DOES COLLABORATIVE GOVERNANCE LEAD TO ENVIRONMENTAL IMPROVEMENTS? THE CRITICAL ELEMENTS AFFECTING WATERSHED PARTNERSHIPS' CAPACITY TO ACHIEVE THEIR GOALS

By

Jennifer C. Biddle

A Dissertation
Submitted to the
Graduate Faculty
of
George Mason University
in Partial Fulfillment of
The Requirements for the Degree
of
Doctor of Philosophy
Environmental Science and Public Policy

Committee:

Dr. Nicole Darnall, Dissertation Director

Dr. Naoru Koizumi, Committee Member

Dr. Tomas Koontz, Committee Member

Dr. Dann Sklarew, Committee Member

Dr. Albert Torzilli, Graduate Program Director

Dr. Robert Jonas, Department Chairperson

Dr. Timothy Born, Associate Dean for Academic and Student Affairs, College of Science

Dr. Vikas Chandhoke, Dean, College of Science

Date: 8/26/2011

Fall Semester 2011
George Mason University
Fairfax, VA

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By

Jennifer C. Biddle
Master of Science
George Mason University, 2005

Director: Nicole Darnall, Professor
Environmental Science and Policy

Fall Semester 2011
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Fairfax, VA

DEDICATION

This is dedicated to my daughter, Annastasia Rose, who has been my inspiration and motivation throughout this process. Let this dissertation be a reminder that together, we can accomplish anything.

ACKNOWLEDGEMENTS

I would like to thank my committee for their assistance and support throughout my research. This dissertation is a reflection of their expertise and excellent mentorship. I would especially like to thank my adviser, Nicole Darnall, for her incredible guidance and support. From late night phonecalls to house visits, Nicole supported me every inch of the way. She is an amazing adviser and I feel fortunate to have been her student. I would also like to thank my cohort of colleagues and friends that helped me along the way, including Leslie Orzetti Gollhofer, Leila Hamdan, Younsung Kim, Lana Gendlin Brooks, Chris Jones, Bob Jonas, Susie Crate, Ryan Albert, Chris Ruck, Dan Fiorino, and members of "dissertation anonymous". A special thanks to Megan Draheim, Irina Stoyanova, Maura Patterson, Lucinda Power, and Susan Keltner for their help brainstorming, proofreading and troubleshooting, as well as providing steadfast encouragement throughout this process. I would also like to thank my colleagues at U.S. Environmental Protection Agency's Office of Water, especially Dov Weitman, Tom Davenport, Steve Dressing, Don Meals, and Katie Flahive, who helped shape my research project and provided me with the dataset used in this study. Lastly, I would like to my family. I would like to thank my parents for their unconditional love and support that lead me to this path of higher education and always helped me see the light at the end of the tunnel, even on the darkest of days. I would also like to thank my in-laws who provided constant support and babysitting during the final stages of writing. Finally, I would like to thank my husband, my rock, Michael. I would never have achieved this goal without him and I will never forget his patience and perseverance that sustained me throughout this journey.

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ABSTRACT

DOES COLLABORATIVE GOVERNANCE LEAD TO ENVIRONMENTAL IMPROVEMENTS? THE CRITICAL ELEMENTS AFFECTING WATERSHED PARTNERSHIPS' CAPACITY TO ACHIEVE THEIR GOALS

Jennifer Cordrey Biddle, PhD

George Mason University, 2011

Dissertation Director: Dr. Nicole Darnall

Policy makers and researchers have long advocated collaborative governance as a means to improve the natural environment. However, determining the effectiveness of collaborative governance as a management strategy for improving environmental outcomes has proven difficult. Addressing this gap has significant bearing on environmental policy as governments at all levels have relied on collaborative governance as a primary way to address complex environmental issues that have not been satisfactorily addressed by conventional regulatory approaches and that are outside the scope of a single agency. Through the empirical assessment of survey data collected from watershed partnerships engaged in collaborative governance and assessments of longitudinal water quality data collected by US Environmental Protection Agency's National Monitoring Program, this study offers early evidence verifying positive

relationships between elements of collaborative governance and improved environmental outcomes. In addition, the findings of this study offer empirical evidence linking collaborative outputs with outcomes, providing guidance to public managers when deciding upon useful proxy measures to use when environmental outcome data is unavailable.

CHAPTER 1: INTRODUCTION

Collaborative governance is an inclusive, interactive public policy approach involving three or more organizations/individuals who collectively resolve disputes over resource management (Bardach, 1998; Ansell and Gash, 2007; Kenis and Provan, 2009). The term collaborative governance refers to any local, state, or federal effort to solve an environmental problem within partnerships among public, private, and nonprofit organizations where collaborative partnerships are the primary feature (Thomas, 2008). Collaborative governance brings multiple stakeholders together to engage in consensus-oriented decision making relating to public policies and issues within a broadly defined issue area, such as environmental management (Ansell and Gash, 2007; Leach et al., 2002). Its focus on public policy distinguishes collaborative governance from other forms of consensus decision making (Ansell and Gash, 2007). The aim of collaborative governance is to make better decisions by sharing information and achieving a more comprehensive understanding of the problem (Wondolleck and Yaffee, 2000). The assumption by managers is that collaboration by decision-makers results in a total effect that is greater than the sum of individual effects. The trend towards collaborative governance is most evident in the environmental sector, especially in watershed management.

Using watershed management as an example, this study focuses on the environmental outcome of achieving goals for water quality improvements by collaborative partnerships. Access to many natural resources, such as watersheds, cannot be easily denied because they lack private ownership (Olson, 1965). The result often is that natural resources are exploited (Hardin, 1968). To address these concerns, government is using collaborative governance in an attempt to reach creative solutions for the way in which natural resources are managed (Imperial, 2005). While it has become more commonplace as an environmental management strategy, no empirical studies have determined a positive relationship between the collaborative governance and the achievement of improvements in environmental outcomes (Koontz and Thomas, 2006; Thomas, 2008).

Establishing a causal link between collaborative governance and improvements in environmental outcomes has proven difficult for several reasons. First, in order to determine whether environmental improvments occurred, environmental data must be collected over relatively long time periods (Koontz and Thomas, 2006; Sabatier, et al., 2005). However, collecting these data is often cost prohibitive. Monitoring environmental conditions is expensive and requires technical expertise, and is often the first line item cut in environmental management budgets. Second, it is difficult to empirically control for confounding influences (Born and Genskow, 2006; Thomas, 2008), such as socioeconomic or physical conditions. This conditions may affect environmental conditions and have little to do with the efficacy of collaborative governance. For example, changes in land use within the watershed may result in water quality improvements in the absence of collaborative governance.

A third factor that makes it difficult to establish a link between collaborative governance and the achievement of environmental improvements relates to ambiguities in how researchers have operationalized "collaborative governance." Imperial (2005) cited inconsistent use of this term to be a major barrier to theory building. For instance, interchangeable use of the terms collective action (Ostrom, 1990), participatory management (Ansell and Gash, 2007), and collaborative management (Koontz, et al, 2004; Ansell and Gash, 2007; Agranoff and McGuire, 2003) have been used by collaboration scholars when referring to similar phenomena. Additionally, scholars have anticipated that collaboration leads to improved environmental outcomes (Leach et al., 2002; Leach and Pelkey, 2001; Genskow and Born, 2006; Ferreyra and Beard, 2007; Mandarano, 2008); however, there is little clarity about what elements characterize collaborative governance. As a result, the concept is viewed as somewhat of a "black box" within public administrative and public policy literature (Thomson and Perry, 2006).

This study examines the critical elements of collaborative governance and the capacity of watershed partnerships to achieve environmental improvements. This knowledge is useful when addressing complex environmental issues like management of our aquatic resources or global climate change. Identification of specific elements (e.g. group structure, commitment, and communication) affecting the performance of collaborative governance will benefit collaboration scholarship as a whole. In addition, this study assists decision-makers in identifying the critical elements of collaborative governance resulting in environmental improvements. While there is some agreement that the capacity of partnerships to engage in effective collaborative governance potentially affects these outcomes (e.g., Bardach, 1998), there has been little systematic assessment of how elements of group structure, commitment, and communication are related to the achievement of environmental improvements.

This research offers two distinct contributions to literature on collaborative governance. The first contribution is to shed light on the issue of collaborative governance and its relationship with environmental outcomes by developing a novel conceptual framework that helps to disentangle the "black box" of collaborative governance. It describes three elements, group structure, commitment, and communication, which are conceptually related to variations partnerships' capacity to achieve environmental improvements. Doing so clarifies what collaborative governance is and how the compositions of these elements are related to the achievement of improved environmental outcomes.

The second contribution of my research is the empirical analysis of the causal link between collaborative governance processes, outputs and outcomes. In examining this causal link, this study uses survey data of individuals who participated in collaborative governance related to watershed restoration and coupling these data with assessments of longitudinal water quality data collected by EPA's National Monitoring Program, while simultaneously controlling for confounding effects related to socioeconomic and physical conditions.

In addition to these theoretical contributions, the findings of this study have relevance to a variety of environmental problems requiring public, private, and nongovernmental organizations to come together, set goals, make decisions, and collect information to promote effective environmental governance through the identification of critical elements of successful collaborative governance.

CHAPTER 2: COLLABORATIVE GOVERNANCE AND WATERSHED PARTNERSHIPS

For more than 50 years, command-and control regulations in the United States (US) have sought to remedy environmental problems associated with the degradation of our surface waters. While significant gains were made to control point source pollution (e.g. discharge by factories and plants), EPA was not granted authority to regulate nonpoint source pollution in the Clean Water Act legislation. As a consequence, regulators are addressing nonpoint source pollution using participatory approaches, such as collaborative governance. In addition, unlike point source pollution, nonpoint source pollution is diffused in nature, making it difficult to quantify and consequently, difficult to manage

The 21st Century has been called the era of collaborative state, especially for environmental issues like nonpoint source pollution where decision-making processes have increasingly shifted from public hierarchies to multi-sector collaborative arrangements (Koontz and Thomas, 2006). This shift began in the 1990s when collaborative environmental management took center stage with the US Environmental Protection Agency's (EPA) community-based environmental programs and the adoption of a watershed-based approach to address nonpoint source pollution.

A growing number of governmental organizations at the local, state, and federal level collaborate with nongovernmental organizations (NGOs) and individuals to address complex environmental problems, like nonpoint source pollution (Imperial and Koontz, 2007). This trend is largely a result of regulators' recognition of the interdependence of natural and socio-economic systems on a watershed scale (Steelman and Carmin, 2002) and the political infeasibility of only using command-and-control approaches. For industries like agriculture and coal, oil, and gas extraction, which generate substantial quantities of nonpoint source pollution, long-standing subsidies and politically persuasive lobbies prevent regulation by federal legislation, thus highlighting the importance of collaborative governance approaches.

The environmental council of the states identified nonpoint source pollution as the nation's largest source of water quality impairment, accounting for 97 percent of water pollution and a problem "too big for any single state or federal agency to manage and fund" (ECOS, 2010). Understanding the complexity of such large-scale environmental problems, agencies throughout the federal government increasingly favor governance approaches that encourage collaboration between actors with conflicting interests and overlapping administrative jurisdictions when managing natural resources (Bardach 1998). Favoritism of collaborative over command-and-control approaches for managing nonpoint source pollution has led to the development of watershed partnerships (Lubell et al., 2002).

A watershed partnership is a self-directed and locally focused collection of interested parties, often including governmental, nongovernmental, and community representatives, that organize to address water-related issues at the watershed scale through collaborative mechanisms (Kenney et al., 2000). Watershed partnerships and use of collaborative governance has become a common governmental strategy for addressing problems associated with common or publicly-shared resources. They fill a niche in fragmented policy domains by providing a new form of governance in which diverse interests can negotiate mutually beneficial rules to manage the use of common natural resources, such as watersheds (Lubel et al., 2002). These partnerships aim to allow for the adoption of innovative and flexible policy tools that address environmental problems in a more cost-effective manner (Genskow and Born, 2006; Lubell, et al., 2002).

A broad range of research has highlighted the important role collaboration plays within watershed governance systems (Imperial, 2005, 2004; Leach, et al., 2002; Leach and Pelkey, 2001; Born and Genskow, 2001). A basic premise of a watershed partnership is that through collaborative governance, larger-scale and more holistic goals are achievable that may not have been within the reach of a single organization working alone (Ferreyra and Beard, 2007; Lubell, et al, 2002; Imperial, 2005). Collaborative governance holistically addresses environmental problems by acknowledging the interrelationships amongst ecological systems and the institutions that govern those systems (Imperial, 2005). In addition, watersheds span multiple jurisdictional boundaries and geographical borders (Imperial, 2005; Mandarano, 2008). For example, the Chesapeake Bay encompasses six states and numerous metropolitan areas. Traditional bureaucratic structures are not equipped to solve public problems of this scope and as a result, collaborative governance has been identified as an approach for achieving congruence between jurisdictions and public problems in the US (Hacegaba, 2008; Imperial, 2005; Lubell, et al, 2002).

Not all collaborative governances are alike (Arganoff, 2003; McGuire, 2006). Collaborative governances differ in structure (Koontz and More, 2003), levels of organizational participation (Bidwell and Ryan, 2006), and outputs (Margerum, 2008). Watershed partnerships represent a hybrid form of collaborative governance involving multiple stakeholders generally within federal, state, and local regulatory agencies, as well as non-profits and private landowners.

Many researchers have suggested that collaborative governance is anticipated to lead to improved environmental outcomes (Leach et al., 2002; Leach and Pelkey, 2001; Genskow and Born, 2006; Ferreyra and Beard, 2007; Mandarano, 2008). However to my knowledge prior scholarship has not articulated how specific elements of collaborative governance are related to the capacity of watershed partnership to achieve goals for environmental improvements. Rather, scholars examining the promise of collaborative governance have focused on assessing the antecedents (Ferreyra and Beard, 2007; Genskow and Born, 2006), outputs (plans and projects) (Mandarano, 2008) and social outcomes (trust and social capital) (Leach et al., 2002; Leach and Pelkey, 2001). In a few other instances, scholars have linked collaborative governance to output proxies, such as management plans (Wilkinson, 2007), or individual perceptions rather than measuring environmental outcomes directly (Leach, et al. 2002) or comparing it to traditional approaches (Koontz Campbell et. al, 2009). This study intends to offer some initial insights into the critical elements of collaborative governance that increase partnerships' capacity to improve environmental outcomes.

CHAPTER 3. ASSESSING CAPACITY OF WATERSHED PARTNERSHIPS TO IMPROVE ENVIRONMENTAL OUTCOMES

Partnership capacity is defined as greater potential for making sustainable and large-scale impacts (Sanyal, 2009). It relates to the ability to develop and implement a management plan (Jones and Burgess, 2005). The capacity of a watershed partnership to achieve their environmental improvement goals, while not the same as measuring environmental outcomes directly, is closely linked. Measuring the capacity or success of a group in achieving their goals for environmental improvements is a performance measure. Looking specifically at the stated goal, we can infer the outcome. For example, if the goal was to reduce nitrogen loads in the water column by 40%, and empirical assessments of water quality data show a 40% reduction, then the partnership was successful in obtaining this goal. We can infer that the partnership successfully improved water quality in that particular waterbody by reducing the pollutant load which caused the impairment.

Environmental outcomes are the resulting environmental conditions from a public policy (e.g. aquatic conditions in a waterbody) (Thomas, 2008). As is often the case in environmental policy, environmental outcomes occur at a rate incompatible with political agendas. Changes in water quality conditions typically take decades to occur; however, management decisions affecting those conditions are made frequently. This inconsistency in environmental and public policy timeframes tends to lead to the development of environmental policy absent of supporting data on environmental outcomes. In the absence of data on environmental outcomes, policy makers often rely upon the use of proxy measures or outputs (e.g. environmental plans) for measuring progress towards end outcomes (e.g. achievement of goals for water quality improvement).

Prior research has evaluated the collaborative outputs (e.g. plans) (Mandarano, 2008; Wilkinson, 2007); however, little research has empirically linked outputs with outcomes (Koontz and Thomas, 2006). One exception relates to the evaluation of social outcomes, whereby scholars have linked collaborative processes with trust and social capital (Leach and Sabatier, 2005; Lubell, 2002). In the absence of studies evaluating environmental outcomes directly, intermediate output measures may serve as proxies. This determination is especially relevant to public managers in the environmental policy arena, as environmental data is costly and occurs in timeframes outside those supporting political agendas.

Collaborative outputs and outcomes are affected by the inputs contributed by the participants of the collaborative governance. Therefore assessing the relationship between the elements comprising collaborative partnerships and their capacity to achieve environmental improvement goals will better our understanding of the variables affecting collaborative governance effectiveness.

3.1. Relationships between Elements of Collaborative Governance and the Capacity of Watershed Partnerships to Achieve their Environmental Improvement Goals

Inputs of collaborative governance are the resources used in the collaborative process, affecting the resulting outcome. The collaborative governance inputs of watershed partnerships are their elements or characteristics and include group structure, commitment, and communication. I hypothesize that the capacity of a collaborative governance partnership to achieve environmental outcomes will depend on the input of three primary elements: **1) the structure of the collaborative governance** (Ostrom, 2000; Alter and Hage, 1993; Thomson, et al., 2007; Astley and Van de Ven, 1983; Ansell and Gash, 2007; Gerlak and Heikkila, 2007; Bidwell and Ryan, 2006), **2) the commitment to the collaborative governance** (Innes and Booher, 1999; Gray, 1989; Margerum, 2008; Thomson, et al. 2007; Sabatier, et al., 2005; Koehler and Koontz, 2008; Wood and Gray, 1991; Steelman and Carmin, 2002; Imperial, 2005; Lubell, et al., 2002; Ansell and Gash, 2007; Payan and Svensson, 2007), and **3) the degree of communication between participants** (Payan and Svensson, 2007; Flanagin *et al.*, 2006; Mishra and Mishra, 2009; Innes and Booher, 1999; McGuire 2006; Leach, et al., 2002; Asthana, et al, 2002).

Each of these elements is comprised of several components, which are described further below and illustrated in Figure 1.

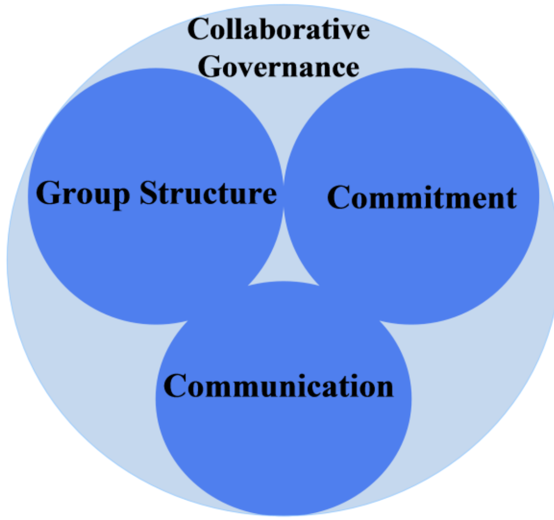


Figure 1. Three elements of Collaborative Governance related to environmental outcomes.

3.1.1 Group Structure

Group structure is discussed in organizational theory and includes the specialization of tasks, information sharing, and congruence between the participant and their organizational role and assigned responsibilities to the partnership (Child, 1972). Organizations and individuals engage in collaborative governance in order to achieve a particular goal, such as restoring water quality to a specific watershed. In order to achieve that goal, some degree of group structure must exist that allows for the execution of effective actions (Thomson, et al., 2007; Born and Genskow, 2001). Group structure is comprised of three components: a clear mission, role congruence, and knowledge capabilities of the collaborative governance (Figure 2).

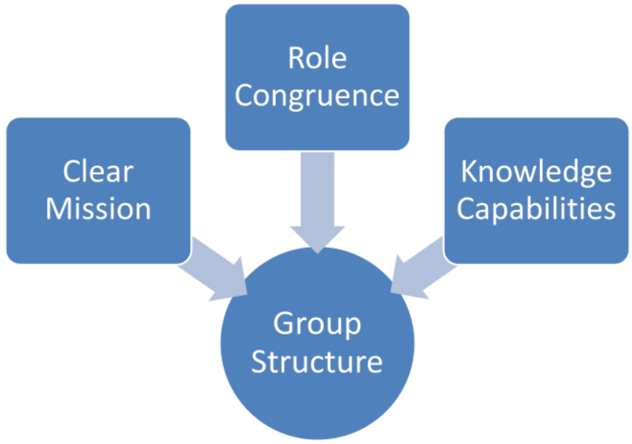


Figure 2. The three components of Group Structure.

The first component of group structure is a clear mission statement that provides direction and guides the decision making of the collaborative governance. A well-supported mission with clear goals allows the partnership to function as a unit, making decisions to attain the mission easier (Astley and Van de Ven, 1983). A well-supported mission is especially important in the absence of hierarchy (Provan and Kenis, 2008). Prioritizing clear goals, objectives, actions, and timeframes have been found to result in a more effective organizational activities to achieve environmental improvements (Astley and Van de Ven, 1983). Effective collaborative governance is affected by social norms and rules that assign responsibilities and actions to participants, set goals, promote communication, monitor actions, and allocate resources (Ostrom, 2000; Alter and Hage, 1993; Thomson, et al., 2007). Partnerships with high degrees of group structure typically possess a clearly defined and well-supported mission that aids actors in their ability to make decisions. The importance of a clear mission is evident in the efficiency and effectiveness of the partnership to identify the environmental problem, set goals that address the problem, delegate actions, and implement an effective solution.

Role congruence is defined as participants' acceptance of their clearly stated role and assigned responsibilities to the partnership, and is the second component of group structure. An individual's acceptance of their role and contribution to the group mission is critical to sustaining their participation throughout the project. The lack of role congruence affects individuals' ability to make decisions and execute actions that contribute to the capacity of the partnership to achieve their goals. As the collaborative governance develops, shared values permeate into participants' relationships, adhering individual concerns to their collective mission (Astley and Van de Ven, 1983; Ansell and Gash, 2007). Similarly, acceptance of their assigned role and responsibility within the partnership focuses their expertise and involvement in an efficient and effective manner, reducing conflict and increasing the potential to overcome Olson's (1965) free rider problem.

The third component of group structure is knowledge capabilities, which is created by sharing information and ideas (Gerlak and Heikkila, 2007). As more information is obtained through monitoring and research, knowledge capabilities will determine how well that information is assimilated into the collaborative governance. With the exchange of information comes a shared knowledge base necessary to resolve complex, environmental problems (Imperial, 2005). Organizational structures (such as scientific panels and citizen-based committees) produce and communicate scientific and technical information about the issues facing the collaborative governance. These structures promote continued information sharing and help identify alternative approaches for solving their problems (Gerlak and Heikkila, 2007, 57). Scientific panels may consist of in-house participants of the partnership or outside, independent partners such as a university or nongovernmental organization. For all these reasons, a clear mission statement, role congruence, and knowledge capabilities will increase the capacity of the watershed partnership to achieve its goals for environmental improvements.

Hypothesis #1: The greater the degree of group structure (clear mission, role congruence, and knowledge capabilities), the greater the capacity of watershed partnerships to achieve their environmental improvement goals.

3.1.2. Commitment

Commitment is a second element that characterizes partnerships, and is defined by participants' committed time (participation) and resources (human, technical, and financial) (Figure 3). Collaborative governance engages participants in an intensive process of consensus building (Gray, 1989). Such engagement requires a sustained commitment of participants' technical expertise and donated time to problem solving (Gray, 1989). Participants' degree of commitment to the partnership is a critical variable in explaining success or failure in achieving their goals for environmental improvements (Ansell and Gash, 2007; Margerum, 2008). These factors are critical to sustaining the environmental performance of collaborative governance (Thomson, et al. 2007) and each is discussed in greater detail below.

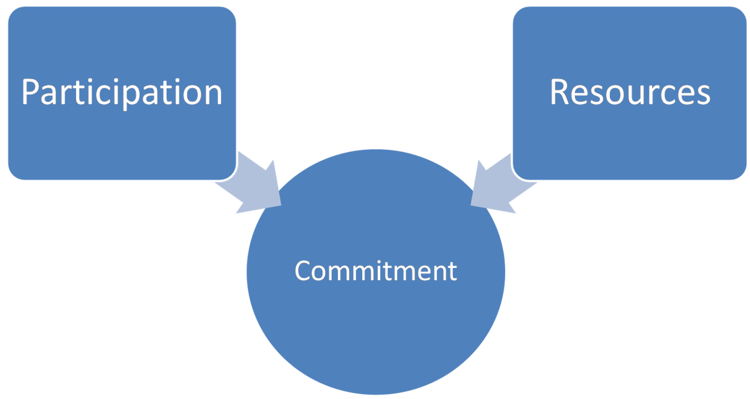


Figure 3. Components of the element Commitment.

The first component of commitment is the participation by members of the collaborative governance. The collaborative governance requires committed time from salient stakeholders who are affected by or express concern about the issue (Ansell and Gash, 2007). Such participation is viewed as a key component to collaborative governance and failure to represent salient stakeholders has the potential to undermine the legitimacy of the collaborative governance (Ansell and Gash, 2007). Handbooks and guidelines for collaborative decision making frequently emphasize the value of citizen involvement (Koehler and Koontz, 2008). Participation by local citizens is important as they provide essential information about that area's natural and sociopolitical systems (e.g. history of development and land use changes within a watershed) and often times possess a profound concern over the impact of nonpoint sources of pollution on their waters (Sabatier, et al., 2005; Koehler and Koontz, 2008). Sustained involvement throughout the lifecycle of the collaborative governance is a critical aspect of participation. Sustained involvement increases trust amongst participants through the recognition of dedicated time and expertise.

Resources (human, technical, and financial) are the second component of commitment. Effective management of natural resources, such as a community's watershed, requires commitment of human and technical resources. Resources expand the capacity of collaborative governance to facilitate action and sustain initiatives over time (Wood and Gray, 1991; Steelman and Carmin, 2002). The availability of resources influences the capacity of a collaborative governance to achieve goals and realize outcomes (Steelman and Carmin, 2002). Expertise, local knowledge, skills, and contacts gained through the collaborative governance all represent human resources, which are often targeted towards specific task completion. Technical resources include monitoring equipment and modeling and data analysis capabilities. Watersheds are complex, dynamic, and subject to a number of internal and external factors that change over time, creating a condition of uncertainty, which poses unique challenges for management (Imperial, 2005). One way to cope with such uncertainty is to incorporate scientific information via participants' expertise. The ability to pool available human and technical resources increases the likelihood to complete projects, measure performance and sustain funding (Imperial, 2005).

