1.5 million acres (University of Iowa 2017). The watershed serves multiple communities including the cities of Cedar Rapids (pop. 126,326), Waterloo (pop. 68,406), and Cedar Falls (39,260) (U.S. Census Bureau 2016). It also supports intensive agriculture, with over 73 percent of the land dedicated to row crop and seed corn production (University of Iowa 2017), and industrial uses.

The tournament focused on the watershed level because it includes groundwater, lakes, streams, reservoirs, and wetlands and allows for a holistic approach to water management. Water management concerns within the watershed include nutrient loading, flooding, and drought.

Water Management Regulatory Issues

The following items are example regulations within the Cedar Rapids Watershed that contribute to the complexity of water management in the basin (U.S. Army Corps of Engineers, 2016).

Ownership and Permitting. Surface and groundwater are public goods of the state; however nearly all of bed and banks of Iowa's rivers and streams are privately owned. Permitting for withdrawals and storage depends upon the quantity of water being diverted. Users must preserve minimum flow values in the river and not interfere with the course of drainage to the extent that it damages others' property.

Water Quality. Agricultural producers are exempt from liability resulting from nitrate or pesticide contamination of groundwater as long as fertilizers and pesticides are applied in accordance with soil test results and applicable regulations. Permits are required for the discharge of anything into underground water bodies and for discharge into surface water. Drinking water facilities must be regulated in accordance with federal standards.

Water Quantity. Water uses are subject to the control of the State and must be for a recognized "beneficial use." The Governor can prohibit various activities and uses to protect life, health, property, or public peace for ten days.

Tournament Description

Participants were organized into teams charged with integrated management of the Cedar River Watershed to create the best solutions for reducing flood, drought, and water quality impacts under climate scenarios affecting the basin (USACE IWR 2016; Muste et al. 2017). Each team worked collaboratively using their knowledge and expertise to select appropriate adaptation options for the scenarios under the constraints of time, budgets, state and municipal regulations, and technical aspects (Table 2).

In addition to team players, the tournament included other roles (USACE IWR 2016). Referees served as content experts for providing insight and feedback into the feasibility of innovative adaptation options and participated in the scoring process for assessing each team's management plan (Figure 4). Team facilitators kept discussions flowing, ensured all team members were respected and heard, tracked the time and budget, and submitted the team's final decisions and peer scores. Fans observed the tournament, participated in the scoring process, and

Table 1. Assessment outcomes matched to the underlying theoretical frameworks.

	Assessed outcome	Applicable theoretical framework(s)
Action to Knowledge	Did the players learn anything regarding the problem, information resources, or strategies?	*Public Participation:* Players were informed about decisions that would affect their lives. *Systems Thinking:* Players' ability to perceive the system as a whole increased as a result of their participation in the tournament. *Complexity and Game Theory:* Players experienced social learning.
	Did players learn or generate knowledge about strengths and weakness in existing strategies for mitigation?	*Systems Thinking:* Players recognized and understood feedbacks within the management system.
	Could players evaluate the investments needed to drive change?	*Systems thinking:* Players understood the behavior of the system. *Complexity and Game Theory:* The game adequately simplified complex interactions within the system.
Knowledge to Action	Will the players incorporate new tools or skills into future activities?	*Public Participation:* Players were empowered to use new information and skills
	Did/Will it improve communication and coordination among player agencies and sectors? Did any new collaborations emerge?	*Public Participation:* Players' experience increased partnerships in the planning process. *Complexity and Game Theory:* Game interactions led to more collaborative planning.
	Do players intend to change plans, policies, decision-making processes based on information obtained from the tournament?	*Public Participation:* Players were empowered to use new information and skills.

Figure 3. Cedar River Basin upstream of the city of Cedar Rapids (University of Iowa 2016).

Figure 4. A team consults with a referee regarding a technical question or innovation.

provided feedback on the tournament process. An announcer presented the scenarios and provided overall facilitation for the event.

Sixty participants, representing entities ranging from federal, state, and local governments to non-governmental organizations, farmers, and academia, attended the tournament. They were sorted into seven teams. Each team was given the same budget and a list of adaptation options to address when working through four scenarios. The format for the day (Figure 5) consisted of four rounds which included a presentation of the scenario, facilitated discussion of the scenarios, adaptation option selection, team report-outs (in the form of a press release, to justify the choices made), and scoring.

In the first scenario each team was given a $1.6 billion budget for adopting water management strategies for a 20 year planning period. This amount was based on a real-world estimate, which included anticipated funding for the region over the next 20 years. The first round was considered a long-term planning round and did not include hazards. In rounds two and three, the planning range was reduced to one year and team budgets dropped to $62 million, including the maintenance and operating costs from round one. Round two emphasized flood, which caused the teams to reconsider previous management choices and consider future flood precautions. Round three focused on drought causing the teams' mindsets to shift from too much water and immediate damage

Table 2. Summary of the Iowa Multi-hazard Tournament design by game element (adapted from Duke 1980).

Game element	Description	Iowa Multi-hazard Tournament
Scenario	Story line and sequence of drought-related events that challenge players	Teams worked collaboratively to address water management issues in the Cedar River Basin under extreme climate events
Sequence	Order in which the game unfolds	Game consisted of four rounds: (1) initial set up of the team's water management strategy and the selection of management options for a (2) flood, (3) drought, and (4) climate change
Steps of play	Progression of the phases in a turn	Introduction of the scenario, facilitated team discussion, selection of adaptation options using a web-based decision-support tool, presentation of a press release, and scoring
Rules	Regulations governing game play	A playbook outlined the game rules. Players worked under time and budget constraints to select pre-determined adaptation options or devise innovative solutions deemed feasible by the referees
Roles	Characters assigned to game participants	Team players, team facilitators, referees, fans, and an announcer
Scoring	Basis for awarding points	Scoring was based on how well team adaptation options performed in the economic, social, and environmental evaluation metrics within the decision-support tool and by how well other participants rated the appropriateness of their options
Game materials	Objects necessary for game play, highly dependent upon game complexity	Playbook, score sheets, decision-support tools, laptops, monitors, and flip charts

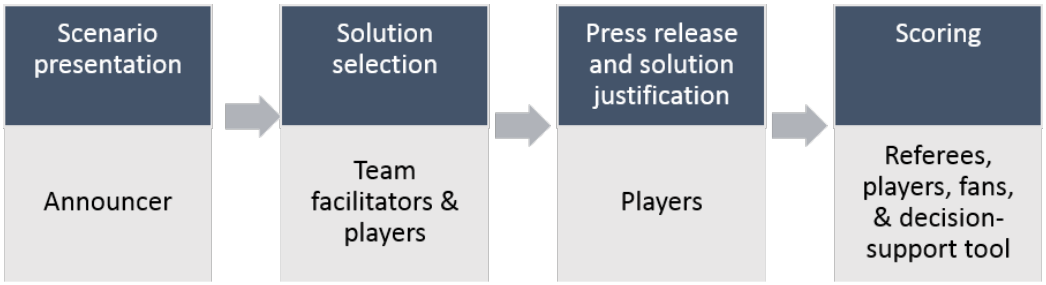

Figure 5. The process for each round of the multi-hazard tournament (Muste et al. 2017).

to a slow moving disaster that involved water shortages and broader impacts. The final round consisted of a climate change scenario with more frequent and extreme flooding and drought events. This round had a $1.6 billion budget and allowed teams to reset their strategies based on the lessons they learned from the other three turns (Muste et al. 2017). In each round, teams could invest in policy, structural adaptation options, or non-structural adaptation options, and they were tasked with identifying an overall management strategy that considered tradeoffs and would minimize social, economic, and environmental impacts.

In each of the scenario rounds, teams brainstormed, discussed, and agreed upon management strategies for the watershed based on the projected climate conditions. A list of management options was included in the team's playbook and incorporated into the decision support tool. Some of the management options included: restoring or adding wetland spaces, reclaiming property, installing deep-water wells, installing nitrate removal equipment, raising houses out of flood zones, infrastructure improvements, and reinforcing levees. A computer based decision support system, designed specifically for the tournament by engineers and hydrologists at the University of Iowa (Muste et al. 2017) was available for each team to evaluate their choices and the impact these would have on public and private property, water quality, and aquifers, among others.

Teams had to justify their strategies to the other teams, judges, and fans by completing and presenting a press release at the conclusion of each round. Competing teams, referees, and fans scored each team's overall management plans based on the appropriateness of the adaptation options; consideration of impacts and trade-offs to society, ecosystems, and the economy; and innovation. In addition, the decision-support tool also calculated a score based on predefined library of simulations. At the end of the day, the team with the highest final score was selected as the winner (U.S Army Corps of Engineers 2016; Muste et al. 2017).

Partners in the event were the Rock Island District, the Institute for Water Resources, and Portland District, all with the U.S. Army Corps of Engineers; Sandia National Laboratories; Iowa Institute of Hydraulic Research (University of Iowa); the city of Cedar Rapids; the National Drought Mitigation Center at University of Nebraska-Lincoln; the Natural Resources Conservation Service; U.S. Geological Survey; the National Integrated Drought Information System; and Iowa State University.

Assessment Methods and Results

To evaluate the action-to-knowledge and knowledge-to-action outcomes of the tournament, we asked participants to complete knowledge and perception assessments prior to participation in the tournament, immediately following the tournament event, and three months after the tournament event. The surveys were administered online to tournament participants using Qualtrics survey software.

Survey questions were developed by tournament organizers following the framework described above. In both the pre-tournament survey and the post-tournament survey, we asked participants to self-assess their familiarity with hazard planning and with using climate information, as well as their familiarity with a variety of water quality, flood control, and drought mitigation strategies. We

also asked participants, pre- and post- tournament, to rate the effectiveness of each strategy, state preferences for implementing each strategy, and estimate the cost of reducing water quality, flood, and drought damages over the next 20 years. Specific questions are listed along with the results below.

We measured collaborations and other actions in the post-tournament survey as well as the three-month follow-up survey, by asking participants whether they had met new people, discussed/pursued potential collaborations or identified opportunities to coordinate efforts, communicated with others, or considered changes to policies or decision-making processes. We also asked how they used new knowledge in decision-making; what plans, policies, or decision-making processes in the Cedar Rapids region that they thought needed to be changed; and what impact they thought the tournament might have on water quality, flood, and drought decisions in the region.

The pre-tournament survey was emailed one week prior to the tournament event (with one reminder) to 36 registered participants (including team members, facilitators, fans, and leaders), with 27 participants (75%) responding. The post-tournament survey was administered the day of the tournament event (with one reminder five days later) to 35 participants with 23 participants (66%) responding. Eighteen of the tournament team members participated in both the pre-tournament and post-tournament survey; we used this group to analyze changes in familiarity with processes and strategies, as well as changes in perceptions. The three-month follow up survey was administered three months after tournament event (with two reminders) to 35 participants, with 11 participants (31%) responding.

Action-to-Knowledge Outcomes

Did the players learn anything regarding the problem, information resources, or strategies?

Before the tournament and after, participants were asked to self-assess their level of familiarity with 15 options associated with water quality, flood control, and drought mitigation on a three-point scale (not at all familiar - very familiar). Six "upstream"-related options included building small agricultural ponds, planting cover crops, installing on-farm denitrifying bioreactors, managing agricultural nutrients to minimize runoff, changing land cover from row crops to grass, and changing land cover from row crops to wetlands. Nine "downstream"-related options included installing municipal nitrate removal equipment, raising municipal well intakes, installing new or upgrading existing municipal wells, building or enhancing levees, elevating structure through planning and zoning processes, improving municipal water system efficiency, lessening municipal water demand through conservation campaigns, and building large dams or reservoirs. Participants were asked the same question after the tournament. As shown in Table 3, participants brought varying levels of technical familiarity with them to the tournament. In the pre-post comparison (n=18), we found that those who were the least familiar with each option before the tournament tended to report higher levels of familiarity after the tournament.

Did players learn or generate knowledge about strengths and weakness in existing plans, policies, or decision-making processes?

Before the tournament and after, participants were asked to select what they believed were the three most cost-effective strategies (each) to "protect and enhance water quality", to "limit flood damages", and to "limit drought damages" for the Cedar Rapids area, using the same list of options described above. They were then asked to imagine that they were responsible for simultaneously protecting and enhancing water quality, minimizing flood damages, and minimizing drought damages in the Cedar Rapids area, and to choose their top three strategies for meeting all three goals.

We found that, in the process of the tournament game, participants changed their judgement of the strengths and weaknesses for some of the options. For example, the percent of survey respondents (n=18) who saw planting cover crops as a cost-effective strategy to protect water quality increased from 54% pre-tournament to 86% post-tournament. At the same time, the percent of respondents who would choose to invest in planting cover crops as a strategy to simultaneously protect and enhance water quality, minimize flood damages, and minimize drought damages increased from 42% pre-tournament to 62% post-tournament. Pre- and

Table 3. Percent of respondents who said they were not familiar/somewhat familiar/very familiar with options pre-tournament (and whether their familiarity increased, didn't change, or decreased post-tournament).

"Tournament Options Associated with Water Quality"	Not familiar pre-tournament	Somewhat familiar pre-tournament	Very familiar pre-tournament
Installing municipal nitrate removal equipment	20% (increase)	75% (no change)	5% (no change)
Raising municipal well intakes	30% (increase)	55% (increase)	15% (no change)
Installing new, or upgrading existing, municipal wells	15% (increase)	65% (increase)	20% (decrease)
Building or enhancing levees	10% (no change)	65% (no change)	25% (no change)
Elevating structures through planning and zoning processes	5% (no change)	55% (no change)	40% (no change)
Relocating structures through planning and zoning processes	15% (increase)	50% (increase)	35% (no change)
Building large dams or reservoir	45% (increase)	35% (no change)	20% (no change)
Improving municipal water system efficiency, including leak detection	35% (increase)	60% (no change)	5% (decrease)
Lessening municipal water demand through conservation campaigns	10% (no change)	80% (increase)	10% (no change)
Building small agricultural ponds	25% (increase)	50% (no change)	25% (no change)
Planting cover crops	15% (increase)	50% (no change)	35% (no change)
Managing agricultural nutrients to minimize runoff	20% (increase)	45% (no change)	35% (no change)
Installing on-farm denitrifying bioreactors	30% (increase)	55% (no change)	15% (decrease)
Changing land cover from row crops to grass	10% (increase)	65% (increase)	25% (no change)
Changing land cover from row crops to wetland	5% (increase)	75% (no change)	20% (no change)

post-tournament prioritization of all options is shown in Figure 6.

In line with the focus of the tournament on agriculture and urban stakeholders, many participants said they had learned more about opportunities and challenges for balancing needs and responsibilities. Comments included:

"*How modest changes in farming practices can lead to cost-effective strategies to mitigate drought, flood and water quality issues. Highlights the importance of including local farmers and associations in mitigation decisions, especially for agricultural-based communities.*"

"*Some farmers think in-field practices should not be compensated since they make good business sense, but edge-of-field practices should be because they do not return anything to the farm business. Community planners and stakeholders have very different ways of thinking about how to plan/organize a watershed or community. Planners manage risk. Many stakeholders described their process as balanced or watershed-based.*"

"The necessity of balancing input from all stakeholders regardless of rural or urban orientation."

Three months after the tournament, three participants reported they had reflected on plans, policies, or decision-making processes in the Cedar Rapids region that they think need to be changed. Suggestions included empowerment of the Watershed Management Authorities, more "respect of the floodplains and more restrictive floodplain development rules," and continued development of nutrient credit trading programs.

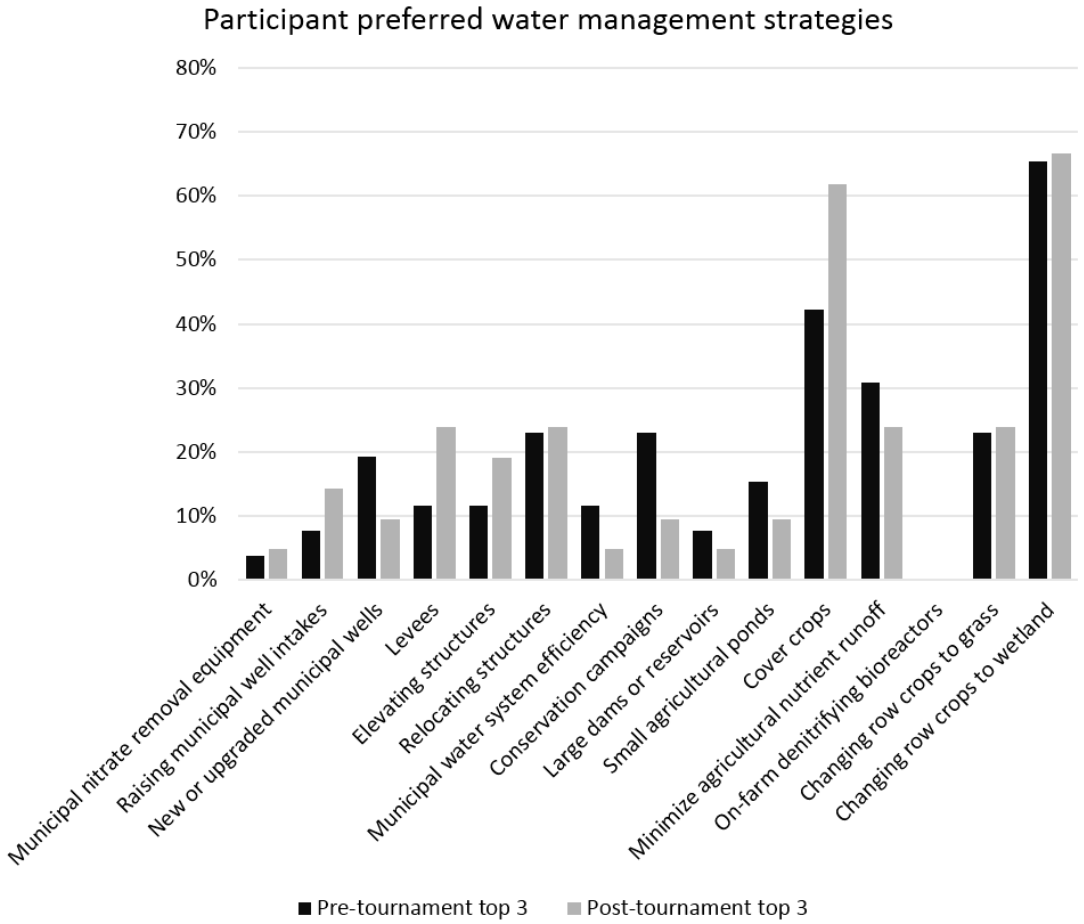

Figure 6. Percent of respondents selecting each option as one of their top three priorities to simultaneously protect and enhance water quality, minimize flood damages, and minimize drought damages in the Cedar Rapids area.

Others said they didn't know, or their opinions had not changed, or did not answer the question.

Could players evaluate the investments needed to drive change?

Prior to the tournament, and after, participants were asked their opinion on two questions related to financial investments needed to drive change: 1) how much of a total financial investment might be required to make an appreciable reduction over the next 20 years in water quality, flood, and drought damages for the Cedar Rapids area; and 2) with an investment of $60 million per year for the next 20 years, what percentage change in water quality, flood, and drought damage reduction might you expect to see in the Cedar Rapids area. Both were open-ended questions with an "I don't know" option.

Through the process of the tournament, some survey respondents (n=18) developed more concrete estimates of the financial investment that would be required to reduce water quality, flood, and drought damages for the Cedar Rapids area. Pre-tournament, 54% of respondents said they did not know how much of a financial investment might be required to reduce damages, and 30% said they did not know the amount of damage reduction possible in the region with an investment of $60 million per year for the next 20 years. Post-tournament, the percentage of "I don't know" decreased to 30% and 15%, respectively. On average, respondents estimated a higher total financial investment required to reduce damages after the tournament than before, but did not change the percent reduction in damages that they thought could be achieved. One participant said they "learned more about the capitol costs of localized and infrastructure related adaption practices. Learned about the different effectiveness of wetlands, this might influence the wetlands [our organization] targets to restore."

Dissenting views on learning objectives:

A few participants were critical of use of this method to meet learning objectives. One participant commented, "I would rather hear from experts on the aforementioned techniques and experiences tacticians to educate me on flood/drought/water supply… Reducing everyone's collectively knowledge and trying to fit into a crafty game with artificial parameters and limits and clunky rules could not have created a greater travesty."

Knowledge to Action Outcomes

Did/Will it improve communication and coordination among player agencies and sectors? Did any new collaborations emerge?

Directly after the tournament, participants were asked whether they had: met a person they didn't know before who could be a beneficial contact in the future; discussed potential projects or collaborations; learned about another person's interests with regard to water quality, flood, and drought mitigation that will be useful to them professionally; or identified potential opportunities to coordinate efforts.

After the tournament 95% of participants (n=20) said they met someone that they didn't know before who could be a beneficial contact in the future; 85% said they had learned about another person's interests that would be useful professionally; 75% said they had discussed potential projects or collaborations; and 63% said they had identified potential opportunities to coordinate efforts (Figure 7a). One participant commented, "I thought the tournament was a great way to get people from many different disciplines in one room to discuss these hazards as they WILL impact the area sometime in the near future."

