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The Role of Social Science in Successfully Implementing Watershed Management Strategies

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Abstract: Successful watershed management and changes in water quality conditions are dependent upon changes in human behaviors. Those tasked with managing watersheds and other natural resources often assume that people are not acting to protect or restore their resources because they lack the necessary knowledge and understanding. However, individual behaviors are impacted by a variety of social, psychological, institutional, and economic factors that need to be understood for successful implementation of watershed management strategies. This paper provides an introduction to the field of human dimensions of watershed management, an overview of social science concepts that have been found to explain water-related behaviors, and how social information can be translated into actionable items in a management plan.

Keywords: *human dimensions, community capacity, theory of planned behavior, social capital, risk, institutions, collaboration*

Human behavior is the driving force underlying many resource management concerns, but is often the component that is given the least amount of attention in the development of management plans. Instead, plans are written that assume the main barrier to changing the behaviors of individuals is a lack of knowledge regarding issues impacting water and the actions that can be taken to solve them. Overreliance on ineffective communication channels to inform stakeholders of watershed planning efforts and traditional methods of technology transfer have potentially delayed progress in achieving behavior changes. Morton (2008, 751) posits that our approach to improving water quality since the adoption of the Clean Water Act has "…one critical weakness, an assumption that a combination of regulation and a cadre of technicians can solve the problem of non-point source pollution." Over the past decade, policy makers and watershed managers have made slow but positive moves toward investing more resources in understanding antecedents to behavior change, and to incorporate that knowledge into watershed management (Prokopy et al. 2009; Davenport 2013). This article aims to provide background knowledge on the social aspects of watershed management for elected officials and policy makers, watershed managers, and citizens interested in improving water resources.

Behavior choices are predicated on a variety of social, psychological, institutional, and economic factors that need to be understood for successful watershed plan implementation. Variables informing social science theories to describe and predict the relationships among these factors and watershed projects include, but are not limited to, attitudes, value orientations, perceptions of social capital, trust, risk, and awareness. In addition, the role of institutions is central in impacting and sustaining natural resources behavior change (Ostrom 1990; Heberlein 2012). The complexity

of implementing strategies that rely upon individual behavior change for improving conditions is exacerbated by the nested and overlapping governmental boundaries that comprise the laws, rules, people, and organizations within a given watershed.

Social information can be used to understand and segment target populations to develop effective messages and policy tools to support behavior change. Management plans should include goals and objectives related to communication and behavior change that are based on social science data rather than potentially erroneous assumptions about what barriers to behavior change exist. This article provides an overview of common factors and theories in the human dimensions of watershed management, and how social science information can be translated into actionable items by those responsible for watershed plan implementation. We begin with a discussion of place, as watershed projects are place-based activities that take into account local natural conditions. Likewise, projects may benefit from understanding how people view their local watershed and community. We move through discussions of individual level variables that impact how people perceive risk related to water management, and individual level variables that can be measured to understand stakeholders and design outreach. Finally, we provide an overview of watershed management institutions and their ideal design, and offering two approaches watershed managers might use social data in planning, implementing, and evaluating watershed projects.

The Impact of Place

Several concepts are prevalent in discussions regarding place. **Sense of place** is seen as a filter influencing how individuals perceive their environment (Cheng et al. 2003; Koshollek 2010). Because of the vagueness associated with initial conceptualizations of sense of place, several additional factors have been developed to support and clarify it. The intensity of the bond that people have with places and communities is often described as **place attachment** (Simoni and Floress 2015; Wynveen et al. 2011), and people assign meaning to these areas through the experiences they have by living in them (Stedman 2003). Place attachment has been found to significantly impact the willingness of individuals to engage in behaviors to protect their place (Stedman 2002). **Place meanings** represent the value an individual places on a resource or community, as opposed to the intensity (Wynveen et al. 2011), and are "… necessary to understand the range of place-related behaviors", (Brehm et al. 2013, p 523). Variables that people associate with place include memories and experiences (Williams et al. 1992), feelings of connectedness and belonging (Cheng et al. 2003), and elements of individual and community identity (Davenport et al. 2010).