Financial resources have been identified as a critical and direct link to accomplishments as well as a critical factor to the success of watershed management (Born and Genskow, 2001; Bidwell and Ryan, 2006). For example, financial capital is a condition that underlies the development of watershed partnership in the U.S. (Lubell, et al., 2002). Depending on the level of committed financial resources, funding may be provided from federal, state, and local sources. The ability for watershed partnerships to leverage funding from multiple sources is critical. Multiplicity in funding sources reduces the vulnerability of conditional grants, whereby items are specified for eligibility in funding and not planning, implementation, or monitoring. (Davenport, 2009). Flexibility and stability of the funding often determines the level of organizational development of the partnership. Therefore, committed participants' time as well as human, technical, and financial resources will increase the capacity of the watershed partnership to achieve their goals for environmental improvements.

Hypothesis #2: The greater degree of commitment (member participation and resource allocation), the greater the capacity of watershed partnerships to achieve their environmental improvement goals.

3.1.3. Communication

Communication is the third element of collaborative governance that may affect the capacity of partnerships to achieve their environmental improvement goals. The element, communication, is defined as imparting or interchanging thoughts, opinions, or information by speech, writing, or signs (Mishra and Mishra, 2009). Communication is a human activity that links people together and creates relationships (Duncan and Moriarty, 1998 in Mishra and Mishra, 2009). This element will be assessed through three components: mode, frequency, and written, formal documentation of results (Figure 4).

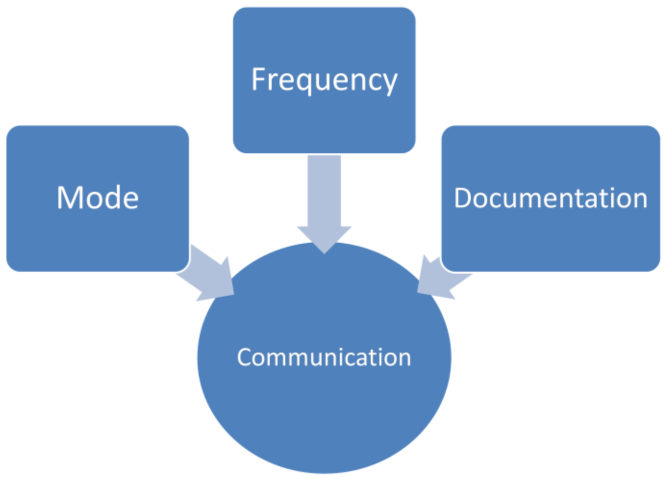


Figure 4. Components of the element Communication.

The first component of communication is the mode or communication style, which has been found to affect the capacity of partnerships to achieve goals for environmental improvements. The terms direct and indirect will be used when discussing type of communication style. Direct communication is defined as hard to avoid. Face-to-face and phone communication are two examples of direct communication, with face-to-face being the most unavoidable. Email and voice messages and posted mail are examples of indirect communication (Mishra and Mishra, 2009). Indirect communication is easily avoidable due to the lack of physical presence of the communicator. One can simply ignore or delay responses more easily, resulting in a longer lag time between communications.

In complex situations, such as watershed management, communication effectiveness is critical and face-to-face communication has been found to be the most effective mode of communication (Mishra and Mishra, 2009; Koontz and Bodine, 2008)). Face-to-face communication can aid understanding and problem solving due to the enriched context, including facial expressions, gestures, posture, appearance, and reaction of other people (Mishra and Mishra, 2009). This mode of communication can produce substantial increases in the effectiveness of collaborative governance than when less direct communication modes such as email are used (Ostrom, 2000). Face-to-face communication has been found to build trust (Innes and Booher, 1999; McGuire 2006; Leach, et al., 2002) and trust allows for more open discussion. Open communication among participants in a watershed partnership and between actors and leaders also can promote group cohesiveness and consensus (Koehler and Koontz, 2008).

Frequency of communication is the second component of communication and may be an important factor affecting the performance of collaborative governance (Koontz and Bodine, 2008). Schneider et al. (2003) found that frequent communication fosters a desire to participate and a commitment to the watershed partnership. The more individuals communicate, the more social capital and trust is built, resulting in more effective collaborative governance. Frequent, reoccurring communication can reinforce trust among actors facing large-scale environmental problems (Raymound, 2006), reduce transaction costs of starting new partnerships, and encourage participation amongst actors to the watershed partnership (Imperial, 2005).

The third component is written, formal documentation to communicate results of the collaborative governance process. Information exchange is not possible without communication, however the knowledge acquired through direct communication may only be retained for a limited time before it is forgotten. Therefore written, formal documentation is viewed as another important measure of information sharing and organizational learning (Mishra and Mishra, 2009). Communication involves the production of documents that convey information gathered and assessed by the watershed partnership, facilitating a shared understanding (Ansell and Gash, 2007). Transmission of knowledge through written, formal documentation provide participants with an opportunity for consultation and dialogue (Asthana, et al, 2002), which facilitates shared learning. Governmental agencies typically require written documentation by collaborating partnerships to report progress towards meeting programmatic goals.

Collaborative governance involves communication among multiple agencies and multiple levels of government (Born and Genskow, 2001). When communication levels are high, the outcomes of the watershed partnership will involve a higher degree of assessment. This is a result of the increased attention and support provided through increased communication of participants. Therefore frequent and direct communication between participants in a watershed partnership will increase the capacity of the watershed partnership to achieve their goals for environmental improvements and report success.

Hypothesis #3: The greater degree of communication (mode, frequency, and documentation), the greater the capacity of watershed partnerships to achieve their environmental improvement goals.

3.2. Relationship between the Elements and the Ladder of Collaborative Governance

Possession of these critical elements, group structure, commitment, and communication, increases the capacity to achieve their environmental improvement goals. However, the degree to which partnerships possess these elements tends to vary, implying a range of capacities for achieving environmental improvements related to the type of collaborative governance processes involved (Koontz and Thomas, 2006*)*.

Using watershed management as an example, the following section describes a "ladder of collaborative governance" that is composed of three types of processes (organized cooperation, systematic coordination, and synergistic consensus). These processes are conceptually related to variations in the capacity of the collaborative governance partnership to achieve improved environmental outcomes. The degree of each element, group structure, commitment, and communication, determines its placement on the ladder. Where watersheds are managed collaboratively, typically this is done through partnerships, and each partnership is unique depending on the elements that characterize their activities or processes. All of these elements affect the performance of the collaborative governance in its capacity to achieve environmental outcomes through the production of outputs. The distinction between the degree to which partnerships possess these elements and their overall performance is described in detail in the following section.

3.2.1 The Ladder of Collaborative Governance: A Typology of Processes

Numerous descriptive and causal studies on collaborative processes have been published in the last twenty years, covering a broad range of topics, however little research has analyzed the effects of process on environmental improvement outcomes (Koontz and Thomas, 2006). One of the primary reasons for this gap in the literature is the lack of clear definitions on the collaborative processes, cooperation, coordination, and consensus. While these terms are recognized as types of collaborative governance, they are used interchangeably and often lack specificity in how they are uniquely related (Thomson, et al, 2007). Variation and ambiguity in terminology of collaboration processes hampers our ability to associate different types of collaborative governance processes with improvements in environmental outcomes. Collaborative governance processes, as defined in Thomas and Koontz's (2011) logic model, are the activities performed by the collaborative partnership. For example, cooperative information sharing, coordinated acquisition of resources, and consensus decision making represent activities of the collaborative governance process. These processes are related to the inputs or elements contributed by the collaborative partnership and impact the capacity to achieve environmental outcomes.

Inspired by Sherry Arnstein's (1969) research, in which she describes a typology of power structures in hierarchical society in the 1960s, this section lays out a typology of collaborative governance processes in pursuit of environmental outcomes. In her article, *The Ladder of Citizen Participation*, Arnstein (1969) contends that citizen participation is simply a redistribution of power to stakeholders not traditionally included in political and economic processes. She further states that a critical difference exists in participation versus power to affect outcomes of that process. Similarly, this research examines the critical differences in three types of collaborative governance processes: ***organized cooperation, systematic coordination, and synergistic consensus*** on the capacity of partnerships to achieve their goals for environmental improvements.

The previous chapter suggested that as group structure, communication, and commitment increase, the capacity of the collaborative governance to achieve environmental outcomes (e.g. water quality goals) increases. The following sections articulate the *ladder of collaborative governance,* which describes how the capacity of watershed partnerships to achieve environmental goals is related to the type of collaborative governance process and the outputs they produce. They address the research challenge of linking collaborative governance to environmental outcomes, which involves disentangling the multiple interacting variables in order to isolate the effects of collaborative inputs (Koontz and Thomas, 2006). By assessing the intermediary causal mechanisms (outputs) between collaborative processes and end outcomes, we begin to understand the interrelationships within partnerships and unpack the "black box" of collaborative governance.

This discussion begins by first describing a typology of collaborative governance processes based on the composition of elements that affect the quality of outputs produced. Several scholars agree that organized cooperation, systematic coordination, and synergistic consensus differ in terms of their input of elements of communication, and commitment over time (Table 1) (Alter and Hage, 1993, Himmelman, 1995, Thomason and Perry, 2006, Davenport, 2003). Organized cooperation requires some level of recognition by each participant of a common interest or goal, acceptance of their assigned roles, and information sharing. Systematic coordination of volunteered time and resources involves specialized participation and formulated planning to sustain effective execution of actions. Synergistic consensus is viewed as a higher-order level of collaborative governance than organized cooperation or systematic coordination, involving high degrees of the elements group structure, commitment, and communication (Figure 5).

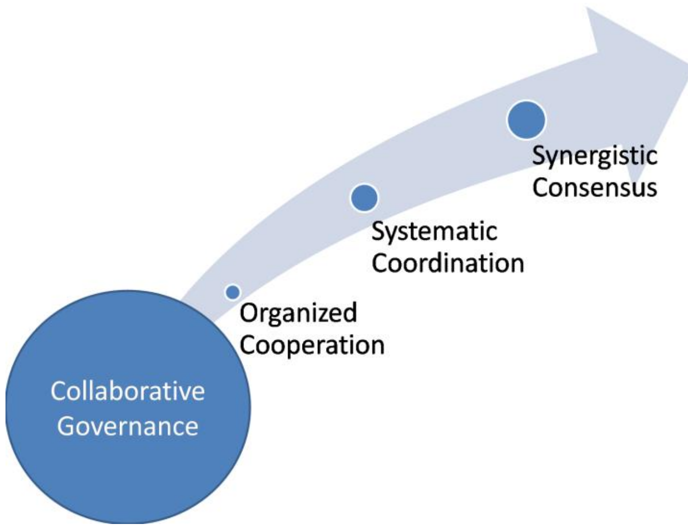


Figure 5. Ladder of Collaborative Governance

The ladder represents an ideal typology of collaborative governance processes based on the degree of elements input into the model, as described in Table 1. In reality, types of collaborative governance processes exist in shades of gray and not as having either a high or low degree of each element. However, the collaborative governance ladder serves as a framework for characterizing the variability in outputs produced amongst the different types of collaborative governance processes in a clear and concise manner. This ability to draw distinctions provides a backdrop for a discussion on the differences between collaborative governance processes, which affect the end outcomes through the production of intermediate outputs. Thus, through the examination of types of collaborative governance processes, we can infer what outputs may be produced, which have an ultimate effect on the desired outcome.

Table 1. Types of Collaborative Governance Processes Distinguished by Elements

Collaborative Governance Processes	Collaborative Governance Elements			
	Group Structure	**Commitment**	**Communication**	**Outputs**
Organized Cooperation	low	low	low	Clear mission statement; pledged resources; characterization studies
Systematic Coordination	moderate	moderate	moderate	Developing structures; agreements for activities; management plans with goals
Synergistic Consensus	high	high	high	Established structures and processes; sustained resources; annual monitoring reports

3.2.1. Organized Cooperation

Organized cooperation is the process of bringing together individual stakeholders in pursuit of a common goal, and involves defining the collective mission and participant roles and creation of organizational structures to share information and increase the efficiency of the partnership. The descriptive “organized” refers to the organization of collective intention to act cooperatively.

Group Structure will generally be low and involves the creation of organizational features (McGuire, 2006) that define the collaborative governance goals, and collection of baseline information. For example, watershed partnerships typically begin by creating a list of participants’ contact information, identifying specific attributes that may be potentially useful to the project and defining participants’ role in the collaborative governance. The role of participants is negotiated, areas of expertise are identified, and rules to resolve conflict are established during this process (Ansell and Gash, 2007). Participants will likely interact to jointly create rules and structures to govern their relationships and construct pathways to act or decide on issues that brought them together (Thomson, et al., 2007). These structures are nascent, and thus low level.

Commitment during the organized cooperation process is also generally low and the time participants’ volunteer is conditional and infrequent. Resources are fewer as they are still being identified. For example, funding for the watershed project may only be pledged and not yet awarded by Federal programs. Technical assistance is limited to data collection of baseline conditions. Successful organization of time and resources will depend on the development of group structures to support and sustain both commitments from participants within the collaborative governance and outside institutions.

During the organized cooperation process, **communication** is typically infrequent and involves mostly indirect modes periodically between group members. For example, the head organizing committee may interact infrequently and indirectly in the formation of sub-committees and meeting logistics. Documentation generally involves characterization studies, which identify the pollutant causing the problem and potential sources of the pollutant. Ambient water quality conditions are recorded in order to establish a baseline against which to measure environmental improvements. Watershed partnerships identify the impairment of their watershed and potential actions they will take to remedy the problem.

Outputs are products or services that result from or are delivered by collaborative governance processes (Thomas and Koontz, 2011). Outputs of the organized cooperation process include a clear mission statement that is agreed upon and supported, pledges of financial and technical support, and characterization studies, identifying the environmental problem.

3.2.2. Systematic Coordination

Systematic coordination is the process of organizing individual time and resources and involves the assessment of resources, and development of a plan. During this process, actions are decided upon and a strategy is devised to execute the goals of the partnership. Systematic implies thoroughness and consistency in the decision making process through increased group structure, commitment, and communication (Davenport, 2003; Payan and Svensson, 2007).

Group structure has an important role in systematic coordination and involves the utilization of organizational structures in the planning process. Information transfer mechanisms generally exist and have been tested. Participants of the partnership most likely have been assigned a specialized role based on the technical expertise they possess.

For example, participants may be tasked with identifying the pollution source impairing the waterbody or collecting water quality monitoring data. In addition to assigning roles and distributing responsibilities, partnership rules are formalized and enforced. The collective mission clearly articulates the specific goals of the partnership, congruence between participants and their roles has been achieved, and information is continuously shared between participants within and outside the partnership. In the systematic coordination stage, members of the watershed partnership accept and understand their role and work in a cohesive manner toward achieving the collective goal. Increased group structure of the collaborative governance will be evident based on these refinements and development of very specific structures and processes to address the collective action problem identified (Mulford and Rogers, 1982).

Commitment of resources in systematic coordination are typically at a moderate level and involve participation; either as a defined, individual role or as a member of a larger division of labor, such as a sub-committee. Sub-committees or scientific panels may be employed during this stage to assist in the development of a plan to address the specific problem in the watershed. This process is represented by specific joint-activities (Payan and Svensson, 2007), therefore requiring an increased commitment of time. For example, devising a plan with goals for specific pollutant removal targets will most likely require more time and resources than setting more generalized goals, implemented at a broader scale.

Communication between participants is at a moderate level and involves both indirect and direct modes with increased frequency. Documentation will generally include a plan or strategy aimed at solving the problem based on specific goals targeted at the sources of pollution, such as a total maximum daily load (TMDL), or a pollution budget for a specific waterbody or watershed. Integrating planning among an array of organizations and stakeholders, requiring a high degree of communication can improve the ability of the partnership to solve problems (Bryson, 2006). Systematic exchange of information and technical expertise and a strong sense of teamwork amongst participants will be dependent upon a high degree of communication (Mulford and Rogers, 1982; Payan and Svensson, 2007).

Outputs of the systematic coordination process include the development of organizational structures for sharing information, agreements on specific joint-activities, and a management plan (e.g. watershed plan or TMDL) with established goals and timeframes.

3.2.3. Synergistic Consensus

Synergistic consensus is the highest-order of collaborative governance processes and is dependent on achieving a virtuous cycle of sharing information, committing resources, and communicating achieved outcomes between the mature collaborative governance and the outside community (Imperial, 2005). Synergistic consensus involves the systematic implementation of a plan through a consensus of opinion. The synergistic consensus process involves implementation and assessment when effective actions are executed, the results are assessed, and, if needed, the process is adapted. The greater the degree of organized cooperation between individual stakeholders and systematic coordination of their time and resources, the more likely collaborative governance will achieve environmental improvements. The descriptive "synergistic" implies the capacity of the collaborative governance to act in synergism or in a way that the total effect is greater than the sum of individual effects.

Group structure is high and expressed by a clear and specific mission statement outlining the goals of the partnership, a strong congruence between participants and their roles and responsibilities, and effective knowledge capabilities providing a consistent exchange of information. During this process, partnerships will generally have well-established rules and norms that pave the way for execution of the collaborative governance goals. Synergistic consensus occurs when multiple organizations collectively agree to engage in activities in order to achieve a specific purpose through a formal arrangement (McGuire, 2006). Strong group structures, such as a consortium of both in-house and outside researchers, and mechanisms to communicate and exchange information exist at this level. These group structures are the foundation for the successful planning and implementation of the collaborative governance mission and goals. A high degree of group structure initiates a positive feedback loop for assessment of action and the distribution of knowledge amongst willing and dedicated participants. For example, watershed partnerships with clearly defined and specified nonpoint source monitoring program goals are more likely to achieve a high level of expected implementation and participation through effective communication and information exchange. Increased group structure results in improved communication mechanisms and strengthened commitment through sustained resources and participation.

A high degree of **commitment** is achieved in synergistic consensus type of collaborative governance process and typically is expressed through sustained funding from multiple sources, and a high level of participation from participants via targeted technical expertise (Steelman and Carmin, 2002). Commitment of human and financial resources will most likely be granted from federal, state, and local programs from varying agencies (i.e. EPA, USDA, state environmental agencies). Resource exchange is extensive and a strong commitment to the partnership's mission exists. Achievement of this high-order level collaborative governance process is dependent upon the availability and quality of information and the human and financial resources that can be deployed for action (Koontz, 2005). Availability of technical expertise and local knowledge will increase the commitment of time and resources by participants (Koehler and Koontz, 2008). The ability to secure multi-year and up-front funding from federal, state, and local sources will provide the stability and flexibility needed to support the collaborative governance and reduce vulnerability to conditions being placed on funding. Synergistic consensus requires a sustained commitment to problem solving (Gray, 1989) from various participants throughout the entire project, planning through implementation. This process engages participants in an intensive process of sustained consensus (Gray, 1989), which leads to more creative and sustainable solutions and increased likelihood of acceptance (Innes and Booher 1999).

A high level of **communication** between participants exists in synergistic consensus and is expressed by a frequent and open communication in the exchange of ideas and information. Open communication and sufficient technical resources were found to be positively correlated with active participation (Koehler and Koontz, 2008). Synergistic consensus requires additional time and depends upon clear communication between representatives and their organizations (Margerum, 2008). Open communication requires trust between participants and a clear perception of their roles in achieving the goal of the collaborative governance. Trust increases interaction, which increases communication of information needed to achieve desired outcomes (Schneider, et al., 2003). Communication will most likely be high and involve face-to-face information exchange and problem solving among participants (Sabatier, et al., 2005).

Communication will consist of effective and ongoing information and education programs to assess and disseminate the knowledge obtained through the collaborative governance. For example, watershed partnerships will have measured the effectiveness of their project through pre-determined and adapted quantified and realistic measurements. The ability to measure success and thus the effectiveness of the partnership is critical to sustaining committed time and resources. For example, monitoring the effects of land treatment on water quality is the best way to document the effectiveness of the nonpoint source control efforts. The implementation and assessment of the watershed plan, targeted toward the achievement of water quality goals, is an indicator of the synergistic consensus process as active participants collectively agree on the problem and proposed solution to restore the impaired watershed. Otherwise, they would not participate. Documents reported through this process are likely to contain critical assessment of the resulting conditions, which can be used to adapt management efforts in a positive way. Monitoring and measuring environmental outcomes is critical to collaborative governance. If environmental improvements are to be realized, improvements need to be measured and compared to initial or baseline conditions. This process of evaluation and assessment is the corner stone of successful and adaptive environmental management.

Outputs of synergistic consensus include development of established structures and processes for information distribution and assessment, a sustained supply of resources, and reports documenting the assessment of sufficient monitoring data for evaluating the progress towards achieving project goals.

3.3 Relationship between the Ladder of Collaborative Governance and the Capacity of Watershed Partnerships to Achieve their Environmental Improvement Goals

While measuring environmental outcomes is desirable for informing policy makers on the critical inputs and most effective types of processes, the use of output measures serve as a useful proxy. Outputs include products or services resulting from the collaborative governance process. They represent an intermediary causal mechanism between collaborative governance processes and end outcomes and are relatively easy to measure (Kootnz and Thomas, 2006). One common and tangible output of collaborative governance processes is consensus documents created by multiple groups, typically in the form of a management plan or progress report (e.g. watershed implementation plans and TMDLs). Such documents are often required by funding agencies as a condition in the allocation of resources (Koontz and Thomas, 2006). Another output measure is actual activities performed by the collaborative, e.g. stream cleanup (Leach and Sabatier, 2005). For example, the implementation of BMPs is often reported as a measure of programmatic success by the Department of Agriculture.

Proponents of collaborative management approaches have argued that collaborative governance can lead to effective solutions while increasing partnerships' capacity to achieve environmental outcomes (Koontz and Thomas, 2006). However, many of the criticisms of collaborative governance revolve around the lack of clear indicators of improved environmental conditions resulting from collaboration (Kenney 2001; Koontz and Thomas, 2006). While existing research has measured and compared collaborative outputs, to date, few studies have empirically linked the inputs (elements), processes, and outputs of the collaborative governance with outcomes. This study offers some important insights into these linkages, and begins discussing the interrelationships affecting the capacity of collaborative governance to achieve improved environmental outcomes.

The ladder of collaborative governance articulates the differences in processes based on the composition of inputs or elements. Mandarano (2008) found types of outputs produced by collaborative processes vary depending upon the goals of the process. Following this logic, differences in processes are hypothesized to result in the production of different outputs. For example, outputs of systematic coordination relate to the planning process, whereas synergistic consensus outputs relate to the process of implementation. The difference between the two processes is an increase in the degrees of group structure, commitment, and communication that allow for the implementation of the planned solution. Mandarano's study (2008) revealed linkages between process, high-quality outputs, and social and environmental outcomes. Therefore, it is logical to assume that partnerships' capacity is related to the type of output produced, as implementation activities are a stronger output measure than planning activities and portray a better indication of the partnerships' capacity to achieve their goals.

Hypothesis #4: Different types of collaborative processes will produce different outputs, affecting partnerships' capacity to achieve their environmental improvement goals.

CHAPTER 4: RESEARCH DESIGN, DATA, AND METHODS

4.1 Dataset Overview

To empirically assess each of the research hypotheses, I obtained longitudinal water quality data from EPA's National Nonpoint Source Monitoring Program (NNPSMP). The program began in 1992 and continues today, consisting of 28 projects. This study included 26 watershed projects involving 40 waterbodies from 20 states across the country (Lombardo, et al., 2008). Two projects were dropped due to incompatibilities with population, including recent entry into the program (young projects) or the incompatibility of their project goals (i.e. environmental outcomes were not waterbody based).

NNPSMP was established primarily to: 1) scientifically evaluate the effectiveness of watershed technologies designed to control NPS pollution, and 2) improve our understanding of NPS pollution (Lombardo et al, 2008). The NNPSMP projects were supported by EPA funds authorized by section 319(i) of the 1987 Amendments to the Clean Water Act, for the collection of information on costs and effectiveness of NPS controls. The program monitors baseline conditions for at least 2 years, followed by the implementation of best management practices (BMPs) and subsequent monitoring for 3-6 years, for a project total of up to 15 years of ambient water quality data. More than half of the projects possessed at least 10 years of monitoring data.

Each project followed a nationally consistent set of guidelines, including the use of an appropriate experimental design and water quality monitoring requirements. Program projects utilized one of more of the following study designs: paired-watershed, upstream-downstream, or single-downstream station (Table 2).

The paired-watershed design involves monitoring water quality for two similar watersheds and assessing the response of both a control and treatment waterbodies, before and after treatment (King et. al, 2008). The control waterbody, often called “reference waterbody”, is chosen for its physical and land use similarities to the waterbody that will undergo treatment of implemented BMPs. Water quality monitoring of the paired watersheds occurs during a calibration period of two to three years when both are simultaneously managed. The calibration period is followed by a period when one of the watersheds is treated with BMPs. The watersheds continue to be monitored for two to three years after treatment is completed. The paired-watershed design accounts for hydrologic variations so that the effect of the BMPs can be isolated. The primary advantage of the paired design is that the use of the control watershed allows the effect of the treatment to be isolated from other confounding factors (i.e., geological and climatic conditions) that might result in a difference in response variables between watersheds and is ideal for isolating treatment effects (King et al., 2008). The majority (85%) of projects used a paired-watershed research design.

In the upstream-downstream design, a monitoring station is installed directly upstream and downstream of an area where significant nonpoint source pollution controls will be implemented. Water quality and land management monitoring should occur before, during, and after implementing controls.

The single-downstream station study design involves monitoring downstream of the entire study area. The quality of the water is compared between the initial project conditions and the conditions at project's end. This design is not recommended because of the difficulty in isolating the effects of nonpoint pollution controls from other variables, such as rainfall.

In each of the designs, monitoring data are analyzed to document that nonpoint pollution controls have significantly reduced pollutant delivery to the sampling station. The water quality monitoring designs of the current National Monitoring Program projects are listed in Table 2.

Table 2. List of monitoring design per National Monitoring Program project.