Three months after the tournament, participants were asked whether they had pursued potential projects or collaborations with someone they hadn't worked with before, or identified synergies or opportunities to coordinate efforts with another agency. Sixty-two percent of respondents (n=8) said they had begun to pursue new projects or collaborations, and 75% said they had identified synergies or opportunities to coordinate efforts with another agency (Figure 7b).

Will the players incorporate new tools or skills into future activities?

Three months after the tournament, participants were asked whether they had learned more about another aspect of water quality, flood, and drought mitigation, or sought additional training based on questions that arose during the tournament. Eighty-nine percent of respondents (n=9) said they had learned more about another aspect of water quality,

flood, and drought mitigation, and 22% said they had sought additional training based on questions that arose during the tournament (Figure 7b).

Do players intend to change plans, policies, or decision-making processes based on information obtained from the tournament?

Three months after the tournament, participants were asked whether they had considered or enacted changes to policies or decision-making processes related to water quality, flood, or drought. Sixty-two percent of respondents (n=8) said they had considered changes to policies or decision-making processes related to water quality, flood, or drought, and one individual had enacted changes to relevant policies or processes (Figure 7b). One participant said, "We are in the process of updating our State Hazard Mitigation Plan. Also, we review submissions local mitigation plans. We are trying to figure out how to change our plan, as well as provide guidance on local plans, to include some of the information and processes discussed in the tournament." Most participants did not feel that the tournament would directly impact water quality, flood, and drought related decisions in

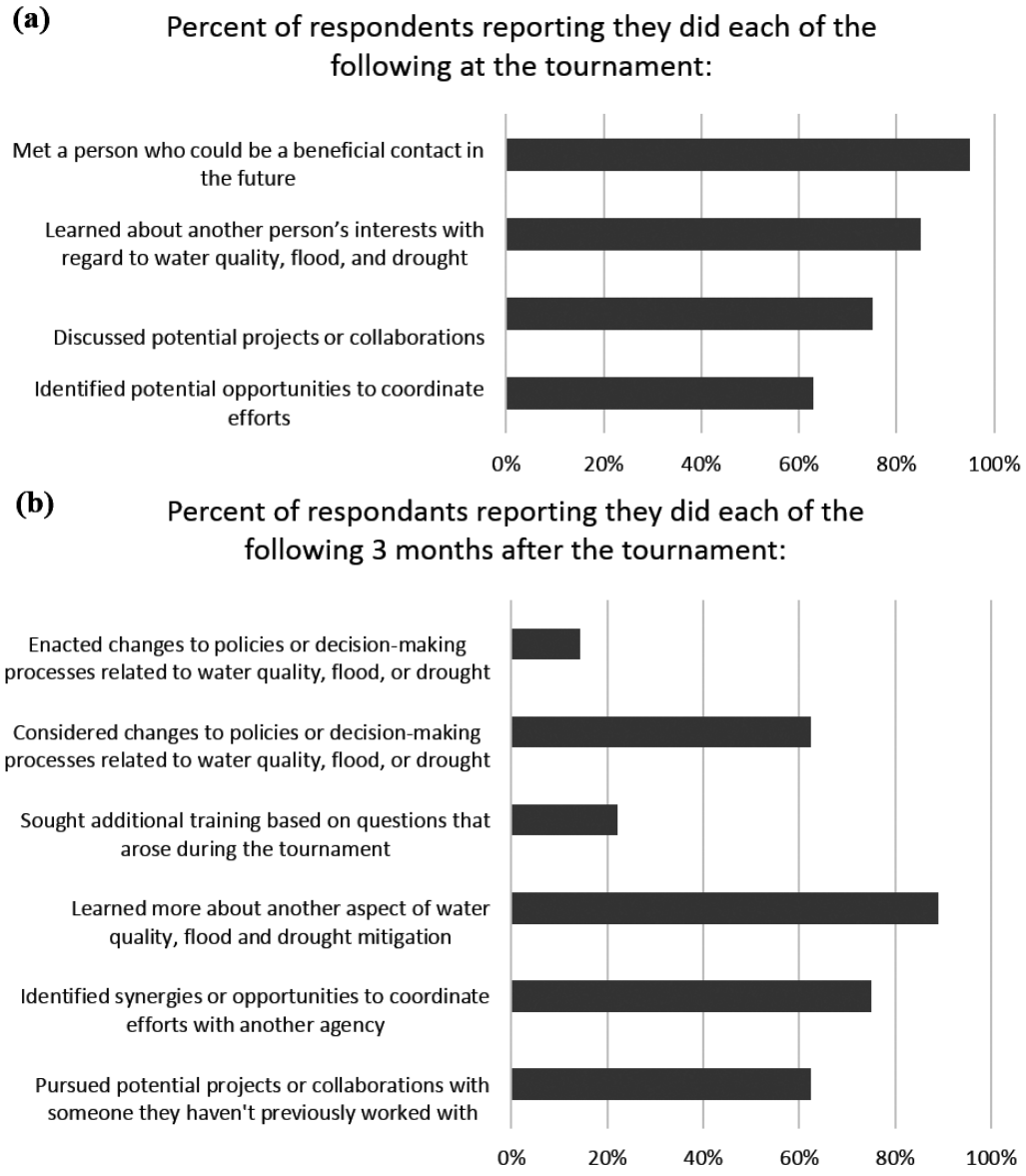

Figure 7. Assessment results (a) immediately following the tournament and (b) three months after the tournament.

the Cedar Rapids area. However, two participants again pointed out the benefit of the tournament; by educating and bringing groups together in collaboration, the tournament was a step toward improving decision-making.

Other Outcomes

After the tournament, participants were asked to agree or disagree with a number of statements about the tournament itself, including whether the tournament was the right mix of information and engagement, and whether the hazard scenarios provided a realistic context for decision-making. Eighty-five percent of participants (n=21) agreed that the tournament was the right mix of information and engagement. About 64% agreed the hazard scenarios used in the tournament provided a realistic context for decision-making.

Conclusion

We found the Iowa multi-hazard tournament to be a successful mechanism for testing the public policy, systems thinking, and complexity and gaming theories. Supporting the public participation theory, players said they gained new knowledge on aspects of water quality, flood, and drought mitigation. Additionally, players felt empowered to use new information and skills, as evidenced by the way they used the information to make decisions. The tournament appeared to be particularly effective for meeting objectives for facilitating new collaboration opportunities and communication across sectors as evidenced by the relatively high percentage of participants who had either identified or pursued new opportunities for collaboration. In support of systems thinking theory, we found that players gained knowledge about water management options and the ability to evaluate them critically in light of the broader systems that affect water quality under flood and drought events. Players also increased their understanding of the financial investments needed to drive change. With regards to the complexity and gaming theory, players experienced social learning social learning as they engaged with new individuals across sectors and worked collaboratively through the scenarios. Finally, the game successfully presented complex information in a way that enabled the participants to interact with and learn from the scenario.

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References

Abt, C.C. 1987. *Serious Games*. University Press of America, Lanham, MD.

AMEC. 2012. *Summary Report: Colorado Drought Tournament*. Available at: https://www.drought.gov/drought/sites/drought.gov.drought/files/media/regions/rdews/UCRB/documents/rpt_ColoDroughtTourn_Sept2012.pdf. Accessed July 16, 2019.

AMEC. 2014. *Summary Report: Oklahoma Water Supply Reliability and Management Challenge*. Available at: https://www.owrb.ok.gov/drought/docs/OKDroughtChallengeReportOct2014.pdf. Accessed July 16, 2019.

Arndt, D.S. and D.S. LaDue. 2008. Applying concepts of adult education to improve weather and climate literacy. *Physical Geography* 29(6): 487-499. DOI: 10.2747/0272-3646.29.6.487.

Arnold, R. and J. Wade. 2015. A definition of systems thinking: A systems approach. *Procedia Computer Science* 44: 669-678. DOI: 10.1016/j.procs.2015.03.050. Accessed July 16, 2019.

Barreteau, O., C. Le Page, and P. Perez. 2007. Contribution of simulation and gaming to natural resource management issues: An introduction. *Simulation & Gaming* 38: 185-194. DOI: 10.1177/1046878107300660.

Behl, D.V. and S. Ferreira. 2014. Systems thinking: An analysis of key factors and relationships. *Procedia Computer Science* 36: 104-109. DOI: 10.1016/j.procs.2014.09.045.

Bots, P. and E. Van Daalen. 2007. Functional design of games to support natural resource management policy development. *Simulation & Gaming* 38: 512-532. DOI: 10.1177/1046878107300674.

Breuer, J. and G. Bente. 2010. Why so serious? On the relation of serious games and learning. *Journal for Computer Game Culture* 4: 7-24.

Burby, R.J. 2003. Making plans that matter: Citizen involvement and government action. *Journal of the American Planning Association* 69(1): 33-49. DOI: 10.1080/01944360308976292.

Burton, M.A. 1993. The irrigation management game: A role playing exercise for training in irrigation management. *Irrigation and Drainage Systems* 7(4): 305-318.

Cash, D., W. Adger, F. Berkes, P. Garden, L. Lebel, P. Olsson, L. Pritchard, and O. Young. 2006. Scale and cross-scale dynamics: Governance and information in a multilevel world. *Ecology and Society* 11(2): 8.

Cohen, K.J. and E. Rhenman. 1961. The role of management games in education and research. *Management Science* 7(2): 131-166.

Creighton, J.L. 2005. *The Public Participation Handbook: Making Better Decisions through Citizen Involvement*. John Wiley & Sons, San Francisco, CA.

Ewen, T. and J. Seibert. 2016. Learning about water resource sharing through game play. *Hydrology and Earth System Sciences* 20(10): 4079-4091. DOI: 10.5194/hess-20-4079-2016.

Falk, J.H. (Ed.). 2001. Free-choice science education: How we learn science outside of school. In: *Ways of Knowing in Science and Mathematics Series*, Teachers College Press, New York, NY.

FEMA. 2016. An Introduction to Exercises. Available at: https://training.fema.gov/is/courseoverview.aspx?code=IS-120.c. Accessed July 16, 2019.

Galvao, J., P. Martins, and M. Gomes. 2000. Modeling reality with simulation games for a cooperative learning. In: *Proceedings of the 2000 Winter Simulation Conference,* J.A. Joines, R.R. Barton, K. Kang, and P.A. Fishwick (Eds.). Orlando, FL, December 10-13, pp. 1692-1698.

Garris, R., R. Ahlers, and J.E. Driskell. 2002. Games, motivation, and learning: A research and practice model. *Simulation & Gaming* 33: 441-467.

Halbe, J., C. Pahl-Wostl, J. Sendzimir, and J. Adamowski. 2013. Towards adaptive and integrated management paradigms to meet the challenges of water governance. *Water Science and Technology* 67(11): 2651-2660. DOI: 10.2166/wst.2013.146.

Hill, H., M. Hadarits, R. Rieger, G. Strickert, E.G. Davies, and K.M. Strobbe. 2014. The Invitational Drought Tournament: What is it and why is it a useful tool for drought preparedness and adaptation? *Weather and Climate Extremes* 3: 107-116. DOI: 10.1016/j.wace.2014.03.002.

Hummel, H.G., J. Van Houcke, R.J. Nadolski, T. Van der Hiele, H. Kurvers, and A. Löhr. 2011. Scripted collaboration in serious gaming for complex learning: Effects of multiple perspectives when acquiring water management skills. *British Journal of Educational Technology* 42(6): 1029-1041. DOI: 10.1111/j.1467-8535.2010.01122.x.

IAP2 Core Values. n.d. Available at: http://www.iap2.org/?page=A4. Accessed July 16, 2019.

Innes, J.E. and D.E. Booher. 1999. Consensus building as role playing and bricolage. *Journal of the American Planning Association* 65(1): 9-26.

Iowa Department of Natural Resources. 2008. Water Planning Law and Government. Available at: http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Iowa-Water-Plan. Accessed July 16, 2019.

Kim, J., T. Keane, and E. Bernard. 2015. Fragmented local governance and water resource management outcomes. *Journal of Environmental Management* 150: 378-386.

Koestler, F. 2009. Acting, knowing, learning, simulating, gaming. *Simulation & Gaming* 40(1): 8-26.

Lapp, S. 2012. Okanagan Invitational Drought Tournament. *Journal of Ecosystems and Management* 13(3): 13-15.

Maxwell, S. (Ed.). 2011. *The Business of Water: A Concise Overview of Challenges and Opportunities in the Water Market*. American Water Works Association, Denver, CO.

Mayer, I.S., E.M. van Bueren, P.W. Bots, H. van der Voort, and R. Seijdel. 2005. Collaborative decisionmaking for sustainable urban renewal projects: A simulation-gaming approach. *Environment and Planning B: Planning and Design* 32(3): 403-423. DOI: 10.1068/b31149.

Mayer, I.S. 2009. The gaming of policy and the politics of gaming: A review. *Simulation & Gaming* 40(6): 825-862. DOI: 10.1177/1046878109346456.

Meadowcroft, J. 2002. Politics and scale: Some implications for environmental governance. *Landscape and Urban Planning* 61(2): 169-179. DOI: 10.1016/S0169-2046(02)00111-1.

Medema, W., A. Furber, J. Adamowski, Q. Zhou, and I. Mayer. 2016. Exploring the potential impact of serious games on social learning and stakeholder collaborations for transboundary watershed management of the St. Lawrence River basin. *Water* 8(5): 175. DOI: 10.3390/w8050175.

Michael, D. and S. Chen. 2006. *Serious Games: Games that Educate, Train, and Inform*. Thompson Course Technology PTR, Boston, MA.

Miskowiak, D. 2004. *Crafting an Effective Plan for Public Participation*. Center for Land Use Education, Stevens Pointe, Wisconsin.

Muste, M., I. Demir, J. Smith, and A. Carson. 2017. Serious gaming for community engagement in multi-hazard mitigation. *Hydrolink* 2017(1): 20-22. Available at: https://www.iahr.org/PDF/Journals/Hydrolink/2017/2017%20issue1/Serious%20Gaming%20For%20Community%20Engagement%20In%20Multi-Hazard%20Mitigation.pdf. Accessed July 16, 2019.

Myerson, R.B. 2013. *Game Theory: Analysis of Conflict*. Harvard University Press, Cambridge, Massachusetts.

Osborne, M.J. and A. Rubinstein. 1994. *A Course in Game Theory*. MIT Press, Cambridge, Massachusetts.

Peters, V.A. and G.A. Vissers. 2004. A simple classification model for debriefing simulation games. *Simulation & Gaming* 35(1): 70-84.

Reimer, A. 2012. US Water Policy: Trends and Future Directions. National Agricultural and Rural Development Policy Center (NARDeP). Available at: http://www.nardep.info/uploads/WaterPolicy_Reimer.pdf. Accessed July 16, 2019.

Richter-Ryerson, S. 2016. Iowa tournament tackles flooding, drought possibilities. *DroughtScape* Fall 2016: 14-16. Available at: https://drought.unl.edu/archive/Documents/NDMC/DroughtScape/DS2016Fall.pdf. Accessed July 16, 2019.

Royse, M. and S. Newton. 2007. How gaming is used as an innovative strategy for nursing education. *Nursing Education Perspectives* 28(5): 263-267.

Rusca, M., J. Heun, and K. Schwartz. 2012. Water management simulation games and the construction of knowledge. *Hydrology and Earth System*

Sciences 16(8): 2749-2757. DOI: 10.5194/hess-16-2749-2012.

Savic, D.A., M.S. Morley, and M. Khoury. 2016. Serious gaming for water systems planning and management. *Water* 8(10): 456. DOI: 10.3390/w8100456.

Schmidt, R., K. Emmerich, and B. Schmidt. 2015. Applied games–In search of a new definition. In: *Entertainment Computing – ICEC 2015,* K. Chorianopoulos, M. Divitini, J.B. Hauge, L. Jaccheri, and R. Malaka (Eds.). 14th International Conference, Trondheim, Norway, September 29 - October 2, 2015. Springer International Publishing, Heidelberg, Germany, pp. 100-111.

Smith K., J. Shull, Y. Shen, A. Dean, and P. Heaney. 2018. A framework for designing smarter serious games. In: *International Conference on Smart Education and Smart E-Learning*, Smart Universities, Springer, Cham, pp. 263-294.

Stave, K. and M. Hopper. 2007. What constitutes systems thinking? A proposed taxonomy. In: *Proceedings of the 26th International Conference of the System Dynamics Society*, Boston, MA, July 29 - August 3, 2007. Systems Dynamics Society, Albany, New York, pp. 1-24.

The Institute for Systemic Leadership. n.d. Basic Principles of Systems Thinking as Applied to Management and Leadership. Available at: https://www.systemicleadershipinstitute.org/basic-principles-of-systems-thinking-as-applied-to-management-and-leadership/. Accessed July 16, 2019.

University of Iowa. 2016. Iowa-Cedar Watershed Interagency Coordination Team. Available at: http://www.iihr.uiowa.edu/iowacedarbasin/. Accessed July 16, 2019.

University of Iowa. 2017. Middle Cedar River Watershed. Available at: https://www.iihr.uiowa.edu/cedarriverwatershed/event/middle-cedar-river-watershed-public-open-house/. Accessed July 16, 2019.

U.S. Army Corps of Engineers Institute for Water Resources (USACE IWR). 2016. Playing for Keeps: Using Games to Address Flooding and Drought in the Cedar River Basin. Available at: http://www.iwr.usace.army.mil/Media/News-Stories/Article/1009509/playing-for-keeps-using-game-theory-to-address-flooding-and-drought-in-the-ceda/. Accessed July 16, 2019.

U.S. Army Corps of Engineers. 2016. Playbook for the Cedar Rapids and Surrounding Area Multi-Hazard Tournament: Flood-Drought-Water Quality, Version 1.0, U.S. Army Corps of Engineers, Institute of Water Resources, Alexandria, VA. Available at: http://www.iowawatersheds.org/iowadss/iw_dss/docs/sample_iowadss_plan.pdf. Accessed July 16, 2019.

U.S. Census Bureau. 2016. December 15. Data. Available at: https://www.census.gov/data/tables/2015/demo/popest/total-cities-and-towns.html. Accessed July 16, 2019.

Wachowicz, M., L.A.E. Vullings, M. van den Broek, and A. Ligtenberg. 2003. *Games for Interactive Spatial Planning: SPLASH a Prototype Strategy Game About Water Management*. Alterra, Wageningen, Netherlands, p. 667.

Wall, N. and M. Hayes. 2016. Drought and health in the context of public engagement. In: *Extreme Weather, Health, and Communities*, S.L. Steinberg and W.A. Sprigg (Eds.). Springer International Publishing, Heidelberg, Germany, pp. 219-244.

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Using Social Science to Improve Outreach to Protect Endangered Aquatic Animals: The Case of Freshwater Mussels in Indiana

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Abstract: Freshwater mussel populations in North America have been declining over the past two centuries due to a variety of land-use changes and anthropogenic water quality degradation. The Tippecanoe River, located in northcentral Indiana, was once home to the world's largest population of clubshell mussels. Currently, the river supports six federally listed species. The Indiana Department of Natural Resources (IDNR) partnered with Purdue University to design and implement an outreach and education campaign to raise awareness about and promote protection of these imperiled species. This article details how researchers used the principles of community-based social marketing to create and evaluate the campaign. Lessons learned and recommendations for future campaigns are provided.

Keywords: *endangered species, campaign, community-based, conservation, social marketing, survey*

Water quality in North America has been declining due to human activities for the past 200 years. As a result of this decline along with overharvesting in the 19th and 20th centuries, habitat alteration, effects of invasive species, and other factors, an estimated 70% of North American freshwater mussel species are extinct or currently imperiled (USFWS 2018). Mussels survive by taking in water, keeping microorganisms and nutrients for food, and releasing water back to the river cleaner than it was. Because mussels filter water for food and oxygen, they are highly vulnerable to water quality issues. Elevated concentrations of pollutants, bacteria, and sediment can have highly detrimental effects on mussel populations. A river that supports healthy populations of mussels usually has good water quality.

Today, freshwater mussels are among the Midwestern U.S.'s most imperiled animals, with around half of Indiana's native species extirpated or listed as endangered or of special concern (IDNR 2018). More than half of the remaining species are federally listed as endangered, threatened, or as state species of special concern. The eight states of the Midwest (Iowa, Michigan, Minnesota, Wisconsin, Illinois, Ohio, Indiana, and Missouri) each have between three and eleven federally listed species of freshwater mussels. Indiana is home to ten federally listed freshwater mussel species.