Place studies can be highly complex but are useful for natural resource managers, as understanding people's sense of place can increase the success of projects (Bott et al. 2003; Cheng et al. 2003). Understanding how place is viewed by watershed residents can help segment the population to target outreach and action (Simoni and Floress 2015). For example, researchers have found that the values held by individuals for lakes were comprised of **emotional identity** (feeling like the place is part of an individual's identity, family memories), **community character** (feeling like the resource is part of the community's identity), **natural processes** (how the resource provides ecological services), and **income** (personal economic dependence upon the resource) (Simoni and Floress 2015). Riparian owners held higher values for the emotional identity and natural process meanings than non-lakeshore owners, and those who were members of their lake group held higher values for the emotional identity and community character meanings than those who were not members. Interestingly, seasonal residents held higher values for the emotional identity meaning than year-round residents. These results highlight how place can be used to segment populations and target outreach efforts based upon their individual characteristics.

Risk Perception

Just as individuals vary in how much they value a place, they also differ in the degree of risk they perceive with regard to environmental threats. Risk focuses on threats to values or things people care

about. The study of **risk perception** focuses on the size, type, and likelihood of these risks (Slovic 1987; 2000; Slovic and Weber 2002). This field examines the ways that ordinary individuals assess risk using reasoning that is influenced by factors other than what is strictly scientific and rational (Weber 2001). For instance, many people are afraid of flying in commercial airplanes but are relatively unafraid of traveling in passenger cars where they are, on average, much more likely to be in a serious accident. Rationally, the risk of driving or riding in a passenger car is higher than flying in a commercial plane, but emotionally, many people perceive the risk of flying as higher.

Watershed managers may work with risk perceptions revolving around water quality, water quantity, flood control, and the impacts of water development on other values, such as biodiversity or scenic views (Robles et al. 2011; 2014). Managers may become frustrated when people perceive great risk to drinking highly chlorinated tap water, choosing to substitute bottled water or to install poorly maintained water filters that are actually more likely to make them sick than municipal tap water. Similarly, an individual who loves to be near a river and chooses to build a dream house in a flood plain perceives the risk of loss of life and property as reasonably small and outweighed by the value of living in a scenic spot with great recreational worth (Alhaki and Slovic 1994).

As managers work with members of the public to achieve watershed management goals, they should not expect that the public's sense of risk to valued resources equates to what a manager perceives as risky (Bennett and Calman 1999; Bontempo et al. 1997; Granger et al. 1992). Managers can instead focus on talking to people to learn what does and does not worry them (Kasperson et al. 1988; McDaniels et al. 1997; Robles Morua et al. 2014). They can learn to listen to understand key underlying values and beliefs (what the individuals hold to be true, which may be different from what managers believe to be true). By developing a sense of the broad range of existing values and beliefs related to the decision in question, managers can learn to, and then build from, these concerns and opinions to communicate their message more effectively (O'Connor et al. 1999; Robles Morua et al. 2014).

For instance, if climate change is increasing 100-year storm events necessitating enhanced stormwater management infrastructure that is expensive and has negative impacts on scenic values, a manager can choose to learn what it is that affected community members care about and believe (O'Conner et al. 1999). It may be that community members are particularly concerned about protecting a local park that will look different with the new infrastructure and that these individuals believe the construction is unnecessary because they are unaware of recent climatological data. Rather than arguing with these individuals, the manager who understands these values and beliefs could instead talk about what a 100 or 500-year storm might do to their park without the new infrastructure and perhaps show them comparisons of storm event data over time. This approach builds from an understanding of the individuals rather than from a simplistic position of trying to convince them that they are wrong (Bennett and Calman 1999; Granger et al. 1992).

It can be difficult to accommodate the differing values and beliefs that members of the same community hold regarding risks to their family, community, and environment. It would be simpler if managers could treat all community members as if they held homogeneous risk perceptions. Unfortunately, this is rarely the case. However, understanding the breadth of concerns and choosing to speak to key beliefs and values across the spectrum can make it more likely that the public will come to understand the rationale behind decisions (Bennett and Calman 1999; Granger et al. 1992). In addition, managers may come to realize that there are options of which they were unaware as they develop understandings of community values and beliefs. It is important for managers to remember that the public is generally the ultimate owner and financier of public works. A lack of technical or scientific understanding does not mean that an individual's risk perceptions are wrong; they may just be different and based on additional factors (Bennett and Calman 1999; Granger et al. 1992).