Project Name	Monitoring Design
Bad River	paired-watershed
Corsica River Watershed	paired-watershed
Eagle River Stamp Sand	paired watershed; upstream/downstream
Eastern Snake River Plain	paired-field networks
Elm Creek Watershed	upstream/downstream/ single downstream station
Jordan Cove Urban Watershed	paired-watershed
Lake Champlain	paired-watershed
Lake Pittsfield	single downstream station (lake)
Lightwood Knot Creek	paired-watershed
Long Creek Watershed	paired-watershed; upstream/downstream; single downstream station

Morro Bay	paired-watershed
New York City Watershed	paired-watershed
Oak Creek Canyon	upstream/downstream
Otter Creek	paired-watershed; upstream/downstream
Peacheater Creek	paired-watershed
Pequea and Mill Creek Watersehd	paired-watershed; upstream/downstream
Sny Magill Watershed	paired-watershed
Stroud Preserve Watershed	paired-watershed
Swatara Creek Watershed	paired watershed; upstream/downstream
Sycamore Creek Watershed	paired-watershed
Totten and Eld Inlet	paired-watershed
Upper Grande Ronde	paired-watershed; upstream/downstream
Walnut Creek	paired-watershed
Warner Creek	paired-watershed; upstream/downstream
Waukegan River	upstream/downstream
Whitewater River Watershed	paired-watershed

4.2 Three Ways (Y's) to Assess Capacity to Achieve Environmental Improvement Goal

Three dependent variables were used to measure watershed partnerships' capacity to achieve their environmental improvement goals: 1) level of achievement of stated goals for water quality improvements, 2) specificity of goals for pollutant reductions, and 3) specificity of goals to evaluate BMP effectiveness.

4.2.1 Y1: Achievement of Stated Goals for Water Quality Improvements (End Outcomes)

The first dependent variable assessing capacity focuses on the partnership's achievement of stated goals for water quality improvements resulting from implemented

BMPs, based on empirical assessments of longitudinal water quality monitoring data from EPA's NNPSMP. While continuous raw water quality values are most desirable for measuring water quality improvements, access to complete data sets was not possible due to a lack of enforcement of data entry into databases. Therefore, the achievement of environmental improvement goals was used as a surrogate from which environmental outcomes may be inferred from the stated goal.

The capacity of each partnership to achieve the stated water quality goals for their project was measured through the examination of third-party, empirical assessments of improvements in ambient water quality conditions resulting from implemented BMPs using data collected for each of the 40 waterbodies within the 26 NNPSMP projects. EPA required watershed partnerships participating in the program to state upfront water quality improvement goals in the initial project report. Achievement of improved environmental outcomes can be inferred by looking at the stated goal of the partnership. For example, the stated project goal by the watershed partnership was to reduce bacteria levels in the waterbody and monitoring reports confirmed that bacteria levels were reduced as a result of the implemented BMPs. While this measure does not report the exact change in water quality conditions, it assesses whether the desired change in environmental conditions were achieved as a result of partnership activities (BMP implementation) with a significant degree of certainty as it was based on raw water quality data.

A partnership's achievement of its stated water quality improvement goals was determined by reviewing public reports assessing project performance. Several sources were used, including NC State University's Water Quality Newsletter reports (NWQEP Notes), program annual reports, and academically published water quality reports. A scale was then created to account for the degree of goal attainment. The successful achievement of all of the water quality goals stated in each project's entry application, earned the corresponding waterbody a ranking of four. If one or more goals were met, but not all, the waterbody earned a ranking of three. If no goals were met, the waterbody earned a ranking of two. Lastly, if the outcome was the reverse of water quality goals (i.e. an increase in bacteria was measured in a waterbody where the goal was to reduce bacteria), the waterbody received the ranking of one (Table 3).

Table 3. Achievement of stated goals for water quality improvements.

	HIGH	MEDIUM	LOW	REVERSE
Met all goals	4			
Met some goals		3		
Met no goals			2	
Outcome was reverse goals				1

Achievement of stated water quality goals was determined through an analysis of water quality monitoring data created by North Carolina State's Biological and Agricultural Engineering Department's Dr. Jean Spooner, who was contracted by EPA to assist project partnerships in the analysis and summarization of project progress. Dr. Jean Spooner and her staff evaluated water quality monitoring data for each of the NNPSMP projects, using the chosen monitoring design, and determined whether changes in water quality were the result of the BMPs implemented. For example, in the paired-watershed design, the water quality data collected from the treatment waterbody was compared to the control or reference waterbody in order to determine if changes were the result of the treatment (implemented BMP) and not due to natural phenomena. Academic institutions were paired up with each of the 26 projects to conduct data analysis of collected water quality data. Jean Spooner at NC State and Don Meals and Steve Dressing from Tetratech conducted additional analysis of water quality outcomes from monitoring data collected for publication in NC State University's Water Quality Newsletter reports, NWQEP Notes, which was a primary resource for assessing partnerships' achievement of project stated goals.

Rankings were validated by professional consultants from Tetratech, Steve Dressing and Don Meals, who have been under contract by EPA from the inception of the NNPSMP to provide technical support to project participants in the data entry and also worked in conjunction with NC State in the statistical analyzation of monitoring data. Table 4 lists the ranking results.

Table 4. Ranking results for the achievement of water quality goals per waterbody.

State	Project Name	Waterbodies	Y1: Achievement of State Goals for Water Quality Improvements
South Dakota	Bad River	Powell Creek	met all project goals
		Whitewater North	met all project goals
Maryland	Corsica River Watershed	Corsica River	met some of project goals
Michigan	Eagle River Stamp Sand	East Branch of Eagle River	met no project goals

Idaho	Eastern Snake River Plain	groundwater	outcome was reverse of goals
Nebraska	Elm Creek Watershed	Elm Creek	met no project goals
Connecticut	Jordan Cove Urban Watershed	Jordon Cove	met some of project goals
Vermont	Lake Champlain	Samsonville Brook	met all project goals
		Godin Brook	met some of project goals
Illinois	Lake Pittsfield	Lake Pittsfield	met all project goals
Alabama	Lightwood Knot Creek	Lightwood Knot Creek	met some of project goals
North Carolina	Long Creek Watershed	Long Creek	met all project goals
California	Morro Bay	Churro Flats	met all project goals
		Chumash	met all project goals
		Dairy	met some of project goals
		Churro	met some of project goals
New York	New York City Watershed	Cannonsville Reservoir	met all project goals
Arizona	Oak Creek Canyon	Oak Creek @ Slide Rock State Park	met some of project goals
		Oak Creek Pine Flats camping site	outcome was reverse of goals
Wisconsin	Otter Creek	Otter Creek	met some of project goals
		Otter Creek (Barnyard Study)	met some of project goals
Oklahoma	Peacheater Creek	Peacheater Creek	met all project goals
Pennsylvania	Pequea and Mill Creek Watersehd	Big Spring Run	met some of project goals
Iowa	Sny Magill Watershed	Sny Magill Creek	met no project goals
Pennsylvania	Stroud Preserve Watershed	Morris Run	met no project goals
		Mine Hill Run	met some of project goals
Pennsylvania	Swatara Creek Watershed	Lorberry Creek	met some of project goals
Michigan	Sycamore Creek Watershed	Willow Creek	met some of project goals
		Marshall Drain	met some of project goals
		Haines Drain	met some of project

			goals
Washington	Totten and Eld Inlet	Pierre Creek	met some of project goals
		Perry Creek	met all project goals
		Burns Creek	met some of project goals
		Schneider Creek	met all project goals
		McLane Creek	met some of project goals
Oregon	Upper Grande Ronde	McCoy Creek	met some of project goals
Iowa	Walnut Creek	Walnut Creek	met some of project goals
Maryland	Warner Creek	Warner Creek	met no project goals
Illinois	Waukegan River	Waukegan River	met some of project goals
Minnesota	Whitewater River Watershed	Finley East	met no project goals

4.2.2 Y2: Set Specific Goals for Pollutant Reductions (Intermediate Output)

The second dependent variable assessing capacity measured whether the watershed partnership set specific goals for pollutant reductions. Setting specific goals typically requires the allocation of more time and resources earlier in the collaborative governance processes. Accurate and detailed information regarding the source of pollution impairing the waterbody and physical conditions of the watershed is necessary when setting specific pollutant reduction goals. An example of a goal set for specific pollutant reductions is percentages of pollutant loadings reduced (e.g. 40% reduction in nitrogen loadings). Such specific goals for pollutant reductions are a common practice with regards to water quality and generated through the mandated Total Maximum Daily

Load (TMDL) process by EPA's Office of Water's Assessment of Watershed Protection Division. TMDLs are a policy planning tool for determining the capacity of a waterbody to handle specific amounts of pollution before it becomes "impaired." Put simply, a TMDL is a pollution budget for a waterbody, identifying specific allocations for pollutant reductions to the various sources of pollution (e.g. factory discharges, runoff from agricultural fields). Table 5 summarizes the type and percentage of pollutants impairing the waterbodies. Approximately 56% of the watershed projects in the data set had an EPA-approved TMDL in place.

Table 5. Summary of type and percentage of impairments of project waterbodies.

Impairment	**Percentage of Waterbodies**
Sediment	50%
Nutrients (Nitrogen and Phosphorus)	38%
Bacteria	43%
Temperature	13%
Mining Pollutants (Acidity and Metals)	5%

This dependent variable serves as a reasonable measure for determining the capacity of a partnership to achieve goals for environmental improvements as it identifies the partnerships that went beyond the programmatic requirements of the NNPSMP of evaluating BMP effectiveness to set specific pollution reduction goals. In addition, this measure provides intermediate outputs or benchmarks for measuring progress towards the end outcome of improved water quality by measuring incremental pollutant reductions.

The nature of this dependent variable was binary. Projects with specific pollutant reduction goals were coded “1” and waterbodies without a specific pollutant reduction goals was coded “0.”

4.2.3 Y3: *Set Broad Goals to Evaluate BMP Effectiveness (Intermediate Output)*

The third and final dependent variable assessing capacity measured whether the watershed partnership set broad goals to evaluate BMP effectiveness. This type of goal setting was most common as the mission of the NNPSMP was to collect data in order to determine the most effective BMPs at controlling various NPS pollutants. An example of a broad goal set to evaluate BMP effectiveness is a general assessment of the performance of a genre of BMP (e.g. agriculture) on a specific pollutant, such as sediment. For instance, the stated goal was to “measure the effectiveness of drip irrigation technologies on the contamination of ground water by applied herbicides.” Goal setting of this nature is more general and BMPs are typically applied to larger drainage acreage and may include more than one type of BMP within a broader genre (e.g agricultural BMPs to target bacteria, sediment, and nutrients) (Table 6).

Table 6. Description of individual waterbody goals.

Waterbodies	Specific Goals	Broad Goals
Powell Creek	sediment reduction (30%)	
Whitewater North	sediment reduction (30%)	
Corsica River	nutrient reductions (60% phosphorus & 60% nitrogen)	

East Branch of Eagle River	meet aqueous copper standard	
groundwater		evaluate effectiveness of irrigation BMPs for nitrate removal
Elm Creek	sediment reduction (50%)	
Jordan Cove	nutrient (65% nitrogen & 40% phosphorus) & bacteria (65%)reductions	broad-demonstrate effectiveness of stormwater BMPs
Samsonville Brook		demonstrate effectiveness of grazing BMPs
Godin Brook		demonstrate effectiveness of grazing BMPs
Lake Pittsfield		demonstrate effectivness of sediment BMPs
Lightwood Knot Creek		demonstrate effectiveness of agricultural BMPs
Long Creek	reduce sediment loads by 60%	demonstrate effectiveness of agricultural BMPs
Churro Flats	reduce sediment loads by 34%	demonstrate effectiveness of agricultural BMPs
Chumash		demonstrate effectiveness of agricultural BMPs
Dairy		demonstrate effectiveness of agricultural BMPs
Churro		demonstrate effectiveness of agricultural BMPs

Cannonsville Reservoir		demonstrate effectiveness of whole farm planning process
Oak Creek @ Slide Rock State Park		demonstrate effectiveness of NPS BMPs
Oak Creek @ Pine Flats camping site		demonstrate effectiveness of NPS BMPs
Otter Creek		demonstrate effectiveness of NPS BMPs
Barnyard Study		demonstrate effectiveness of NPS BMPs
Peacheater Creek		demonstrate effectiveness of NPS BMPs
Big Spring Run		demonstrate effectiveness of streambank fencing
Sny Magill Creek	reduce sediment loads by 50%	demonstrate effectiveness of aAgricultural BMPs
Morris Run		demonstrate effectiveness of riparian forest buffer
Mine Hill Run		demonstrate effectiveness of riparian forest buffer
Lorberry Creek		demonstrate effectiveness of passive treatment systems (Acid Mine Drainage)
Willow Creek	reduce sediment loads by 52%	demonstrate effectiveness of agricultural BMPs

Marshall Drain	reduce sediment loads by 52%	demonstrate effectiveness of agricultural BMPs
Haines Drain	reduce sediment loads by 52%	demonstrate effectiveness of agricultural BMPs
Pierre Creek	reduce bacteria loads by 69%	demonstrate effectiveness of NPS BMPs
Perry Creek		demonstrate effectiveness of NPS BMPs
Burns Creek	reduce bacteria loads by 63%	demonstrate effectiveness of NPS BMPs
Schneider Creek	reduce bacteria loads by 50%	demonstrate effectiveness of NPS BMPs
McLane Creek	reduce bacteria loads by 44%	demonstrate effectiveness of NPS BMPs
McCoy Creek		demonstrate effectiveness of BMPs for improving biological habitat
Walnut Creek		The long-term goal of the US Fish and Wildlife Service is to restore this area to pre-settlement conditions
Warner Creek		USDA goals: validate hydroloigc and water quality models
Waukegan River		demonstrate effectiveness of NPS BMPs
Finley Creek		demonstrate effectiveness of NPS BMPs

This dependent variable serves as an adequate measure for determining the capacity of a partnership to achieve goals for environmental improvements when long-term or complete data is unavailable. The situation of not having long-term environment data is common. The ability to provide managers with a proxy measure would be useful in determining how to use limited resources most effectively.

The nature of this dependent variable was binary. Projects possessing broad goals were coded “1” and “0” for those that did not have a broad goal assigned.

4.3 Explanatory Variables: The Elements of Collaborative Governance

To evaluate the elements of collaborative governance, survey data was collected from individuals who participated in collaborative governance related to watershed partnerships. The survey examined the relationship between elements of collaborative governance and the capacity of watershed partnerships to achieve their stated goals for water quality improvements. Respondents were identified as “project contacts” in the annual reports submitted to EPA. They included the following titles (roles): administration, land treatment, water quality monitoring, and information and education. Email correspondence and phonecalls verified current email addresses and identified additional contacts. An introductory email was first sent in February 2009 alerting respondents of the online survey and requesting their commitment to participate. Subjects were sent an email with the online survey link in early spring of 2010.

The survey was approved by George Mason's Human Subject Review Board and respondents consented to taking the survey. Five-point Likert scales were used to assess individual perceptions: 1) Strongly disagree 2) Disagree 3) Neither agree nor disagree 4) Agree 5) Strongly agree. The 60 question survey was distributed on-line and via email through SurveyMonkey.com between months of March through May, 2010. Data from a total of 64 respondents, with a minimum of one respondent per watershed partnership, was collected at a response rate of 80%. Respondents answered questions relating to the three theoretical constructs discussed in the previous chapter: group structure, commitment, and communication.

A pilot group validated the survey prior to distribution to population. The pilot group was represented by 15 individuals who participated in the NNPSMP, but whose responses would not be included in the final data set due to their recent entry into the program (young projects) or the incompatibility of their project goals (i.e. environmental outcomes were not waterbody based). Feedback on the clarity of questions, length of survey, and validity of survey objectives was provided by the pilot group and incorporated into the final survey.

Out of a total of 64 respondents who started the survey, 50 respondents completed it. Fourteen watershed projects had one corresponding waterbody and eight watershed projects had multiple waterbodies with Washington State's Totten and Eld Inlet watershed consisting of the greatest number (6) of waterbodies (Table 7). To account for these waterbodies, the respondents' answers of the corresponding watershed projects were duplicated, resulting in a total of 72 observations for 40 waterbodies.

Table 7. Description of waterbodies per watershed projects highlighting multiple waterbody watershed projects.

State	Project Name	Waterbodies	Multiple Waterbodies
South Dakota	Bad River	Powell Creek	•
		Whitewater Creek North	
Maryland	Corsica River Watershed	Corsica River	
Michigan	Eagle River Stamp Sand	East Branch of Eagle River	
Idaho	Eastern Snake River Plain	Eastern Snake River*	
Nebraska	Elm Creek Watershed	Elm Creek	
Conneticut	Jordan Cove Urban Watershed	Jordon Cove	
Vermont	Lake Champlain	Samsonville Brook	•
		Godin Brook	
Illinois	Lake Pittsfield	Lake Pittsfield	
Alabama	Lightwood Knot Creek	Lightwood Knot Creek	
North Carolina	Long Creek Watershed	Long Creek	•
California	Morro Bay	Churro Flats	•
		Chumash Creek	
		Dairy Creek	
		Churro Creek	
New York	New York City Watershed	Cannonsville Reservoir	
Arizona	Oak Creek Canyon	Slide Rock	•
		Pine Flats	
Wisconsin	Otter Creek	Otter Creek	•
		Barnyard	
Oklahoma	Peacheater Creek	Peacheater Creek	
Pennsylvania	Pequea and Mill Creek Watersehd	Big Spring Run	
Iowa	Sny Magill Watershed	Sny Magill Creek	
Pennsylvania	Stroud Preserve Watershed	Morris Run	•
		Mine Hill Run	
Pennsylvania	Swatara Creek Watershed	Lorberry Creek	

Michigan	Sycamore Creek Watershed	Willow Creek	•
		Marshall Drain	
		Haines Drain	
Washington	Totten and Eld Inlet	Pierre Creek	•
		Perry Creek	
		Burns Creek	
		Schneider Creek	
		McLane Creek	
Oregon	Upper Grande Ronde	McCoy Creek	
Iowa	Walnut Creek	Walnut Creek	
Maryland	Warner Creek	Warner Creek	
Illinois	Waukegan River	Waukegan River	
Minnesota	Whitewater River Watershed	Finley Creek	

*Baseflow recharge from groundwater.

Respondents of the survey were asked to identify their role(s) within the project partnership. Approximately 31% of respondents identified themselves as the administrator or project leader or manager. Nearly 62% identified themselves as having a significant role in sample collection (i.e. water quality data collection). Approximately 57% of respondents identified themselves as a government agent, while 21% were in academia. Nearly all (91%) respondents possessed a college degree, with the majority (68%) having advanced degrees.

The majority (57%) of the population was employed by the government and was asked questions about a government program. Therefore, the desire to respond favorably on their experience presented the potential for a social desirability bias. Social desirability bias was addressed by ensuring anonymity for all respondents. In the situation that a social desirability bias existed, the ability to find statistically significant relationships would be reduced as less variability exists in respondents' survey answers. However, findings of statistically significant relationships offered additional evidence that social desirability bias did not reduce the strength of the relationship between the variables of interest (Darnall, et al., 2009).

Surveyed participants of watershed partnerships directly contributed to the inputs, activities, and outputs involved in improving environmental conditions in their watershed. Unlike cases where partnerships engaged in activities that improved environmental conditions indirectly through an education and outreach campaign, or through a change in public policy, the partnerships in this study engaged in "on the ground" actions that directly affected the outcome. Watershed partnerships participating in this study implemented BMPs to address the nonpoint source pollution impairing their waterbody, and then they measured the change in water quality conditions that resulted from that BMP. Therefore, responses to survey questions measured relationships between the explanatory variables and dependent variables.

The explanatory variables consisted of the three elements of the collaborative governance: group structure, commitment, and communication. Each element was broken into components. Two to four survey questions related to each component. Aggregate variables or indices were created for each component within each element by summing the individual questions, which are described in detail below.

The first element, **Group Structure,** is comprised of three components: a clear mission statement, role congruence, and knowledge capabilities of the collaborative governance as a whole. Clear mission was measured using three questions: "I felt the mission statement of our watershed was clearly defined"; "I believed improving the health of our watershed was our partnership's common goal"; and "I felt that our partnership's mission statement outlined the objectives for achieving the common goal". Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed to create an aggregate score for each respondent. Out of a total possible score of 15, indicating that the respondent answered "strongly agreed" to all three questions, the mean for clear mission index was a score of 11. On average, the majority (78%) of respondents "agreed" or "strongly agreed" that their partnership possessed a clear mission statement, 86% "agreed" or "strongly agreed" that the common goal of their partnership was improve the health of their watershed, and 73% "agreed" or "strongly agreed" that the mission statement outlined the partnership's objectives for achieving their goal(s).

Role congruence was measured using three questions: "I felt the division of responsibilities was fairly assigned"; "I agreed with the responsibilities I was assigned"; and "I understood my role in the partnership because it was clearly stated". Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed to create an overall score for each respondent. Out of a total possible score of 15, whereby respondent answered "strongly agreed" to all three questions, the mean for this index was a score of 12. On average, over half (55-58%) of respondents "agreed" or "strongly agreed" that responsibilities were divided up fairly and accepted the responsibilities they themselves were assigned. The majority (72%) "agreed" or "strongly agreed" that their role in the partnership was clearly stated.

Knowledge capabilities was measured using two questions: “I believed that information was shared between our partnership and outside scientific panels” and “I shared information that I received with members of our partnership”. Like the previous two variables, responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed to create an aggregate score for each respondent. Out of a total possible score of ten, whereby the respondent answered “strongly agreed” to both questions, the mean for this index was a score of eight. On average, the majority (70%) “agreed” or “strongly agreed” that information was shared between the partnership and outside panel. A high percentage (94%) of respondents “agreed” or “strongly agreed” that they themselves readily shared information with partnership members.

The second element, **Commitment,** is comprised of two components: participants’ committed time (participation) and resources. Resources are disaggregated into human (knowledge and expertise) and technical and financial resources. Participation was measured using two questions: “I was involved in our partnership from the beginning” and “I was involved in our partnership throughout the entire project”. Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed to create an aggregate score for each respondent. Out of a total possible score of ten, whereby respondents answered “strongly agree” for both questions, the mean for this index was a score of six. On average, a majority (58%) “agreed” or “strongly agreed” that they participated from the beginning and 47% “agreed” or “strongly agreed” that they participated throughout the duration of the project.

Human resources were measured using four questions: “I provided expertise to the watershed partnership about sources of pollution”; “I provided expertise to the watershed partnership about the best management practices available to control pollution”; “I provided knowledge to the watershed partnership about changes in land use”; and “I provided knowledge to the watershed partnership about health of the waterbodies”. Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed to create an aggregate score for each respondent. Out of a total possible score of 20, whereby the respondent answered “strongly agreed” to all four questions, the mean for this index was a score of 13. On average, 51% of respondents “agreed” or “strongly agreed” that they provided expertise regarding the source of pollution, but less than half (33%) “agreed” or “strongly agreed” that they provided expertise with regards to the BMP choice. Similarly, 50% of respondents “agreed” or “strongly agreed” that they provided knowledge regarding the health of the waterbodies, but less than half (35%) “agreed” or “strongly agreed” that they provided knowledge about the changes in land use within their watershed.

Sufficient resources was measured using four questions: “I felt that our partnership has sufficient equipment to conduct monitoring”; “I felt that our partnership has sufficient equipment to conduct data analysis”; “I believed that our partnership had continued funding throughout the project"; and " I believed that our partnership and freedom to use the funding however we wanted". Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed to create an aggregate score for each respondent. Out of a total possible score of 20, whereby the respondent answered "strongly agree" to all four questions, the mean for this index was a score of 15. On average, a consistent majority (76%) of respondents "agreed" or "strongly agreed" that their partnership had sufficient resources to conduct monitoring and data analysis and financial resources. However, greater variance was exhibited with regards to respondents perception of the freedom associated with funding, whereby 39% disagreed and 25% agreed that their partnership had the freedom to use funding however they wanted.

The third element, **Communication,** is comprised of three components: mode, frequency, and documentation. Mode was measured using four questions: "I believe that the most common method of communication for our partnership was in-person conversations"; "I believe that the most common method of communication for our partnership was phone conversations"; "I believe that the most common method of communication for our partnership was email messages"; and "I believe that the most common method of communication for our partnership was mailed letters". Direct modes of communication, in-person and phone conversations, were coded positively (i.e. +5: strongly agree) based on previous literature that found direct communication to be the more effective mode. This variable had a total possible score of 10, whereby the respondent answered "strongly agree" to these two forms being the most commonly used, face-to-face and phone conversations (Mishra and Mishra, 2009; Koontz and Bodine, 2008). Indirect modes of communication, email and mailed letters, were coded negatively (i.e. -5: strongly agree) with a total possible score of -10, whereby the respondent answered "strongly agree" to these two forms being the most commonly used. Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed for an aggregate score of this index for each respondent. The mean score for this index was 2, indicating that respondents felt that there was a mix of direct and indirect modes of communication commonly used within their partnership. The majority of respondents (63%) agreed that the most common modes of communication were direct forms, in-person and phone conversations. While less than half (47%) agreed that email messages were a common mode of communication and 43% of respondents disagreed that mailed letters were a common mode of communication for their partnership. Combined, 88% reported phone conversations to be the most common mode of communication.

Frequency was measured using responses to one four-part question: "Please indicate the frequency with which you communicated with members of your partnership a) in-person conversations, b) phone conversations, c) email messages, and d) mailed letters". Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed for an aggregate score of this index for each respondent. Out of a total possible score of 20, whereby the respondent answered "daily" to all four parts of this question, the mean for this index was a score of 14. The majority (62%) of respondents communicated monthly via in-person conversations and via phone conversations (47%). Whereas, 35% reported communicating monthly via email messages and 38% reported receiving mailed letters annually. Combined, the majority (90%) of respondents reported that they communicated most frequently (weekly to monthly) via phone conversations.

Documentation was measured using two questions: “I believed that documents (e.g. watershed action plans, stream assessments, etc…) were written in-house by members of our partnership” and “I believed that documents (e.g. watershed action plans, stream assessments, etc…) were written collectively by all members of our partnership”. Responses to these questions were given using a 5-point Likert scale ranging from 1-strongly disagree to 5-strongly agree, which were summed for an aggregate score of this index for each respondent. Out of a total possible score of 10, whereby respondent answered “strongly agreed” to both questions, the mean for this index was a score of 7. An overwhelming majority of respondents (87%) “agreed” or “strongly agreed” that documents were written in-house. Greater variance existed in responses to the question of whether or not documents were written collectively, with 37% of respondents agreeing and 29% percent disagreeing. Table 8 summarizes the descriptive statistics for the four dependent variables and nine explanatory variables.