The Charge

Once home to the world's largest population of clubshell mussels (USFWS 2001), the Tippecanoe River in northcentral Indiana (Figure 1) now supports six federally listed species of freshwater mussels: the clubshell, fanshell, rayed bean, sheepnose, snuffbox, and rabbitsfoot. The Indiana Department of Natural Resources (IDNR) has been working to conserve the Tippecanoe River and its endangered mussels but is concerned about human impacts that are beyond the IDNR's

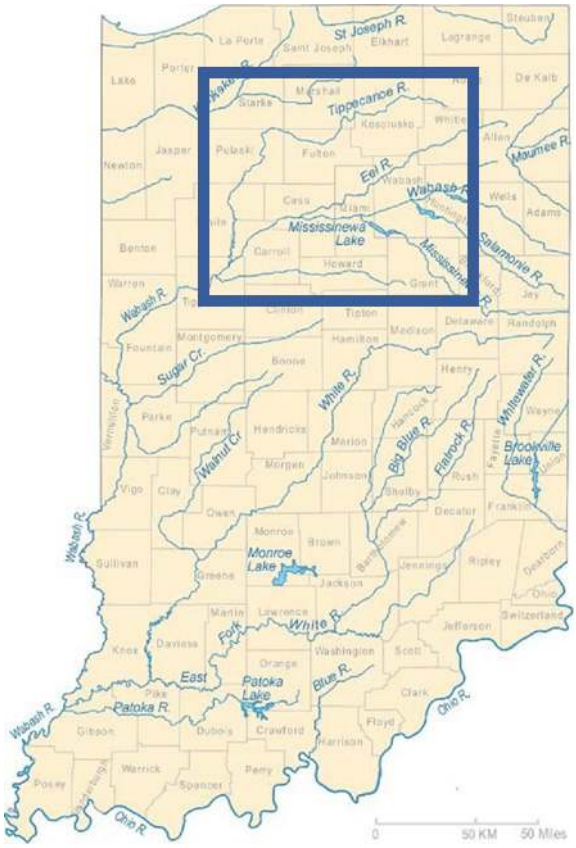

Figure 1. The Tippecanoe River in the North Central portion of Indiana.

control. This includes intentional and accidental take (as defined by the Endangered Species Act § 1532 (19)), activities that lead to poor water quality, and possible mussel habitat destruction by recreationists engaging in behaviors such as dragging canoes across shallow water and disturbing the substrate. The IDNR asked the Purdue University Natural Resources Social Science Lab to develop and evaluate a community-based social marketing campaign to help (1) raise awareness among riparian landowners and recreational users of the Tippecanoe River about the endangered status of mussels in the river, and (2) inform these stakeholders of actions they could take to protect and conserve mussels and their habitat.

Community-based Social Marketing

Marketing is frequently used to inspire consumers to purchase particular products, ranging from toothpaste to shoes to cars. Community-based social marketing (CBSM), conversely, can be used to "sell" environmentally-desirable behaviors to consumers. CBSM has been applied to specific practices such as recycling, turning off cars instead of idling, and drinking tap water instead of bottled water (McKenzie-Mohr 2011; Saylor et al. 2011). Principles of CBSM have also been used in targeted campaigns for wildlife conservation (Boss 2008; Mullendore et al. 2014) and in more general environmental campaigns dealing with issues such as water quality (Jacobson et al. 2006; Kotler and Lee 2008). The effective use of CBSM requires an in-depth understanding of the target audience – what are their current behaviors? What barriers are preventing them from making more environmentally-desirable choices? How can they benefit from adopting the suggested behavior changes? CBSM relies on many strategies including prompts, social norms, and effective communication to encourage behavioral change (Kotler and Lee 2008; McKenzie-Mohr 2011).

For the mussels campaign, we followed standard social science practices by conducting baseline surveys of current conditions to determine barriers to adoption of desirable behaviors and subsequently developed an outreach program using CBSM tools. Finally, we evaluated the effectiveness of our outreach program through post-campaign surveys. We document this process in this article and illustrate learnings from each stage of campaign development and evaluation.

Pre-campaign Surveys

During the summer and fall months of 2014, surveys were mailed to riparian landowners along the Tippecanoe River. Survey mailing followed Dillman et al.'s Tailored Design Method (2009) and consisted of an advance letter, a survey, a postcard reminder, and two subsequent survey mailings. Respondents were given the chance in each mailing to go online to complete the survey or they could complete the paper survey and return it through the mail (envelopes were pre-stamped and pre-addressed for convenience). Surveys contained questions to ascertain awareness of mussels, behavioral intentions towards mussels, attitudes toward the mussels, local water quality, and wildlife in general. Out of 1,804 total surveys

distributed, 628 completed surveys were returned by mail or online (48 % response rate).

An in-person survey of visitors of the Tippecanoe River was also conducted from June to August 2014. Five state public access sites, two canoe liveries, one city park, and one state park were used as sampling locations. Times of day, days of the week, and locations to sample were all randomly selected. Two interviewers visited the sites together and interviewed as many people as were available at the sites. These surveys were designed to last for about five minutes and questions focused on recreational activities, personal interactions with, and awareness about the six endangered/threatened mussel species. A total of 387 surveys were completed.

Baseline survey results from 2014 indicated that outreach efforts should focus on raising awareness about the existence of the mussels and about their federally endangered status. Overall, our surveys showed that visitors to and landowners along the river were largely unaware that the mussels lived in the Tippecanoe River and that it is illegal to remove live mussels and empty mussel shells from the waters of Indiana. Survey data also showed that despite a lack of awareness, public attitudes toward the mussels and their conservation were generally very positive. Therefore, campaign materials needed to focus on raising awareness about the existence of the mussels and what to do when mussels are found. The campaign did not need to focus on mitigating negative attitudes toward the mussels. Four main audiences for the campaign were identified through this baseline data collection: landowners, anglers, children, and visitors to the river.

Developing the Campaign

We coupled our survey findings with the principles of CBSM to develop our outreach and education campaign. The CBSM tools we used included getting people to commit to enhancing water quality and protecting the mussels, prompting them about the appropriate behaviors, normalizing these behaviors, rewarding those who engaged in the specified behaviors, and removing barriers to information and action. Four undergraduate students, as part of a spring semester class, synthesized these tools with our survey information to draft outreach and education materials (Figure 2).

Draft materials were presented in February 2015 at a public meeting of interested partners and stakeholders including representatives from the U.S. Fish & Wildlife Service, Indiana Department of Natural Resources, Natural Resources Conservation Service, county extension offices, soil & water conservation districts, Grace College Center for Lakes & Streams, local liveries, and landowners. Feedback was collected on the presented designs and materials, plus any new ideas that were shared. Comments were used to further develop materials.

Further testing took place at Purdue's SpringFest (an annual university festival) to gauge how well the materials and ideas worked with children and parents. Pilot testing for a lesson plan to be used in local elementary schools occurred at a local church to make sure the lesson plan met objectives. Using the feedback, the team at Purdue hired a graphic design artist to finalize the materials. Staff members in the Natural Resources Social Science Lab at Purdue University also created, revised, and finalized campaign components.

Final outreach materials were produced and distributed at several local community festivals throughout the summers of 2015 and 2016. The campaign was named "Heart of the Tippy." For a complete list of outreach materials developed, see Figure 3. Informational packets containing brochures, pledge forms, and prizes were distributed to canoe rental businesses and bait shops to help increase awareness and participation in the campaign.

Post-campaign Surveys

Post-campaign surveys to evaluate the success of the campaign included a five-wave mail survey and in-person interview surveys conducted in 2016. Survey methodologies for both the 2016 mail survey and in-person survey were similar to those in 2014. Mail surveys contained the same questions in both years, although the 2016 survey included additional questions about the Heart of the Tippy campaign. The 2016 surveys were mailed to riparian landowners that received a survey in 2014.

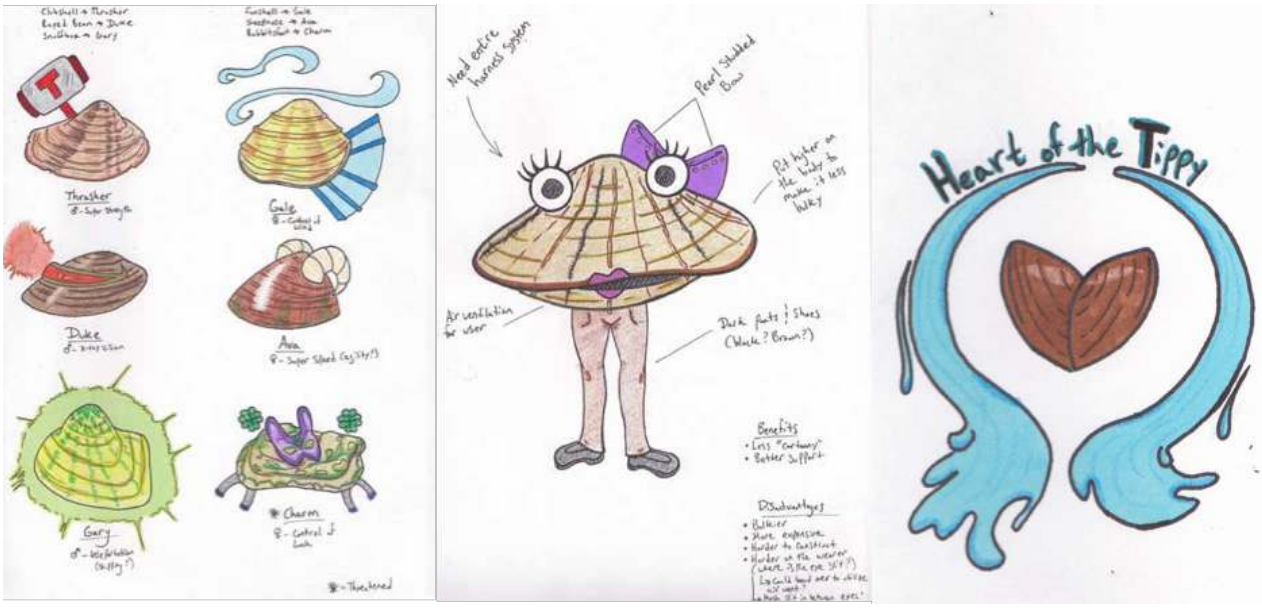

Figure 2. Original designs for Mighty Mussels, costume/mascot, and campaign logo (l to r). Illustrations by Jaclyn O'Connor.

Addresses that resulted in undeliverable surveys in 2014 were removed from the mailing list in 2016. Out of 1,276 total surveys distributed, 449 completed surveys were returned by mail or online (41% response rate).

In-person survey methodology differed slightly in sampling timeframe, sites sampled, and questions asked. Surveys were conducted from June to August in 2014 and from July to August in 2016. Four public access sites, three canoe liveries, and two parks were used as sampling locations in 2016. The northernmost public access site sampled in 2014 was not used in 2016 due to low numbers of visitors. Instead, a canoe rental location was added as a sampling site in 2016 and was chosen because of the location's high volume of visitors and its involvement with the Heart of the Tippy outreach and education campaign. Similar to the mail survey, in 2016 visitors were asked about their familiarity with the Heart of the Tippy campaign. A total of 180 surveys were completed.

Results

Visitors

Finalized Heart of the Tippy materials were distributed throughout 2015 and 2016 and results from the 2016 surveys show the success of the campaign. In 2016, while only 10 % of respondents said they had heard of the campaign by name, 33 % had seen at least one outreach item. This demonstrates that although the campaign name was not necessarily familiar to visitors of the Tippecanoe River, Heart of the Tippy campaign materials were reaching one in three visitors during the summer months.

For visitors to the river, the most visible outreach items were the interpretive signs (installed in three sampling locations), yard signs (numerous posted in yards and at local businesses throughout the watershed), and canoe stickers (on canoes and kayaks at all three canoe livery sampling sites). A plurality of respondents said they saw outreach materials at Winamac Town Park, Tippecanoe River State Park, from their neighbors/neighborhood, or Oakdale Dam.

In terms of mussel awareness, comparisons between 2014 and 2016 in-person survey data suggest that the education campaign was also successful. When 2016 visitors to the Tippecanoe River were shown a picture of four of the endangered mussel species, a significantly higher percentage of them knew what kind of animal the mussels were compared to visitors in 2014 (p-value < 0.01). Additionally, a higher percentage of 2016 visitors said they had heard of the endangered mussels (p-value < 0.1) and had seen a mussel in the Tippecanoe River (p-value < 0.1) compared

Audience: Anglers

- Informational brochure
- Prizes (floating keychains and bobbers)
- Bilingual signs for fishing location, targeting angler messaging and defining violations

Audience: Kids

- Mighty Mussel Mania seek-and-find game
- Placemats for local restaurants
- Lesson plan

Audience: Recreationists and Visitors

- Interpretive signs for parks and public access sites
- Flyers for canoe rental transport vehicles

Audience: Riparian Residents

- Yard signs encouraging people to take pledge
- Postcards

Audience: All

- Web site (http://www.HeartoftheTippy.org)
- Messages (Don't Pick Me Up, Don't Litter, Babies Go Back, Forget the Fertilizer, and Carry Your Canoe/Kayak)
- Stickers (logo, Mighty Mussels, Carry Your Canoe/Kayak)
- Mascot/mussel costume
- String bag
- Informational brochure for general public
- H2-WOW! Protecting our Water Resources Exhibit

Figure 3. Examples of outreach materials developed.

with visitors in 2014. When asked whether or not it is legal to remove native, live mussels from the waters of Indiana, visitors in 2016 were less likely to say they did not know and more likely to say removing mussels is illegal compared to visitors in 2014 (p-value < 0.05). However, when asked the same question about dead mussels and empty mussel shells, visitors in both years largely did not know. Overall, it appears that visitors were more aware of the mussels in 2016 than before the outreach campaign.

Landowners

Riparian landowners seemed to be more aware of the Heart of the Tippy campaign than visitors to the river. At least one outreach item was seen by 41 % of riparian landowners. The most viewed outreach items among mail survey respondents were yard signs, pledge forms calling for the protection of the mussels, brochures with information about the mussels, and postcards with pledge information. Although postcards were one of the most seen items, only 12 % of respondents reported seeing one. This is a curious result because every address that received a survey during the summer and fall of 2016 also received a postcard in the spring of 2016. Such a low percentage indicates that postcards may not be an effective method for similar outreach campaigns in the future. However, about one in five riverside residents had spotted a yard sign, indicating that this method should continue in future campaigns.

Awareness of the mussels and information related to their conservation among riparian landowners increased between 2014 and 2016. A significantly higher percentage of landowners in 2016 (64%) said they had heard of the endangered mussels in the Tippecanoe River than in 2014 (49%) (p-value <0.01). Landowners, unlike visitors, were also asked whether or not they were aware that the Lake Freeman water level had been lowered to protect the mussels. A significantly higher percentage of landowners had heard of this in 2016 compared to 2014 (p-value < 0.05). As with visitors, the proportion of landowners who reported seeing live mussels or empty mussel shells was higher in 2016 than in 2014. When asked, "*Have you seen a live freshwater mussel in a river*?," 50 % of landowners in 2016 said, "*Yes, in the Tippecanoe River*" compared to 42 % in 2014. Although that difference is not statistically significant, the question "*Have you seen a dead freshwater mussel or an empty mussel shell in a river*?" did elicit significant differences. A significantly higher percentage of landowners in 2016 compared to 2014 also answered the question "*Have you seen a live freshwater mussel on the banks of the Tippecanoe River before*?" with "*No, but I've seen a dead freshwater mussel or an empty mussel shell on the banks of the Tippecanoe River.*"

When it comes to the legality of taking mussels, landowners were more likely in 2016 than in 2014 to say that removing live mussels and empty mussel shells from the waters of Indiana is illegal. Over half of landowners (55 %) in 2016 said removing native, live mussels is illegal compared to only 33 % in 2014. Just under one third of landowners in 2016 (32 %) said removing dead mussels or empty mussel shells is illegal compared to one fifth (20 %) of landowners in 2014. Additionally, lower percentages of "*Don't know*" responses were recorded in 2016 than in 2014.

To summarize, from 2014 to 2016, landowner awareness about the existence of endangered mussels in the Tippecanoe River increased, as did reported sightings of the mussels, knowledge about the illegality of removing mussels, and awareness that Lake Freeman was lowered to protect the mussels.

Although awareness of the mussels increased after the launch of Heart of the Tippy campaign, attitudes toward the mussels and efforts related to their conservation did not always shift in a more positive direction among landowners. Landowners were presented with pictures of the mussels and asked to circle the number that best fit their opinion of the mussels. Numbers corresponded to 11 different semantic differential pairs (e.g., Good:Bad) and ranged from 1 to 7, where 1 indicates a more positive evaluation, 7 indicates a more negative evaluation, and 4 indicates neutrality. Of the 11 pairs, 4 pairs resulted in means that significantly shifted toward more negative evaluations (Table 1). While means for all 11 pairs were under 4, indicating overall positive evaluation, it is important to note that attitudes toward the mussels may be trending negatively over time or that these are not effective measures.

Table 1. Answers to the prompt: "Please check the number (1-7) in each row that best describes your opinion of the mussels pictured above." Bolded rows signify statistically significant results (significance level $p<0.05$).

	------2014------		------2016------		
Semantic Differential Pair	**n**	**Mean**	**n**	**Mean**	**p-value**
Good (1) to Bad (7)	526	2.32	388	2.41	0.375737
Important (1) to Unimportant (7)	536	2.63	397	2.72	0.482134
Beautiful (1) to Ugly (7)	**521**	**2.85**	**398**	**3.18**	**0.005138**
Friendly (1) to Unfriendly (7)	507	2.75	391	2.93	0.118727
Active (1) to Passive (7)	502	3.71	396	3.52	0.127431
Pleasant (1) to Unpleasant (7)	514	2.83	396	3.03	0.072632
Valuable (1) to Worthless (7)	**524**	**2.79**	**400**	**3.09**	**0.020772**
Clean (1) to Dirty (7)	519	2.69	397	2.78	0.421493
Hardy (1) to Fragile (7)	508	3.31	396	3.30	0.957454
Harmless (1) to Dangerous (7)	**526**	**1.90**	**399**	**2.12**	**0.026636**
Dry (1) to Slimy (7)	**506**	**3.56**	**389**	**3.88**	**0.003651**

Landowners received various prompts throughout the survey and were asked to mark the option that best fit their opinion on a scale from Strongly Disagree (1) to Strongly Agree (5). Therefore, a lower mean for each prompt indicates that landowners largely disagree/strongly disagree with that statement, while higher means indicate agreement/strong agreement. Results from the prompts (Table 2) give us insight as to why the attitudes above became more negative over time. Landowners in 2016 disagreed more strongly with the statement "*I would be willing to pay more to improve water quality (e.g., recreational fees, local taxes, etc.)*" than in 2014.

Perhaps a more positive result is that landowners more strongly disagreed with the statement "*These mussels are valuable for their shells*" in 2016 than in 2014. This could indicate that attitudes toward the mussels are becoming potentially more negative in some aspects as seen in Table 1, but could also indicate that landowners have learned that removing mussels from the waters of Indiana is illegal and therefore harvesting mussels for their shells is not an acceptable behavior. Another indication of potentially pro-conservation behavior is the fact that landowners strongly disagreed with the statement *"I think we as a nation should repeal the Endangered Species Act"* more often in 2016 than in 2014. Based on the results from various survey prompts, it seems landowners do not oppose larger conservation efforts.

Behaviors of Both Visitors and Landowners

Reported behaviors toward the mussels were resoundingly positive. Less than 1 % of landowners in both 2014 and 2016 reported that they would take or harm a mussel if they found one while recreating in/along the Tippecanoe River. An overwhelming majority of landowners in both years, 80 % in 2014 and 84 % in 2016, said they would put a mussel back if they found one.

In both years and for both in-person and mailed surveys, canoeing/kayaking was one of the most popular recreational activities. As such, one focus of the Heart of the Tippy campaign was to promote carrying canoes and kayaks over areas of low water in the Tippecanoe River. Unfortunately,

Table 2. Responses to statements about mussels and related conservation efforts. Response options ranged from 1 (Strongly Disagree) to 5 (Strongly Agree). Bolded rows signify statistically significant results (significance level $p<0.05$).

	------2014------		------2016------		
Prompt	**n**	**Mean**	**n**	**Mean**	**p-value**
If I saw one of these mussels, I would catch or touch them.	**574**	**2.01**	**419**	**1.76**	**0.000178**
I would like to keep one of these mussels.	574	1.40	418	1.39	0.749400
These mussels are valuable for their shells.	**571**	**2.07**	**418**	**1.89**	**0.006960**
I think these mussels are good bait to use while fishing.	571	1.80	419	1.73	0.261967
These mussels help to improve water quality.	576	3.77	419	3.83	0.460613
These mussels harm local ecosystems.	570	1.85	419	1.85	0.962206
Government money should be used to protect these mussels.	573	3.06	420	2.99	0.387796
I would try to find/hunt more of these mussels.	574	1.53	421	1.51	0.738795
These mussels are important to the Tippecanoe River ecosystems.	581	3.82	423	3.82	0.997518
Nature will take care of the mussels, therefore we don't need to protect them.	239	2.62	421	2.63	0.907203
Mussels in the Tippecanoe River indicate that the river is healthy.	240	3.80	420	3.87	0.377505
I would be willing to pay more to improve water quality (e.g., recreational fees, local taxes, etc.)	**597**	**2.93**	**420**	**2.77**	**0.039190**
I think we as a nation should repeal the Endangered Species Act.	**237**	**2.49**	**420**	**2.27**	**0.019437**

Table 3. Answers to the question: "When canoeing/kayaking, how often to do you carry your canoe/kayak over shallow water areas?"