Attitudes, Norms, and Behavior

Variables associated with risk are but one approach to understanding the impact of beliefs on

actions. The **theory of planned behavior** (TPB), which explains the influence of attitudes, subjective norms, and perceived behavioral control on the intentions of individuals to undertake particular actions, also holds promise for understanding the social determinants of human behavior related to water resources, and for informing policies on watershed management. **Attitudes** toward a specific behavior can strongly influence the performance of the behavior (Ajzen 2001). Attitudes are based on **beliefs** and involve a positive or negative assessment of the performance and outcome of the behavior (Ajzen 1991; Fishbein and Ajzen 2010). In the example of lawn-watering, a person is likely to water if he or she believes watering will result in a healthy, green lawn and feels a positive attitude about this outcome. Conversely, a person facing a costly repair to a leaky septic system will likely experience a negative attitude towards fixing it. The negative attitude may be based on beliefs that the cost and inconvenience of a repair out-weigh the personal benefits of a repair. For behaviors that are within a person's control, those associated with positive attitudes are more likely to be performed than those associated with negative attitudes (Ajzen 1991; Fishbein and Ajzen 2010).

Norms and the beliefs underpinning them can similarly be strong predictors of behaviors. Norms can be viewed as the 'peer-pressure' component of behaviors because they are based on commonly-held beliefs about the expectations of important others (Babbie 1995; Fishbein and Ajzen 2010). That is, a person is likely to perform a behavior if he or she perceives strong social pressures to do so. The approval or disapproval of a given behavior by important others (e.g., friends or neighbors) affects an individual's perceptions about the performance of the behavior (Ajzen 1991; Fishbein and Ajzen 2010). For instance, a person may feel social pressures to water his/her lawn if he or she perceives that important others approve of a green lawn. A person who believes that many septic systems leak may not perceive social pressures to have his or her own leaky system repaired, particularly if others view the repair as a waste of money. Norms can strongly influence behaviors because they can be enforced formally or informally and can be very difficult to change (Babbie 1995).

The concept of control is an important factor in peoples' decision-making processes and associated behaviors. Similar to the concept of self-efficacy, perceptions about control relate to one's ability to perform a given behavior and the ease or difficulty associated with it (Ajzen 1991; Ajzen 2002; Fishbein and Ajzen 2010). **Perceived behavioral control** can have several components, including one's understanding of opportunity, knowledge, skills, time, or perception of financial resources necessary to carry out the behavior (Ajzen 1991; Ajzen 2002; Fishbein and Ajzen 2010). Control is often viewed as the behavioral determinant capable of outweighing normative pressures and attitudes because of its limiting capabilities (Ajzen 2002; Corbett 2005; Fishbein and Ajzen 2010). For instance, financial limitations may cause a person to neglect a leaky septic system, despite substantial normative pressures or a positive attitude about repairing it.

The interplay between attitudes, norms, and control are frequently examined to assess the extent to which each determines behaviors. According to theoretical models such as TPB, intentions to perform a given behavior are strong when factors related to norms, attitudes, and control all support the performance of the behavior (Ajzen 1991; Ajzen 2002; Fishbein and Ajzen 2010). The TPB is an extension of the Theory of Reasoned Action and its utility for predicting and explaining behaviors has been supported in a variety of studies (Figure 1). It has been effectively used to explain numerous environment-impacting behaviors such as littering, recycling, energy conservation, industrial pollution, and participation in landowner management programs (Armitage and Conner 2001; Cheung et al. 1999; Corbett 2002; Cordano and Frieze 2000; Harland et al. 1999; Kaiser and Gutscher 2003; Kaiser et al. 2005; Knussen et al. 2004; Russell and Fielding 2010).

Studies of residential water use typically share the objective of determining factors that predict conservation behaviors. Among those are factors that focus on socio-demographic variables such as age, income, or homeownership; however, findings tend to be contradictory and contextual (Jorgensen et al. 2009). The TPB, on the other hand, has frequently been applied in studies of conservation and its elements have consistently been shown to be effective predictors of intentions to conserve. In