Table 8. Descriptive Statistics of Dependent and Explanatory Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Dependent Variables					

Achievement of Stated Goals for Water Quality Improvement	72	3.00	.89	1	4
Partnership Chose Appropriate BMP	72	.75	.44	0	1
Specific Goals for Pollutant Reductions	72	.71	.46	0	1
Broad Goals to Evaluate BMP Effectiveness	72	.74	.44	0	1
Explanatory Variables					
Clear Mission	72	11.00	3.80	2	15
Role Congruence	72	11.90	2.11	6	15
Knowledge Capabilities	72	7.76	1.50	5	10
Participation	72	6.33	3.12	0	10
Human Resources	72	13.38	3.67	4	18
Sufficient Technical and Financial Resources	72	14.56	2.94	6	20
Documentation	72	10.33	2.69	0	15
Communication Mode	72	1.54	1.48	-2	6*
Communication Frequency	72	14.00	2.63	8	18

*Indirect modes of communication was coded negatively resulting in negative score for overall frequency index.

4.4. Control Variables for Sociological and Environmental Variance

Several socioeconomic and physical control variables were included in regression models to isolate the effect of specific independent variables. The use of a paired-watershed monitoring design further controlled for changes happening upstream of the restoration site to limit confounding effects, allowing the effectiveness of partnership activities (BMP implementation) to be isolated.

Lubell et al., (2002) found that socioeconomic status had significant effects on the formation of partnerships and that higher status was associated with increased human resources to further the collaborative governance. The variables of age, income, education, and occupation were measured by survey responses to questions asking the respondent's age, highest level of education, annual income, and employment at the time of the project. Occupation was self reported by the respondent from a list of categories including government agent, academic, environmental scientist, and landowner. Due to the majority (57%) of respondents identifying themselves as government agents, a dummy variable was created for occupation coded "1" for government agent and "0" for non-government. This variable indirectly assessed impact of participant composition as previous studies associated differences in collaborative outputs and outcomes based on classification of partnership members (Moore and Koontz, 2003; Bidwell and Ryan, 2006).

A continuous variable was included to account for the acreage of each watershed project. The delineated watershed acreage was collected from annual reports created for the NNPSMP and data was entered for each of the 26 projects, with the same number entered for additional waterbodies within the project watershed. Watershed ranged in size from 487 acres to 2,053,760 acres. This range in size amongst the different watersheds could potentially confound findings of this project as restoration efforts would presumably require less time to result in improvements in water quality. Additionally, smaller watersheds may require fewer resources than larger watersheds. Approximately 30% of project watersheds were less than 10,000 acres, and less than 10% greater than 100,000 acres, with the majority of projects having a watershed size ranging from 14,000 to 70,000 acres.

Since precipitation rates differ across the country based on climate, water usage, and land runoff, a variable was created (measured in inches) to account for average annual rainfall. These data were collected via annual reports for the NNPSMP. Data was entered for each of the 26 projects, with the same number entered for additional waterbodies within the project watershed. Average annual rainfall rates ranged from an average of 10 inches in the Idaho project to 56 inches in the Alabama project. The amount of rainfall directly impacts the amount of pollutants entering the waterbodies via runoff (USEPA, 2002. Runoff involves the transportation of pollutants picked up from the land and carried in rain and snowmelt to surface waterbodies. For example, bacteria levels typically spike after a heavy storm event as increased runoff carries bacteria from manure and animal wastes into the waterbody. Depending on the land use and presence or absence of management practices, the type and amount of runoff will differ. In addition, excess runoff may result in flooding conditions that erode streambanks and downcut streambeds, destabilizing the physical structure of the waterbody channel and flushing inhabiting species downstream. An excess volume of water in the stream channel also creates a dilution effect on water chemistry, temporarily reducing levels of pollutants by increasing the overall water volume.

Land use was an additional control variable included in this study. The land use variable was measured using information provided in the NNPSMP annual reports. The prominent land use (highest percentage) was used to define this measure for each project waterbody. Agriculture was the prominent land use for projects included in this study, representing 62.5% of watersheds. The remaining projects included a mixture of forested, wetland, residential, commercial/industrial (37.5%) and urban (1.4%). The dominance of agricultural projects may be due to EPA's partnership with the US Department of

Agriculture's Natural Resource Conservation Service for this program. Agriculture is the leading source of non point source pollution. The dominance of agricultural projects may be due to EPA's partnership with the US Department of Agriculture's Natural Resource Conservation Service for this program. The variable was binary and coded 1 for agriculture and 0 for non-agricultural land uses, including forest and urban.

Soil erodibilty is the fourth control variable used in regression models. Highly erodible soil is defined as unstable soil that has a high potential to be carried by runoff away from its origin and potentially into nearby surface waterbodies. Eroded soil entering the waterbody clouds the water preventing aquatic species' ability to find food and coats the surface of the streambed, reducing habitat. Sediment particles often carry additional pollutants on their surface into the waterbody. For example the nutrient phosphorus readily adheres to soil particle surfaces. Excess levels of phosphorus result in eutrophic or low oxygen conditions in the waterbody further impairing its condition. The variable is binary and coded "1" if the soil was highly erodible and "0" is it was not highly erodible. Additional control variables included were partnership age and whether or not respondents resided within the watershed boundaries. Partnership age is continuous variable and measured by the difference from conception to completion of the watershed project as reported by the NNPSMP. Sabatier et al. (2005) found the age of the partnership to be related to the achievement of particular milestones and goals. Whether or not the respondent resided in the watershed has been suggested to impact their level of concern and thus their participation level (Koehler and Koontz, 2008). Whether or not the respondents resided in the watershed during the project timeframe was a binary variable coded “1” for yes, they did reside in the watershed during the project timeframe and “0” if respondents did not reside in the watershed.

Lastly, a binary variable was created to control for the presence of a Total Maximum Daily Load (TMDL) for waterbodies included in this dataset. This variable was measured by conducting a simple internet search to see if a TMDL was created and/or approved within the project timeline (i.e. partnership age variable). Waterbodies for which a TMDL was created within the project timeline was coded 1 for yes and 0 for those without a TMDL.

4.5 Assessing Linkages between Collaborative Governance Processes and Watershed Partnership Capacity

4.5.1 Collaborative Governance Logic Model

Thomas and Koontz (2011) suggest evaluating the performance of collaborative governance by using a logic model that carefully distinguishes collaborative processes from the outputs and outcomes of those processes (Figure 6).

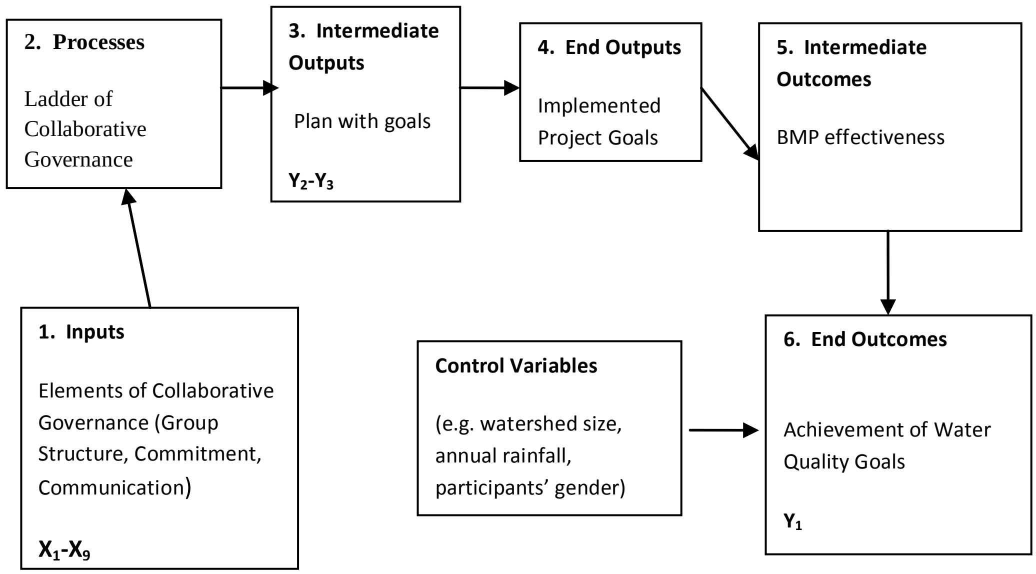


Figure 6. Collaborative Governance Logic Model (adapted from Thomas and Koontz, 2011).

Figure 6 depicts Thomas and Koontz (2011) logic model, adapted for evaluating collaborative governance. The three dependent variables of this study, Y_1-Y_3, measure the steps of the collaborative governance logic model. Testing of multiple linkages from inputs, processes, and intermediate outputs and outcomes, reduces confounding influences by directly linking individual steps (i.e. inputs to processes, processes to outputs, outputs, to outcomes).

The first component of the collaborative governance model is inputs. Inputs are defined as the resources used in collaborative governance and include the elements or characteristics of the collaborative partnership (e.g. group structure, commitment, and communication). The relationship between the elements of watershed partnerships and their capacity to achieve environmental improvement goals was tested in this study based on the logic model with dependent variables representing outputs and intermediate outcomes steps. The collaborative governance elements are represented by the nine explanatory variables described in the previous section.

The second component of the collaborative governance model is processes. Processes include the activities of the collaborative governance (Thomas and Koontz, 2011). The ladder of collaborative governance describes a typology of processes through which partnerships develop in response to increasing inputs. For example, the organized cooperation process includes structuring activities in the formation of the watershed partnership; whereas, systematic coordination involves planning activities and synergistic consensus involves implementation activities. The relationship between the type of collaborative governance process and the outputs produced was tested using the collaborative governance ladder score, described later in this section.

Intermediate outputs are the third component of the logic model and include the early products or services resulting from the process (Thomas and Koontz, 2011). For example, an intermediate output of collaborative governance could be an action plan (e.g. watershed-based plan) with clear goals. Defining the goals of the watershed project focuses the activities and increases the capacity of the partnership (Weitman, 2011). Outputs are represented by the dependent variables, specific goals for pollutant reductions (Y_2) and broad goals to evaluate BMP effectiveness (Y_3).

The fourth component in the collaborative governance logic model is end outputs. End outputs are defined as subsequent products and services delivered from a process (Thomas and Koontz, 2011). An example of an end output would be implemented project goals by the partnership (i.e. did the partnership implement their stated water quality goals?). The longitudinal design of the program provided the opportunity for partnership members to be included throughout the entire collaborative process from planning through measuring performance of implemented plans.

Intermediate outcomes are the fifth component in the logic model. Thomas and Koontz (2011) define these outcomes as conditions outside a process that precede the desired end result. An example of an intermediate outcome is the effectiveness of the BMP that the collaborative partnership chose to implement. Further monitoring of waterbody conditions is required to determine whether the chosen BMP in fact improved water quality. However, this intermediate outcome indicates a preceding condition of the intended result by assessing whether or not the collaborative implemented a solution that solved a problem in similar conditions.

The final component of the collaborative governance logic model is end outcomes, or the end results. Using watershed partnerships as an example, the end outcome would be improvement in water quality and aquatic conditions of the waterbody. The end environmental outcome used in this study is dependent variable, achievement of stated goals for water quality improvements (Y_1).

Control variables are those extraneous to the collaborative governance logic model. Non-programmatic variables were represented by the control measures used the regression models to address confounding influences exerted by socioeconomic and physical conditions. For example, the size of the watershed, percentage annual rainfall control for differences in the physical conditions of the watershed projects and participants' gender and occupation control for differences in socioeconomic statuses of the survey respondents.

The interrelated components of the collaborative governance logic model are examined in this study to better understand the complex relationships between inputs, processes, outputs, and resulting end outcomes of collaborative governance. The logic model described above serves as an effective model for assessing the capacity of partnerships to achieve environmental outcomes.

Regressions were run testing the relationships between collaborative governance elements (inputs) and logic model components, intermediate outputs (Y_2 and Y_3), and outcomes (Y_1). Therefore, in order to complete the assessment of linkages, specifically between the ladder of collaborative governance processes and the next step in the logic model, intermediate outputs, a ladder classification score was devised.

4.5.2 The Ladder of Collaborative Governance Processes Classification Score

To assess the linkages between collaborative governance processes and the partnership's capacity to achieve water quality goals, an inductive scale was devised to score each of the 26 partnerships. The scale measured the collective effect of all three elements, group structure, commitment, and communication, in terms of their process using the explanatory variables. First, the component indices within each element (e.g.

clear mission within group structure) were summed to create an aggregate score for each of the three elements. These scores were then summed to create a total, combined score for each of the 26 partnerships, classifying them as type of process on the ladder of collaborative governance (Table 9) based on the overall composition of the three elements and their components. The total possible score was 130, representing the top rung of the ladder of collaborative governance, whereby respondents answered "strongly agreed" for all nine explanatory variables. This total score was divided into thirds and collaborative governance process scores ranging from 0-43 were coded "organized cooperation", "systematic coordination" for scores ranging from 44-87, and "synergistic consensus" for scores ranging from 88-130. On average, the 77% of partnerships fell within the range of the highest ladder rung, synergistic consensus (Table 10).

Table 9. Ladder of Collaborative Governance Score

Element	Mean	Minimum	Maximum
Group Structure	31	17	40
Commitment	34	12	50
Communication	26	19	40
Organized Cooperation	---	0	43
Systematic Coordination	---	44	87
Synergistic Consensus	---	88	130

Table 10. Classification of Partnerships as Processes on Ladder of Collaborative Governance

Watershed Partnership	Ladder of Collaborative Governance Score	Type of Collaborative Governance Process
Bad River	76	*Systematic Coordination*
Eastern Snake River Plain	86	*Systematic Coordination*
Stroud Preserve	85	*Systematic Coordination*
Totten & Eld Inlet	59	*Systematic Coordination*
Upper Grande Ronde	66	*Systematic Coordination*
Waukegan River	84	*Systematic Coordination*
Corsica River	106	*Synergistic Consensus*
Eagle River	95	*Synergistic Consensus*
Elm Creek	93	*Synergistic Consensus*
Jordon Cove	93	*Synergistic Consensus*
Lake Champlain Basin	93	*Synergistic Consensus*
Lake Pittsfield	91	*Synergistic Consensus*
Lightwood Knot Creek	95	*Synergistic Consensus*
Long Creek	102	*Synergistic Consensus*
Morro Bay	97	*Synergistic Consensus*
New York City Watershed	97	*Synergistic Consensus*
Oak Creek Canyon	97	*Synergistic Consensus*
Otter Creek	101	*Synergistic Consensus*
Peacheater Creek	89	*Synergistic Consensus*
Pequea & Mill Creeks	91	*Synergistic Consensus*
Sny Magill	88	*Synergistic Consensus*
Swatara Creek	106	*Synergistic Consensus*
Sycamore Creek	94	*Synergistic Consensus*
Walnut Creek	93	*Synergistic Consensus*
Warner Creek	89	*Synergistic Consensus*
Whitewater River	96	*Synergistic Consensus*

4.6 Challenges to Empirical Design

4.6.1 Poor data management

The ability to include the raw water quality monitoring data as a continuous dependent variable was not possible because of issues of data availability and accessability due to poor data management. Poor data management is a common problem in water quality monitoring programs, whereby raw data values are not entered into a common database for public use. Depending on the type of database used, data entry may be on the burden of one person, which reduces the accessibility of that data.

A software package, The Nonpoint Source Management System (NPSMS), was designed specifically for the National Monitoring Program in order to track and report land management and water quality information. However, data entry into this management system was not strictly enforced, and as a result, data for several projects were not entered. In addition, references were made in project annual reports to data being housed in EPA's Storage and Retrieval (STORET) Data Warehouse. However, when I searched for this database, no entries were found. Anecdotal explanation given by NNPSMP participants for failure to enter data in STORET cited confusion during the modernization of STORET database. As the database was being updated into a modernized version, confusion and frustration in learning a new entry system resulted in a complete failure of data entry. After three months searching for water quality monitoring data, continuous water quality data was retrieved for only 18 out of 40 waterbodies. In response to this data management issue, the previously described alternative dependent variable, Y_1 was created.

4.6.2 Missing Data

An unfortunate issue with survey data collection techniques is the inevitability of skipped questions resulting in missing values for one or more variables. These missing values (6% of variables tested) are especially problematic in longitudinal models as all waterbodies with at least one missing value are deleted from the estimations. The statistical package used in the data analysis of this study, STATA, deletes cases with missing values by default. The result is a loss of a lot of information, therefore affecting the ability to evaluate empirical relationships.

To estimate missing observations to allow all 40 watersbodies within our sample to be included in the analysis, a remedial procedure was used to replace missing values with group means obtained from the available data (Hutcheson and Sofroniou, 1999). This procedure may produce a bias in the parameter estimates. To test whether a bias was produced that affected the estimates, the analysis was repeated with and without the estimated missing values and similar results were obtained.

4.6.3 Small Sample Size

A smaller sample size may be a constraint in evaluating the relationships of interest in this study. If the sample size is too small, the estimates of the parameters are unstable, resulting in large standard errors and nonsignificant z tests. However, the robustness in consistent results reduces this concern, and the finding of statistically significant relationships offers additional evidence regarding the strength of the relationship between the variables of interest (Darnall, et al., 2009).

4.6.4 *Multicollinearity*

The presence of multicollinearlity, which is caused by strong interrelationships amongst explanatory variables, commonly occurs when computing generalized linear models (Hutcheson and Sofroniou, 1999). High multicollinearity can cause problems in data analyzation as it affects the reliability of the regression parameters, making it difficult to accurately interpret the results. A common method used to address issues of multicollinearity is to collapse variables that appear to be indicators of the same underlying concept in a single aggregate or index variable (Hutcheson and Sofroniou, 1999). This aggregation technique reduces the level of multicollinearity, enabling generalized linear models to be more successfully applied to the data (Hutcheson and Sofroniou, 1999). Factor analysis is a well-established technique used in the creation of index variables (Berman, 2007). Using correlations among measurement variables, the factor analysis identified subgroups or factors that accounted for the majority of the variance in the data. Principal component analysis (PCA) identified the common factors using a varimax rotation, which caused the variables to load higher on one factor, and less on others, enabling a pattern of groups to come into focus for purposes of interpretation (Berman, 2007). While a useful technique or explaining trends in observed variables, factor analysis was not appropriate for this study. Hutcheson and Sofroniou (1999) recommend at least 150 - 300 observations for a factor analysis and this study's data had less than 100 observations. In addition, correlation coefficients between explanatory variables in this analysis were small (less than 0.5), resulting in a low level of muticolinearity. For these reasons, a factor analysis was deemed inappropriate.

Table 7 describes the correlation among the latent, explanatory variables. The highest correlation was 0.54 for variables role congruence and human resources. This is a plausible correlation, as one would expect respondents to agree with their role in responsibilities within the partnership, particularly when based on the knowledge and expertise they provided. Still, this correlation is less than Kennedy's (2003) recommended maximum threshold of .80. The variance inflation factor (VIF) for each variable was computed. By the common rule of thumb, the VIF greater than 4.0 indicates a multicollinearity problem (Kennedy, 2003). Variance inflation factors (VIFs) were below 2.0, well below the recommended maximum threshold of 10 (Table 11), indicating that multicollinearity between non-interacted independent variables in not a concern (Kennedy, 2003).

Table 11. Correlation matrix for explanatory variables.

	1	2	3	4	5	6	7	8	9
1 Clear Mission	1.00								
2 Role Congruence	.28	1.00							
3 Knowledge capabilities	.31	.36	1.00						
4 Participation	.21	.43	.26	1.00					
5 Human Resources	.35	.54	.42	.34	1.00				
6 Sufficient Resources	.46	.38	.17	.41	.39	1.00			
7 Documentation	.15	.03	.21	.07	.11	.36	1.00		
8 Mode	.08	.24	.26	.20	.23	.06	.07	1.00	
9 Frequency	-.42	-.17	-.15	.19	-.18	-.28	-.49	-.36	1.00
Mean	11.00	11.90	7.76	6.33	13.38	14.56	10.33	1.54	14
Std. Dev.	3.80	2.11	1.50	3.12	3.67	2.94	2.69	1.48	2.63
VIF	1.73	1.68	1.48	1.40	1.66	1.87	1.68	1.34	1.95

4.7 Empirics

Full and reduced models were run to test relationships between each dependent variable and explanatory variables (see Table 12). The full models examine the relationship between all of the components for each element to evaluate their importance when combined. For example, the three components of the element group structure are clear mission, role congruence, and knowledge capabilities. These components were estimated simultaneously along with the control variables to test collective effect of these explanatory variables on the dependent variable. The reduced models examine the relationship between each component on its own along with control variables to assess the individual effect of that component on the dependent variable.

Table 12. Empirical Models- Full and Reduced.

Full Models	Reduced Models
Collaborative Governance Elements	**Characteristics of Collaborative Governance Elements**
Model 1: ***Group Structure***	
• Variable 1: Clear Mission	**Model 4** • Variable 1: Clear Mission
• Variable 2: Role Congruence	**Model 5** • Variable 2: Role Congruence
• Variable 3: Knowledge Capabilities	**Model 6** • Variable 3: Knowledge Capabilities
Model 2: ***Commitment***	
• Variable 4: Participation	**Model 7** • Variable 4: Participation
• Variable 5: Human Resources	**Model 8** • Variable 5: Human Resources
• Variable 6: Sufficient Resources	**Model 9** • Variable 6: Sufficient Resources
Model 3: ***Communication***	

• Variable 7: Documentation	**Model 10** • Variable 7: Documentation
• Variable 8: Mode	**Model 11** • Variable 8: Mode
• Variable 9: Frequency	**Model 12** • Variable 9: Frequency

The full and reduced models listed in Table 12 examined the relationship between explanatory variables and the dependent variable, achievement of stated goals for water quality improvement (Y_1) using linear regression, hierarchical linear model (HLM), and ordered logistical regression. Full and reduced models examined the relationship between explanatory variables and the dependent variables, Y_2 through Y_4 using linear regression and logistical regression.

4.7.1 Linear Regression Model

The linear regression model is a useful model for providing an easily understandable measure of the unique effect explanatory variables have on the dependent variable while controlling for other terms in the model. The ordinal nature of dependent variable, Y_1, violates the assumptions of the linear regression model that distances between categories are equal. The distance between categories of achieving water quality goals (all, some, none, and the reverse outcomes of goals) are not equal distance from eachother, which may lead to incorrect conclusions. The binary nature of dependent variables, Y_1-Y_2, does not conform to the assumptions of a linear model. However, this model was included in my analysis for reasons of parsimony. The robustness of findings from this model was checked using a logistic regression model. Despite these incompatibilities, linear regression models have modeled many phenomena providing a starting point for relating a group of variables, in the absence of quantitative theory (Hutcheson and Sofroniou, 1999). Robustness checks of the linear model findings were conducted using more advanced regression models. This included hierarchical linear model and ordered logistical model where similar results were found, validating the linear model findings.

The model fit is estimated by a single explanatory variable, R-squared statistic, which provides an indication of how well the model fits the data. In the simple linear regression, R-squared acts as a coefficient of determination on the strength of the linear relationship between the explanatory and dependent variables (Hutcheson and Sofroniou, 1999). Model significance is measured by F statistic, indicating how likely the R-squared value was obtained by chance (Hutcheson and Sofroniou, 1999). The F statistic tests the hypothesis that the regression coefficient, β, equals zero. If the F statistic is significant, a linear relationship between explanatory and dependent variables exists and we reject the null. If the F statistic is not significant the null hypothesis that no linear relationship between explanatory and dependent variables exists is accepted (Hutcheson and Sofroniou, 1999).

4.7.2 Hierarchical Linear Model and Hierarchical Logistic Model

Hierarchical linear modeling (HLM) is a multilevel model designed to take into account hierarchical structured and nested data (Willms, 1999; Albright and Marinova, 2010). Thus, this model is appropriate for ordinal, hierarchical data whereby respondents (n=72) are nested by waterbodies (n=40) and most robust model for assessing Y_1.

However, unlike traditional regression approaches, which assumes observations are independent and not in any way systematically related to observations of any other individual, HLM is able to explicitly examine the effects on water quality of various social and policy relevant variables (i.e. communication, and availability of resources). Social and political scientists utilize mixed models, such as HLM, due to their ability to recognize hierarchical structured data that violates standard linear regression assumptions (Albright and Marinova, 2010).

The underlying concept of the HLM is to conduct two separate analyses per unit of analysis in hierarchical structures (Willms, 1999). The hierarchical linear model has two levels: project (watershed) and individual (waterbody). In the first step, analyses are conducted separately for each project-level using watershed-level data. In the second step, the regression parameters from the first step of the analyses are regressed at the individual-level. The hierarchical nature of this model addresses the inherent duplicity of the data set as survey participants answered questions on a project-level. Their responses were duplicated at the waterbody-level which was the unit of analysis for this study.

The HLM was also used to examine the degree of consistency among people assessing the same phenomena. For example, respondents answering questions regarding the success of the watershed partnership to achieve water quality goals included responses from administrators and multiple levels of government and academics with varying expertise. The modeling revealed whether responses were consistent. This replaces the need for averaging respondents (n=72) answers per waterbody (n=40), through which data is lost and the sample size is reduced.

The log-likelihood statistic estimates model fit for the HLM model, providing a measure of variance (Hutcheson and Sofroniou, 1999). It corresponds to the value of log likelihood at convergence and is always represented as a negative value because the likelihood is between 0 and 1 (Long and Freese, 2006). In interpreting the log-likelihood statistic, the smaller the value, the better model fit. Using logit (p), (i.e. log of odds) linear parameters are estimated from the data. Relationships between the variables are measured using a regression analysis transforming the S-shaped distribution into a linear one (Hutcheson and Sofroniou, 1999). Regression coefficient, β, estimates the change in logit (p) resulting from a unit change or the change in log odds of an event happening for a unit change in the explanatory variable. Model significance is measured by the Wald Chi-squared statistic, which tests the hypothesis that the regression coefficient for explanatory variables equals zero and thus has no effect on the dependent variable. Significance in the Wald chi^2 statistic, suggests that the explanatory variables has a significant effect on the dependent variable and we reject the null. If significance is not found, the null hypothesis is accepted that no relationship between explanatory and dependent variables exists. The number in parenthesis refers to the degrees of freedom.