	Mail Survey Comparison		**In-person Survey Comparison**	
	2014 (n=351)	**2016 (n=418)**	**2014 (n=102)**	**2016 (n=55)**
I do not canoe/kayak	47%	53%	NA	NA
Never	15%	13%	27%	38%
Rarely	NA	NA	13%	16%
Sometimes	30%	30%	31%	26%
Always	8%	4%	29%	20%

lower percentages of visitors and landowners in 2016 reported that they "*sometimes*" or "*always*" carry their canoe or kayak over low water (Table 3). However, this decrease may have more to do with the weather than with the campaign. High temperatures and low levels of precipitation in 2014 resulted in extremely low water levels in parts of the Tippecanoe River. The next year was drastically different. Canoe liveries along the river had to close and cancel trips in 2015 due to dangerously high river levels resulting from more precipitation and milder temperatures. Weather in 2016 was more or less average for the area. Therefore, visitors and landowners in 2014 may have experienced areas of low water more frequently than visitors and landowners in 2016, who might have answered the question thinking that they did not need to carry their canoes and kayaks across areas of low water because there were not as many opportunities to do so.

Conclusion

Success of the Heart of the Tippy campaign is evidenced by the number of people living along or visiting the river who saw and interacted with outreach items and education efforts. Analysis of in-person and mail surveys showed that the Heart of the Tippy campaign reached about one in three visitors during the summer recreational season. Due to campaign efforts, awareness of the mussels increased over time, as did awareness about the illegality of removing native mussels from the waters of Indiana. Campaign efforts and materials that were most often seen by visitors and landowners included yard signs, interpretive signs along the river, stickers, and brochures. Post-campaign data showed that both visitors and landowners were more aware of the endangered mussels in the Tippecanoe River. The use of baseline social science data helped to design an effective community-based social marketing campaign and provided data to quantify the impacts of the conservation interventions.

Summary of Lessons Learned

- Before launching a CBSM campaign, conduct baseline assessments of your target audience to determine their attitudes, behaviors, and perceived barriers to adopting behavior changes.
- Based on your findings, design outreach strategies and materials that best fit your target audience and the goals of your campaign.
- Assess the effectiveness of your efforts and adjust as necessary. We found that some activities (e.g., placing yard signs throughout the community) might be more effective than others (e.g., mailing postcards).

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References

Boss, S. 2008. The cultural touch: Environmental nonprofit RARE tailors its programs to local cultures and needs. *Stanford Social Innovation Review* 6: 75-79.

Dillman, D.A., J.D. Smyth, and L.M. Christian. 2009. *Internet, Mail, and Mixed-mode Surveys: The Tailored Design Method* (3rd Ed.). John Wiley and Sons, Hoboken, New Jersey.

Indiana Department of Natural Resources (IDNR). 2018. Freshwater mussels. Available at: https://www.in.gov/dnr/fishwild/8684.htm. Accessed April 9, 2018.

Jacobson, S.K., M.D. McDuff, and M.C. Monroe. 2006. *Conservation Education and Outreach Techniques*. University Press, Oxford, United Kingdom.

Kotler, P. and N.R. Lee. 2008. *Social Marketing: Influencing Behaviors for Good* (3rd Ed.). Sage Publications, Thousand Oaks, California.

McKenzie-Mohr, D. 2011. *Fostering Sustainable Behavior: An Introduction to Community-based Social Marketing.* New Society Publishers, Gabriola Island, British Columbia, Canada.

Mullendore, N., A.S. Mase, K. Mulvaney, R. Perry-Hill, A. Reimer, L. Behbehani, R.N. Williams, and L.S. Prokopy. 2014. Conserving the eastern hellbender salamander. *Human Dimensions of Wildlife* 19(2): 166-178. Available at: https://www.tandfonline.com/doi/abs/10.1080/10871209.2014.853221. Accessed April 9, 2018.

Saylor, A., L.S. Prokopy, and S. Amberg. 2011. What's wrong with the tap? Examining perceptions of tap water and bottled water at Purdue University. *Environmental Management* 48(3): 588-601. Available at: https://link.springer.com/article/10.1007/s00267-011-9692-6. Accessed April 9, 2018.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2001. Tippecanoe River, Indiana: Defining Point Source Threats to Rare and Endangered Mussels. Biological Report: Bloomington Field Office. FFS ID# 32F23.

U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2018. America's Mussels: Silent Sentinels. Available at: https://www.fws.gov/midwest/endangered/clams/mussels.html. Accessed October 21, 2018.

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The Beargrass Story: Utilizing Social Science to Evaluate and Learn from the "Watershed Approach"

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Abstract: This paper presents the case of a voluntary watershed project that addressed the need for improving water quality by reducing agricultural nutrient loss. The Beargrass Creek Watershed Approach Project in Wabash County, Indiana aimed to demonstrate that it is possible to achieve ambitious water quality goals and maximize the effectiveness of conservation funding through locally-led efforts that bring together multiple stakeholders throughout the process. The project focused on implementing the "right practices" in the "right places" through a goal-oriented, science-based, and locally-adapted approach to voluntary conservation. We examine and evaluate all three phases of the project and discuss successes and lessons learned from the point of view of both agricultural producers and agency staff from the local Soil and Water Conservation District and the Natural Resources Conservation Service.

Keywords: *watershed, water quality, agriculture, applied social science, evaluation, surveys, interviews, observations*

Growing public concern over nutrient related problems such as algal blooms in Lake Erie and dead zones in the Gulf of Mexico has intensified pressure on agricultural producers to decrease nutrient loss from agricultural watersheds. Increasingly, this concern is expressed through calls for regulatory and prescriptive approaches to achieving water quality goals. However, the agricultural sector prefers a voluntary approach to nutrient loss reduction (e.g., Church and Prokopy 2017), which producers believe allows for flexibility in land use decision making that acknowledges variation in different farming operations.

This paper presents one example of a voluntary watershed project that sought to address the need for improved water quality through agricultural nutrient loss reduction. The Beargrass Creek Watershed Approach Project (henceforth referred to as the Beargrass project) in Indiana aimed to demonstrate that it is possible to achieve ambitious water quality goals and maximize the effectiveness of conservation funding through locally-led efforts that bring together multiple stakeholders throughout the process. The project focused on implementing the "right practices" in the "right places" through a goal-oriented, science-based, and locally-adapted approach to voluntary conservation (Bentlage et al. 2016).

Background

The Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force calls for a 45%

reduction in nutrient load over the average load measured between 1980 to 1996 (Gulf Hypoxia Action Plan 2008). Achieving this goal will require a combination of in-field practices (such as improved nutrient management, conservation tillage, and cover crops) and practices that intercept and treat nutrients at the edge of a field, at a tile outlet, at the edge of a stream or drainage ditch, or within a stream or drainage ditch. Equally important is targeting these practices to the "right places" in the landscape where they can most effectively intercept and treat the greatest nutrient loads (targeted conservation).

As part of a Conservation Innovation Grant (CIG) from the Natural Resources Conservation Service (NRCS), the Wabash County Soil and Water Conservation District (SWCD), Manchester University, and Environmental Defense Fund (EDF) joined together in 2014 to address this call for increased nutrient load reduction through outreach aimed at increasing the voluntary adoption of conservation practices in conjunction with targeted conservation. The Beargrass Creek Watershed was selected in part because it met key social criteria (e.g., funding availability, funded watershed group with paid staff, project interest, problem salience, and stakeholder collaboration and trust). Research had shown that such social criteria can contribute to eventual watershed project success (Babin et al. 2016; Church and Prokopy 2017).

It was envisioned that scientists, producers, and local stakeholders would work together to reduce nutrient loss through the following approach: 1) Scientists would determine the sources of nutrients and how the nutrients move across the landscape; 2) Farmers and other local stakeholders would provide input on natural resource concerns, watershed needs and opportunities, past and current conservation efforts, and how to integrate conservation and agricultural production (and other) goals; 3) The combined information (from scientists, producers, and stakeholders) would then be used to suggest how to meet water quality goals in order to effectively and efficiently utilize conservation funding (McLellan et al. 2015).

In addition to scientific information that generated recommendations for implementing the "right practices" in the "right places" (along with water monitoring data), we utilized social science methods before, during, and after the project in order to understand the human components of the project. Having good natural and physical science available for land use decision-making does not mean that producers will actually decide to implement recommended practices. Through social indicator studies of current and potential program participants, land managers and conservation staff can learn about motivations and barriers to producers' voluntary participation in conservation programs (see Prokopy et al. 2009; Genskow and Prokopy 2011). Moreover, through evaluations of specific conservation initiatives, social science can illuminate issues and opportunities with program elements as well as with program implementation staff.

Purdue University's Natural Resources Social Science (NRSS) Lab staff used a variety of social science methods to inform and evaluate the project, including surveys, interviews, and observations. In this paper, we review the following three phases of the project and explore how social science evaluation techniques were used:

1. Formative evaluation. In 2014, NRSS Lab staff conducted surveys and interviews with agricultural producers and agency staff to collect baseline data that fed into project development.
2. Process evaluation. During the project, NRSS Lab staff observed large watershed meetings and smaller on-farm meetings, reporting to project partners on key takeaways to further refine such interactions.
3. Summative evaluation. As the project drew to a close in 2016, a second round of surveys and interviews was conducted to evaluate the project from the perspectives of producers and agency staff.

Project Context

Beargrass Creek is a sub-watershed of the Middle Eel River Watershed in Wabash County, Indiana. In 2009, Manchester College (now Manchester University) spearheaded the Middle Eel River Watershed Initiative (the Initiative) – a collaborative, community-wide effort to protect and enhance water resources through education and implementation of soil and water

conservation practices. This initial effort was funded through a $1 million Indiana Department of Environmental Management Section 319 grant to write a watershed plan, monitor water quality, and conduct education and outreach; $212,000 of this was designated to cost-share funding to local landowners. In 2010, the Initiative received a Mississippi River Basin Healthy Watersheds Initiative (MRBI) grant from NRCS. In 2013, the Initiative received a second Section 319 grant totaling $833,000, $250,000 of which went to fund cost-share projects. In 2014, project partners Manchester University and the Wabash County SWCD agreed to work with EDF as part of a new project grant (the NRCS funded CIG) to demonstrate the efficacy of *the watershed approach* – a systemic and strategic approach to reducing nutrient losses from agricultural landscapes. This implementation grant funded water monitoring and research, but provided no cost-share funding to local landowners. One watershed coordinator managed all aspects of local project efforts. Project partners focused efforts on the Beargrass Creek Watershed (Figure 1), a 5,985-hectare HUC 12 watershed with approximately 45 producers.

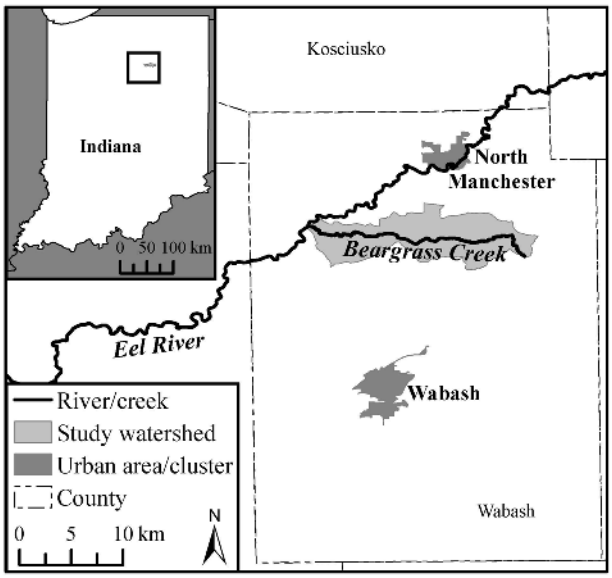


Figure 1. Beargrass Creek Watershed.
Notes: One watershed of interest (Beargrass [HUC 12]) within one Indiana county (Wabash). Extent area shown by box in the inset map. Urban area/cluster as defined by population. Sources: U.S. Census Bureau 2010; U.S. Census Bureau TIGER 2015; USGS n.d.

A major goal of the three-year project was to demonstrate how a locally-led partnership approach could encourage voluntary adoption of conservation practices to meet water quality goals. Manchester University scientists conducted water quality monitoring and USDA Agricultural Research Service (USDA-ARS) staff explored the use of the Agricultural Conservation Planning Framework (ACPF) (Tomer et al. 2013) to better understand where the practices could be located to provide the greatest water quality benefit (see Figure 2 for project photos).

Figure 2. Project photos. Top) Water sampler. Middle) Corn field in the Beargrass Creek Watershed. Bottom) Discussing an ACPF-generated map. Photo Credit: NRSS Lab.

Phase One: Formative Evaluation

2014 Surveys

In the first year of the project, 2014, a social indicators survey of all agricultural producers in the Beargrass Creek Watershed was conducted using an address list provided by the local SWCD. Those on the list were contacted up to four times (advance letter, 1st mailing of paper survey, reminder postcard, drop off and pick up of 2nd paper survey with a reminder postcard) which achieved a response rate of 73% (n=60). Questions on the survey included characteristics of the farming operation and farmer, opinions about water quality and sources of pollution, and usage and opinions about various conservation practices. After following lab protocols for quality checking and cleaning, the data were analyzed using a statistical software package.

2014 Interviews

In-depth interviews with 13 producers (11 different farm operations) and five conservation agency staff within the Beargrass Creek Watershed were also conducted. With the insight and assistance of the local SWCD, the selection of the decision-makers was designed to reflect the diversity of farm type, size, conservation attitudes ("supportive" of adopting/already adopted conservation practices, "unsure" about adopting, "unsupportive" of adopting), and inclination to participate in collaborative initiatives. Most interviews with staff were conducted in April 2014 and all interviews with producers were conducted in August and September of 2014 at conservation offices and producers' homes or farm buildings. Interviews typically lasted 45 minutes. Interviews were recorded, with permission from the interviewee, and later transcribed.

After reading all transcribed interviews, one researcher developed two coding frameworks: 1) agency staff and 2) producers. The codebook was refined by two researchers and all transcriptions were coded in NVivo 11 qualitative research software. Coding comparison queries resulted in overall Cohen's kappa scores above 0.7 for both sets of interviews, which indicates "substantial agreement" (where 1 is perfect agreement) (Viera and Garrett 2005). Through an analysis of the coding frameworks, key interview themes emerged. Illustrative quotes are used throughout this chapter.

Formative Evaluation Results

The findings from the 2014 interviews and surveys provided insight into current use of agricultural conservation practices, factors which encourage and discourage the adoption of these practices, relationships between project partners and producers, and recommendations for effective outreach. Specifically, the NRSS Lab made several recommendations to project leaders related to communicating about the project and holding meetings, including:

- Clearly articulate the goals of the project. While it is necessary to outline the environmental issues that create a need for action, it is also important to acknowledge that producers are not solely responsible for these issues. For example, there are other contributory factors such as heavy rains, fertilizer use on non-farmland, urban discharge, etc. Producers are, however, an important piece of the puzzle and the project must be portrayed as a means of demonstrating that if producers have access to adequate support and information, voluntary positive change can ensue.
- Emphasize how the project represents an opportunity for producers. Despite a degree of unfamiliarity, many producers are willing to consider novel conservation practices. Implementing creative cost-share programs would allow for adoption with reduced financial risk – thus helping to overcome the single most important discouraging factor. Additionally, it should be emphasized that the project's success would lessen the likelihood of future regulation.
- Alleviate fears about the project. There is a need to stress that participation is voluntary and to clarify what might be expected of producers if they are to participate. Flexibility to opt out would help to ease producers' concerns about being tied to a plan that may not be working on their land or with their operation. Because of fear of

further regulation, producers' concerns over privacy and information/data use also need to be addressed. Specifically, there is a need to explicitly explain what type of data would benefit the project, how and by whom it would be collected, who would have access to it, and what it would (and would not) be used for.

- Have trusted individuals help to convey or back messages and findings. NRCS and SWCD staff have established good relations with a number of producers within the watershed. Their reputations – built on trust, a local connection, and first-hand experience of farming practices – represent an extremely important resource. Producers will be more inclined to consider participating in the project if these staff are present when findings are communicated, and are able and willing to reiterate to producers the intricacies of the available practices. Other local champions including individuals from Manchester University, well-respected local farmers, and the county surveyor also have a role to play in promoting the value of the project, ideally as an active advisory committee. In addition, news of the project's progress should be communicated to producers regularly. Those participating in the Middle Eel Initiative bemoaned irregular communication which threatened producers' sense of involvement and ownership in the project.
- Provide multiple opportunities for dialogue. Since the project will only be a success if participation is widespread throughout the watershed, it is important to generate a sense of togetherness and collaboration. Introducing the project in a group setting can help to achieve this goal without conveying that individuals are being singled out or targeted. While a group setting is appropriate for explaining the concept of the project, producers would also benefit from one-on-one meetings to discuss issues and opportunities specific to their operation. A flexible approach to meeting producers, including on-site visits, minimizes producers' inconvenience and helps to reassure them that details of their operation will remain private.
- Familiarize producers with the range of conservation practices and their purpose. Although certain practices such as no-till, cover crops, and grassed waterways were commonplace in the watershed, a large proportion of producers were unaware of more novel approaches. Without the knowledge of what a practice is designed to achieve, whether it will require land to be removed from production, and how costly it will be in terms of time and money, producers are unlikely to move towards adoption. A series of unwarranted and disproportionate concerns emerged during interviews. For example, fears over a loss of farmable land and reduced resale value could be lessened if producers were aware that a number of novel practices require very little land to be taken out of production. Similarly, familiarity with the mapping process for targeted conservation could help producers recognize that practices would not be mandated, but rather suggested for select localities where a significant environmental benefit could be expected to result.

These recommendations were discussed with the watershed team and influenced the planning of project meetings and how information was communicated. A very tangible output was the generation of a booklet for the watershed that described practices, included quotes from local users of the practices, and provided information about cost share (Figure 3). Other outputs included the design of watershed meetings and the way the ACPF-generated maps (Figure 4) were presented.

Phase Two: Process Evaluation

Meeting Observations

Over the three-year grant period, project partners held three public watershed meetings that were attended by a variety of stakeholders, as well as three core project partner meetings. These meetings were developed to address concerns that emerged during the formative evaluation and focused on clearly articulating the goals of

Figure 3. Practice booklet, examples. Top) Booklet cover. Left) Two-stage ditch. Right) Grassed waterway.

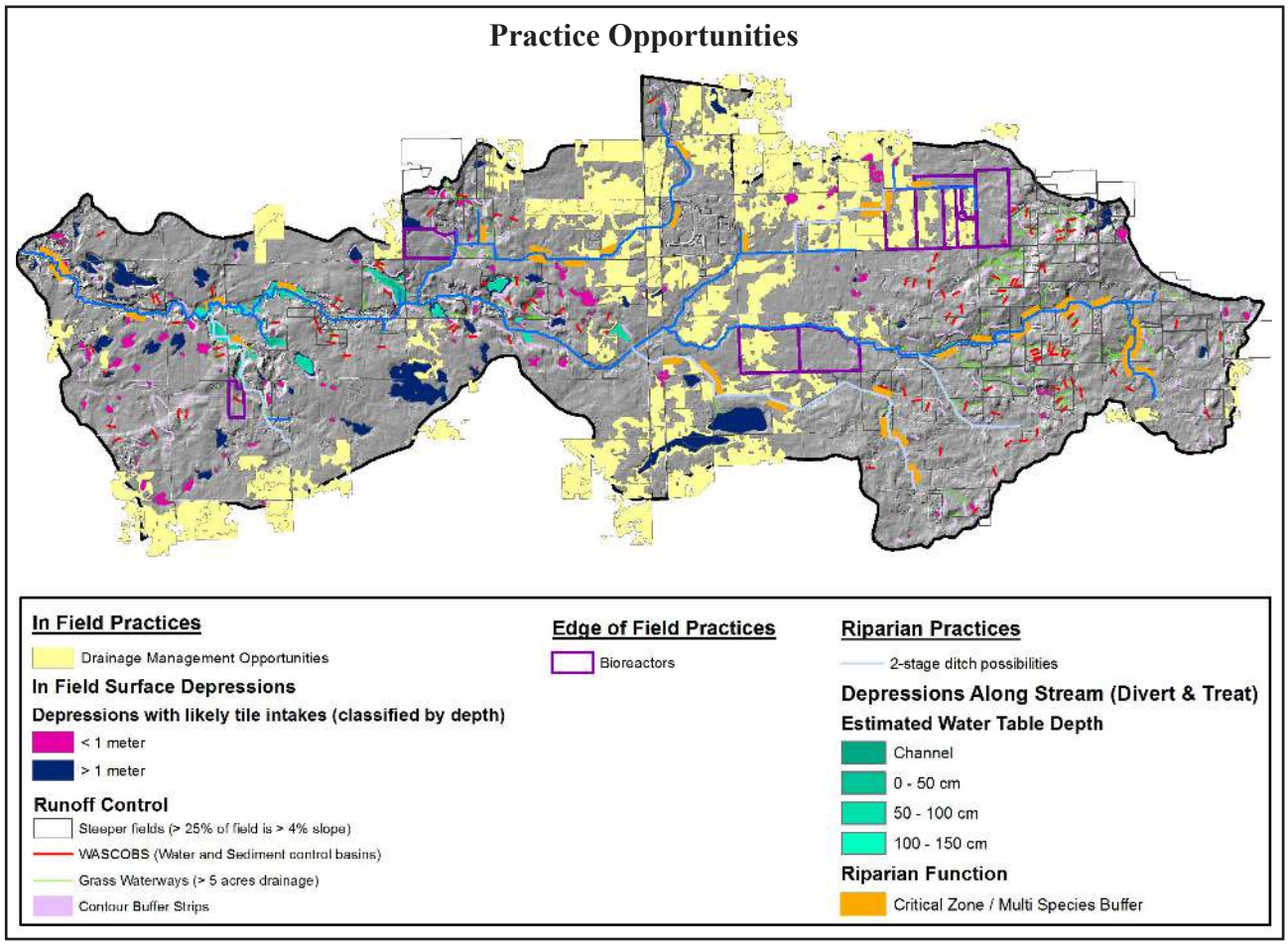


Figure 4. An ACPF-generated map. Map generated by research staff at the National Laboratory for Agriculture and the Environment, USDA-ARS (Ames, Iowa), utilizing ACPF software (Porter et al. 2015).

the project, emphasizing the opportunities for producers, and alleviating fears. Specifically, the meetings included discussions about project intent and progress, educational presentations on project-specific conservation practices, data presentations (e.g., water monitoring outcomes, ACPF-generated maps), and opportunities for informal networking and peer-to-peer learning among producers.