4.7.3 Ordered Logistic Regression

Ordered logistic regression is an extension of binary logistic regression that is particularly appropriate for ordered outcome variables (Ashby, et al., 1989) and therefore a good fit for my Y1 dependent variable. I applied the same structure as the HLM, specifying project and individual levels. While statistically significant results were found to be consistent with HLM model, my small sample size makes strong inferences difficult. Specifically, in the case of the ordered logistical regression model, a larger sample size would be preferred. A general rule of thumb is to have no more than 20% of cells with expected frequencies of less than 5 and no cell should have an expected frequency of less than 1, if there is more than 1 degree-of-freedom (Hutcheson and Sofroniou, 1999). It is recommended that populations include at least 10 cases per variable for regression methods (Hutcheson and Sofroniou, 1999).

Ordered logistic regression assumes scales are based on quantitative value. The categorical nature of the dependent variable was based on a qualitative assessment on the ability of the watershed partnership to meet achieved goals. Thus, a score of “four” implies that the partnership achieved all of their stated goals and not that they were four times as successful as those earning a score of “one.” This inconsistency in the relationship of the dependent variable scale and the resulting outcome may be misinterpreted due to an inflated or deflated standard error.

Model significance is measured using the likelihood ratio, LR chi^2, tests estimated coefficients in nested models (Long and Freese, 2006). Significance in the LR Chi-squared statistic, suggests that the explanatory variables has a significant effect on the dependent variable and we reject the null. If significance is not found, the null hypothesis is accepted that all coefficients associated with the explanatory variable are simultaneously equal to zero (Long and Freese, 2006).

4.7.4 Logistic Regression Model

Logistic regression is a nonlinear model that uses binary dependent variables and uses a form of maximum likihood estimation (log of odds) that selects parameters that make observed results most likely for a response variable with binomial errors (not normally distributed errors) (Hutcheson and Sofroniou, 1999). Regression models for binary outcomes explore how each explanatory variable affects the probability for the event occurring (Long, 2006). Therefore, this model was a good fit for testing the relationships between the binary dependent variables, Y2-Y3, and the explanatory variables. Values of the dependent variable are typically coded as 0 for negative outcome and 1 as positive outcome.

The log-likelihood statistic estimates model fit for logistic regression, providing a measure of deviance (Hutcheson and Sofroniou, 1999). It corresponds to the value of log likelihood at convergence and is always represented as a negative value because the likelihood is between 0 and 1 (Long and Freese, 2006). In interpreting the log-likelihood statistic, the smaller the value, the better model fit. Using logit (p), i.e. log of odds, linear parameters are estimated from the data and relationships between the variables are measured using a regression analysis transforming the S-shaped distribution into a linear one (Hutcheson and Sofroniou, 1999). Regression coefficient, β, estimates the change in logit(p) resulting from a unit change or the change in log odds of an event happening for a unit change in the explanatory variable. Model significance is measured using the likelihood ratio, LR chi^2, tests estimated coefficients in nested models (Long and Freese, 2006). Significance in the LR chi^2 statistic, suggests that the explanatory variables has a significant effect on the dependent variable and we reject the null. If significance is not found, the null hypothesis that all coefficients associated with the explanatory variable are simultaneously equal to zero is accepted. The number in the parentheses refers to the number of coefficients being tested (Long and Freese, 2006).

4.7.5 Path Analysis

The previously described regression models, linear and logistic, are useful for examining direct relationships between independent and dependent variables. All share a common format:

Dependent Variable = Independent variable$_1$ + Independent Variable$_2$ + Independent Variable$_{3.}$ However, in reality the relationships between the variables of interest are likely to be more complex and "web-like." To better understand the inter-relationships between dependent variables as they relate to the collaborative governance logic model, a path analysis was conducted. Specifically, this analysis examined the relationships between processes performed in collaborative governance ladder, corresponding intermediate outputs and their affect on partnerships' capacity to achieve end environmental outcomes. As explained in section 3.6.3, the small sample size of the NNPSMP data set prohibited a full path analysis of the nine explanatory variables that are included in the regression models. Therefore, an aggregated score for explanatory variables, the ladder classification score, was utilized. Klein (1998) recommends a minimum of 10 cases for every parameter estimated. The path analysis included in this study consisted of eight estimated parameters, which would require a sample size of 80 observations. While this study's sample size of 72 observations is just shy of the minimum requirement, significance was indicated for several path estimations. Therefore, the results are interpreted with confidence.

This "web" of relationships could not be easily modeled with standard regression techniques, requiring the use of structural equation modeling (SEM), which allows one to explore such complex interrelationships. Path analysis, also known as causal modeling, is a form of structural equation modeling (SEM) and refers to the analysis of causal models when single indicators are employed for each of the variables in the model (Pedhazur and Schmelkin, 1991). In SEM, the terms independent and dependent variables are abandoned, and instead variables are referred to as “exogenous” or “endogenous.” Endogenous variables are those modeled as dependent on other variables, while exogenous are not dependent on other variables (Pedhazur and Schmelkin, 1991). Put more simply, variables with arrows solely going away from them are exogenous, those with any pointed toward it are endogenous. Path analysis generated in Stata is based on an ordinary least squares regression. Beta, β, refers to the expected change in dependent variables per standard deviation increase in predictor variables and represents the standardized regression or “path” coefficients. In SEM modeling, one explicitly models the uncertainty in the model. Each endogenous term also has an error or "disturbance" term. This disturbance term represents not only the uncertainty or inaccuracy of the measurement, but also represents all the unknown variables not measured in this particular model. Errors are computed as $(1 - R^2)$.

The findings of the path analysis provide a more holistic view of the relationships between the variables of interest, allowing inferences to be drawn about the indirect and direct relationships with dependent variables. In other words, the path analysis represents an aggregate model that helps tie together the story of collaborative governance.

CHAPTER 5: RESULTS AND FINDINGS

5.1 Predicting the Capacity of Watershed Partnerships to Achieve their Environmental Improvement Goals

The capacity of watershed partnerships to achieve their environmental improvement goals was tested using four dependent variables and the ladder classification score. Each dependent variable represents a step in the collaborative governance logic model towards the end goal of improved environmental outcomes. The ladder classification score represents the type of collaborative governance processes based on the composition of elements. The regression results for full and reduced models were run for each dependent variable to test the relationship with explanatory variables. A full model was also run testing the ladder's relationship with the three dependent variables to assess linkages between the steps of the logic model.

5.2 Predicting the Association: Elements of Collaborative Governance and Capacity of Watershed Partnerships to Achieve their Environmental Improvement Goals: *Relationship between Inputs and End Outcomes in Collaborative Governance Logic Model*

5.2.1 Group Structure

To test hypotheses 1 of whether or not the greater the degree of group structure leads to an increased capacity in watershed partnership to achieve their environmental improvement goal, I began by testing the components of group structure in reduced models to assess their individual effects on partnership's capacity. I then ran a full model including all components of the element to test their collective effect and assess the *degree* of group structure.

Table 13. Reduced model testing the individual effect of clear mission on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Clear Mission	.046**	.023	.046*	.027	.161**	.079
Residence in Watershed	.071*	.037	.071	.061	2.97***	1.07
Education	-.252	.184	-.252	.181	-1.47**	.611
Gender	1.17***	.297	1.17***	.279	3.66***	.930
Watershed acreage	8.39e-07***	1.84e-07	8.39e-07***	2.94e-07	2.56e-06**	1.12e-06
Annual rainfall	.046***	.010	.046***	.008	.124***	.031
Landuse_ag[t]	-.069	.216	-.069	.120	-.290	.586
Occupation_gov't[tt]	-.350*	.188	-.350**	.181	-1.02*	.537
Project age	-.078**	.035	-.078**	.035	-.206**	.105
Soil erodibility	-.228	.139	-.228	.148		
F (12, 59)	7.37***					
R-squared	.461					
Root MSE	.703					
Wald Chi2 (10)			52.21***			
Pseudo R-squared					.271	
LR chi2(10)					47.75***	
Log restricted Likelihood			-102.29		-64.084	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the group structure component, clear mission, indicate a significant, positive relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .461 with an F statistic of 7.37 indicate a goodness of fit and significance in the model. The Wald chi^2 of 52.21 and LR chi^2 of 47.75 with p-values of less than .01 further indicate goodness of fit and significance in the model.

These findings support the theoretical identification of a clear mission is related to a watershed partnership's capacity to achieve their environmental improvement goals. The existence of a clear, well-supported mission enables the partnership to function as a unit, increasing the capacity of collaborative partnerships in the achievement of environmental improvement goals. Specifically, a clear mission statement outlining the common goals of the partnership is related to their capacity to achieve water quality goals.

Table 14. Reduced model testing the individual effect of role congruence on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Role Congruence	.004	.038	.004	.043	.006	.127
Residence in Watershed	.071**	.036	.071	.063	2.64**	1.05
Gender	1.27***	.320	1.27***	.282	3.84***	.941
Education	-.196	.186	-.196	.185	-1.18	.586
Watershed acreage	7.03e-07***	2.12e-07	7.03e-07**	3.00e-07	2.05e-06*	1.09e-06
Annual rainfall	.042***	.010	.042***	.008	.105***	.029
Landuse_ag	-.074	.214	-.074	.204	-.329	.571

Occupation_gov't	-.281	.186	-.281	.181	-.702	.509
Project age	-.081**	.033	-.081**	.036	-.207**	.101
Soil erodibility	-.324**	.133	-.324**	.142	-1.26***	.442
F (9, 62)	7.47***					
R-squared	.435					
Root MSE	.720					
Pseudo R-Squared					.246	
LR chi2					43.34***	
Wald Chi2			47.03***			
Log restricted Likelihood			-103.27		-66.29	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the group structure component, role congruence, indicate no statistically significant relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .435 with a p-value of less than .01 indicate a goodness of fit and significance in the model. The Wald chi^2 of 52.21 and LR chi^2 of 47.75 with p-values of less than .01 further indicate goodness of fit and significance in hierarchical linear and ordered logistic models. However, regression coefficients expressed by all three regression models indicate that the explanatory variable, role congruence, is not related statistically with partnerships' capacity to achieve their environmental improvement goals.

These findings imply that role congruence does not have significant impact on the capacity of a watershed partnership to achieve their environmental improvement goals.

Responses of participants in this population indicate that individual's acceptance of their role in the partnership did not have a significant effect on the partnership's capacity to achieve their environmental improvement goals. Specifically, agreement with the responsibilities assigned and acceptance of partnership role is not statistically related to partnership's capacity to achieve their water quality goals.

Table 15. Reduced model testing the individual effect of knowledge capabilities on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
Knowledge Capabilities	.024	.067	.024	.065	.058	.185
Residence in Watershed	.072**	.036	.071	.062	2.64**	1.04
Gender	1.26***	.303	1.26***	.280	3.81***	.934
Education	-.198	.182	-.198	.182	-1.17**	.575
Watershed acreage	7.34e-07***	2.00e-07	7.34e-07**	3.06e-07	2.13e-06*	1.11e-06
Annual rainfall	.043***	.010	.043***	.009	.107***	.029
Landuse_ag	-.067	.218	-.067	.204	-.307	.572
Occupation_gov't	-.292	.192	-.292	.183	-.737	.521
Project age	-.081**	.033	-.081**	.036	-.208**	.101
Soil erodibility	-.310**	.134	-.310**	.146	-1.22***	.456
F (9, 62)	7.64***					
R-squared	.437***					
Root MSE	.719					
Adjusted R-Squared						
Wald Chi2			47.27***			
Pseudo R-squared					.247	
LR chi2(12)					43.43***	
Log restricted			-102.8		-66.24	

Likelihood						

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the variable, knowledge capabilities, indicate no statistically significant relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .437 with a p-value of less than .01 indicate a goodness of fit and significance in the model. The Wald chi^2 of 47.27 and LR chi^2 of 43.43 with p-values of less than .01 further indicate goodness of fit and significance in the model. However, regression coefficients expressed by all three regression models indicate that the explanatory variable, knowledge capabilities, is not related statistically with partnerships' capacity to achieve their environmental improvement goals.

These findings imply that knowledge capabilities does not have a significant impact on the capacity of a watershed partnership to achieve their environmental improvement goals.. Responses of participants in this population indicate that information sharing between partnership member and outside scientific panels is not related statistically with partnership's capacity to achieve their environmental improvement goals.

Table 16. Full model testing collective effect of all group structure components on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Std. Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Clear Mission	.172***	.021	.040	.026	.149*	.080
Role Congruence	-.090	.038	-.038	.043	-.071	.137
Knowledge Capabilities	.083	.064	.050	.064	.134	.202
Residence in Watershed	.054	.033	.033	.059	2.93***	1.12
Gender	288**	.317	.680**	.310	2.60***	.978
Education	-.055	.180	-.098	.181	-1.07*	.631
Watershed acreage	163*	2.50e-07	4.29e-07	3.26e-07	1.58e-06	1.25e-06
Annual rainfall	.593***	.010	.041***	.008	.118***	.031
Landuse_ag	0152	.204	.276	.220	.480	.660
Occupation_gov't	-.207*	.189	-.368**	.175	-1.17**	.566
Partnership age	-.077	.037	-.026	.037	-.053	.115
Soil erodibility	-.256**	.131	-.318**	.149	-1.37**	.531
TMDL	.403***	.206	.716***	.233	2.17***	.752
F (13, 58)	12.01***					
R-squared	.538					
Root MSE	.668					
Wald Chi2(13)			67.49***			
Pseudo R-squared					.322	
LR chi2(13)					56.71***	
Log restricted Likelihood			-102.31			

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the full model, which tests the collective effect of all three components of group structure simultaneously, indicate a significant, positive relationship between the component, clear mission and watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression models. Linear regression's R^2 of .538 with an F statistic of 12.01indicate a goodness of fit and significance in the model. The Wald chi^2 of 67.49 and LR chi^2 of 56.71 with p-values of less than .01 further indicate goodness of fit and significance in the model.

Regression coefficients expressed by all three regression models indicate that the explanatory variables, role congruence and knowledge capabilities are not related to partnerships' capacity to achieve their environmental improvement goals, holding all other variables constant.

Combined, these findings offer some support to hypothesis 1 that states that a greater degree of group structure, the greater degree the capacity of watershed partnerships to achieve their environmental improvement goals. The collective effect measured in the full model indicates that having a clear mission statement outlining the partnership's objectives for achieving their common goal is related to the capacity of the partnership to achieve their stated water quality goals.

5.2.2 Commitment

To test hypotheses 2 of whether or not the greater the degree of commitment leads to an increased capacity in watershed partnership to achieve their environmental improvement goal, I began by testing the components of commitment in reduced models to assess their individual effects on partnership's capacity. I then ran a full model including all components of the element to test their collective effect and assess the *degree* of commitment.

Table 17. Reduced model testing the individual effect of participation on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Participation	.041	.028	.041	.030	.161*	.088
Residence in Watershed	.072**	.036	.072**	.062	3.02***	1.12
Education	-.197	.171	-.197	.179	-1.27**	.578
Gender	1.41***	.332	1.41***	.295	4.58***	1.05
Watershed acreage	7.74e-07***	1.82e-07	7.74e-07***	2.90e-07	2.39e-06**	1.14e-06
Annual rainfall	.043***	.010	.043***	.008	.114***	.030
Landuse_ag	-.098	.209	-.098	.201	-.459	.580
Occupation_gov't	-.305*	.181	-.305*	.179	-.825	.522
Project age	-.081**	.033	-.082**	.035	-.205**	.103
Soil erodibility	-.337**	.128	-.337**	.138	-1.41***	.458
F (9, 62)	8.05***					
R-squared	.453					
Root MSE	.709					
Wald Chi2			50.48***			
LR chi2(12)					46.80***	
Pseudo R-squared					.266	
Log restricted Likelihood			-103.34		-64.56	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, participation, indicate a weak, positive relationship with a watershed partnership's capacity to achieve their environmental improvement goals using logistic regression. Linear regression's R^2 of .435 with an F statistic of 8.15 and HLM Wald chi^2 statistic of 50.48 indicate a goodness of fit and significance in the model. However regression coefficients in both regression models indicate that participation had no statistically significant relationship with the dependent variable. Ordered logistic regression's test statistic $LRchi^2$ of 46.80 indicates goodness of fit and significance in the model and regression coefficient indicate that participation is related to commitment.

These findings support the theoretical identification of member participation as having a significant impact on the capacity of a watershed partnership to achieve their environmental improvement goals. Sustained involvement throughout the lifecycle of the collaborative governance is related to the capacity of collaborative partnerships in their achievement of environmental improvement goals.

Table 18. Reduced model testing the individual effect of human resources on partnerships' capacity to achieve their environmental improvement goals

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Human Resources	.024	.019	.024	.027	.095	.074
Residence in Watershed	.070*	.037	.070	.062	2.84***	1.08
Education	-.196	.184	-.196	.180	-1.22**	.585
Gender	1.23***	.300	1.23***	.280	3.81***	.939
Watershed acreage	7.53e-07***	1.93e-07	7.53e-07**	2.94e-07	2.27e-06**	1.10e-06
Annual rainfall	.044***	.010	.044***	.009	.116***	.030
Landuse_ag	-.106	.218	-.106	.206	-.456	.582

Occupation_gov't	-.286	.184	-.286	.180	-.731	.516
Project age	-.078**	.034	-.078**	.036	-1.94*	.103
Soil erodibility	-.305**	.138	-.305**	.141	-1.26**	.450
F (9, 62)	7.92***					
R-squared	.443					
Root MSE	.715					
Wald Chi2			48.50***			
LR chi2(12)					45.00***	
Pseudo R-squared					.256	
Log restricted Likelihood			-103.34		-65.46	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, human resources, indicate no statistically significant relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .443with an F statistic of 7.92 indicate a goodness of fit and significance in the model. The Wald chi^2 of 48.50 and LR chi^2 of 45.00 further indicate goodness of fit and significance in the model. However, regression coefficients expressed by all three regression models indicate that the explanatory variable, human resources, is not related statistically with partnerships' capacity to achieve their environmental improvement goals.

These findings imply that human resources are related to the capacity of a watershed partnership to achieve their environmental improvement goals. Responses of participants in this population expertise, and local knowledge, and skills contributed by partnership members did not have a significant relationship with partnership's capacity to achieve their environmental improvement goals.

Table 19. Reduced model testing the individual effect of sufficient resources on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Sufficient Resources	.062**	.026	.062**	.031	.230**	.095
Residence in Watershed	.077**	.035	.077	.061	3.23***	1.17
Education	-.236	.161	-.236	.177	-1.42**	.584
Gender	1.18***	.294	1.18***	2.74	3.96***	.974
Watershed acreage	8.20e-07***	1.78e-07	8.20e-07***	2.87e-07	2.66e-06**	1.15e-06
Annual rainfall	.045***	.010	.045***	.008	.131***	.033
Landuse_ag	-.070	.213	-.070	.197	-.327	.587
Occupation_gov't	-.338*	.184	-.338*	.178	-.906*	.527
Project age	-.081**	.035	-.081**	.034	-.212**	.106
Soil erodibility	-.304**	.128	.304**	.136	-1.33***	.454
F (9, 62)	8.94***					
R-squared	.470					
Root MSE	.680					
Wald Chi2			54.01***			
LR chi2(12)					49.67***	
Pseudo R-squared					.282	
Log restricted Likelihood			-101.67		-63.12	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, sufficient resources, indicate a significant, positive relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .470 with an F statistic of 8.94 indicate a goodness of fit and significance in the model. The Wald chi^2 of 54.01 and LR chi^2 of 49.67 with p-values of less than .01 further indicate goodness of fit and significance in the model.

These findings support the theoretical argument that sufficient resources are related to the capacity of a watershed partnership to achieve their environmental improvement goals. The ability to acquire and sustain technical and financial resources is statistically related to partnership's capacity to achieve their environmental improvement goals.

Table 20. Full model testing collective effect of all Commitment components on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Std.Coefficient	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
Participation	.031	.036	.008	.034	.075	.113
Human Resources	.019	.024	.004	.028	.027	.088
Sufficient Resources	.183*	.029	.055	.034	.250**	.114
Residence in Watershed	.063	.032	.039	.059	3.40***	1.34
Education	-.063	.157	-.111	.172	-1.18*	.619

Gender	.325**	.354	.769**	.338	3.24***	1.13
Watershed acreage	.170**	2.12e-07	4.46e-07	3.03e-07	1.66e-06	1.30e-06
Annual rainfall	.589***	.009	.041***	.008	.135***	.034
Landuse_ag	.126	.196	.230	.216	-.356	.660
Occupation_gov't	-.190*	.178	-.339**	.169	-1.22**	.571
Project age	-.089	.034	-.030	.037	-.008	.120
Soil erodibility	-.316***	.119	-.392***	.135	-2.02***	.569
TMDL	.394***	.188	.699***	.225	2.65***	.812
F(13, 58)	14.79***					
R-squared	.547					
Root MSE	.661					
Wald Chi2 (13)			70.15***			
LR chi2(13)					62.21***	
Pseudo R-squared					.354	
Log restricted Likelihood			-102.63			

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the full model, which tests the collective effect of all three components of commitment simultaneously, indicate a positive relationship between the component, sufficient resources and watershed partnership's capacity to achieve their environmental improvement goals across all three linear, hierarchical, and logistic regression models. Linear regression's R^2 of .547 with an F statistic of 14.79 indicate a goodness of fit and significance in the model. The Wald chi^2 of 70.15 and LR chi^2 of 62.21 with p-values of less than .01 further indicate goodness of fit and significance in the model.

Regression coefficients expressed by all three regression models indicate that the explanatory variables, participation and human resources, had no statistically significant relationship with partnerships' capacity to achieve their environmental improvement goals, holding all other variables constant.

Combined, these findings offer support to hypothesis 2 that states that a greater degree of commitment, the greater degree the capacity of watershed partnerships to achieve their environmental improvement goals. The collective effect measured in the full model indicates that the component, sufficient resources, has a statistically significant relationship with partnerships' capacity to achieve their environmental improvement goals. Specifically, sufficient technical equipment to conduct monitoring and data analysis and sustained, flexible funding is related with partnerships' capacity to achieve their stated water quality goals.

5.2.3 Communication

To test hypotheses 3 of whether or not the greater the degree of communication leads to an increased capacity in watershed partnership to achieve their environmental improvement goal, I began by testing the components of communication in reduced models to assess their individual effects on partnership's capacity. I then ran a full model including all components of the element to test their collective effect and assess the *degree* of communication.

Table 21. Reduced model testing the individual effect of documentation on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error

Documentation	-.002	.033	-.002	.035	.071	.097
Residence in Watershed	.071*	.037	.071	.063	2.87**	1.11
Education	-.192	.181	-.192	.182	-1.24**	.587
Gender	1.27***	.270	.127***	.287	3.72***	.944
Watershed acreage	6.92e-07***	1.94e-07	6.92e-07**	2.95e-07	2.11e-06**	1.06e-06
Annual rainfall	.042***	.010	.042***	.008	.106***	.029
Landuse_ag	-.073	.212	-.073	.204	-.306	.569
Occupation_gov't	-.281	.183	-.281	.182	-.727	.510
Project age	-.082**	.033	-.082**	.036	-.201**	.101
Soil erodibility	-.325**	.140	-.325**	.141	-1.33****	.456
F(9, 62)	7.24***					
R-squared	.435					
Root MSE	.720					
Wald Chi2			47.03***			
LR chi2(13)					43.88***	
Pseudo R-squared					.250	
Log restricted Likelihood			-103.48		-66.02	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, documentation, indicate no statistically significant relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .435with an F statistic of 7.24 indicate a goodness of fit and significance in the model. The Wald chi^2 of 47.03 and LR chi^2 of 43.88 with p-values of less than .01 further indicate goodness of fit and significance in the model. However, regression coefficients expressed by all three regression models indicate that the explanatory variable, documentation, is not related statistically with partnerships' capacity to achieve their environmental improvement goals.

These findings imply that documentation is not related to the capacity of a watershed partnership to achieve their environmental improvement goals. Responses of participants in this population indicated that formal documentation communicating the results of the collaborative governance process and outputs did not have a significant relationship with partnerships' capacity to achieve their environmental improvement goals. Specifically, the creation of in-house documents, written collectively by all members was not statistically related with partnerships' capacity to achieve their water quality goals.

Table 22. Reduced model testing the individual effect of all communication frequency on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
Frequency	-.010	.034	-.010	.035	-.117	.103
Residence in Watershed	.070*	.038	.07	.063	3.05***	1.13
Education	-.206	.191	-.206	.187	-1.41**	.624
Gender	1.27***	.310	1.27***	.280	3.94***	.934
Watershed acreage	7.16e-07***	2.00e-07	7.16e-07**	2.96e-07	2.19e-06**	1.07e-06
Annual rainfall	.042***	.010	.042***	.008	.110***	.029
Landuse_ag	-.077	.210	-.077	.204	-.359	.573
Occupation_gov't	-.289	.187	.289	.183	-.819	.522
Project age	-.083**	.034	-.083**	.036	-.220**	.102

Soil erodibility	-.327**	.137	-.327**	.140	-1.36***	.457
F(9, 62)	7.05***					
R-squared	.436					
Root MSE	.720					
Wald Chi2			47.17***			
LR chi2(13)					44.65***	
Pseudo R-squared					.254	
Log restricted Likelihood			-103.44		-65.63	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, frequency, indicate no statistically significant relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .436 with an F statistic of 7.05 indicate a goodness of fit and significance in the model. The Wald chi^2 of 47.17 and LR chi^2 of 44.65 with p-values of less than .01 further indicate goodness of fit and significance in the model. However, regression coefficients expressed by all three regression models indicate that the explanatory variable, frequency, is not related statistically with partnerships' capacity to achieve their environmental improvement goals.

These findings imply that frequency is not related to the capacity of a watershed partnership to achieve their environmental improvement goals. Responses of participants in this population indicated frequent communication between members did not have a significant relationship with partnerships' capacity to achieve their environmental improvement goals. Specifically, how often members communicated with eachother had no bearing on the partnership's capacity to achieve their water quality goals.

Table 23. Reduced model testing the individual effect of all communication mode on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
Mode	-.023	.067	-.227	.060	.009	.173
Residence in Watershed	.072**	.036	.072	.062	2.65**	1.05
Education	-.188	.186	-.188	.181	-1.17**	.583
Gender	1.26***	.301	1.26***	.280	3.84***	.933
Watershed acreage	6.75e-07***	2.02e-07	6.75e-07**	2.94e-07	2.04e-06*	1.08e-06
Annual rainfall	.042***	.010	.042***	.008	.105***	.028
Landuse_ag	-.069	.213	-.069	.204	-.329	.569
Occupation_gov't	-.276	.184	-.276	.181	-.705	.510
Project age	-.082**	.033	-.082**	.036	-.206**	.101
Soil erodibility	-.325**	.137	-.325**	.140	-1.26***	.441
F(9, 62)	7.26***					
R-squared	.437					
Root MSE	.719					
Wald Chi2			47.28***			
LR chi2(13)					43.34***	
Pseudo R-squared					.246	
Log restricted Likelihood			-102.88		-66.29	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced mode for the communication component, mode, indicate no statistically significant relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .437 with an F statistic of 7.26 indicate a goodness of fit and significance in the model. The Wald chi^2 of 47.28 and LR chi^2 of 43.34 with p-values of less than .01 further indicate goodness of fit and significance in the model. However, regression coefficients expressed by all three regression models indicate that the explanatory variable, mode, is not related statistically with partnerships' capacity to achieve their environmental improvement goals.

These findings imply that mode is not related to the capacity of a watershed partnership to achieve their environmental improvement goals. Responses of participants in this population indicated that their communication style was not statistically related with partnerships' capacity to achieve their environmental improvement goals. Specifically, whether or not members used direct or indirect modes of communication when interacting was not related with partnerships' capacity to achieve their water quality goals.

Table 24. Full model testing the collective effect of all communication components on partnerships' capacity to achieve their environmental improvement goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Std. Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Documentation	-.061	.041	-.020	.038	.009	.114
Frequency	-.075	.066	-.045	.061	-.079	.194

Mode	-.064	.036	-.022	.041	-.105	.119
Residence in Watershed	.059	.032	.036	.061	3.07**	1.23
Education	-.043	.187	-.076	.182	-1.05	.655
Gender	.359***	.296	.848***	.313	2.94***	.970
Watershed acreage	.100	2.39e-07	2.64e-07**	3.17e-07	1.08e-06	1.16e-06
Annual rainfall	.531***	.009	.037***	.008	.103***	.028
Landuse_ag	.129	.187	.235	.221	.361	.642
Occupation_gov't	-.156	.181	-.278	.174	-.907*	.540
Project age	-.106	.034	-.036	.038	-.064	.114
Soil erodibilty	-.331***	.126	-.411***	.136	-1.77***	.531
TMDL	.403***	.189	.715***	.233	2.17***	.741
F (13, 58)	12.69***					
R-squared	.518					
Root MSE	.682					
Wald Chi2(13)			62.32***			
LR chi2(13)					53.79***	
Pseudo R-squared					.306	
Log restricted Likelihood			-103.47		-61.06	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the full model, which tests the collective effect of all three components of communication simultaneously, indicate no statistically significant relationship with a watershed partnership's capacity to achieve their environmental improvement goals using linear, hierarchical, and logistic regression. Linear regression's R^2 of .518 with an F statistic of 12.69 indicate a goodness of fit and significance in the model. The Wald chi^2 of 62.32 and LR chi^2 of 53.79 with p-values of less than .01 further indicate goodness of fit and significance in the model. However, regression coefficients expressed by all three regression models indicate that none of the three explanatory variables, documentation, frequency, and mode, were related statistically with partnerships' capacity to achieve their environmental improvement goals, holding all other variables in the model constant.

Combined, these findings do not offer support to hypothesis 3 that states that a greater degree of communication, the greater degree the capacity of watershed partnerships to achieve their environmental improvement goals. The collective effect measured in the full model indicates that the element communication has no significant relationship with partnerships' capacity to achieve their environmental improvement goals.

5.3 Predicting the Association: Elements of Collaborative Governance and Type of Outputs Produced: *Relationship between Inputs and Outputs in Collaborative Governance Logic Model*

Linkages between logic model steps inputs and outputs were assessed using linear and logistic regression. The relationships between collaborative governance elements (inputs) and the dependent variables, partnership set specific goals for pollutant reductions (Y_2) and partnership set broad goals to evaluate BMP effectiveness (Y_3), were tested using full and reduced models.

5.3.1 Specific Goals for Pollutant Reductions

Group Structure

To assess the effect of the element, group structure, on partnerships' capacity to set specific goals for pollutant reductions, I first ran reduced models on each component to test their individual effect. Then I ran a full model on all group structure components combined, to test their collective effect on partnerships' capacity.

Table 25. Reduced model testing the individual effect of clear mission on partnerships capacity to set specific goals for pollutant reductions.

Index	**Simple Linear Model**		**Logistical Model**	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Clear Mission	.034**	.017	.270**	.121
Residence in Watershed	.021	.026	2.24*	1.23
Education	-.089	.133	-1.23	.967
Gender	.397**	.179	2.26**	1.15
Watershed acreage	3.63e-07***	8.48e-08	2.73e-06	2.45e-06
Annual rainfall	.006	.006	.027	.037
Landuse_ag	-.250**	.117	-1.46*	.842
Occupation_gov't	-.050	.111	-.248	.751
Project age	-.017	.019	-.073	.145
F (12, 59)	2.72***			
R-squared	.253			
Root MSE	.434			
LR chi2(12)			23.34**	
Psuedo R-Squared			.269	
Log restricted Likelihood			-31.79	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the group structure component, clear mission, indicate a significant, positive relationship with a watershed partnerships' capacity to set specific goals for pollutant reductions using linear and logistic regression.

Linear regression's R^2 of .253 with an F statistic of 2.72 indicate a goodness of fit and significance in the model. The LR chi^2 of 23.34 with p-values of less than .05 also indicate goodness of fit and significance in the model. Regression coefficients for both models indicate that clear mission is related statistically with partnerships' capacity to set specific goals for pollutant reductions.

Table 26. Reduced model testing the individual effect of role congruence on partnerships capacity to set specific goals for pollutant reductions.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Role Congruence	.029	.028	.258	.185
Residence in Watershed	.033*	.017	2.19*	1.31
Education	.009	.111	-1.17	.967
Gender	.384*	.198	2.75**	1.15
Watershed acreage	3.02e-07***	9.49e-08	2.25e-06	1.76 e-06
Annual rainfall	.009*	.005	.010	.034
Landuse_ag	-.197*	.116	-1.58*	.820
Occupation_gov't	-.032	.119	.453	.700
Project age	-.022	.021	-.024	.135
F (9, 62)	3.06***			
R-squared	.157			
Root MSE	.450			
LR chi2(12)			19.33*	
Psuedo R-Squared			.222	
Log restricted Likelihood			-33.80	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the group structure component, role congruence, indicate no statistically significant relationship with a watershed partnership's capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .157 with an F statistic of 3.06 indicate a goodness of fit and significance in the model. Logistic regression's $LRchi^2$ of 19.33 with a p-value of less than .10, also indicate a goodness of fit and significance in the model; however, regression coefficients generated by both regressions indicate that the explanatory variable, role congruence, is not related statistically with partnerships' capacity to set specific goals for pollutant reductions, holding all other variables in the model constant.

Table 27. Reduced model testing the individual effect of knowledge capabilities on partnerships capacity to set specific goals for pollutant reductions.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Knowledge Capabilities	.059	.040	.595**	.284
Residence in Watershed	.032*	.018	2.17*	1.28
Education	.019	.111	-1.04	.995
Gender	.359*	.185	2.69**	1.19
Watershed acreage	3.24e-07***	9.20e-08	2.80e-06	2.12e-06
Annual rainfall	.010**	.005	.023	.035
Landuse_ag	-.172	.121	-1.51*	.835
Occupation_gov't	-.069	.114	.217	.738
Project age	-.021	.021	-.032	.139
F (9, 62)	3.19***			
R-squared	.171			

Root MSE	.446			
LR chi2(12)			22.53**	
Psuedo R-Squared			.259	
Log restricted Likelihood			-32.20	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the group structure component, knowledge capabilities, indicate a positive relationship with a watershed partnership's capacity to set specific goals for pollutant reductions using logistic regression. Linear regression's R^2 of .171 with an F statistic of 3.19 indicate a goodness of fit and significance in the model; however, the regression coefficient generated indicates that no statistically significant relationship between knowledge capabilities and a partnership's capacity exists. Logistic regression's LR chi^2 of 22.53 with p-values of less than .05 also indicate goodness of fit and significance in the model and the regression coefficient generated did indicate that knowledge capabilities are related statistically to partnership's capacity to set specific goals for pollutant reductions.

Table 28. Full Model to test the collective effect of all group structure components on partnerships' capacity to set specific pollutant reduction goals.

Index	Simple Linear Model		Logistical Model		Hierarchical Logistic Model	
	Std. Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error

Clear Mission	.194	.017	.192*	.113	.094	.058
Role Congruence	.032	.031	.017	.1612	.035	.116
Knowledge Capabilities	.243*	.039	.561*	.341	.113	.120
Residence in Watershed	.103	.020	2.00*	1.14	.085	.111
Gender	.091	.260	.689	1.37	-.068	.498
Education	.032	.131	-.298	.835	.222	.418
Watershed acreage	.291**	1.60e-08	2.51e-06***	9.64e-06	2.78e-06***	7.39e-07
Annual rainfall	.311**	.005	.058**	.028	.011	.020
Landuse_ag	-.074	.138	-.372	.792	-.610	.559
Occupation_gov't	-.072	.115	-.490	.718	-.367	.365
Project age	.021	.027	.090	.214	.001	.091
Soil erodibility	.247*	.087	.885	.549	.596	.482
TMDL	.247	.168	1.39	1.09	-.026	.574
F (13,58)	3.80***					
R-squared	.263					
Root MSE	.435					
Wald chi2(13)			31.95***		25.99**	
Psuedo R-Squared			.268		.044	
Log restricted Likelihood			-31.81		-188.24	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The full model testing the collective effects of all three components of the element, group structure, indicate that no relationship exists with a watershed partnership's capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .263 with an F statistic of 3.80 indicate a goodness of fit and significance in the model and logistic regression's Wald chi^2 of 31.95 with p-values of less than .01 and hierarchical logistic models' Wald chi^2 25.99 with a p-value of less than .05 also indicate goodness of fit and significance in the model; however regression coefficients generated by both indicate that the explanatory variables clear mission, role congruence and knowledge capabilities, had no statistically significant relationships with partnership's capacity to set specific goals for pollutant reductions, holding all other variables in the model constant.

Commitment

To assess the effect of the element, commitment, on partnerships' capacity to set specific goals for pollutant reductions, I first ran reduced models on each component to test their individual effect. Then I ran a full model on all commitment components combined, to test their collective effect on partnerships' capacity.

Table 29. Reduced model testing the individual effect of participation on partnerships' capacity to set specific goals for pollutant reductions.

Index	**Simple Linear Model**		**Logistical Model**	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Participation	.029	.018	.194*	.112
Residence in Watershed	.036**	.017	2.19*	1.29
Education	.033	.108	-.205	.653
Gender	.450**	.192	2.66**	1.14
Watershed acreage	3.16e-07***	8.95e-08	2.02e-06	1.70e-06
Annual rainfall	.009*	.005	.038	.029
Landuse_ag	-.203*	.116	-1.22*	.721
Occupation_gov't	-.045	.115	-.135	.621
Project age	-.020	.020	-.062	.117
F (9, 62)	3.18***			
R-squared	.172			
Root MSE	.446			
LR chi2(9)			15.91*	
Psuedo R-Squared			.183	
Log restricted Likelihood			-35.51	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, participation, indicate a weak, positive relationship with a watershed partnership's capacity to set specific goals for pollutant reductions using logistic regression. Linear regression's R^2 of .172 with an F statistic of 3.18 indicate a goodness of fit and significance in the model; however, the regression coefficient generated indicates that no statistically significant relationship between participation and a partnership's capacity exists. Logistic regression's LR chi^2 of 15.91 with p-values of less than .10 also indicate goodness of fit and significance in the model and the regression coefficient did indicate a statistically significant relationship between participation and partnership's capacity to set specific goals for pollutant reductions.

Table 30. Reduced model testing the individual effect of human resources on partnerships' capacity to set specific goals for pollutant reductions.

Index	**Simple Linear Model**		**Logistical Model**	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Human Resources	.043**	.020	.287**	.112
Residence in Watershed	.030	.018	2.35*	1.28
Education	.028	.107	-.314	.685
Gender	.314*	.185	1.68*	1.01
Watershed acreage	3.31e-07***	9.11e-08	2.14e-06	1.68e-06
Annual rainfall	.012***	.004	.060*	.036
Landuse_ag	-.245**	.113	-1.62**	.825

Occupation_gov't	-.051	.112	-.114	.643
Project age	-.016	.020	-.047	.126
F (9, 62)	3.28***			
R-squared	.230			
Root MSE	.430			
LR chi2(9)			20.95**	
Psuedo R-Squared			.241	
Log restricted Likelihood			-32.99	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, human resources, indicate a significant, positive relationship with a watershed partnerships' capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .230 with an F statistic of 3.28 indicate a goodness of fit and significance in the model. The linear regression coefficient generated indicated that human resources was related statistically with partnerships' capacity to set specific goals for pollutant reductions, holding all other variables in the model constant. The LR chi^2 of 20.95 with p-values of less than .05 also indicate goodness of fit and significance in the model. The logistical regression coefficient generated also indicated a statistically significant relationship between human resources and partnerships' capacity to set specific goals for pollutant reductions.

Table 31. Reduced model testing the individual effect of sufficient resources on partnerships' capacity to set specific goals for pollutant reductions.

Index	Simple Linear	Logistical Model

	Model			
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Sufficient Resources	.056***	.017	.414**	.162
Residence in Watershed	.038**	.018	2.72**	1.32
Education	-.005	.098	-.414	.705
Gender	.293	.183	1.54	1.01
Watershed acreage	3.56e-07***	7.80e-08	2.54e-06	2.01e-06
Annual rainfall	.011**	.004	.059*	.035
Landuse_ag	-.184	.112	-1.16	.774
Occupation_gov't	-.088	.108	-.454	.678
Project age	-.021	.017	-.067	.139
F (9, 62)	7.56***			
R-squared	.247			
Root MSE	.425			
LR chi2(9)			22.77**	
Psuedo R-Squared			.262	
Log restricted Likelihood			-32.08	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, sufficient resources, indicate a significant, positive relationship with a watershed partnerships' capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .247 with an F statistic of 7.56 indicate a goodness of fit and significance in the model. The linear regression coefficient indicated that sufficient resources were related statistically with partnerships' capacity to set specific goals for pollutant reductions. The LR chi^2 of 22.77 with p-values of less than .05 also indicate goodness of fit and significance in the model. The logistic regression coefficient also indicated a statistically significant relationship between sufficient resources and partnerships' capacity to set specific goals for pollutant reductions, given all other variables are held constant.

Table 32. Full model testing the collective effect of all commitment components on partnerships capacity to set specific goals for pollutant reductions.

Index	Simple Linear Model		Logistical Model		Hierarchical Logistic Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Participation	-.132	.016	-.123	.137	-.050	.080
Human Resources	.320*	.023	.328	.250	.082	.058
Sufficient Resources	.349***	.018	.431**	.183	.227***	.083
Residence in Watershed	.108*	.018	3.05**	1.50	.098	.095
Education	.045	.102	-.229	.760	.170	.382
Gender	-.021	.233	-.109	1.14	-.262	.599
Watershed acreage	.263**	1.46e-07	2.62e-06*	1.46e-06	3.03e-06***	7.01e-07
Annual rainfall	.343***	.004	.084*	.049	.021	.020
Landuse_ag	-.136	.130	-1.07	1.04	-.740	.479
Occupation_gov't	-.053	.104	-.430	.686	-.403	.364
Project age	.040	.017	.162	.150	.002	.082
Soil erodibility	.180	.079	.375	.577	.478	.360
TMDL	.216*	.127	1.66*	.904	.042	.506
F (13, 58)	5.82***					
R-squared	.356					
Root MSE	.407					
Psuedo R-Squared			.372		.065	
Wald chi2(11)			25.32**		34.54***	
Log restricted Likelihood			-27.30		-184.23	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the full model testing the collective effect of all three components of the element commitment indicate positive relationships between human and sufficient resources and a watershed partnership's capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .356 with an F statistic of 5.82 indicate a goodness of fit and significance in the model. The linear regression coefficient indicated that human and sufficient resources were related statistically to partnerships' capacity to set specific goals for pollutant reductions, holding all other variables in the model constant. The Wald chi^2 of 25.32 and 34.54 with p-values of less than .05 and .01, respectively, also indicate goodness of fit and significance in the model. The logistic regression coefficient also indicated that a statistically significant relationship between human and sufficient resources and partnership's capacity to set specific goals for pollutant reduction existed. However sufficient resources is statistically more significant than human resources as evident by the larger regression coefficients across all three models.

Communication

To assess the effect of the element, communication, on partnerships' capacity to set specific goals for pollutant reductions, I first ran reduced models on each component to test their individual effect. Then I ran a full model on all communication components combined, to test their collective effect on partnerships' capacity.

Table 33. Reduced model testing the individual effect of documentation on partnerships' capacity to set specific goals for pollutant reductions.

Index	Simple Linear Model		Logistical Model	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Documentation	.057***	.016	.482**	.208
Residence in Watershed	.026	.021	3.06**	1.40
Education	.007	.106	-.724	.731
Gender	.238	.190	1.33	1.01
Watershed acreage	3.65e-07***	9.53e-08	2.29e-06*	1.31e-06
Annual rainfall	.010**	.005	.034	.034
Landuse_ag	-.158	.102	-1.06	.802
Occupation_gov't	-.051	.112	-.151	.656
Project age	-.014	.019	-.051	.131
F (9, 62)	5.43***			
R-squared	.232			
Root MSE	.429			
LR chi2(9)			22.79***	
Psuedo R-Squared			.262	
Log restricted Likelihood			-32.07	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, documentation, indicate a significant, positive relationship with a watershed partnerships' capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .232 with an F statistic of 5.43 indicate a goodness of fit and significance in the model. The linear regression coefficient indicated that documentation was related statistically to partnerships' capacity to set specific goals for pollutant reductions, holding all other variables in the model constant. The LR chi^2 of 22.79 with p-values of less than .01 also indicate goodness of fit and significance in the model. The logistic regression coefficient also indicated that a statistically significant relationship between documentation and partnerships' capacity to set specific goals for pollutant reductions existed.

Table 34. Reduced model testing the individual effect of communication frequency on partnerships capacity to set specific goals for pollutant reductions.

Index	Simple Linear Model		Logistical Model	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Frequency	-.010	.022	-.010	.118
Residence in Watershed	.033*	.018	2.04*	1.24
Education	.023	.120	-.385	.677
Gender	.357*	.183	1.91*	.975
Watershed acreage	2.77e-07***	1.02e-07	1.72e-06	1.48e-06
Annual rainfall	.008	.005	.036	.030
Landuse_ag	-.190	.118	-1.06	.688
Occupation_gov't	-.038	.116	-.087	.602
Project age	-.022	.020	-.079	.114
F (9, 62)	2.35**			
R-squared	.143			
Root MSE	.453			
LR chi2(9)			13.43	
Psuedo R-Squared			.155	
Log restricted Likelihood				

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, frequency, indicate no relationship with a watershed partnership's capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .143

with an F statistic of 2.35 indicate a goodness of fit and significance in the model. The logistic regression model was not significant. Regression coefficients generated by both regressions indicate that the explanatory variable, frequency, was not related statistically with partnerships' capacity to set specific goals for pollutant reductions, holding all other variables in the model constant.

Table 35. Reduced model testing the individual effect of communication mode on partnerships' capacity to set specific goals for pollutant reductions.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Mode	-.052	.037	-.239	.205
Residence in Watershed	.036**	.017	1.46	1.11
Education	.046	.114	-.083	.638
Gender	.350**	.176	1.91*	.987
Watershed acreage	2.07e-07**	9.01e-08	1.38e-06	1.54e-06
Annual rainfall	.007	.005	.036	.031
Landuse_ag	-.177	.115	-.968	.691
Occupation_gov't	-.019	.116	-.053	.599
Project age	-.023	.021	-.092	.114
F (9, 62)	2.96***			
R-squared	.167			
Root MSE	.447			
LR chi2(9)			14.11	
Psuedo R-Squared			.162	
Log restricted Likelihood			-36.41	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, mode, indicate no relationship with a watershed partnership's capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .167 with an F statistic of 2.96 indicate a goodness of fit and significance in the model. The logistic regression model was not significant. Regression coefficients generated by both regressions indicate that the explanatory variable, mode, was not related statistically with partnerships' capacity to set specific goals for pollutant reductions, holding all other variables in the model constant.

Table 36. Full model testing the collective effect of all communication components on partnerships' capacity to set specific goals for pollutant reductions.

Index	**Simple Linear Model**		**Logistical Model**		**Hierarchical Logistic Model**	
	Std. Coefficient	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
Documentation	.337***	.017	.491**	.199	.103*	.062
Frequency	-.159	.037	-.220	.242	-.178	.120
Mode	.056	.023	.032	.119	-.009	.081
Residence in Watershed	.075	.021	2.69**	1.38	.042	.103
Education	.078	.117	-.364	.769	.369	.387
Gender	.050	.241	.647	1.27	-.124	.509
Watershed acreage	.169	1.56e-07	1.51e-06*	8.56e-07	1.86e-06***	6.61e-07
Annual rainfall	.196	.005	.028	.036	-.006	.021
Landuse_ag	-.054	.126	-.456	.717	-.474	.565
Occupation_gov't	-.014	.106	-.098	.668	-.108	.374
Project age	.021	.021	.041	.123	.025	.108
Soil erodibility	.065	.086	-.059	.540	.096	.413
TMDL	.230	.154	1.16	.775	.175	.588
F (13, 58)	7.60***					

R-squared	.292					
Root MSE	.426					
Wald chi2(11)			25.98**		27.32**	
Psuedo R-Squared			.292		.042	
Log restricted Likelihood			-30.76		-188.66	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the full model testing the collective effect of all three components of the element, communication, indicate positive relationships between documentation and a watershed partnership's capacity to set specific goals for pollutant reductions using linear and logistic regression. Linear regression's R^2 of .292 with an F statistic of 7.60 indicate a goodness of fit and significance in the model. The linear regression coefficient indicated that documentation is related statistically with partnerships' capacity to set specific goals for pollutant reductions. The Wald chi^2 of the logistic regression and hierarchical logistic regression's of 25.98 and 27.32 with p-values of less than .05 also indicate goodness of fit and significance in the model. The logistic regression coefficient also indicates that a statistically significant relationship between documentation and partnerships' capacity to set specific goals for pollutant reductions exists, holding all other variables in the model constant.

5.3.2 Set Broad Goals to Evaluate BMP Effectiveness

Linkages between logic model steps inputs and outputs were assessed using linear and logistic regression. The relationships between collaborative governance elements (inputs) and dependent variable Y3: Partnership set broad goals to evaluate BMP effectiveness, were tested using full and reduced models.

Group Structure

To assess the effect of the element, group structure, on partnerships' capacity to set broad goals to evaluate BMP effectiveness, I first ran reduced models on each component to test their individual effect. Then I ran a full model on all group structure components combined, to test their collective effect on partnerships' capacity.

Table 37. Reduced model testing the individual effect of clear mission on partnerships' capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Clear Mission	.013	.018	.071	.085
Residence in Watershed	.042**	.135	.302	.406
Education	-.081	.113	-.494	.629
Gender	.300**	.135	2.05*	1.23
Watershed acreage	-2.48e-07***	7.27-08	-2.08e-06	2.94-06
Annual rainfall	.004	.004	.029	.033
Landuse_ag	.111	.119	.766	.742
Occupation_gov't	.176	.108	1.15*	.686
Project age	-.051**	.024	-.287**	.126
F (9, 62)	29.95***			
R-squared	.248			
Root MSE	.419			
LR chi2(9)			19.17**	
Psuedo R-Squared			.225	
Log restricted Likelihood			-32.95	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

[ttt] Gender variable omitted due to perfect

The results of the reduced model for the group structure component, clear mission, indicate no statistically significant relationship with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .248 with an F statistic of 29.95 indicate a goodness of fit and significance in the model. The LR chi^2 of 19.17 with a p-value of less than .05 also indicate goodness of fit and significance in the model; however, regression coefficients generated by both regressions indicate that the explanatory variable, clear mission, is not related statistically with partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 38. Reduced model testing the individual effect of role congruence on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Role Congruence	-.000	.025	-.002	.151
Residence in Watershed	.044***	.014	.298	.364
Education	-.062	.113	-.380	.623
Gender	.310**	.113	2.13*	1.24
Watershed acreage	-2.72e-07***	6.78e-08	-2.38-06	3.32e-06
Annual rainfall	.002	.004	.020	.032
Landuse_ag	.111	.118	.739	.730
Occupation_gov't	.204*	.104	1.30**	.662
Project age	-.049**	.024	-.275**	.124
F (9, 62)	28.50***			

R-squared	.239			
Root MSE	.421			
LR chi2(9)			18.45**	
Psuedo R-Squared			.217	
Log restricted Likelihood			-33.32	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the group structure component, role congruence, indicate no statistically significant relationship exists with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .239 with an F statistic of 28.50 indicate a goodness of fit and significance in the model. The LR chi^2 of 18.45 with p-values of less than .05 also indicate goodness of fit and significance in the model; however, regression coefficients generated by both regressions indicate that the explanatory variable, role congruence, is not related statistically with partnerships capacity' to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 39. Reduced model testing the individual effect of knowledge capabilities on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	**Simple Linear Model**		**Logistical Model**	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Knowledge Capabilities	.069**	.037	.406*	.243
Residence in Watershed	.042***	.014	.290	.393

Education	-.082	.105	-.539	.640
Gender	.320**	.140	2.31*	1.26
Watershed acreage	-1.92e07***	7.01e-08	-1.44e-06	2.48e-06
Annual rainfall	.004	.004	.041	.036
Landuse_ag	.126	.110	.823	.794
Occupation_gov't	.160	.010	.970	.694
Project age	-.050**	.023	-.289**	.130
F (9, 62)	26.46***			
R-squared	.283			
Root MSE	.409			
LR chi2(9)			21.52**	
Psuedo R-Squared			.253	
Log restricted Likelihood			-31.78	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the group structure component, knowledge capabilities, indicate a significant, positive relationship with a watershed partnerships' capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .283 with an F statistic of 26.46 indicate a goodness of fit and significance in the model. The linear regression coefficient indicates that a statistically significant relationship exists between knowledge capabilities and partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables constant. The LR chi^2 of 21.52 with p-values of less than .05 also indicate goodness of fit and significance in the model. The logistic regression coefficient also indicates that knowledge capabilities are related statistically with partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables constant.