In addition to these large meetings, many on-farm meetings took place throughout the project. In on-farm meetings, producers, project scientists, and SWCD staff reviewed the maps generated by ACPF that highlighted targeted conservation opportunities within the watershed. This allowed producers to consider the suggested practices in a private setting, while also discussing the accuracy of the maps in relation to producers' land. Staff from the NRSS Lab attended and observed watershed and on-farm meetings. Staff took detailed research notes and generated reports based on these observations and meeting notes.

Process Evaluation Results

Suggestions included changing the room configuration to foster dialogue and including additional opportunities for farmer-to-farmer networking. Project staff utilized meeting observation reports to improve future meeting formats and content.

Phase Three: Summative Evaluation

2016 Surveys

Survey data were collected by mail during the summer of 2016 (see Figure 5 for example survey pages). The content of the 2016 survey was identical to the 2014 baseline surveys except that some items were replaced with questions specifically designed to evaluate the Beargrass project.

A modified list of respondents created by the SWCD for the 2014 survey was used for distributing the 2016 surveys. In 2016, respondents were contacted up to four times (advance letter, 1st mailing of paper survey, reminder postcard, drop off and pick up of 2nd paper survey with a reminder postcard). This methodology achieved a 47% response rate (n=40). Respondents were assigned the same 4-digit ID number in 2014 and 2016. Based upon these ID numbers, we found that 28 respondents completed the survey in both years. Data cleaning and analysis followed the same processes as the 2014 surveys.

2016 Interviews

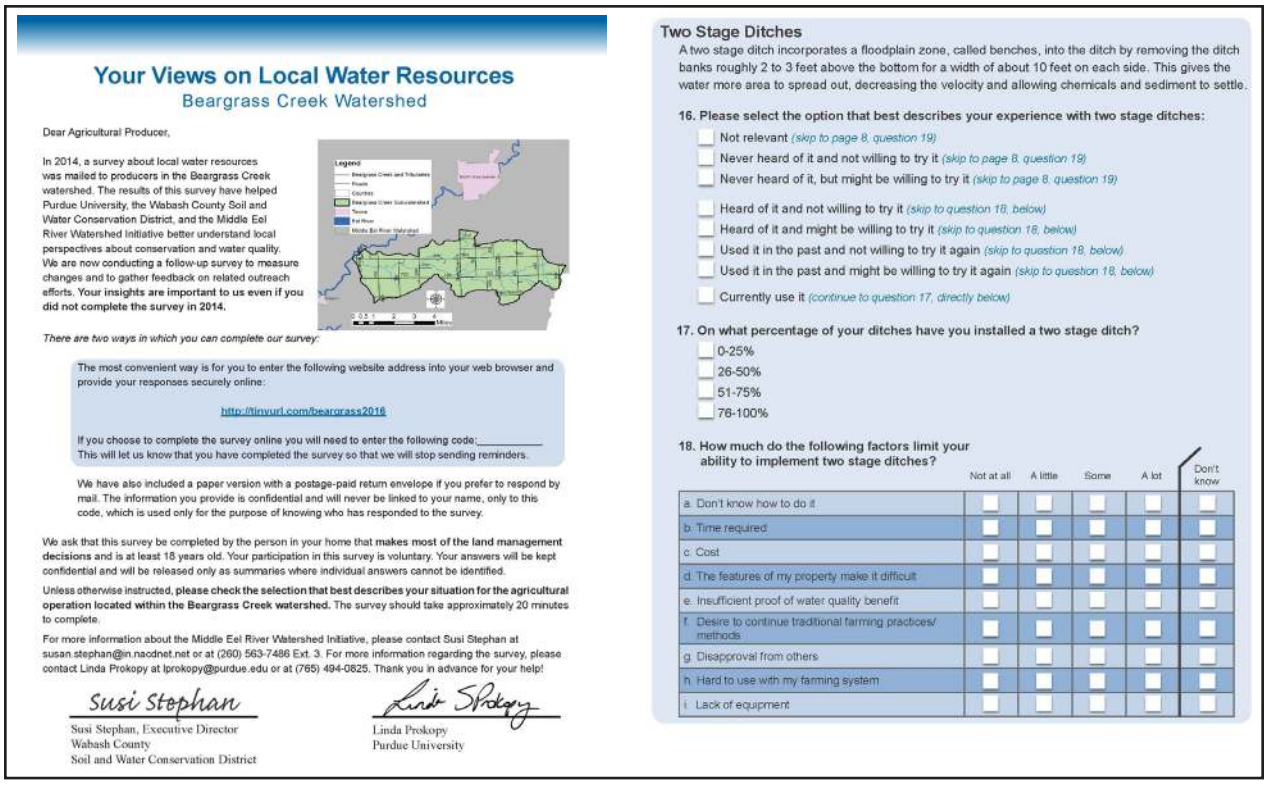
In August 2016, four agency staff members and 13 producers (representing 10 different farm operations in the Beargrass Creek Watershed) were interviewed regarding their experiences with the project. SWCD staff selected interviewees with varying levels of engagement in the project. Interviews lasted approximately 45 minutes and took place at producers' homes or shops or at the SWCD office. Interviews were recorded, with permission from the interviewee, and later transcribed. The same coding process utilized for the 2014 interviews was followed for the 2016 interviews.

Summative Evaluation Results

The final social science evaluation provided data that highlighted the efficacy of the project and the results will be used to inform continued improvement of the watershed approach to conservation. Below we present some project outcomes, including benefits and successes as seen through project participants' eyes, that were gathered through a variety of social science methods.

Producer Attitudes, Awareness, and Adoption

The 2016 surveys were, in part, intended to assess changes in environmental attitudes and conservation practice awareness over the two years of project activities. Means for variables across the two different years (2014 pre-project and 2016 post-project) were generally very similar, and no significant differences were found. For example, survey respondents' opinions about the severity of various water quality impairments (e.g., sedimentation, nitrogen, phosphorus, etc.) increased between 2014 and 2016, but not to a significant degree. Similarly, respondents' awareness of denitrifying bioreactors, saturated buffers, stream channel restoration, and two stage ditches increased in the Beargrass Creek Watershed, however not by a statistically significant number. While there was interest among some interviewees



Your Views on Local Water Resources
Beargrass Creek Watershed

Dear Agricultural Producer,

In 2014, a survey about local water resources was mailed to producers in the Beargrass Creek watershed. The results of this survey have helped Purdue University, the Wabash County Soil and Water Conservation District, and the Middle Eel River Watershed Initiative better understand local perspectives about conservation and water quality. We are now conducting a follow-up survey to measure changes and to gather feedback on related outreach efforts. **Your insights are important to us even if you did not complete the survey in 2014.**

There are two ways in which you can complete our survey:

The most convenient way is for you to enter the following website address into your web browser and provide your responses securely online:

http://tinyurl.com/beargrass2016

If you choose to complete the survey online you will need to enter the following code:_____
This will let us know that you have completed the survey so that we will stop sending reminders.

We have also included a paper version with a postage-paid return envelope if you prefer to respond by mail. The information you provide is confidential and will never be linked to your name, only to this code, which is used only for the purpose of knowing who has responded to the survey.

We ask that this survey be completed by the person in your home that **makes most of the land management decisions** and is at least 18 years old. Your participation in this survey is voluntary. Your answers will be kept confidential and will be released only as summaries where individual answers cannot be identified.

Unless otherwise instructed, **please check the selection that best describes your situation for the agricultural operation located within the Beargrass Creek watershed.** The survey should take approximately 20 minutes to complete.

For more information about the Middle Eel River Watershed Initiative, please contact Susi Stephan at susan.stephan@in.nacdnet.net or at (260) 563-7486 Ext. 3. For more information regarding the survey, please contact Linda Prokopy at lprokopy@purdue.edu or at (765) 494-0825. Thank you in advance for your help!

Susi Stephan, Executive Director
Wabash County
Soil and Water Conservation District

Linda Prokopy
Purdue University

Two Stage Ditches

A two stage ditch incorporates a floodplain zone, called benches, into the ditch by removing the ditch banks roughly 2 to 3 feet above the bottom for a width of about 10 feet on each side. This gives the water more area to spread out, decreasing the velocity and allowing chemicals and sediment to settle.

16. Please select the option that best describes your experience with two stage ditches:

- ☐ Not relevant *(skip to page 8, question 19)*
- ☐ Never heard of it and not willing to try it *(skip to page 8, question 19)*
- ☐ Never heard of it, but might be willing to try it *(skip to page 8, question 19)*
- ☐ Heard of it and not willing to try it *(skip to question 18, below)*
- ☐ Heard of it and might be willing to try it *(skip to question 18, below)*
- ☐ Used it in the past and not willing to try it again *(skip to question 18, below)*
- ☐ Used it in the past and might be willing to try it again *(skip to question 18, below)*
- ☐ Currently use it *(continue to question 17, directly below)*

17. On what percentage of your ditches have you installed a two stage ditch?

- ☐ 0-25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ 76-100%

18. How much do the following factors limit your ability to implement two stage ditches?

	Not at all	A little	Some	A lot	Don't know
a. Don't know how to do it	☐	☐	☐	☐	☐
b. Time required	☐	☐	☐	☐	☐
c. Cost	☐	☐	☐	☐	☐
d. The features of my property make it difficult	☐	☐	☐	☐	☐
e. Insufficient proof of water quality benefit	☐	☐	☐	☐	☐
f. Desire to continue traditional farming practices/ methods	☐	☐	☐	☐	☐
g. Disapproval from others	☐	☐	☐	☐	☐
h. Hard to use with my farming system	☐	☐	☐	☐	☐
i. Lack of equipment	☐	☐	☐	☐	☐

Figure 5. 2016 survey examples.

in adopting these practices, survey results suggest that adoption rates are likely to remain low given the high costs of implementation.

In terms of actual conservation practice adoption, survey data show that grassed waterway use remained extensive between 2014 and 2016, with a majority of producers reporting grass coverage in 76-100% of their waterways. Of the respondents who completed the survey in both 2014 and 2016, conservation tillage use remained relatively consistent – conservation tillage on corn acres increased slightly from 37% to 40% and soybean acres decreased from 61% to 52%. Use of conservation tillage on corn and soybean acres might fluctuate based on an operation's use of cover crops. Interviews with producers revealed that cost-share contracts for cover crops required that producers not till their cover crop acres. Therefore, if an operation adjusted their cover crop acres, they might also adjust their acres in conservation tillage. Based on data from producers who completed surveys in 2014 and 2016, use and coverage of cover crops on corn and soybean acres remained about the same. However, interviewees indicated that future usage of cover crops might be inhibited by negative experiences over the last three years.

Overall, there was increased awareness of water quality issues and various conservation practices over the course of this project. However, statistically significant changes cannot be reported. The lack of significant differences could be due to the small sample size (e.g., a larger sample size can ensure a more accurate mean) (see Schutt 2011), related to the small number of producers in the Beargrass Creek Watershed. Moreover, two years may not have been enough time to measure change since change – particularly behavior change – is complex and slow (e.g., De Young 2011).

Successes, Benefits, Challenges, and Lessons Learned

The results we report in this section are primarily taken from end-of-project interviews because the surveys did not include measurements for respondent-defined project successes, benefits, challenges, and lessons learned; this type of

qualitative information is best ascertained via interviews. Indeed, by interviewing participants, we were able to learn details of perceived successes and benefits of the project as well as key takeaways and lessons learned. While data collected throughout the project informed the Beargrass project's development and refinement, these evaluations will inform future directions for the Beargrass Creek Watershed as well as conservation programs overall.

"Success" Defined

Producer and agency staff interviewees were asked to define the Beargrass project's success. Both groups primarily defined project success as improving water quality in the watershed through implementation of conservation practices.

> *"I think the main thing would be if, overall, if everybody that participated… actually made the water quality better, if we wound up with less nutrients in the water, less soil, sediments in the water because of the Beargrass project, then I'd say it was an overall success." – Producer*

Given the goals of the project – reducing nitrogen loss to meet the Gulf Hypoxia Action Plan goals – this definition of success is not surprising; the project was built around expectations of improved water quality. However, almost all interviewees said they were uncertain about how successful the project was in terms of water quality improvements. Interviewees often stated that three years of water quality data are not sufficient to assess the project's success, a sentiment that was also expressed by Manchester University water scientists at project meetings. Some interviewees believed more time would be necessary to evaluate water quality improvements because the impacts of conservation practices might be delayed. One producer stated that, "Long term success may be literally five, ten years. Because it may take that long for some of these practices to really show its full effect."

Beyond water quality, many producer and agency staff interviewees defined project success as increased awareness about conservation practices.

> *"What I hoped to see out of the project was an opportunity for education…And it very much did that…even if we didn't get as much…projects implemented as we wanted to, it still was an educational, an opportunity for knowledge. It's like, you got to plant a seed and let it grow." – Agency employee*

Both groups of interviewees had hoped to see more extensive implementation of conservation practices throughout the watershed. Despite a lag in practice implementation, interviewees placed great value on the project for facilitating educational opportunities about new conservation practices and structures. However, some producers and agency staff believed the success of the project would be confirmed only if producers continued to use newly adopted conservation practices. One producer described success and ongoing maintenance of conservation practices: "If it was a true, total success, everybody that was involved would probably stay involved and maybe increase their acreage. If some guys back out and say, 'well this didn't work for me,' then maybe it wasn't a total success."

Success was also defined in terms of leadership. Producer interviewees often credited local NRCS and SWCD staff for being dependable sources of information and providing reliable support throughout the project. The local project coordinator was frequently mentioned by name, as were project personnel who presented "creative" conservation practice ideas and led the water quality monitoring efforts.

> *"[Local project coordinator]'s been fantastic. [District coordinator]'s been great. Actually, the whole office has been very solid from that standpoint…It's been a concerted effort, you can tell, of the whole office." – Producer*

In a related theme, agency staff interviewees valued the relationships they built with producers and the partnerships they formed between partner organizations.

> *"One-on-one meetings with producers, telephone calls, got them out to some demonstration plots and stuff like that. But it's still… the best part of it though is still talking to those producers, you know, meeting them on the street, at the grocery*

store, at the county fair, stuff like that."
– Agency employee

The community-led nature of the project, which entailed formal and informal mechanisms for learning through meetings and project outputs, was seen as a key benefit of participation, feeding into overall perceptions of success. Some of this success can also be seen through survey responses. For example, 83% of question respondents (n=29 of 35 respondents who answered the question) said they were *aware of The Beargrass Creek Watershed Approach Project* prior to taking the survey, and half (n=18) of the 36 respondents who answered the question had attended a producer meeting.

Benefits of Participation

Producers. Perceived project benefits aligned with views on project success. Analysis of interview transcripts revealed that producers benefited from the project in multiple ways. Two key benefits were brought up in every interview: 1) Producers often described their experience with the project as "eye-opening" in terms of raising their awareness about environmental problems associated with farming and learning about what conservation practices are available to reduce their environmental impacts; and 2) Producers frequently referenced water quality monitoring by Manchester University as a major benefit associated with the project.

> *"Probably the main thing for us would be that it's shown us that there are different ways to go about farming than what we were doing before instead of just conventional [till] and all that, there's a different way… So it's kind of opened our eyes, you might say, a little bit." – Producer*

> *"Before the project started, there were some practices that we didn't know about… so we have learned some new practices to use." – Producer*

> *"It brings your attention to what's going on in the creek, in the whole watershed area. And going to the annual meeting, that's pretty eye opening; what they're finding when they're testing the waters. The things I thought they would find are not what they're finding – nitrogen seems to be the biggie here." – Producer*

Project meetings provided opportunities for producers to learn about new practices from agencies and universities, and to hear from their peers about personal experiences with conservation practices such as cover crops. A few interviewees appreciated meetings where their peers shared experiences of cover crop successes, failures, and different management strategies. Both round table discussions and informal networking opportunities during project meetings helped interviewees learn from their fellow producers.

> *"I think having other farmers come in that have done it, and share their experiences helps, too. Because, at our annual meeting, they've had different farmers from different areas come in and talk about that. I think people like to know, 'I'm not out here by my own on this island.' It's like, other guys have done this, and yeah, they've had headaches, and they've learned. But you can do it." – Producer*

Some interviewees mentioned additional social benefits, such as meeting and interacting with new people and collaborating with outside partners. The collaborative nature of the project gave some interviewees the sense that government agencies were willing to listen to the experiences of producers and learn about the difficulties associated with conservation practices such as cover crops.

> *"We've been able to meet some people that we would not have been able to meet if it had not been for the Beargrass project… we would have never had an opportunity to meet or talk with or present our side of the table to them. And it's not just all one-sided where they've [agencies] just been throwing the Beargrass stuff at us. We've been able to give some information back to those people…" – Producer*

These results suggest that the multi-faceted approach of the Beargrass project was a success, illustrating the learning process from problem awareness to behavior change (conservation implementation). Water monitoring legitimized the nitrogen reduction goals of the project, raising awareness of water quality issues in the watershed. The collaborative nature of the project fostered

a sense of being heard by government agencies (again legitimizing the watershed project), while informal data sharing and networking allowed producers to learn from each other about the ins and outs of various conservation practices (particularly cover crops). By participating in this project, it is also possible that producers and other partners in this watershed have expanded the social networks necessary for successful action on future social and environmental issues in the watershed (Floress et al. 2011).

Agency Staff. Interviews with agency employees revealed many of the same benefits expressed by producers. Agency employees saw the project as a valuable opportunity to bring funding to the watershed to improve water quality and soil health, which were said to "go hand-in-hand."

> *"It was nice that the district was able to bring in some funds…we get very little from the county to do anything with our programs…So we definitely would not have been able to do a watershed project obviously without the funding that EDF allowed the district to have…"*
> *– Agency employee*

> *"Benefits would be improving water quality, soil health promotion, reducing soil loss. Those are some of the things we try to quantify. That's where Manchester University has been a big advocate on telling us – Are we making improvements? What best management practices are needed out here?" – Agency employee*

Employees from NRCS and SWCD also viewed the watershed project as beneficial for producers interested in learning about and trying new practices, saying that the project "sparked a lot of interest" in conservation practices and programs.

> *"They're [producers] very comfortable with the way they've been doing it, they know how to get it done that way and that's what they stay with. But with this project, it has allowed some producers…to try it on a small part of their farm. Which is the way you want them to do it. You don't want them to change everything overnight. Because there's a learning curve, there definitely is. So this was an opportunity for some of them to get their feet in the ground a little bit and try it a little bit at a time. And it gave others an opportunity that were willing to start something, to do something, it was a great opportunity for them to really get involved." – Agency employee*

Project meetings were seen as a benefit, allowing for information sharing among partner organizations, as well as between outside organizations and the local producers. The ability to share information and to connect with producers was seen as a benefit from the agency perspective because local staff were able to build trusting relationships with participating producers. Benefits of the project are described by agency employee interviewees below.

> *"The fact that these farmers sat in a group together to talk about it [conservation] is huge." – Agency employee*

> *"They [producers] put a lot of trust in what the group is saying, what NRCS is saying, what Soil and Water is saying…I mean they are basically making cropping decisions that affect what they do for a living on what [the agencies are] advising them to do." – Agency employee*

Producers and agency staff expressed similar benefits of the project, particularly benefits surrounding information sharing and collaboration. These results point to the importance of building trust between agency employees and producers as a vital ingredient in watershed project success.

Project Outputs

As noted above, much of the Beargrass project entailed processes that ensured collaboration and information sharing. Overall, interviews with agency employees and producers showed project outputs to be useful tools in encouraging education about different opportunities for conservation practices.