Table 40. Full model testing the collective effect of all group structure components on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model		Hierarchical Logistic Model	
	Std. Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Clear Mission	.077	.018	.052	.105	.037	.052
Role Congruence	-.106	.026	-.137	.170	-.068	.088
Knowledge Capabilities	.247*	.043	.443	.297	.136	.130
Residence in Watershed	.116*	.020	.303*	.174	.069	.114
Gender	.219*	.149	2.67	1.65	.294	.502
Education	-.076	.118	-.609	.735	-.095	.370
Watershed acreage	-.183	1.66e-07	-1.35e-06	1.26e-06	-4.60e-06	3.49e-06
Annual rainfall	.137	.004	.054	.034	-.017	.019
Landuse_ag	.172	.137	.851	.780	-.309	.481
Occupation_gov't	.147	.107	.878	.734	.165	.328
Project age	-.272	.023	-.345*	.188	-.134	.090
Soil erodibility	-.036	.110	-.206	.567	.145	.386
TMDL	.058	.137	-.352	1.07	-.283	.509
F (13, 58)	20.62***					
R-squared	.296					
Root MSE	.419					
Psuedo R-Squared			.268		.029	
Wald chi2 (13)			15.48		8.35	
Log restricted Likelihood			-31.14		-193.95	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the full model testing the collective effect of all three components of the element group structure indicate positive relationship between knowledge capabilities and a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .296 with an F statistic of 20.62 indicate a goodness of fit and significance in the model. The linear regression coefficient indicated that a statistically significant relationship exists between knowledge capabilities and partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables constant. Logistic regression and HLM's test statistics did not indicate a goodness of fit in the model as they were not statistically significant.

Commitment

To assess the effect of the element, commitment, on partnerships' capacity to set broad goals to evaluate BMP effectiveness, I first ran reduced models on each component to test their individual effect. Then I ran a full model on all group structure components combined, to test their collective effect on partnerships' capacity.

Table 41. Reduced model testing the individual effect of participation on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Participation	.028	.018	.191*	.111
Residence in Watershed	.046***	.013	.330	.411
Education	-.065	.106	-.428	.643
Gender	.406**	.157	3.00**	1.42
Watershed acreage	-2.14e-07***	6.86e-08	-1.48e-06	2.28e-06
Annual rainfall	.003	.004	.033	.033
Landuse_ag	.094	.117	.728	.752
Occupation_gov't	.190*	.102	1.32*	.696
Project age	-.049*	.024	-.294**	.129

F (9, 62)	27.72***			
R-squared	.269			
Root MSE	.413			
LR chi2(9)			21.62**	
Psuedo R-Squared			.254	
Log restricted Likelihood			-31.73	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, participation, indicate a significant, positive relationship with a watershed partnerships' capacity to set broad goals to evaluate BMP effectiveness using linear regression. Linear regression's R^2 of .269 with an F statistic of 27.72 indicate a goodness of fit and significance in the model. The linear regression coefficient indicate no statistically significant relationship with partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables constant. Logistic regression's LR chi^2 of 21.62 with a p-value of less than .05 also indicate goodness of fit and significance in the model. The logistic regression coefficient did indicate a statistically significant relationship between participation and a watershed partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 42. Reduced model testing the individual effect of human resources on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Human Resources	.021	.017	.110	.087
Residence in Watershed	.042***	.013	.297	.393
Education	-.066	.110	-.417	.618
Gender	.293**	.139	2.07*	1.23
Watershed acreage	-2.34e-07***	6.36e-08	-1.91e-06	2.79e-06
Annual rainfall	.004	.004	.036	.033
Landuse_ag	.081	.115	.594	.762
Occupation_gov't	.194*	.104	1.23*	.670
Project age	-.047*	.024	-.277**	.127
F (9, 62)	27.91***			
R-squared	.261			
Root MSE	.415			
LR chi2(9)			20.13**	
Psuedo R-Squared			.237	
Log restricted Likelihood			-33.48	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, human resources, indicate no statistically significant relationship with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .261 with an F statistic of 27.91 indicate a goodness of fit and significance in the model. The LR chi^2 of 20.13 with a p-value of less than .05 also indicate goodness of fit and significance in the model; however, regression coefficients generated by both regressions indicate that the explanatory variable, human resources, is not related statistically with partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 43. Reduced model testing the individual effect of sufficient resources on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Sufficient Resources	.006	.023	.041	.103
Residence in Watershed	.045***	.014	.307	.375
Education	-.067	.112	-.409	.614
Gender	.305**	.137	2.07*	1.24
Watershed acreage	-2.59e-07***	7.50e-08	-2.19e-06	3.07 e-06
Annual rainfall	.002	.004	.024	.033
Landuse_ag	.111	.120	.776	.742
Occupation_gov't	.197*	.108	1.26*	.668
Project age	-.049*	.024	-.278**	.124
F (9, 62)	27.97***			
R-squared	.240			
Root MSE	.421			
LR chi2(9)			18.61**	
Psuedo R-Squared			.219	
Log restricted Likelihood			-33.24	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the commitment component, sufficient resources, indicate no statistically significant relationship with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .240 with an F statistic of 27.97 indicate a goodness of fit and significance in the model. The LR chi^2 of 18.61 with a p-value of less than .05

also indicate goodness of fit and significance in the model; however, regression coefficients generated by both regressions indicate that the explanatory variable, sufficient resources, is not related statistically with partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 44. Full model testing the collective effect of all commitment components on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model		Hierarchical Logistic Model	
	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Participation	.210	.020	.269	.209	.020	.073
Human Resources	.089	.019	.030	.108	.038	.050
Sufficient Resources	-.098	.023	-.136	.162	.017	.072
Residence in Watershed	.117**	.017	.317**	.151	.068	.105
Education	-.070	.111	-.613	.709	-.093	.353
Gender	.384**	.210	5.14	3.37	.440	.536
Watershed acreage	-.200*	1.41e-07	-1.14e-06	1.18e-06	-4.55e-06	3.54e-06
Annual rainfall	.105	.004	.056*	.030	-.019	.021
Landuse_ag	.081	.150	.313	.925	-.531	.439
Occupation_gov't	.195	.109	1.53*	.809	.181	.337
Project age	-.302**	.022	-.397**	.158	-.125	.091
Soil erodibility	-.122	.098	-.535	.494	.089	.313
TMDL	.001	.134	-.899	1.10	-.422	.469
F (13, 58)	22.53***					
R-squared	.291					
Root MSE	.420					
Pseudo R-Squared			.283		.027	
Wald chi2 (13)			24.21**		9.37	
Log restricted Likelihood			-30.51		-194.44	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the full model testing the collective effect of all three components of the element, communication, indicate no statistically significant relationship with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear regression. Linear regression's R^2 of .291 with an F statistic of 22.53 indicate a goodness of fit and significance in the model. Logistic regression's Walkd chi^2 of 24.21 with p-values of less than .05 also indicate goodness of fit and significance in the model; however, both regression coefficients indicated that no statistically significant relationship existed with the explanatory variables participation, human and sufficient resources and a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant. The HLM model test statistic was not significant and therefore no statistically significant relationships were found.

Communication

To assess the effect of the element, communication, on partnerships' capacity to set broad goals to evaluate BMP effectiveness, I first ran reduced models on each component to test their individual effect. Then I ran a full model on all group structure components combined, to test their collective effect on partnerships' capacity.

Table 45. Reduced model testing the individual effect of documentation on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear	Logistical Model

	Model			
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Documentation	.007	.021	.035	.117
Residence in Watershed	.043***	.015	.297	.377
Education	-.066	.111	-.402	.611
Gender	.298**	.142	2.06	1.26
Watershed acreage	-2.58e-07***	7.28e-08	-2.42e-06	3.60e-06
Annual rainfall	.003	.004	.021	.032
Landuse_ag	.114	.118	.746	.734
Occupation_gov't	.202*	.105	1.29*	.663
Project age	-.048*	.024	-.272**	.123
F (9, 62)	29.11***			
R-squared	.240			
Root MSE	.421			
LR chi2(9)			18.54**	
Psuedo R-Squared			.218	
Log restricted Likelihood			-33.27	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, documentation, indicated no statistically significant relationship with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .240 with an F statistic of 29.11 indicate a goodness of fit and significance in the model. The LR chi^2 of 18.54 with a p-value of less than .05 also indicate goodness of fit and significance in the model; however, regression coefficients generated by both regressions indicate that the explanatory variable, documentation, is not related statistically with partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 46. Reduced model testing the individual effect of communication frequency on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	Simple Linear Model		Logistical Model	
	Coefficient	Std. Error	Coefficient	Std. Error
Frequency	-.033*	.019	-.224	.141
Residence in Watershed	.042***	.013	.293	.423
Education	-.102	.110	-.674	.647
Gender	.326***	.130	2.14*	1.23
Watershed acreage	-2.06e-07***	7.45e-08	-2.45e-06	4.53e-06
Annual rainfall	.004	.004	.031	.034
Landuse_ag	.097	.119	.707	.766
Occupation_gov't	.182*	.105	1.31*	.680
Project age	-.052**	.024	-.323**	.136
F (9, 62)	37.01***			
R-squared	.269			
Root MSE	.413			
LR chi2(9)			21.27**	
Psuedo R-Squared			.250	
Log restricted Likelihood			-31.91	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, frequency, indicate a weak, negative relationship with a watershed partnerships' capacity to set broad goals to evaluate BMP effectiveness using linear regression. Linear regression's R^2 of .269 with an F statistic of 37.01 indicate a goodness of fit and significance in the model. The linear regression coefficient indicates that a statistically significant relationship exists between frequency and partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables constant. The LR chi^2 of 21.27 with p-values of less than .05 also indicate goodness of fit and significance in the model; however, logistic regression coefficient indicated no statistically significant relationship between frequency and a watershed partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 47. Reduced model testing the individual effect of communication mode on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	**Simple Linear Model**		**Logistical Model**	
	Coefficient	**Std. Error**	**Coefficient**	**Std. Error**
Mode	.037	.033	.231	.233
Residence in Watershed	.043***	.013	.285	.376
Education	-.070	.109	-.425	.612
Gender	.313**	.134	2.13*	1.25
Watershed acreage	-2.35e-07***	7.08e-08	-2.05e-06	3.03e-06
Annual rainfall	.003	.004	.023	.032
Landuse_ag	.106	.119	.711	.732
Occupation_gov't	.195*	.104	1.25*	.664
Project age	-.048*	.024	-.266**	.124
F (9, 62)	30.59***			
R-squared	.253			
Root MSE	.417			
LR chi2(9)			19.50**	
Psuedo R-Squared			.229	
Log restricted Likelihood			-32.79	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture

[tt]Excluded occupation dummy variable is non-government agent

The results of the reduced model for the communication component, mode, indicated no statistically significant relationship with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .253 an F statistic of 30.59 indicate a goodness of fit and significance in the model. The LR chi^2 of 19.50 with a p-value of less than .05 also indicate goodness of fit and significance in the model; however, regression coefficients generated by both regressions indicate that the explanatory variable, mode, is not related statistically with partnerships' capacity to set broad goals to evaluate BMP effectiveness, holding all other variables in the model constant.

Table 48. Full model testing the collective effect of all communication components on partnerships capacity to set broad goals to evaluate BMP effectiveness.

Index	**Simple Linear Model**		**Logistical Model**		**Hierarchical Logistic Model**	
	Std. Coefficient	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
Documentation	-.038	.027	-.025	.151	.051	.071
Frequency	.065	.035	.187	.259	-.028	.106
Mode	-.189	.024	-.259	.187	-.060	.065
Residence in Watershed	.111*	.019	.310*	.179	.045	.100
Education	-.122	.114	-1.12	.776	-.179	.349
Gender	.315**	.160	4.00**	1.80	.402	.485
Watershed acreage	-.188	1.45e-07	-1.31e-06	1.68e-06	-5.94e-06*	3.35e-06
Annual rainfall	.110	.004	.064*	.038	-.023	.018
Landuse_ag	.097	.153	.408	.847	-.497	.452
Occupation_gov't	.174	.113	1.26*	.715	.124	.331
Project age	-.330**	.023	-.485**	.196	-.152*	.092
Soil erodibility	-.121	.010	-.529	.531	-.020	.310
TMDL	-.121	.142	-1.21	1.14	-.435	.479

F (13, 58)	30.12***					
R-squared	.285					
Root MSE	.422					
Wald chi2(13)			19.51		10.35	
Psuedo R-Squared			.278		.030	
Log restricted Likelihood			-30.68		-193.74	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

The results of the full model testing the collective effect of all communication components indicated no statistically significant relationship with a watershed partnership's capacity to set broad goals to evaluate BMP effectiveness using linear and logistic regression. Linear regression's R^2 of .285 with an F statistic of 30.12 indicate a goodness of fit and significance in the model. The test statistics for the logistic regression and HLM were not significant.

Table 49 summarizes the results of the reduced models for all four dependent variables in the assessment of partnership's capacity based on their elements or characteristics. The direction of significant relationships is designated by +/- signs. If no relationship between an individual explanatory variable and dependent variable exists, the cell was left blank.

Table 49. Summary of reduced model results for all three dependent variables.

Collaborative Governance Elements	Componetns of Collaborative Governance Elements	Y1: Achievement of Stated WQ Goals	Y2: Set Specific Goals for Pollutant Reductions	Y3: Set Broad Goals to evaluate BMP effectiveness
Group Structure	Clear Mission Statement	+	+	
	Knowledge Capabilities		+	+
	Role Congruence			
Commitment	Participation	+	+	+
	Human Resources		+	
	Sufficient Resources	+	+	
Communication	Frequency			-
	Documentation		+	
	Mode			

Table 50 summarizes the results of the full models for all three dependent variables in the assessment of partnership's capacity based on their elements or characteristics. The direction of significant relationships is designated by +/- signs. If no relationship between an individual explanatory variable and dependent variable exists, the cell was left blank.

Table 50. Summary of full model results for all three dependent variables.

Collaborative Governance Elements	Characteristics of Collaborative Governance Elements	Y1: Achievement of Stated WQ Goals	Y3: Set Specific Goals for Pollutant Reductions	Y4: Set Broad Goals to evaluate BMP effectiveness
Group Structure	Clear Mission Statement	+		
	Knowledge Capabilities		+	+
	Role Congruence			
Commitment	Participation			
	Human Resources		+	
	Sufficient Resources	+	+	
Communication	Frequency			
	Documentation		+	
	Mode			

5.4 Predicting the Association: The Ladder of Collaborative Governance and Watershed Partnerships' Capacity to Achieve their Environmental Improvement Goals: *Relationship between Processes and Outputs Produced in Collaborative Governance Logic Model*

The final assessment of watershed partnerships' capacity to achieve their environmental improvement goals evaluates the linkage between collaborative governance processes and the outputs produced. The type of collaborative governance process is determined based on the elements that comprise the partnership. To test hypothesis 4 that the type of collaborative process is related to the type of output produced and therefore the capacity of partnerships' to achieve their environmental improvement goals, linear, hierarchical linear, and logistic regressions were run. These tests evaluated the linkages between collaborative governance processes, outputs, and resulting outcomes.

Table 51. Results of regressions testing the relationship between the types of collaborative governance processes and collaborative outputs and outcomes.

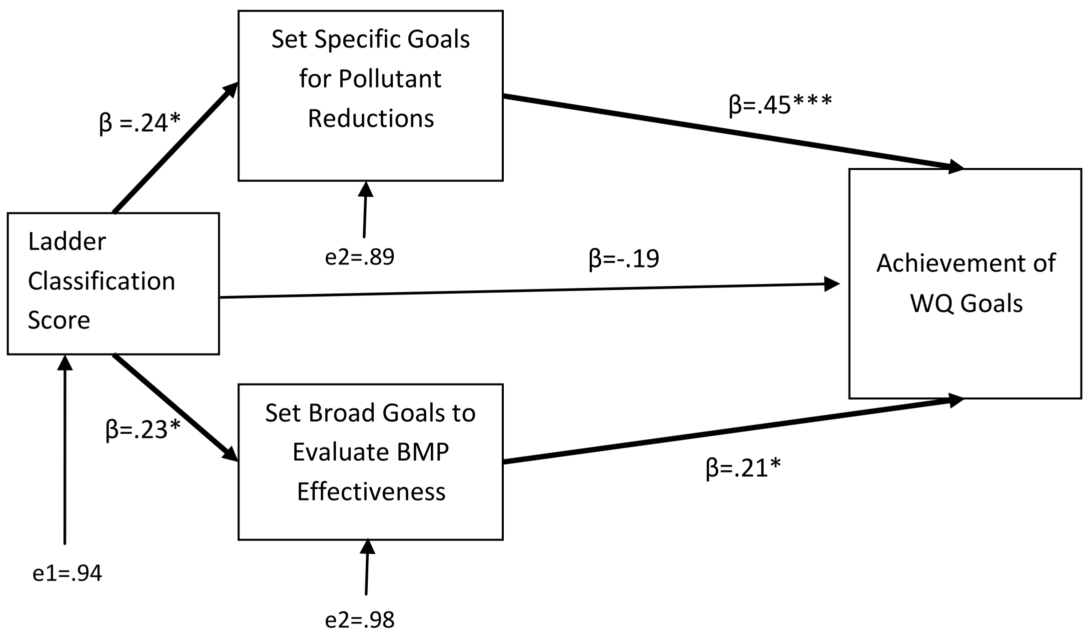
Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Std. Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Achievement of WQ Goals	.010	3.28	-.116	3.48	.118	.354
Set Specific Goals	.366***	5.87	14.53***	5.34	1.29**	.619
Set Broad Goals	.039	6.55	4.58	5.79	.405	.679
Residence in Watershed	-.046	.846	-.964	1.49	-.113	.135
Gender	.040	10.46	-.588	7.69	.062	.901
Education	.102	4.25	5.14	4.33	.462	.450
Watershed acreage	-.336***	6.98e-06	-.000***	7.64e-06	-2.34e-06***	8.19e-07
Annual rainfall	-.422***	.235	-.645***	.233	-.058**	.026
Landuse_ag	-.044	5.73	-.944	5.20	-.400	.567
Occupation_gov't	.102	4.53	2.95	4.50	.225	.470
Project age	-.139	.855	-.427	.920	-.067	.095
Soil erodibility	-.371**	3.98	-10.60***	3.62	-1.07**	.412
TMDL	-.371	6.57	-6.37	6.37	-.372	
F (13, 58)	6.22***					
R-squared	.406					
Root MSE	16.88					
Wald Chi2(13)			39.66***			
Pseudo R-squared					.052	

LR chi2(13)					26.23**	
Log restricted Likelihood			-285.24		-239.78	

N=72 ***/p< .01/ **/p< .05/ */p<.10/
[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

Of the three explanatory variables tested, a significant, positive relationship was found between the type of collaborative governance process and the output of setting specific goals for pollutant removal using linear, hierarchical, and logistic regressions. Linear regression's R2 of .406 with an F statistic of 6.22 indicate a goodness of fit and significance in the model. HLM's Wald chi2 of 39.66 with a p-value of less than .01 and ordered logistic regression's LR chi2 of 26.23 with a p-value of less than .05 further indicate a goodness of fit and model significance. Linear, hierarchical, and ordered logistical regression coefficients indicated that the setting of specific goals for pollutant reductions was related statistically with the type of collaborative governance ladder processes utilized by the partnership. Regression coefficients expressed by all three regression models indicated that no statistically significant relationship exists between the type of collaborative governance process and the output of setting broad goals to evaluate BMP effectiveness, the capacity of the partnership to choose the appropriate BMP to implement, and the achievement of water quality goals.

These findings offer some support to hypothesis 4 that states that different types of collaborative processes will produce different outputs affecting partnerships' capacity to achieve their environmental improvement goals. The results of the regression models indicate that the higher order collaborative governance process, synergistic consensus is positively linked with the capacity for the partnership to set specific goals for pollutant reductions (Figure 7).



N=72 ***/p< .01/ **/p< .05/ */p<.10/

Figure 7. Path Analysis results showing inter-relationships between ladder of collaborative governance process and four dependent variables.

The results of the path analysis indicate that the ladder classification score is related statistically with both types of outputs (specific goal for pollutant reductions and broad goals to evaluate BMP effectivenessBoth he setting of specific goals for pollutant reductions by the partnership and the setting of broad goals to evaluate BMP effectivenessare linked with the achievement of those water quality goals. However, the beta coefficients reveal a much stronger statistical relationship between the setting of specific goals and achievement of water quality goals,suggesting that watershed partnerships setting specific goals are more than twice as likely to achieve those goals than those that set broad goals.

Table 52. Results of regressions testing the relationship between the achievement of water quality goals and collaborative outputs, specific and broad goals.

Index	Simple Linear Model		Hierarchical Linear Model		Ordered Logistical Model	
	Std. Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
Set Specific Goals	.293***	.163	.569***	.176	2.13***	.675
Set Broad Goals	.224**	.226	.530**	.252	2.32**	.926
Residence in Watershed	.016	.025	.010	.055	2.77**	1.17
Gender	.289**	.287	.683**	.275	2.80***	1.02
Education	-.054	.149	-.010	.160	-.898	.617
Watershed acreage	.159**	1.85e-07	4.18e-07	2.92e-07	1.60e-06	1.23e-06
Annual rainfall	.432***	.009	.030***	.007	.086***	.031
Landuse_ag	.105	.193	.191	.203	.167	.709
Occupation_gov't	-.154*	.155	-.274*	.154	-.904	.553
Project age	-.036	.037	-.012	.035	-.007	.127
Soil erodibility	-.363***	.089	-.451***	.123	-2.12***	.545
TMDL	.240**	.198	.427*	.225	1.49*	.829
F (12, 59)	19.78***					
R-squared	.604					
Root MSE	.613					
Wald Chi2 (12)			90.00***			
Pseudo R-squared					.390	
LR chi2(13)					68.59***	
Log restricted Likelihood			-.92.02		-53.66	

N=72 ***/p< .01/ **/p< .05/ */p<.10/

[t]Excluded landuse dummy variable is non-agriculture
[tt]Excluded occupation dummy variable is non-government agent

A significant, positive relationship was found between the achievement of water quality goals and both output variables-setting specific goals for pollutant removal and broad goals to evaluate BMP effectiveness. Linear regression's R2 of .604 with an F statistic of 19.78 indicate a goodness of fit and significance in the model. HLM's Wald chi2 of 90.00 with a p-value of less than .01 and ordered logistic regression's LR chi2 of 68.59 with a p-value of less than .01 further indicate a goodness of fit and model significance. Linear, hierarchical, and ordered logistical regression coefficients indicated that the setting of both specific and broad goals was related statistically with the achievement of water quality goals. However, regression coefficients expressed by all three regression models indicated that partnerships were statistically more likely to achieve water quality goals by setting specific goals than setting broad goals.

Table 53 summarizes the findings of this study. The results of regressions offer evidence to partially support three of the four hypotheses and contribute initial insights to collaboration governance scholarship. The broad scope of this study warrants further research into each of the significant components within the three elements to better understand the nature of the relationships.

Table 53. Summary of Findings

Variable	Hypothesis	Evidence Offered?
Group Structure	***The greater the degree of group structure, the greater the capacity of watershed partnerships to achieve their environmental improvement goals.***	
Clear Mission		**Yes (+)**
Role Congruence		**No**
Knowledge Capabilities		**No**
Commitment	***The greater degree of commitment, the greater the capacity of watershed partnerships to achieve their environmental improvement goals.***	
Participation		**Yes (+)**
Human Resources		**No**
Sufficient Technical and Financial Resources		**Yes (+)**
Communication	***The greater degree of communication, the greater the capacity of watershed partnerships to achieve their environmental improvement goals.***	
Documentation		**No**
Frequency		**No**
Mode		**No**
Ladder Classification Score	***Different types of collaborative processes will produce different outputs, affecting partnerships' capacity to achieve their environmental improvement goals.***	**Some (+)**

CHAPTER 6: DISCUSSION

6.1 The Relationships between Collaborative Governance Elements *(Inputs)* and the Capacity of Watershed Partnerships to Achieve their Environmental Improvement Goals

6.1.1 Group Structure

The findings of this study indicated a significant, positive relationship between a clear mission and the capacity of watershed partnerships to achieve their environmental improvement goals. The latent variable clear mission measured the clarity through which a partnerships mission outlined the objectives of their common goal and consensus on the common goal to improve the health of their individual watershed. As illustrated in Table 49, regression results for the reduced models indicated that clear mission is statistically significant to partnerships' capacity for two out of three dependent variables. The variable clear mission was especially significant to the achievement of water quality goals (Y_1), as indicated by statistical significance in both the reduced and full models. The robustness of these models findings lend further support to the salience of this variable and offers some support to hypothesis #1 that a greater degree of group structure increases partnerships' capacity to achieve environmental improvement goals, especially the possession of a clear mission for achieving stated water quality goals.

This study found a clear mission to be important for the execution of effective collaborative governance. This study provides evidence supporting previous scholar's assumption that clear and well-supported mission allows the partnership to function as a unit, resulting in more efficient decision-making and effective implementation of solutions (Astley and Van de Ven, 1983), which is especially important in the absence of hierarchy (Provan and Kenis, 2008). In agreement with Imperial (2005) finding, in the presence of common values and interests, participants often find ways to work together in a manner more productive than achieved working alone.

This study's finding extends those offered in previous research by empirically linking the possession of a clear mission to improvements in environmental outcomes, providing fodder for further exploration of this variable. Practically speaking, the existence of a clear mission outlining the common goal, allows the partnership to identify the problem, set goals to address the problem, delegate actions, and implement an effective solution.

6.1.2 Commitment

Participation and resources are often cited in the literature as important for the sustainability of collaborative governance (Ansell and Gash, 2007; Leach et al, 2002; Leach and Pelkey, 2001); however, the type of participation and resources are not typically specified. This study assessed the impact participation, human resources (i.e. expertise), technical resources (e.g. monitoring equipment, and data analysis capabilities), and funding had on partnerships' capacity to improve environmental outcomes. The findings of this study indicate a positive relationship with commitment components- participation and resources, and partnerships' capacity to achieve their environmental improvement goals. Two out of the three dependent variables in the reduced models indicated that sustained participation from the beginning throughout the lifecycle of the partnership was significantly and positively related to partnerships' capacity. However, full models did not indicate a statistically significant relationship between participation and partnerships' capacity. The latent variable participation was measured using questions regarding the duration of respondents' participation (i.e. from the beginning and throughout the entire project). Potential ambiguity in the measurement of this variable may have existed as respondents may have felt they were involved from the beginning but not throughout (or vice versa), resulting in the lack of robustness in findings.

Human resources (i.e. participant's expertise) were found to be statistically and positively related to partnerships' capacity and reduced and full models indicated that human resources were especially significant to partnerships' capacity to set specific goals for pollutant reductions (Y_2). This latent variable measured respondent's perception of their contribution of expertise regarding the sources of pollution and potential BMPs, as well as their knowledge regarding land use changes and waterbody health. This finding is specific to the contribution of human resources provided to the partnership by the respondent and not generalizable to the partnership as a group. However, it offers support to Imperial's (2005) argument that expertise provided by partnership members helps to reduce the uncertainty inherit in complex systems such as watersheds. In addition, knowledge of the particular pollutant impairing the watershed would be especially useful when setting specified goals to reduce pollutant amounts.

The latent variable, sufficient resources, measures respondent's perception of whether or not the partnership as a whole possessed sufficient equipment to conduct monitoring and data analysis and the flexibility and sustainability of funding throughout the project timeframe. A significant and positive relationship was indicated between sufficient resources and two out of three dependent variables in both reduced and full models. These robust findings offer greater evidence of the salience of sufficient resources to partnerships' capacity to achieve their environmental improvement goals (Y_1) and to set specific goals for pollutant reductions (Y_2). In addition, these findings offer support for hypothesis #2 that a greater degree of commitment increases partnerships' capacity to achieve their environmental improvement goals, specifically related to water quality (Y_1). This study's finding that sufficient resources (technical, and financial) expands the capacity of partnerships to facilitate action and sustain initiatives over time in order to achieve goals and realize outcomes is consistent with the literature (Wood and Gray, 1991; Steelman and Carmin, 2002), especially the importance of funding (Bidwell and Ryan, 2006). The complex nature of watersheds accentuates the need for ample technical resources to monitor and assess environmental outcomes (Imperial, 2005). Previous studies have also found that sustained and flexible funding is a critical factor to the success of watershed management (Born and Genskow, 2001), and an underlying condition in the development of watershed partnerships (Lubell, et al., 2002). Bidwell and Ryan (2006) found funding to be strongly related to outcomes.

However, this study's findings did not indicate any conditional support by the parent agency regarding the use of their financial resources as suggested by Bidwell and Ryan (2006). When asked, more than half (55%) of respondents in this study did not feel that "conditions were placed on funding". This raises the question of whether or not increased capacity affects the likelihood of partnerships to reinforce or replace institutional norms set by the parent agency, which future research should explore. However, I would be remiss to not acknowledge the possibility of a bias on the part of the respondent to answer favorably regarding their experience with the program given my association with EPA at the time the survey was conducted.

Practically speaking, the common limiting factor in watershed management is staff expertise and knowledge in the identification of pollution sources, technical resources for monitoring and data analysis as well as funding, which may explain the importance of these components. It is not enough to simply assemble collaborative governance partnerships and expect environmental outcomes; they must be supported with sufficient resources.

6.1.3 Communication.

The findings of this study indicate that latent variables, mode and frequency, were not statistically related to watershed partnerships' capacity to achieve their environmental improvement goals. This result is contrary to literature that found open and frequent communication to be an important factor for successful collaboration (Koehler and Koontz, 2008; Koontz and Bodine, 2008; Schneider et al, 2003; Imperial, 2005). This inconsistency in findings may be due to an inaccurate measurement of communication. The questionnaire asked respondents to report on the frequency and mode (style) of communication used by their partnership; however, these questions may not have sufficiently measured the *quality* of communication. For example, one phone call may result in more effective communication and information shared than several face-to-face meetings. Further research assessing the quality of communication directly is needed to better understand the relationship with partnerships' capacity to achieve their environmental improvement goals. In contrast, a statistically significant and positive relationship was indicated in both reduced and full models between documentation and partnerships' capacity to set specific goals for pollutant reductions (Y2). The production and transmission of knowledge through formal, written documentation facilitates a shared learning and understanding among partnership members (Asthana, et al., 2002; Ansell and Gash, 2007; Mishra and Mishra, 2009), which increases their capacity to set specific goals for pollutant reductions. Shared learning and a common understanding of the problem and pollution sources is necessary to set specific goals for pollutant reductions. Watershed management plans and TMDLs are examples of formal documents created with the intent to identify specific pollutant reduction goals that would result in improved water quality conditions. This study concurs with previous studies that found documents (e.g. watershed management plans) to be correlated with environmental and policy outcomes (Wilkinson, 2007; Lubel, et al., 2005).

6. 2 Relationship between the Ladder of Collaborative Governance and Watershed Partnerships' Capacity to Achieve their Environmental Improvement Goals.

This study addressed the gap in literature by articulating the conceptual relationships between collaborative processes and outcomes based on the type of outputs produced through the *Ladder of Collaborative Governance*. This typology of processes is based on composition of elements and related to variations in partnerships' capacity to achieve their environmental improvement goals. Through this assessment of intermediate causal mechanisms (outputs) between collaborative processes and outcomes, this study begins to unpack the "black box" of collaborative governance. The findings of this study indicate that the higher order collaborative governance process (synergistic consensus) is positively linked with partnerships' capacity to set specific goals for pollutant reductions, which is positively linked with the achievement of stated water quality goals. These results offer some support to hypothesis #4 that the type of collaborative governance process would affect the type of output produced and the overall capacity of the watershed partnership to achieve their environmental improvement goals.

Further support for this hypothesis was offered by the path analysis that illustrated the statistical pathway linking the ladder classification score (type of process) with both outputs, setting specific goals for pollutant reductions (Y_2) and setting broad goals to evaluate BMP effectiveness (Y_3). Statistically, there is very little difference in the linkages between the ladder processes and the type of goal; however, standardized coefficients indicated that partnerships that set specific goals were twice as likely to achieve those goals as partnerships that only set broad goals to evaluate BMP effectiveness.

In addition, full and reduced regression models indicated further support to the significant relationship between synergistic consensus process and the output of setting specific goals as indicated by significant, positive relationships between sufficient human and documentation, and partnerships' capacity to set specific goals for pollutant reductions.

6.3 Relationships between the Steps of the Collaborative Governance Logic Model (Processes, Outputs, and Outcomes) and Watershed Partnerships' Capacity to Achieve their Environmental Improvement Goals.

Many of the criticisms of collaborative governance revolve around the lack of clear indicators of improved environmental conditions resulting from collaboration. The findings of this study offer empirical evidence verifying that collaborative processes have a measurable, beneficial effect on environmental outcomes by linking outputs with outcomes. Given the inherent difficulties in relating environmental improvement to collaborative governance elements and processes, and the lengthy time horizon required for establishing such a causal link, this study provides a useful analysis of the collaborative governance outputs and their potential to serve as proxy measures for the achievement of environmental improvement goals.

6.3.1 Outputs: Specificity in Goals

The collaborative governance output of setting specific goals for pollutant removal was positively linked with the ladder of collaborative governance processes in regression and the path analysis results. When tested individually in the reduced model, group structure components clear mission and knowledge capabilities, were positively associated with specific goal setting. The findings also indicated significant, positive relationships with committed participation and resources (human, technical, and financial) and the communication component (documentation). Overall, the output variable, setting specific goals (Y_2), was related to more elements than the other two dependent variables tested. Therefore it comes as no surprise that a significant, positive relationship exists between the partnerships' capacity to set specific goals and the ladder classification score, which was a summation of all of the explanatory variables.

This study found the output of setting specific goals to be strongly related to partnerships' capacity to achieve those goals. Despite the strong EPA affiliation, which dictated the primary objective of the NNPSMP to reduce NPS pollution in watersheds, and increased representation by government agents in the population, several partnerships acted individually to set more specific goals. As a result, they were found to be more likely to meet those goals. This raises the issue of the tautology, questioning whether it is easier to classify a project as having attained their goals if the goals are written specifically. In other words, is it easier to determine successful attainment of a specific reduction in pollutant level versus the effectiveness of a type of BMP. However, the objective of the EPA NPSMP assessed was to test the effectiveness of BMPs at reducing nonpoint source pollution and partnerships were required to report whether broad goals for evaluating BMPs were achieved. Therefore, it should be easier to classify broad goals as having been attained. The monitoring design of the program to include monitoring of BMP effectiveness before and after implementation may be a greater factor explaining these findings as it provided sufficient outcome data for determining whether more specific goals were met.

Affirming Bidwell and Ryan's (2006) finding that funding was an important structural characteristic of watershed partnership's capacity to achieve their goals, this study also found sufficient technical resources to be strongly related to partnerships capacity to set and achieve specific goals for pollutant reductions. The political implications of this finding suggest the necessity of public managers to provide sufficient technical and financial resources for attaining specific water quality goals. In order to assess the achievement of specific pollutant reductions, more targeted monitoring and water quality analyses are required. The setting of specific goals requires more information and consensus on the main objective of the watershed partnership. In order to achieve goals, specific targets must be defined to guide data collection (Conley and Moot, 2003). According to the branch chief of the nonpoint source control branch “setting specific goals targets the mind” (Dov Weitman, 2011). When the existence of a TMDL was controlled, regression results indicated a strong statistical and positive relationship with achievement of water quality goals. Assessment reports of TMDLs supports this study’s findings of the importance of commitment components, participation and resources (Jones and Cordrey, 2004). Setting specific goals (e.g. percentage of load reductions in pollutant levels) requires more donated time and resources, especially during monitoring and data analysis. These findings suggest that the use of setting of specific goals for reporting progress towards improvements in environmental outcomes is a useful proxy measure when long-term environmental data is not available.

6.4 Controlling for confounding influences

Collaboration scholars have cited the challenge of controlling confounding influences to the difficulty in attributing improvements in environmental outcomes to collaborative governance (Born and Genskow, 2006; Thomas and Koontz, 2011). Acknowledging the interdependence of natural and socio-economic systems at the watershed scale (Imperial, 2005; Steelman and Carmin, 2002), differences in physical characteristics between waterbodies and socioeconomic conditions between respondents were controlled for when examining linkages between collaborative governance elements and partnerships' capacity to achieve their environmental improvement goals.

A strength of this study was the ability to control for physical differences in environmental conditions, allowing for attribution of changes in water quality to be attributed to the collaborative activities performed by watershed partnerships. The paired-watershed design utilized by partnerships participating in EPA's NNPSMP, accounted for hydrologic variations between the treatment and control watershed, allowing the effect of the treatment (implemented BMP) to be isolated from other confounding factors (i.e., geological and climatic conditions) that might result in a difference in response. The pair-watershed design feature increases the credibility of the ranked achievement of stated water quality goals (Y1) by reducing the confounding influences when assessing partnerships' attainment of stated water quality goals. In addition, secondary data was collected to further account for differences in the size of watershed (acreage), amount of annual rainfall, and erodiblity of the soils.

This study also included socio-economic control variables to further reduce confounding influences. Survey respondents were asked questions about their education, gender, occupation, and whether or not they resided within the boundaries of their project watershed. In addition, secondary information was collected on the age of the partnership, surrounding land use, and whether or not a TMDL existed for each waterbody. The presence of these control variables generated some interesting results, warranting some discussion. In particular, regression results indicated that individual respondents' gender, whether or not they resided with the watershed boundaries and the presence of a TMDL affected the relationship between collaborative governance element, group structure, and partnerships' capacity to set specific goals (Y2). When these variables were removed, full model regression results indicated a statistical significance with clear mission and knowledge capabilities and partnerships' capacity to set specific goals (Y_2). In addition, the variable land use became significant when respondent's residence was no longer controlled for. While interesting, implications of these findings are specific to individual respondents, limiting the generalizablity to factors affecting survey responses, and therefore does not permit analysis of group-level effects on collaborative governance.

In a study of forty-four watershed partnerships in California and Washington, Sabatier et al, (2005) found that success takes time and the older the partnership (older than 48 months) the more successful they were in terms of perceived effect of social and human capital and in the achievement of milestones (e.g. agreements on proposed restoration projects, implementation of restoration projects, and monitoring of project effects). This study did not support Sabatier, et al. (2005) findings as regression results indicated a statistically significant negative relationship between the age of watershed partnerships and their capacity to achieve their water quality goals (Y_1) and set specific goals for pollutant removal (Y_2). This study did not include any partnerships less than four years old with the majority being older than 10 years; however, this lack of variability in partnership ages limits any strong determination to be made regarding the significance of partnerships' age.

As mentioned previously, the creation of a TMDL within the project timeline for each partnership was significantly and positively associated with achievement of stated water quality goals. It is not clear whether the partnership was involved in the creation of the TMDL or the role the TMDL may have played in partnerships' planning as data was not collected on this control variable directly. Future research should explore the impact TMDLs may or may not have made in partnerships' decision making process.

CHAPTER 7: CONCLUSIONS

Collaborative governance has long been advocated by policy makers and researchers alike as a means to improve the natural environment. However, determining the effectiveness of collaborative governance as a management strategy for improving environmental outcomes has proven difficult (Koontz and Thomas, 2006; Sabateri, et al., 2005; Born and Genskow, 2006; Thomas, 2008). Addressing this gap has significant bearing on environmental policy as governments at all levels have relied on collaborative governance as a primary way to address complex environmental issues that have not been satisfactorily addressed by conventional regulatory approaches and that are outside the scope of a single agency. This research conducted an initial empirical assessment of the relationships between specific collaborative governance elements and improved environmental outcomes. This knowledge is useful for addressing complex environmental issues like management of our aquatic resources and global climate change and identification of specific qualities for successful collaboration would benefit collaborative policy literature as a whole.

The findings of this study offer three distinct contributions to collaboration theory and public policy. First, the findings of this study offer early evidence on the relationships between critical elements, group structure, commitment, and communication and capacity of a collaborative partnership to achieve environmental improvements. Collaboration scholars have acknowledged the linkages between variability in outcomes and differences in collaboratives (Leach et al, 2002; Leach and Pelkey, 2001; O'Leary and Bignham, 2003) and prior research has addressed aspects relating to collaborative governance and social and environmental outcomes. However, the direct link between this form of governance and resulting environmental outcomes has not been evaluated empirically. The results of this study offer early evidence of these relationships, specifically linking critical elements and outputs with increased partnership capacity for achieving their environmental improvement goals.

The second contribution of this research is the creation and analysis of the conceptual typology, the ladder of collaborative governance that relates collaborative processes to outputs. Theoretically, the concept of collaborative governance has become a “black box” within public administrative and public policy literature. Interchangeable and inconsistent use of collaboration terminology has posed a barrier to theory building. The lack of empirical analysis on the effects of various elements or characteristics comprising collaborative governance processes and corresponding outputs has left researchers and practitioners wondering, does collaborative governance really lead to improved environmental outcomes? This research begins to unpack the “black box” of collaborative governance by disentangling the multiple interactive variables in order to isolate the effects of specific elements of collaborative governance on partnerships' capacity to achieve their environmental improvement goals. Finally, the empirical assessment of the causal linkages of the collaborative governance logic model benefits theory by disentangling the multiple interactions between variables of interest and isolating the effects of individual variables, providing public managers a useful tool for measuring the performance of collaborative governance when sufficient environmental data in unavailable.

In general, the findings of this study will have relevance to any environmental problem requiring public, private, and/or nongovernmental organizations to come together and make decisions, set goals, and collect information to promote effective environmental governance. In addition, this research provides researchers with a comprehensive view into the factors affecting the performance of collaborative governance as an environmental management approach and a platform for further studies to build upon.

Collaboration scholars have suggested that partnership characteristics affect their capacity to achieve environmental and policy outcomes (Wood and Gray, 1991; Steelman and Carmin, 2002; Imperial, 2005; Thompson, et al., 2007; Born and Genskow, 2001; Astley and Van de Ven, 1983; Ansell and Gash, 2007; Bidwell and Ryan, 2006; Leach et al, 2002); however, empirically linking specific characteristics to environmental outcomes has remained elusive. This study fills this gap by examining the relationships of specific elements to achieving partnership's environmental improvement goals, offering early insights into the factors affecting performance of collaborative governance. Similar to Bidwell and Ryan (2006), this study tested the relationships between elements or characteristics of watershed partnerships and outputs resulting from collaborative processes. However, the generalizabilty of this study's findings extends those of Bidwell and Ryan (2006) as the sample population included partnerships from states across the country and with diverse environmental outcomes. In addition, the breadth of variables tested in this study offers researchers a comprehensive review of collaborative governance while contributing empirical evidence of the importance of specific elements to achieving improvements in environmental outcomes. Empirical assessment of surveyed participants from twenty-six watershed partnerships found the presence of a clear mission and sufficient resources to be the most salient elements, providing early evidence verifying a positive relationship between elements of collaborative governance and improved environmental outcomes. In addition, sufficient resources were related statistically with partnerships' capacity to set specific goals for pollutant reductions,

representing a common thread in the collaborative governance logic model. This study concurs with Bidwell and Ryan's (2006) finding that funding is an important element for successful achievement of goals. However, contrary to their finding participants surveyed in this study did not feel that conditions were placed on their funding, implying that parent-agency directives may not have influenced their activities. These results prompt the question of whether or not possession of sufficient financial resources permits partnerships to act independently when setting their environmental improvement goals instead of adopting parent agency priorities, and one future research should explore.

Overall, the identification of these elements as critical to effective collaborative governance contributes a platform for future research exploring linkages between collaborative governance and environmental outcomes.

The ladder of collaborative governance articulates differences between the types of collaborative processes, comprised of design-relevant characteristics (elements), and their corresponding outputs (activities). The inductive analysis of these linkages helps government understand where to focus their resources by understanding which type of groups are inclined to achieve particular outcomes. In addition, these findings contribute to collaboration scholarship by distinguishing different types of collaborative processes based on partnership design characteristics and corresponding activities or outputs.

The overarching goal of the NNPSMP of implementing BMPs to control NPS pollution results in a homeogenous “action-level” classification of partnership’s institutional level, as described in Margerum's (2008) typology. However where Margerum (2008) found no consistent trend between contextual characteristics of watershed partnerships in Australia, this study provides useful information assisting collaboration scholars by identifying critical elements affecting the performance collaborative governance.

The participant composition of this study is closely related to Bidwell and Ryan's (2006) "agency-affiliated" watershed partnerships in Oregon in that there was a dominance of government agents administering the partnership activities. However, unlike Bidwell and Ryan's findings, the staff from the parent agency of the program

(EPA) did not participant as members of the partnership. While a strong representation by government agents existed, it was at the State level. The majority (57%) of survey respondents included agents from State and local governments. Therefore, Koontz and Moore's (2003) "agency-based" partnerships may be a more appropriate classification of participant composition for partnerships included in this study. While not tested directly, this prevalence of government agents as the leads on projects was addressed by including the occupation dummy variable in regression models. When controlled for, participants' occupation was negatively and marginally significant, indicating that participant's "government agent" status was not related to partnerships' capacity to achieve their environmental improvement goals.

Building off prior research that found management plans are useful output measures when evaluating watershed partnerships (Mandarano, 2008; Wilkinson, 2007), this study went a step further to evaluate outputs as a stepping stone linking collaborative processes and outcomes. The assessment of components of the collaborative governance logic model verifies the assumption that collaborative processes have a measurable, beneficial effect on environmental outcomes (Leach et al, 2002; Leach and Pelkey, 2001; Genskow and Born, 2006; Ferreyra and Beard, 2007; Mandarano, 2008). Given the inherent difficulties in relating environmental improvement to collaborative governance elements and processes, and the lengthy time horizon required for establishing such a causal link, application of evidence-based evaluation is difficult to apply to public policy addressing environmental issues. This study provides a useful analysis of the collaborative governance outputs and their potential to serve as proxy measures for the achievement of environmental improvement goals when environmental outcome data is unavailable.

Future research should examine in greater detail the elements identified as being significant to partnerships' capacity to improve environmental outcomes. Specifically, how important is consensus when defining the mission of the partnership and how much technical and financial resources are sufficient. Also, public managers would benefit from applied research on the cost-effectiveness of collaborative governance for achieving environmental improvements. In addition, collaborative governance literature would benefit from a study designed to more accurately measure the quality of partnership communication and its impact on environmental outcomes, especially in this era of advanced communication technology. The findings of this study prompted further inquiry into the relationship initially indentified by Bidwell and Ryan (2006) regarding the likelihood of partnerships to reinforce institutional norms set by the parent agency when they possess sufficient resources to act independently. Lastly, the importance of TMDLs to public policy governing watersheds was alluded to in the findings of this study. Future research should measure the impact of TDML implementation directly and compare the top-down, regulatory process associated with TMDL creation to the bottom-up, collaborative approach used by partnerships to create watershed management plans.

In conclusion, this research addressed the gap in literature by empirically assessing the effectiveness of environmental governance in achieving environmental improvements. Drawing from survey responses from participants of EPA's National

Nonpoint Source Monitoring Program, we found the presence of a clear mission and sufficient resources to be critical elements increasing collaborative partnerships' capacity to achieve their environmental improvement goals. In addition, the findings of this study offer empirical evidence linking collaborative outputs with outcomes, providing guidance to public managers when deciding upon useful proxy measures to use when environmental outcome data is unavailable.

APPENDIX I. WATERSHED PARTNERSHIP SURVEY

Independent Variables	**question**	**responses**				
Group Structure	1. The mission statement of our watershed partnership was clearly defined	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	2. The mission statement outlined the objectives for achieving the common goal of restoring our watershed.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	3. My role in the partnership was clearly and appropriately identfied.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	4. Duties within the partnership were	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree

	delegated to those most qualified.					
	5. I felt my role used my expertise to its fullest extent.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	6. I was happy with the duties I was assigned.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	7. I felt the division of labor was fairly assigned.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	8. I felt knowledge obtained by the partnership was used well.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	9. Our partnership had scientific panels of outside experts.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	10. Our partnership divided into committee based on our expertise.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
Commitment	11. I allocated a lot of time to the project.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	12. I was a part of the partnership from the beginning.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree

	13. I was actively involved in the partnership throughout the entire project.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	14. I provided expertise to the watershed partnership about the source of pollution.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	15. I provided expertise to the watershed partnership about the land treatment or best management practice to control the pollution.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	16. I provided expertise to the watershed partnership about monitoring.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	17. I provided expertise to the watershed partnership during data analysis.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	18. I provided knowledge on the current land use practices	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree

	within the watershed.					
	19. I provided the history of the watershed (land use and development).	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	20. Our partnership had sufficient equipment to conduct monitoring.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	21. Our partnership had sufficient resources to conduct data analysis.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	22. We had continued funding throughout our project.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	23. Conditions were placed on funding that went against our mission.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	24. We never seemed to have enough money.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	25. The most expensive part of the project was monitoring the effects of the BMP.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	26. The majority of our funding came from	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree

	federal sources.					
	27. The majority of our funding came from state sources.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	28. The majority of our funding came from local sources.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	29. The majority of our funding came from non-governmental sources.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
Communication	30. Our partnership communicated on a frequent basis.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	31. I communicated with the partnership on a regular basis.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	32. Our partnership communicated more frequently when completing documents.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	33. I met with members of our partnership in person	never	weekly	monthly	quarterly	annually
	34. I spoke on the phone to members of	never	weekly	monthly	quarterly	annually

	our partnership					
	35. I received/sent emails to members of our partnership	never	weekly	monthly	quarterly	annually
	36. I received/sent letters in the mail to members of our partnership	never	weekly	monthly	quarterly	annually
	37. I participated in live web chat room or instant messaging with members of our partnerships	never	weekly	monthly	quarterly	annually
	38. The perferred method of communication for our partnership was in-person conversations.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	39. The perferred method of communication for our partnership was phone converstations.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	40. The perferred method of communication for our partnership was email	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree

	messages.					
	41. The perferred method of communication for our partnership was mailed letters.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	42. The perferred method of communication for our partnership was instant messaging or some other web-based live "chat".	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	43. Major decisions were made in-person at meetings.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	44. I trusted my fellow partners.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	45. My fellow partners trusted me.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	46. Documents were written collectively by the watershed partnership.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	47. All individuals within the partnership had an opportunity to	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree

	contribute to the documents produced.					
	48. Documents were written in formal manner.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	49. Our partnership completed a watershed-based plan	yes	no	I don't know		
Perceived Success	50. I felt our project was successful.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	51. The practices installed effectively reduced pollution from entering waterway.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	52. Our partnership did not improve the water quality in the watershed.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
Control Variables	53. At the time of the project, I lived within the boundaries of watershed.	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	54. If you answered yes to # 53, how long did you live in the watershed?	0-2 years	3-5 years	6-10 years	11-20 years	20+ years

	55. The watershed has changed in the time I have lived within its boundaries	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	56. At the time of the project, I was employed as a	governmen t agent	environment al scientist	academi c	landowne r	other
	57. I worked on more than one watershed restoration project	strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
	58. If you answered yes to # 57, how many watershed restoration projects have you worked on?	1 to 3	4 to 6	7 to 9	10 to 12	12 +
	59. At the time of the project, my age was between	20-30	30-40	40-50	50-60	70+
	60. At the time of the project, the highest level of education I had completed was	high school/GE D	some college	4-year degree	graduate	technica l degree
	61. Gender	male	female			
	62. At the time of the project, my annual income was	less than 20,000	21-40,000	41-50,000	51-70,000	over 70,000

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CURRICULUM VITAE

Jennifer C. Biddle graduated from Perkiomen Valley High School, Graterford, Pennsylvania, in 1996. She received her Bachelor of Science in Horticulture from Pennsylvania State University in 2000. She was employed as an environmental consultant in the private sector for several years and received her Master of Science in Environmental Science and Policy from George Mason University in 2005.