Booklet. Both agency employees and producers were pleased with the *Strategies for Voluntarily Improving the Soil Health on your Farm* booklet. Agency employees said they found the booklet useful because they could distribute it at project meetings and to producers who visited

their offices. An agency employee interviewee described the booklet as a helpful "Cliffs Notes of each practice and what it does." Eighteen (52.9%) of the 34 respondents who answered the question reported they had seen the booklet. Although one respondent thought the booklet was *not very useful*, most thought it was *somewhat* (n=12) or *very* (n=5) useful. Producer interviewees appreciated the booklet, saying they were able to reference it if they wanted to refresh their memory about a practice they recently learned about at a project meeting. If they were interested in a practice depicted in the booklet, producer interviewees said they would check with their local NRCS/SWCD office for more information.

ACPF-generated Maps. Reviews of ACPF-generated maps were also generally positive. Agency staff interviewees described the maps as a "great tool for the NRCS to utilize," "a huge ice breaker," and a useful catalyst for conversations with producers about conservation practices. While helpful for providing "options" for practices such as bioreactors, two stage ditches, and Water and Sediment Control Basins (WASCOBs), agency employees noted that "there needs to be a practicality, because you're not going to go out there and implement every practice that's available." Agency employees recognized that the maps were useful in an educational rather than a motivational sense, noting that cost and availability of cost-share funds were limiting factors for producers interested in implementing practices shown on the maps. When using the maps, agency staff interviewees said they reminded producers that they were not limited to only practices on the maps and that "waterways can go in any field, buffer strips… the biggies like no till, nutrient management, pest management, any type of manure management, those are big practices, cover crops, can apply anywhere."

All producer interviewees (n=13) and 17 (51.4%) of the 35 survey respondents to the question *"I have seen Lidar maps of the Beargrass Creek Watershed that depict practice opportunities"* had seen the ACPF-generated maps. All survey respondents who had seen a map rated it as *somewhat* (n=11) to *very accurate* (n=6). Producer interviewees expressed similar confidence in the maps' accuracy, but some went on to say they would need to explore the physical characteristics of their property before agreeing that the maps showed the "right location" for a given practice. In terms of general location, many interviewees had difficulty finding their property on a map because there were no road numbers. Producer interviewees preferred map versions with key road numbers "so you kind of knew where your property and everything was."

All producer interviewees believed the maps were not an invasion of privacy, saying that "it's just basically public knowledge" and "pretty much anyone that knows how to use the computer can look [this] stuff up." Of the survey respondents who took the survey in 2014 and 2016, attitudes remained fairly split between those who thought targeted conservation efforts and tools such as ACPF-generated maps invaded privacy. Interview data provide further insight into potential concerns over privacy. Some interviewees said the maps as they were being used at the time did not cause concern but they foresaw issues if in the future the maps were used for regulatory purposes. This type of attitude toward ACPF-generated maps is summarized in the following quote from a producer:

> *"I would think they'd need to approach it with going to the farmer and saying, 'We think this might fit. What do you think?' Because the farmer's going to have first-hand experience tilling the ground, and if he has any kind of a care for the land at all, he's going to want to take that into consideration. But for them to come out and say, 'Here's something we need to do. You're going to be forced to do it,' that's not going to be a pill that anybody's wanting to swallow very well." – Producer*

These tools facilitated awareness building and contributed to the collaborative, rather than top-down, feel of the project. For example, our observations of on-farm meetings revealed that the ACPF-generated maps were used as reference points to begin a conversation about implementation instead of a document of final, targeted decisions. This approach thus gave producers a feeling of autonomy and flexibility in considering changes to their farming operations and land. This is consistent with the intent of the ACPF approach (Tomer et al. 2013).

Project Challenges

Producers. Other than extra paperwork and time, which interviewees acknowledged is "like anything else, everything takes more time than what you expect it to," challenges associated with the project from the producers' perspectives focused on the management of cover crops. When asked, "What was challenging about the project?" interviewees most frequently spoke of cover crops as the only challenge, rather than project-specific issues such as shifts in personnel or other types of concerns. For example, "Other than just the actual physical management of the cover crop, no" and "Other than that [cover crops], I don't think there's been any major challenges. Nobody's caused us any grief or headaches."

In a more general sense, when asked what they would improve about the project, producer interviewees said they would have liked the project to continue for a longer period of time. Extending the project into the future corresponds with producers' difficulty of defining success within the project's short timeframe. One producer interviewee said "we're just getting started really" and "was kind of surprised the other day, when [local project coordinator] said that this meeting was more or less getting ready for the end of it [the project]." Overall, producer interviewees felt as though the project needed more time to implement conservation practices, collect more water quality data, and improve conservation decision-making in the watershed. Despite this feeling, projects like these that cover two to three years of funding and outreach efforts can expect successful outcomes such as building awareness about water resources and about the multiple benefits of conservation. Project activities and awareness building can contribute to the watershed's capacity for conservation, while getting started with conservation implementation that then might build over time.

Agency Staff. Agency employees experienced different challenges than producers. Although they mentioned producers' difficulty with cover crops, challenges for agency staff focused on communication, shifts in project personnel, and producer participation. While building relationships with multiple partners across different states, agencies, and areas of expertise was a perceived benefit of the project, agency employees acknowledged that effective communication between all groups was, at times, a struggle.

> *"Just keeping an open line of communication. The more partners becoming involved, it became more evident to us very quickly that we needed to keep these teleconferences going. A lot of the partners aren't located in Wabash, Miami County. So we had to make special efforts to get everyone together in the same room. Keep everybody up to speed. That was a challenge. But [local coordinator] did a good job coordinating that. That's an issue. Communication and off-site staff. Out of state staff." – Agency employee*

There were also personnel changes within different partner groups that came as "a huge blow in momentum"; however, those were challenges outside the control of local agency employees. Within their control was recruiting producers to the project. Local NRCS and SWCD staff interviewees said one of their primary challenges was recruiting some producers, noting that it had taken quite a bit of "convincing them [producers] we are working with them, not really against them…that's come a long way in this project…It's been difficult, but it's been fun." Interviewees believed that changing the mindset of more resistant producers to motivate them to change their practices and to manage their operations in a more conservation-minded way would be an "ongoing" challenge.

> *"…there are some farmers you are just not going to get…and you have to accept that…the farmers that farm in Beargrass, some of them, it was going to be a hard sell from the get-go. So in a way you set yourself up to fail but there's probably not a perfect watershed or an easy watershed. There's always going to be farmers that farm it that are going to be tough to get." – Agency employee*

Additionally, although interviewees understood the benefits of, and advocated for, the adoption of new conservation practices, they also sympathized with producers over legitimate fears and risks associated with changing their operations.

"...I understand that it sounds great, why wouldn't you just do all these things? Because at $3.00 corn there's not a lot of extra money to do a lot of things with. And so I've been farming and I've been making a living so why would I all of a sudden change my management practices and not make as high of a yield? That's always a challenge as well to us, that it's not our bank account." – Agency employee

For producers who did implement conservation practices such as cover crops, agency staff interviewees said the next challenge would be helping producers continue the practices: "These EQIP applications are running out and you can't necessarily convince somebody to continue and so that obviously is a huge struggle."

Other challenges agency employees experienced when recommending practices to producers were the differences in state NRCS construction specifications for conservation practices. Some project partners involved in making conservation practice recommendations were from states other than Indiana. Construction specifications for certain practices may have been within NRCS guidelines in these other states, but made them ineligible for funding in Indiana. Such discrepancies led to some frustration among agency employees and producers. One agency staff member said, "… there were a few curveballs as far as policy stuff goes…When I say policy, I mean NRCS policy."

Overall, agency interviewees would have liked to see more practices implemented, but they struggled to pinpoint how exactly they could have improved rates of adoption throughout the project: "Well it's tough to say because… we tried our hardest." Overall, agency staff felt satisfied with what they accomplished, given the time, staff, and other resources they had: "I look back at 2015 and the amount of work between the two counties. Beargrass, the lower Eel River, the Middle Eel River. We had so many irons in the fire. We did the best we could with what we had. I feel like we went above and beyond." Generally satisfied with their efforts, the primary suggestion for improvement was increased guidance from EDF, the organization who funded the project. Challenges with communication subsequently led to uncertainty regarding the roles and deliverables expected of the organizations and people involved: "I don't know that we've fulfilled what they [EDF] thought we were supposed to do and I'm not really sure what that was." Local agency employees would have appreciated more specific guidelines at the beginning and throughout the project.

Lessons Learned

Producers. When speaking about lessons learned, producers focused on cover crops. Despite the difficulties with cover crops, interviewees said they would encourage producers in other watersheds to try cover crops on a small scale and to get involved with a local initiative like the Beargrass project. Interviewees advocated for initial and continued participation and education, and advised other producers in similar projects to "keep an open mind."

"Join a project, because if you don't, you're not going to learn anything at all. Whereas if you do join the project, at least you're going to learn a little bit." – Producer

Because financial considerations are highly influential in conservation decision-making, producers also advised their peers to seek out cost-share opportunities.

"You get out there and figure out what program is there, and what funding there is for different applications… If there's funding available, make use of them and try them out." – Producer

Many of the producers' comments revolved around difficulties of complex conservation practices such as cover crops. Integrating such practices into farm operations requires a long learning curve that entails patience, time, education, and funding. The Beargrass project included each of the elements to some degree – education, information sharing, farmer networking, and cost-share funding.

Agency Staff. Agency employees advocated for keeping the scale of a watershed project small to make interacting with and recruiting producers achievable. Within that smaller watershed, agency employees called for social science investigations prior to the project so that project personnel would have a sense of "who is in that watershed…

what practices they are already doing…what practices they might be willing to do." Based on that information, interviewees advised that their peers in other watersheds should first recruit conservation-minded producers. Moreover, if producers had already implemented project-specific conservation practices on their land, interviewees suggested asking these producer leaders to host a demonstration site for their neighbors in the watershed.

In addition, agency staff realized that implementation of conservation practices is not and should not be the sole measure of success for a project. For example, methods of recruiting and educating producers were especially important to interviewees.

> *"The most interesting part of this concept of this project is what I realized really early on: That it's not – with this particular project – it's just not about getting the practices on the ground, but it's a lot about how we got those practices on the ground." – Agency employee*

> *"The main thing is to realize your responsibilities…It's our responsibility to realize that sustainable agriculture is possible, and to try to make other producers realize what sustainable agriculture really is and what it needs to be."*
> *– Agency employee*

Agency staff interviewees strongly recommended forming personal contacts with producers and taking responsibility for quality engagement and education regarding conservation practices. To do so, one agency employee summarized, "Definitely make it personable… You have to get face to face."

Finally, agency employees saw Manchester University's water quality monitoring as a crucial ingredient for a successful project. They highly recommended that future projects find partnerships and pathways to collecting water quality data when possible.

> *"Start with the water quality monitoring and build those partnerships…Find out who's doing water quality monitoring. And that's tough. That takes money. I keep coming back to Manchester because [of] their strong partnership… get that scientific baseline set." – Agency employee*

Themes of trust (through building relationships) and legitimacy (through water monitoring and through trusted relationships) continued to emerge in each social science analysis of the project. It is also notable that although the ultimate goal of the Beargrass project was to reduce nitrogen loss through implementation of conservation practices, ancillary benefits such as trust, collaboration, and learning emerged as key project successes.

Conclusions

The Beargrass project was developed as a partnership between government agencies, non-governmental organizations, universities, local stakeholders, and producers. The purpose of the project was for these partners to work together to reduce nutrient loss through scientifically-based conservation approaches and producer adoption of conservation practices. Social science was used throughout the project to inform project development and interim project information sharing, and to evaluate project successes, challenges, and lessons learned.

Prior to the project commencing, social indicator surveys were sent to watershed producers to assess their understanding of water quality issues, and their knowledge, attitudes, and perception of various conservation practices. The survey data indicated the degree to which producers had already implemented conservation practices, and were willing to try (or not to try) new practices. The data also highlighted constraints to conservation implementation and perceptions of the targeted conservation practices on which the Beargrass project focused. This information informed project development.

Once the project launched, NRSS Lab staff observed on-farm meetings and large information sharing meetings, and shared observations with project staff who continuously improved meeting format and content. At the project conclusion, a post-project social indicator survey was distributed to assess changes in environmental behaviors and conservation attitudes over the course of the project. Although no significant differences were found in the pre- and post-survey data, interviewees

suggested many supplementary project benefits and successes. Indeed, analysis of the interviews helped identify project benefits that may not have otherwise been recognized.

In this paper we highlighted information gathered through the project's evaluation. We found that producers benefited from the project through increased awareness of water resource issues and different ways of farming through conservation. Agency staff also saw these benefits and realized that the process of working with farmers through education and face-to-face interactions was key to getting conservation measures implemented on the ground. This pointed toward the efficacy of working in a small-scale watershed. The Beargrass project offers an example of how social science can be used to inform conservation watershed projects from project development to evaluation.

Recommendations

Beargrass Creek Watershed

Moving forward in the Beargrass Creek Watershed, producers will require motivation and assistance to continue and expand conservation practices. Final interviews and surveys demonstrated that conservation-minded producers in the watershed were largely limited by financial factors. Survey data showed that the number of producers who planned to apply cost-share funds to implement practices was similar to the number of producers who were not interested in applying for cost-share programs.

Continued outreach for cost-share opportunities might encourage future adoption of conservation practices to improve water quality. More survey respondents *agreed/strongly agreed* (n=20) than *disagreed/strongly disagreed* (n=5) that producers played a key role in reducing nutrient loading by 45%. More producers also *agreed/strongly agreed* (n=12) than *disagreed/strongly disagreed* (n=3) that the 45% reduction goal was achievable. These data, along with interviewee interest in continuing the Beargrass project and the practice of cover crops, suggest there is momentum to motivate producers to continue and potentially increase their conservation efforts.

Future Projects

Based on our study, we recommend that future projects should:

- Incorporate water quality data through rigorous sampling methods and analysis. Both agency employees and producer interviewees cited water quality data, collected by Manchester University, as a primary benefit of the Beargrass project. If future projects set a goal to reduce nutrient loading in waterways, baseline and continued assessment of water quality must occur to track improvements in water quality over time. Evaluation of a project's success should also not be limited to a few years' worth of water quality data.
- Continue to assign a local project coordinator within the watershed. Personal contact and face-to-face meetings were highly valued by all interviewees. The local project coordinator and other project partners who directly interacted with producers were often mentioned as valuable assets and sources of information. Local staff should continue to be responsible for maintaining positive relationships with producers in the watershed. The local project coordinator should be provided with and have access to resources that will help them fulfill clear project goals. Overall, a consistent presence and commitment through the project's duration is crucial, especially given the long timeframes involved from initial producer engagement to eventual adoption of conservation practices.
- Keep project scale within manageable limits. Agency staff interviewees were in favor of focusing on relatively small watersheds so that outreach and education efforts would be effective and achievable. Producer and agency staff interviewees valued project meetings and in-person conversations, which are difficult to facilitate on a larger scale. If future projects are implemented in a larger watershed, assigning multiple local coordinators to cover smaller geographic areas or sub-watersheds should be considered.
- Consider extending timeframes of future

projects. In interviews, producers expressed interest in having more time to learn how to best incorporate conservation practices, specifically cover crops, into their operations. Three years may not be enough time for producers to effectively adopt and maintain new conservation practices.

Social science investigations should occur during the early stages of the project so that local agency staff may gain in-depth insights into producers' conservation attitudes, practices, and willingness to adopt new practices.

Evaluation of future projects should not be limited to strictly quantifiable measures, such as water quality data and number of acres enrolled in a conservation practice. Qualitative assessment, such as interviews with participants, should also occur. For example, producer interviewees often considered the Beargrass project successful based on the educational opportunities and awareness-raising throughout the area.

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References

Babin, N., N.D. Mullendore, and L.S. Prokopy. 2016. Using social criteria to select watersheds for non-point source agricultural pollution abatement projects. *Land Use Policy* 55: 327-333. Available at: https://doi.org/10.1016/j.landusepol.2015.06.021. Accessed June 20, 2019.

Bentlage, B., P. Ranjan, and L.S. Prokopy. 2016. Social Science Evaluation Report: Beargrass Creek Watershed Approach Project. West Lafayette: Purdue University. Available at: https://www.purdue.edu/fnr/prokopy/wp-content/uploads/2014/06/Beargrass_Social_Science_Findings_with_all_appendices_20161129.pdf. Accessed June 20, 2019.

Church, S.P. and L.S. Prokopy. 2017. The influence of social criteria in mobilizing watershed conservation efforts: A case study of a successful watershed in the Midwestern US. *Land Use Policy* 61: 353-367. Available at: https://doi.org/10.1016/j.landusepol.2016.11.030. Accessed June 20, 2019.

De Young, R. 2011. Slow wins: Patience, perseverance and behavior change. *Carbon Management* 2(6): 607-611. Available at: https://doi.org/10.4155/cmt.11.59. Accessed June 20, 2019.

Floress, K., L.S. Prokopy, and S.B. Allred. 2011. It's who you know: Social capital, social networks, and watershed groups. *Society and Natural Resources* 24(9): 871-886. Available at: https://doi.org/10.1080/08941920903493926. Accessed June 20, 2019.

Genskow, K. and L.S. Prokopy. 2011. The Social Indicator Planning and Evaluation System (SIPES) for nonpoint source management: A handbook for watershed projects. Great Lakes Regional Water Program. Available at: https://iwr.msu.edu/sidma/Info/pdfs/SI_Handbook_v4_02012012.pdf. Accessed July 12, 2019.

Gulf Hypoxia Action Plan. 2008. Gulf Hypoxia Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico and Improving Water Quality in the Mississippi River Basin. Washington, DC: Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Available at: https://www.epa.gov/sites/production/files/2015-03/documents/2008_8_28_msbasin_ghap2008_update082608.pdf. Accessed July 12, 2019.

McLellan, E., D. Robertson, K. Schilling, M.D. Tomer, J. Kostel, D. Smith, and K. King. 2015. Reducing nitrogen export from the corn belt to the Gulf of Mexico: Agricultural strategies for remediating hypoxia. *Journal of the American Water Resources Association* 51(1): 263-289. Available at: https://doi.org/10.1111/jawr.12246. Accessed June 20, 2019.

Porter, S.A., M.D. Tomer, D.E. James, and K.M.B. Boomer. 2015. Agricultural Conservation Planning Framework ArcGIS® User Manual (Ver. 1). USDA-ARS National Laboratory for Agriculture and the Environment. Available at: www.northcentralwater.org/acpf/. Accessed June 20, 2019.

Prokopy, L.S., K. Genskow, J. Asher, A. Baumgart-Getz, J. Bonnell, S. Broussard, C. Curtis, K. Floress, K. McDermaid, R. Power, and D. Wood. 2009. Designing a regional system of social indicators to evaluate nonpoint source water projects. *Journal of Extension* 47(2): 8.

Schutt, R.K. 2011. *Investigating the Social World: The Process and Practice of Research*. Sage Publications, Thousand Oaks, California.

Tomer, M.D., S.A. Porter, D.E. James, K.M.B. Boomer, J.A. Kostel, and E. McLellan. 2013. Combining precision conservation technologies into a flexible framework to facilitate agricultural watershed planning. *Journal of Soil and Water Conservation* 68(5): 113A-120A. Available at: https://doi.org/10.2489/jswc.68.5.113A. Accessed June 20, 2019.

USGS. n.d. USGS National Hydrography Dataset (NHD) Best Resolution for 20160915 State or Territory File GDB 10.1 Model Version 2.2.1. U.S. Geological Survey, National Geospatial Program. Available at: https://catalog.data.gov/dataset/usgs-national-hydrography-dataset-nhd-best-resolution-20180216-for-washington-state-or-territorf90ea. Accessed July 19, 2019.

U.S. Census Bureau. 2010. 2010 Census Urban and Rural Classification and Urban Area Criteria. Available at: https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/2010-urban-rural.html. Accessed June 20, 2019.

U.S. Census Bureau. 2015. 2015 TIGER/Line Shapefiles. Available at: https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html. Accessed July 19, 2019.

Viera, A.J. and J.M. Garrett. 2005. Understanding interobserver agreement: The kappa statistic. *Family Medicine* 37(5): 360-363.

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Assessing Principles of Good Governance: The Case of Lake Wausau, Wisconsin

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Abstract: This paper describes how in-depth interviews and content analysis of water-related policies and plans were used to assess good governance principles (transparency, effectiveness, equity, accountability, and appropriate scale) for Lake Wausau in central Wisconsin. The purpose of the research was to support and inform development of a lake management plan. One of the key findings was that the existing system of water governance lacked transparency. In addition, responsibility for and benefits from potential improved lake conditions were distributed unevenly and inequitably among stakeholders. Local and county plans were vague and lacked strong language (e.g., "should" vs. "must" comply) to indicate which actions were required. Both barriers to and opportunities for creating a more effective system were identified. This paper offers suggestions for improving the governance system, discusses the limits of local watershed planning for overcoming watershed management issues, and provides suggestions for anyone wishing to undertake governance analyses to support water resources management.

Keywords: *watershed management, planning, nonpoint source pollution, policy analysis*

Managing water resources at the watershed level has been promoted as one of the most promising ways of achieving water quality goals. This perspective reflects the limitations of top-down approaches to improving water conditions. At the same time, community-based watershed management has not been fully successful in changing voluntary behaviors to improve water quality, as evidenced by the fact that nearly half of United States' surface waters are impaired (DeSimone et al. 2015). Because the impact of individual activities can be minute, motivations to change may be absent and, according to Ostrom (2011), the perceived benefits either may not outweigh the costs or may simply not be considered at all.

The United States Environmental Protection Agency (EPA) began promoting management at the watershed scale in earnest in the 1990s. The agency published several documents, including guidance for states and associated projects about the importance of watershed management and why a more integrated and holistic approach was necessary:

> *The Watershed Protection Approach (WPA) is a departure from the way the EPA has traditionally operated its water quality programs and how federal, tribal, and state governments have typically approached natural resource management. Resource management programs…have tended to operate as individual entities and occasionally at cross-purposes…We also recognize that solving environmental problems depends increasingly on local governments and local citizens. Thus, the need to integrate across traditional program areas (e.g. flood control, wastewater, land use) and across levels of government (federal, state, tribal, local) is leading natural resource management toward a watershed approach.* – From Watershed Protection, A Project Focus (Sosin et al. 1995, 6).

Recognizing the overlaps in relevant programs, agencies, and management scales, the EPA has since invested extensive resources in building the capacity of states and watershed projects to effectively use the WPA. From online training tools (e.g., the Watershed Academy) to the approximately 400-page watershed planning handbook (USEPA 2005), there is no shortage of guidance for developing watershed management plans. While these resources provide formulas for step-by-step approaches to watershed management, they focus heavily on watershed conditions like water quality, land use, and socio-economics. They usually do not include detailed information or analyses of the policies, programs, and organizations that may influence the management of an individual water body. These policies, programs, and organizations are each part of the system of water governance that operates to facilitate and constrain actions that impact water quality.

In this chapter, we describe an evaluation of the system of water governance of Lake Wausau, an impoundment in central Wisconsin, USA that is part of the Wisconsin River system. The central portion of the Wisconsin River Basin, shown in Figure 1, is impaired due to excess nutrient loading from landscape runoff, industrial and municipal wastewater, storm water, and naturally occurring nutrients from wetlands and forests (Turyk 2018). The authors were invited by a community-based organization, the Lake Wausau Association (LWA), to engage in research to help them understand issues, challenges, and strengths associated with managing the lake. One piece of this work is the governance assessment requested by lake planning project partners presented in this paper.

This assessment is based on several approaches used to understand institutional design: principles of good governance (Sheng 2009), relevant components of a watershed management capacity model (Davenport and Seekamp 2013), understanding perceptions related to scales at which organizations operate (Smith 2002), and our own previous work on understanding collaborative resource management (e.g., Floress et al. 2011; Floress et al. 2015). Together, these resources have demonstrated that there are numerous interactions between and among different scales even for

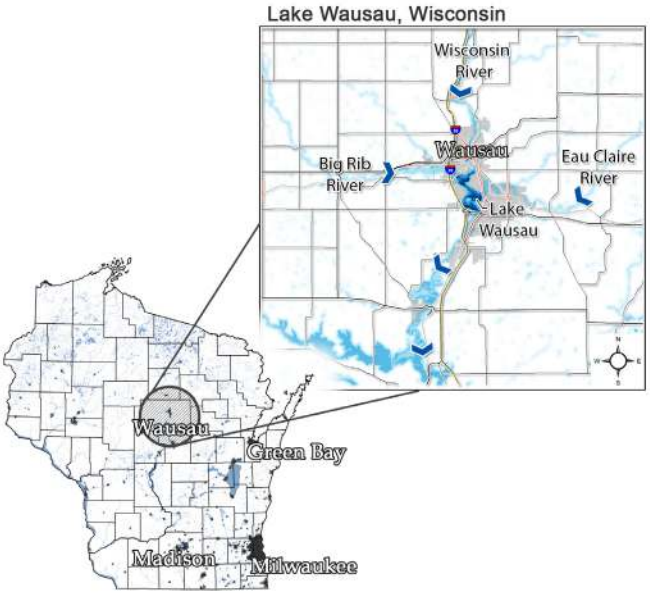

Figure 1. Map of study area.

watershed management problems that, on the surface, appear at least spatially bounded (e.g., a single lake). Thus, watershed management is a complex system comprised of "an interconnected network of components" that is not easily described (Berkes 2008, 2). Collaborative, watershed-scale approaches have been criticized for giving inadequate attention to this complexity (Akamani and Wilson 2011; Floress et al. 2015). Despite these challenges, there is overlap in factors that have been identified throughout the literature and summarized by a number of researchers about what facilitates effective watershed management (e.g., Prokopy et al. 2009; Davenport and Seekamp 2013; Floress et al. 2015), but often these highly interrelated factors are artificially separated or connections among them are not clearly defined. Thus, more attention is being paid in the watershed and landscape-scale management literature to the interrelated processes, policies, and organizations that impact and mediate how people interact with natural resources (Pahl-Wostl et al. 2009; Plummer and Fennell 2009; Floress et al. 2015); that is, the system of governance.

Table 1 presents five principles of good governance expanded from Sheng (2009) and Citizens' League (2009), each principle's description and indicators from the literature, and interview and web survey questions used to

assess each in the current study (methods for each are described below). The principles are interdependent and require a system of governance to be: 1) transparent – the system, its policies, and relevant information can be understood by stakeholders; 2) effective – the system "meet(s) the needs of society while making the best use of resources" (Sheng 2009, 3); 3) equitable – all stakeholders are included and share responsibility for and benefits of the managed resources; 4) accountable – relevant governmental institutions and private industry are accountable for decisions/actions; and 5) appropriately scalable – policies and authority, from the federal to local level, are clear and flexible enough to be implemented at the watershed scale.

Methods

Content Analysis

To understand the plans and policies potentially impacting management of Lake Wausau, we conducted a content analysis of relevant documents from local, county, and state agencies. Federal policies were omitted since state statutes are intended to ensure compliance with federal code. The initial intent was to utilize the Institutional Grammar Tool (Crawford and Ostrom 1995; Siddiki et al. 2012) as a method for understanding transparency, equity, and accountability. The Institutional Grammar Tool was designed to understand the structure of written policies, laws, and other documents. The components and definitions of this structure can be found in Table 2.

However, early feedback from the LWA and resource management staff led us to simplify our analysis by using plain, understandable language and refine what was included to address their needs. Because sanctions ("or else" component) were not included in the majority of documents, this information was not collected. Thus, for each policy we identified the target resources (e.g., soil, water quality, property), impacted stakeholders (e.g., lakeshore owners, agricultural producers, municipalities), actions suggested, required, or forbidden (e.g., activities that can potentially harm the lake's resources, requirements for cost-sharing), the entity/entities accountable for meeting the policy's goals (e.g., Wisconsin Department of Natural Resources (WDNR), county conservation, planning, and zoning office, etc.), and the administrative scale (state, county, or city/village/town) at which the policy applies. Plans and policies were identified through interviews with land and water resource managers in Marathon County and through web searches for ordinances, plans, and policies related to nonpoint source pollution in the state of Wisconsin and each of the cities, towns, and villages in the watershed.

Interviews and Follow-up Web Survey

We conducted a series of 12 interviews with individuals involved in water/watershed management, local government agencies and non-governmental organizations, lake association members, and others who were identified as potentially having knowledge that would be useful for understanding the management of Lake Wausau. The interviews were designed to elicit feedback about specific components of good governance (see Table 1).

After analyzing the interview transcripts, the researchers developed a series of questions based on Smith (2002, see Table 1) about 11 specific agencies and organizations that had been mentioned by one or more interviewees, in order to garner additional information about governance principles. A web survey was used to gather input from the 12 interview participants themselves and several others that interview participants forwarded the survey to because they were knowledgeable about watershed management. The number of people who were forwarded the survey link is not known.

The 11 agencies/organizations that were identified during interviews or during the policy analysis as influencing the management of Lake Wausau and included in the web survey questions were: EPA; WDNR; Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP); local cities/towns/villages; Marathon County Department of Conservation, Planning, and Zoning (CPZ); Natural Resources Conservation Service (NRCS); River Alliance of Wisconsin; LWA; North Central Stormwater Coalition (NCWSC); Wisconsin Association of Lakes (WAL); and University of Wisconsin-Extension (UWEX).

Table 1. Descriptions and data sources for principles of good governance.

Principle	Description/ Indicators*	Key Interview Questions	Web Survey Questions**
Transparency	Coordination across spatial and issue boundaries, knowledge of programs	• Are you involved in any other organization that might also impact or be impacted by (water policies in Wisconsin/the Lake Wausau management plan?) • What is the primary role your organization plays, and how is that related to (water policies in Wisconsin/the Lake Wausau management plan?) • How frequently do you work directly with other organizations on water management issues? How would you characterize that work? • Integration of all findings from other principles	• How would you characterize [organization] in terms of its functional scale? Functional scale means the variety of issues the organization addresses. *(narrow, medium, broad)*
Effectiveness	Presence of adequate resources, effectiveness of programs, engagement in adaptive management	• What policies or plans shape the role you and your organization play? • What policies help or hinder successful watershed management? • What resources do you know of that are available to you to work on Lake Wausau issues? • What types of resources do you and your organization use to help achieve your goals? Which do you rely upon most often? • Please describe how well you think our agencies, policies, and programs are working to protect water quality? Which do you think are the most effective? The least?	• How would you characterize the financial support, or willingness for the public to invest in actions to improve water quality, for the organization? *(minimal, fair, optimal)* • In general, how effective do you think the organization's programs and policies are for improving water quality? *(very effective, somewhat effective, neither, somewhat ineffective, very ineffective)*
Equity	Benefits from and responsibility for safe water shared among and supported by stakeholders	• Are there people, agencies, or groups who you see as having too much influence on attempts to protect water quality? Too little?	• How would you characterize the ideological support, or public and political support for actions, the organization has to achieve water quality goals? *(minimal, fair, optimal)*
Accountability	For problems and solutions	• To whom or what do you see your organization as most accountable?	• How would you characterize the authority the organization has over decisions impacting water quality? *(weak, moderate, strong)* • How would you characterize the power the organization has to change people's behavior to improve water quality? *(weak, moderate, strong)*
Appropriate Scale	Presence of flexible policy options for implementation at watershed scale	• What is unique to the local population in the Lake Wausau watershed that affects your ability to achieve your goals? • What unique natural resource features in the area simplify or complicate your ability to achieve your goals?	• How would you characterize [the organization] in terms of its spatial scale? Spatial scale means the geographic area to which the organization's policies apply. (*narrow, medium, broad)*

*Informed by Prokopy et al. 2009; Floress et al. 2011; Davenport and Seekamp 2013; and Floress et al. 2015. **Revised from Smith 2002.

Table 2. Institutional grammar components, definitions, and simplified analysis.

Institutional Grammar Component	Definition	Simplified Analysis (Institutional Grammar Tool Component in parentheses)
Attribute	Who the policy refers to (e.g., municipality, farmer, resident)	1. Resources protected (e.g., soil, water quality, human health) (Aim) 2. Stakeholders impacted: Those identified in the policy as carrying out actions (Attribute) 3. Actions and whether they were suggested, required, or forbidden (Deontic, Conditions) 4. Accountability: Entity accountable for meeting policy's goals (Attribute) 5. Administrative scale at which policy applied (city/village/town, county, or state) (Conditions)
Deontic	Conditional or imperative statement (e.g., must, should not, etc.)	
Aim	What the policy is about (e.g., livestock fencing)	
Conditions	The specifics regarding when the aim occurs	
Or else	A sanction if the policy is not followed	

Mail Survey

A mail survey questionnaire was designed to measure residents' attitudes toward Lake Wausau, their economic priorities, and demographic information. The recruitment letter specified that the survey results would be treated as anonymous and that participation was completely voluntary. Participants were selected using a random sample of 850 mailing addresses in the Lake Wausau area. The sample was developed from tax parcel records to identify and randomly select residential homeowners within each of the communities. Using Dillman's (2000) tailored design method a five wave survey was conducted that resulted in a 44.3% (n=376) response rate. In this paper, results of only two questions are reported that were included on the survey to support the governance analysis: respondents' familiarity with and importance of five specific policies: the Clean Water Act, three state administrative rules (Natural Resources 115, Shoreland Zoning; Natural Resources 151, Phosphorus Rule; and Natural Resources 40, Invasive Species Rule), and a general category for "local planning & zoning regulations". See Thompson et al. (2014) for a full report of this survey.

Results

The sections below first provide overviews of the content analysis and web survey results, followed by an assessment of each principle of good governance. These assessments are supported by interview, content analysis, and survey results.

Overview of Policies and Plans Impacting Lake Wausau

Thirty-two policy and plan documents were identified and analyzed. Half (n=16) were at the state administrative scale, followed by city/village/town (n=10), and county (n=6). All state-level policies were administrative rules (i.e., official agency regulations that describe how a law will be implemented). At the county level, two documents were general plans (land and water plan, comprehensive plan) and four were county ordinances. At the city/village/town level, four were comprehensive plans and six were ordinances. In general, plans and policies in the watershed are implemented to reduce soil loss and protect surface, ground, and drinking water quality, wetlands and shorelands, floodplains, and aquatic life and habitat. In addition, many of the plans and policies mentioned enhancing natural beauty and aesthetics as benefits of protecting other resources. Tables 3-6 provide an overview of the policies and resources addressed, stakeholders, and responsible entities. The appendix includes more detailed information about each policy.

The plans and policies differed greatly in the degree to which certain actions were required, encouraged, or forbidden. Local and county

comprehensive plans that were largely voluntary in nature used language such as "strive for", "attempt", and "encourage." State administrative rules and local/county ordinances were regulatory in nature and used much stronger language such as "must", "must not", "is/are required", and "will."

The majority of policies and plans analyzed were identified by the research team and not mentioned by interviewees. However, several were mentioned by at least one interviewee, including state administrative rules that established performance standards for nonpoint source pollution, regulated stormwater discharge permitting, and regulated animal feeding operations, along with two county ordinances that regulated livestock facilities and waste.

Table 3. Number of policies analyzed at each administrative scale.

Administrative Scale	Frequency (number)
City/Town/Village	10
County	6
State	16

Table 4. Stakeholders groups and the number of policies/plans that target them.

Stakeholder Group	Frequency (number)
City/Town/Village	10
All residents	9
All agricultural producers	7
County	7
All property owners	6
Developers/Builders	6
Livestock producers	5
University/School	4
Lake organizations	3
Community, general	3
Crop producers	2
Dairy producers	2
Construction/Developers	1
Mine operators	1
Industry, general	1
Woodland owner	1
All riparian owners	1
Waste storage operators	1

Table 5. Number of policies that aim to protect each resource.

Resources Protected	Frequency (number)
Surface water quality	11
Ground/Surface water, general*	10
Wetlands	10
Shorelands	7
Aquatic life	6
Natural beauty	6
Floodplains	4
Native species	4
Public health, people	4
Groundwater quality	3
Groundwater quantity	3
Woodlands	3
Habitat	2
Lake resources, general	2
Wildlife	2
Economic/Property values	1
Recreation	1
Soil	1
Surface water quantity	1
Threatened/Endangered species	1
Water supply	1
Wellheads	1

*Not specific to quality or quantity, includes surface and ground.

Table 6. Agencies responsible for enforcing policies and plans.

Responsible for Enforcing	Frequency
WDNR	17
CPZ	13
City/Town/Village	11
DATCP	5

Overview of Web Survey Results

Nineteen individuals responded to the web survey. As explained above, there were 12 interview participants who were sent the survey, and several of those individuals asked if they could forward it to others. We do not know how many people were forwarded the link, thus we are unable to calculate a response rate. Regardless, this was not intended to be a representative survey but, instead, gather additional information from interview respondents about organizations mentioned during interviews. Respondents were initially asked if they were familiar with 11 organizations listed on the survey. If they answered no about any organization, skip logic "piped" them to the next organization. If they answered yes about any organization, they were asked follow-up questions about that organization. Thus, the total number of individuals answering any given question may not always add up to 19.

Respondents were asked which agency/organization types they were affiliated with, and were allowed to check multiple responses (some elected officials, part time staff or volunteers, for example, might have other jobs). Respondents represented city/town/village governments (n=6), state agencies (n=9), non-governmental organizations (n=4), college/university/extension programs (n=8), and a federal agency (n=1). These results are used below to highlight findings organized by good governance principles.

Good Governance Principle 1: Transparency

The system of water governance for Lake Wausau (and in general) was not very transparent. There were a variety of administrative rules, local and county ordinances, and plans that could impact the lake, very few of which were mentioned by interviewees as being important to their work. While those who were responsible for the implementation of specific programs and policies might know the goals of a policy and to whom it applied, most respondents to the mail survey found it difficult to understand who was ultimately responsible for achieving outcomes and how policies were inter-related (Figure 2). In terms of the level of agreement in web survey responses about the functional scale – or variety of issues addressed by each agency/organization – the organization most people agreed had the most narrow functional scale was the LWA, with EPA and WDNR having the most broad (Figure 3).

Good Governance Principle 2: Effectiveness

Adequate Resources. Having the resources necessary to develop, implement, and enforce policies and plans was described as important by all participants, and not having (enough) appropriate staff and funding for implementation and monitoring were noted as barriers to protecting water quality. The technical skills of those working in the area long-term were seen as a having the potential to help improve water quality, as was increased monitoring that resulted from the Wisconsin River total maximum daily load process.

The comment below illustrates the connection between effectiveness and having adequate resources, and the need for additional cooperation among the various Lake Wausau stakeholders, to improve the lake as a community resource. Further, the participant discusses how disconnection among stakeholders and the system of governance was hindering that process at the time of the interview.

> *Well you've got a fragmented approach. You've got different regulations in different municipalities and you've got different thought processes relative to the value and the role of that governmental unit in protecting quality and I think that the hope of the lake association was there would be some opportunities to approach it holistically with all the governmental units.*

Funding for municipal and agricultural practices – in addition to activities such as weed removal – was repeatedly mentioned as being vital and currently insufficient to improve water quality. One person noted, "The DNR, they set the standards that we have to follow and other than quantity, we are typically not more restrictive. We are not because it boils down to money. It costs a lot of money to be in compliance with DNR rules and regulations, so we do our best to be in compliance."

Web survey respondents reported that no organization had optimal financial support (Figure 4). The Wisconsin DATCP was ranked as having minimal support most often (n=10), while funding

for the County Department of Conservation, Planning, and Zoning was ranked as both minimal (n=8) and fair (n=7). All other organizations were rated as having fair financial support. Most people responding to the question did not know the financial support associated with River Alliance and the Wisconsin Association of Lakes.

Specific Policies and Programs. Agricultural performance standards (Wisconsin Administrative Rule Natural Resources 151 – Runoff Management, hereafter NR 151) were noted as having the potential to positively impact Lake Wausau water quality, but, as one individual stated, they don't "go far enough to protect water quality" since producers did not need to change potentially harmful practices unless cost-share funding was available. Another participant stated that current regulations in general were not effective for protecting water quality: "They take steps in the right direction, but they certainly aren't strong enough because they're a political compromise. So they're not strong enough to protect water quality."

However, the municipal separate storm sewer system (MS4) program was seen as having positive impacts on water quality. Further, several participants believed that the NCWSC was a positive asset to and driver of change in the Lake Wausau watershed.

When asked how effective each organization was with regard to improving water quality, respondents most often ranked each organization as somewhat effective, though UWEX was considered neither effective nor ineffective, and DATCP was most often considered somewhat ineffective followed closely by very ineffective (Figure 5). Overall, there was disagreement about whether policies and programs created by various agencies were positively impacting water quality. This finding, taken together with perceptions about the agencies' inability to impact behaviors that affected water quality, indicates that the institutional structure for water governance was seen, at best, as only mildly effective.

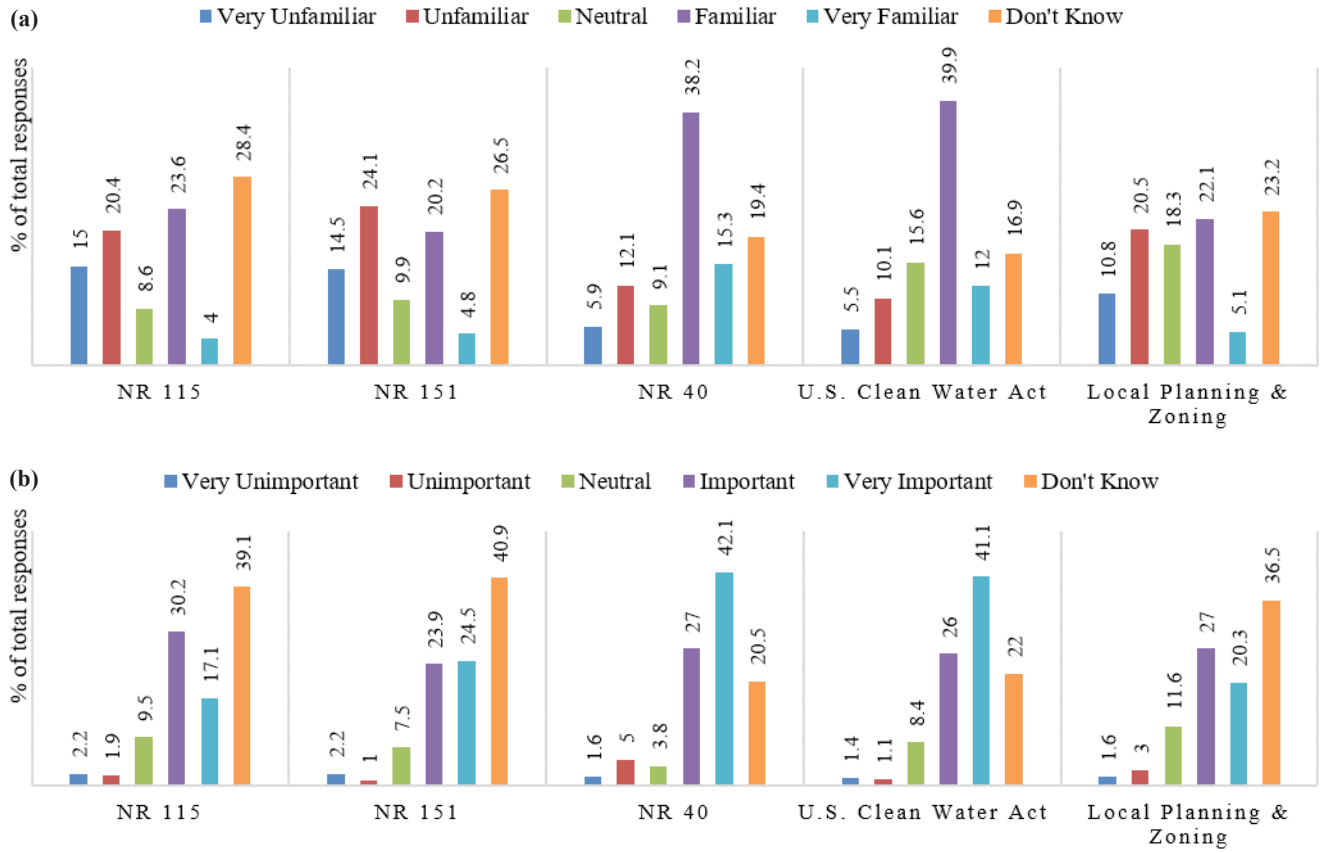

Figure 2. Mail survey respondents' rating of their (a) familiarity with and (b) importance of policies.

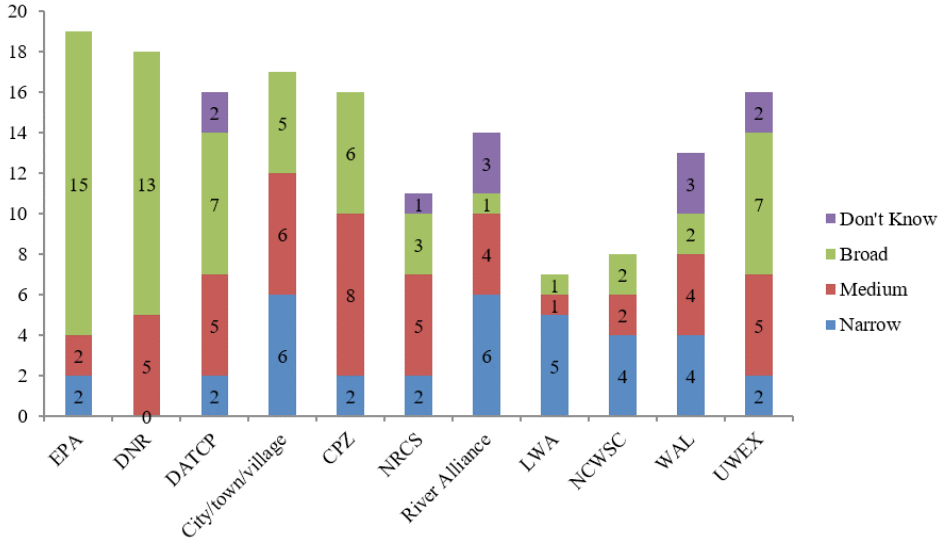

Figure 3. Web survey respondents' rating of each organization's functional scale.

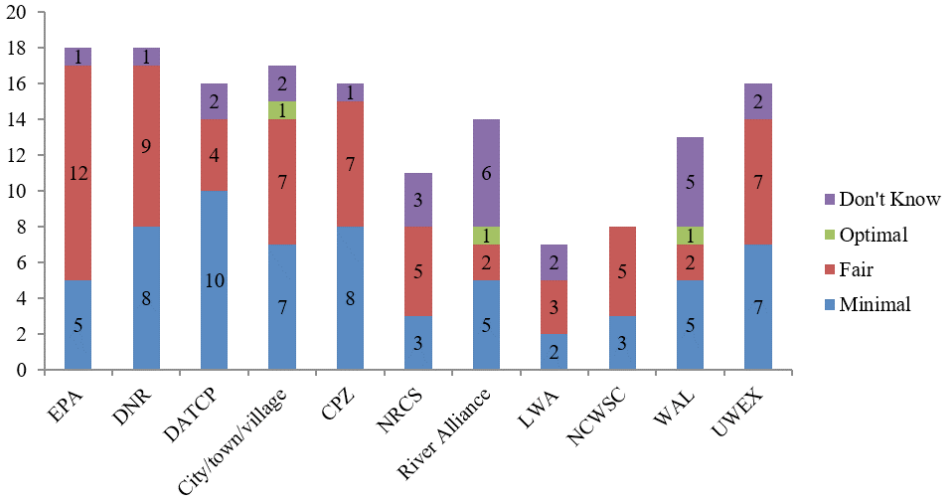

Figure 4. Web survey respondents' rating of each organization's financial support.

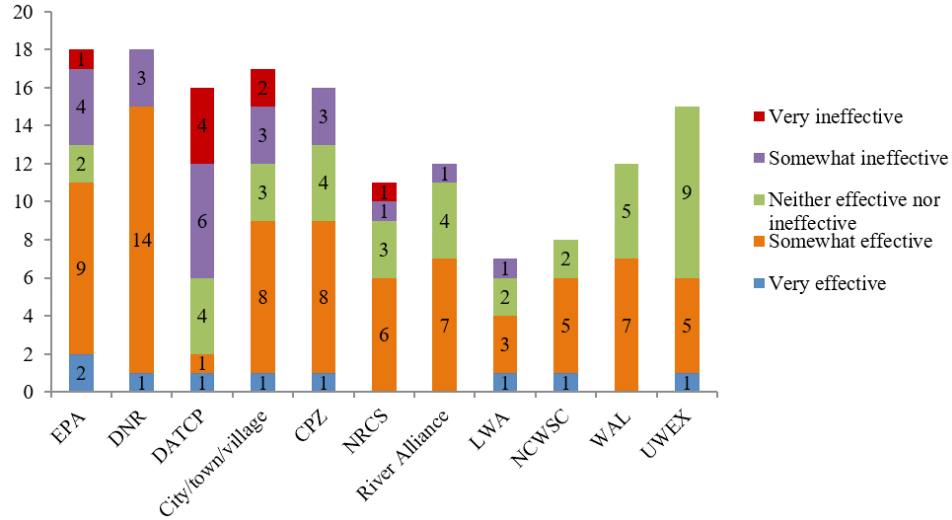

Figure 5. Web survey respondents' rating of each organization's effectiveness.

The MS4 permitting program (Wisconsin Administrative Rule Natural Resources 216) and agricultural performance standards (NR 151, Wisconsin Administrative Code ATCP 50 – Soil and Water Resource Management Program) were the two policies/programs that interviewees perceived as effective. One participant noted that the performance standard "doesn't go far enough to protect water quality… it gets us a little bit closer, but not quite where we need to be." With regard to MS4 permits, an interviewee stated that a goal was to educate people about stormwater discharging directly to the river and that "a lot of people for some reason don't think that happened." Both statements indicate that even policies viewed as effective have issues with implementation and achieving target outcomes.

Good Governance Principle 3: Accountability

Individuals involved in implementing state and local policies considered themselves accountable to agencies hierarchically above them (like WIDNR) and to local citizens. One person said, "I am most accountable to the residents of the county. They tell their representatives what they would like to see, issues they have, and that's passed down to me. If I'm not doing my job, they go to their representatives and I find out about it."

The policies and plans accountable for addressing nonpoint source pollution that could impact Lake Wausau were mostly aimed at agriculture and development. Residents who were not agricultural producers were largely ignored in regulatory policy. Even the MS4 permits that regulated municipal stormwater runoff were issued to the local government, which was then responsible for ensuring that individuals were not contributing too much of a given pollutant to the system. In spite of this, agri-business and those who represented agri-businesses ("big ag," lobbyists, or the Dairy Business Association) were viewed as having too much influence and power with regard to water policy. One interviewee stated that the WIDNR needs to be "back in charge of regulating or protecting water quality" instead of DATCP.

Another component of accountability is that those who are responsible for meeting goals have the resources necessary to do so. Several interviewees noted that this was not the case. For example, respondents mentioned staff shortages, lack of financial and staff commitment for implementation and monitoring, and funding being removed from some programs (specifically WIDNR programs) to be funneled toward others that were not natural resources-related. Web survey respondents indicated most organizations had fair or minimal financial support (Figure 4).

Good Governance Principle 4: Equitable Distribution of Power, Responsibility, and Benefits

Interviewees were asked to assess the level of power stakeholders had with regard to water quality in Lake Wausau. "The people who enjoy the lake" were noted as not being involved in decision-making. Wastewater dischargers were seen as having some degree of power to make policy changes that could impact Lake Wausau water quality. One person said that "tree huggers" have unfairly influenced policy by attending meetings and being a vocal minority with regard to stormwater and runoff. Agri-business, concentrated animal feeding operations, and farmers were repeatedly mentioned as having too much power and influence over actions that impact water quality. One respondent noted, "The involvement of big ag in this area, they are structured in a way that can prevent a lot of water quality improvement." Several participants noted it was not individual farmers but the agricultural lobby "down in Madison" and "whoever is representing the farmer at the state level" that had the power and influence. Another said, "I think the farming organizations have too much lobbying power down in Madison and at the national level...Dairy Business Association, Wisconsin Corn Growers, and all those different organizations, I think they have too much power."

Several interviewees believed that there were unreasonable burdens placed on municipalities to reduce phosphorus contributions rather than other land uses that were negatively impacting water quality, most notably agriculture. One individual noted that the MS4 permits were "… a great idea. But to turn around and put the burden on the incorporated entities and not everyone that may have an impact on the river, I don't think it's fair."

In addition, some stakeholders are not being engaged in the decision-making processes around water quality. Most of the targeted populations identified in plans and policies had not been involved in the planning efforts and were not reaping the same benefits from the lake as lakeshore residents. In fact, "people who enjoy the lake" and individual farmers (as opposed to the agriculture lobby or "big ag") were seen as having little power with regard to Lake Wausau decision-making.

Touching upon the intersection of resources and equity, one person said about monitoring that, "They're talking about making the treatment plants reduce their phosphorus…and it's supposed to cost millions of dollars. And we haven't even hardly touched on some of the agricultural runoff things so I think the monitoring is important."

Perceptions of Authority and Power to Change Behavior. Web survey respondents had differing views on the authority and power each organization had to impact water quality and the power of each organization to actually change behavior. Organizations with formal authority (WIDNR, USEPA) were perceived as seeing strong authority but weak power to actually change behavior. Conversely, those organizations with less formal authority (UWEX, River Alliance, LWA) were perceived as having less authority but moderate to strong power to change behavior (Table 6).

Good Governance Principle 5: Appropriate Scale and Flexibility of Policies

Of the five good governance principles, spatial scale is often the most difficult to assess since it fluctuates depending on the resource in question. As one interviewee said, "the biggest problem is that we people in Lake Wausau tend to look at the weeds and the algae growth in terms of, 'here's our local problem,'" instead of seeing the various land uses in the Wisconsin River watershed as impacting the Lake, illustrating that the scale at which people view lake issues may not be appropriate for solving them. In addition, the greatest number of regulations that required action and enforcement were at the state, rather than local, level. While numerous policies and plans existed at the local level, they were mainly voluntary in nature. Ideally, the state policies would be both specific and broad enough to protect water quality and be applied locally, respectively. However, interview participants did not perceive most of the policies as effective. Further, the perceptions of authority and power to change behavior differ by administrative scale of each organization (see Table 6).

Discussion

Good governance of water resources requires systems to be transparent, effective, equitable, and operating at the appropriate scale with adequate resources. Currently, multiple, separate systems of administrative rules, ordinances, and plans regulate and address polluted runoff that affects Lake Wausau, and multiple entities that do not work closely together are responsible for attaining water quality goals. Results of this research that were presented to the LWA suggested that transparency in the governance of Lake Wausau could be improved by developing the lake management plan in a way that all stakeholders could contribute, and with the ultimate goal of engaging all stakeholders in the effort to achieve agreed-on resource management goals.

However, lake and watershed management plans often do not have regulatory power on their own, and caution is needed in interpreting how effective they can be for overcoming shortfalls in existing laws, policies, and programs. It may not be reasonable to expect local water planning efforts to achieve what state and federal laws have not been able to accomplish. Further, the strength of language in policies varies: state level administrative rules have much more powerful language than local policies with regard to whether an action should/should not occur vs. must/must not. Even so, local staff responsible for administering state rules often lack resources for monitoring and enforcement, so lack of resources becomes a barrier to effective policy implementation.

Approaches to managing stormwater near the Lake Wausau study site have included creating a stormwater utility fee that can be pooled and used to address nutrient and other pollutant loading from stormwater. Lake Wausau project partners may want to consider implementing a watershed utility fee program that would support changes in land management practices. Since funding was seen as one of the barriers to successfully improving

water quality in Lake Wausau, a steady source of funding could be significant. A watershed utility fee that uses parcel size and land use as metrics for determining each property owner's fee could be an equitable means of funding water quality protection.

The strategies included in the lake management plan are more likely to be successful if ties are formed with all stakeholder groups impacting the lake, including farmers who may not be able to enjoy the resource at all or to the extent other residents in the watershed can, as they are closely tied to their own land from spring through fall. Inviting farmers to have a role in managing the lake and enjoying its benefits could provide opportunities for all Lake Wausau stakeholders to meet and interact with each other, thereby increasing the probability of cooperation. Additionally, including representatives from all state, county, and local administrative agencies in planning meetings could be a beneficial way to incorporate multiple sources of knowledge and more resources into the processes.

Conclusion

Those wishing to assess governance principles at the level of a lake, watershed – or for conservation projects of any type that cross administrative, political, and geographic scales – should consider the intensive nature of this process and consult with professionals with appropriate skills. However, examining a limited number of policies using the simplified approach developed to understand what resources are protected, who is supposed to protect them, and who is accountable for enforcing policies, may be within the time and skill constraints of some water management staff. The need to simplify this process illustrates how researchers engaged in this type of participatory process should be able to adapt to the needs of stakeholders. Because the Institutional Grammar Tool was not easily understood by stakeholders, including local program staff or research assistants, it may have limited utility beyond a scholarly audience.

Finally, the Lake Wausau Management Plan was officially adopted in September, 2018. The Plan included multiple goals that relate directly to this research, including developing a more inclusive Advisory Team that linked stakeholders previously not engaged in planning efforts for the lake, including representatives from local and state governments affecting Lake Wausau's management, and farmers and farmer groups as recommended in this analysis. As stated in the final plan in direct relation to the findings of this report, "…additional cooperation among the various stakeholders of Lake Wausau could provide for improving it as a community resource, but disconnection among stakeholders and governance hinders this opportunity. This plan and the process to develop it were designed to break through some of the barriers that created fragmented management."

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References

Akamani, K. and P.I. Wilson. 2011. Toward the adaptive governance of transboundary water resources. *Conservation Letters* 4: 409-416.

Berkes, F. 2008. Commons in a multi-level world. *International Journal of the Commons* 2: 1-6.

Citizens League. 2009. *Moving Minnesota's Water Governance Upstream*. Report of the Citizens League Water Policy Study Committee, St. Paul, MN. Available at: https://citizensleague.org/wp-content/uploads/2017/08/PolicyReportLandNov-2009.pdf. Accessed July 19, 2019.

Crawford, S.E.S. and E. Ostrom. 1995. A grammar of institutions. *American Political Science Review* 89: 582-600.

Davenport, M.A. and E. Seekamp. 2013. A multi-level community capacity model for sustainable watershed management. *Society and Natural Resources* 26: 1101-1111.

DeSimone, L.A., P.B. McMahon, and M.R. Rosen. 2015. *The Quality of Our Nation's Waters – Water Quality in Principal Aquifers of the United States, 1991-2010*. U.S. Geological Survey Circular 1360. Available at: https://dx.doi.org/10.3133/cir1360. Accessed July 19, 2019.

Dillman, D.A. 2000. *Mail and Internet Surveys: The Tailored Design Method*. John Wiley & Sons, New York, NY.

Floress, K., K. Akamani, K.E. Halvorsen, A.T. Kozich, and M. Davenport. 2015. The role of social science in successfully implementing watershed management strategies. *Journal of Contemporary Water Research and Education* 154: 85-105.

Floress, K., L.S. Prokopy, and S.R.B. Allred. 2011. It's who you know: Social capital, social networks, and watershed groups. *Society and Natural Resources* 24: 871-886.

Ostrom, E. 2011. Background on the Institutional Analysis and Development Framework. *Policy Studies Journal* 39: 7-27.

Pahl-Wostl, C., J. Sendzimir, P. Jeffrey, J. Aerts, G. Berkamp, and K. Cross. 2009. Managing change toward adaptive water management through social learning. *Ecology and Society* 12: 30.

Plummer, R. and D.A. Fennell. 2009. Managing protected areas for sustainable tourism: Prospects for adaptive co-management. *Journal of Sustainable Tourism* 17: 149-168.

Prokopy, L.S., K. Genskow, J. Asher, A. Baumgart-Getz, J.E. Bonnell, S. Broussard, C. Curtis, K. Floress, K. McDermaid, R. Power, and D. Wood. 2009. Designing a regional system of social indicators to evaluate nonpoint source water projects. *Journal of Extension* 47: 2FEA1.

Sheng, Y.K. 2009. What is good governance? United Nations Economic and Social Commission for Asia and the Pacific, Bangkok, Thailand.

Siddiki, S.; X. Basurto, and C.M. Weible. 2012. Using the institutional grammar tool to understand regulatory compliance: The case of Colorado aquaculture. *Regulation and Governance* 6: 167-188.

Smith, C.L. 2002. Institutional mapping of Oregon coastal watershed management options. *Ocean & Coastal Management* 45: 357-375.

Sosin, A., D. Brady, M. McCarthy, W. Cooter, and S. Alexander. 1995. Watershed Protection: A Project Focus. EPA 4503F. United States Environmental Protection Agency, Office of Water, Washington, D.C.

Thompson, A., M. Vokoun, and K. Floress. 2014. Lake Wausau Community Survey: Understanding the Socioeconomic Conditions Surrounding Management of Lake Wausau. UWEX Center for Land Use Education, University of Wisconsin – Stevens Point.

Turyk, N. 2018. Lake Wausau Protection and Improvement Plan. Center for Watershed Science and Education, University of Wisconsin – Stevens Point.

USEPA. 2005. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. EPA 841-B-08-002. United States Environmental Protection Agency Office of Water, Nonpoint Source Control Branch, Washington, D.C.

UCOWR
UNIVERSITIES COUNCIL ON WATER RESOURCES

NIWR
The National Institutes for Water Resources

2020 UCOWR/NIWR Annual Water Resources Conference

June 9-11, 2020

Graduate Hotel, Minneapolis, MN

Important Dates:

Proposal for special session due: Sep. 16, 2019
Special session acceptance: Oct. 2019
General call for abstracts: Oct. 2019
Abstracts due: Jan. 24, 2020
Abstract acceptance: Late Feb. 2020

The conference planning committee is pleased to invite special session proposals for the 2020 UCOWR/NIWR Water Resources Conference. These sessions are a vital part of the program, highlighting recent advances and transdisciplinary solutions to address complex water problems.

Near the headwaters of three continental basins, Minneapolis serves as a reminder that water connects distant places and diverse peoples. The committee encourages sessions that frame water resource issues in the context of:

- Geographic transitions and spatial gradients in land use,population density, and climate.
- Inclusive engagement among stakeholders to address water competition, conflict, and inequities.

#ucowr2020

The organizer's role includes submitting the proposed session, recruiting speakers to submit abstracts for the session, and moderating the session during the conference. Organizers can choose from 90- or 60-minute session formats or propose their own. Creativity is encouraged! Track proposals with multiple sessions are welcome.

Those interested in organizing and hosting a special session should complete the online form at z.umn.edu/ucowr2020.

Proposals for Special Sessions will be evaluated by the Conference Planning Committee based on the timeliness and relevance of the topic.

For more info, visit www.ucowr.org.
General questions about the conference can be directed to Karl Williard (williard@siu.edu), Executive Director of UCOWR.

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