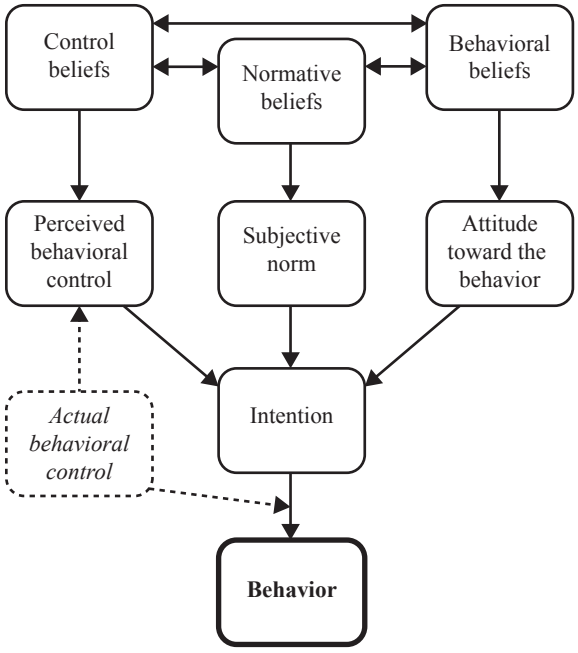

Figure 1. The Theory of Planned Behavior (adapted from Ajzen 1991; Fishbein 2010).

many cases, all three key elements (norms, attitudes, and behavioral control) positively and significantly predicted household conservation intentions (Clark and Finley 2007; Lam 1999; Trumbo and O'Keefe 2001). All three elements have also been shown to predict commercial farmers' intentions to adopt water-saving technologies (Lynne et al. 1995).

Perhaps more importantly to watershed managers, the TPB can also reveal factors that do not appear to influence intentions to conserve. For example, Lam (2006) found that the TPB was not able to explain intentions to purchase and install low-flush toilets, indicating that other factors (such as cost) may be relevant. In many studies, one TPB variable emerged as a considerably more powerful predictor of conservation intentions than others. In some contexts researchers found norms to exert the greatest influence over water use (Corral-Verdugo et al. 2002; Nancarrow et al. 2008), while others found the influence of attitudes to prevail (Armitage and Connor 2001; Clark and Finley 2007; Harland et al. 1999; Lam 2006; Russell and Fielding 2010). In other instances yet, perceived behavioral control surfaced as a very strong predictor (Kaiser et al. 2005; Lam 1999). A watershed manager who gathers data on water use through a TPB framework could therefore tailor outreach messages based on the relative influence of each of these factors as they explain the decision-making processes of the target audience. Knowing how to best appeal to water-users in a particular setting should save time and resources and lead to more effective policy formulation.

Overall, the TPB can be an important tool for watershed managers by improving their understanding of water-impacting behaviors of residents. If managers are concerned about water supply and wish to promote conservation, for instance, they could use the TPB to measure individuals' intentions to conserve based on their abilities to conserve, perceptions that important others approve of conservation, and attitudes towards conservation. The same strategy could help managers understand what motivates people to engage in behaviors that degrade water quality such as littering or dumping. By themselves, educational outreach programs intended to encourage water-friendly behaviors have been met with mixed results (Campbell et al. 2004; Gregory and DiLeo 2003; Syme et al. 2000). By characterizing how norms, attitudes, and control each influence water-impacting behaviors, watershed managers could fine-tune messages to reach the target audience more effectively than generalized attempts at 'educating the public'.

Social Networks, Social Capital, and Trust

The Theory of Planned Behavior recognizes that individuals do not make decisions in isolation. It operationalizes the impact important others can have on behavior by including subjective norms. Norms are only one part of how people impact our lives and decisions. Almost everyone will acknowledge the important role their friends, family, and colleagues play in their lives. In general, our social ties – or our social network - provide access to information (Granovetter 1973; Burt 1992), status attainment (Lin 1999), and influence our identities (Harshaw and Tindall 2005). At the individual level, **social capital** is the idea that we invest in our relations with those ties in the interest of achieving outcomes (Lin 2001). Wellman and Frank (2001) put forth that access to resources, diversity of one's social network ties,

and support systems are elements often studied from this perspective.

Establishing and utilizing social networks have been identified as important functions of a watershed group (Conley and Moote 2003; Koontz 2003; Floress et al. 2011a). Networks provide access to financial and technical resources, information, and assistance in addition to building cohesion among members of watershed groups and watershed residents. Social networks are also a significant component of the capacity individuals have to engage in behaviors to improve water quality, as noted by Davenport and Seekamp (2013). Decisions are not made in isolation, and social networks can influence behavior (Floress 2008). Social norms, often developed and maintained within a social network, are integral components of other theories of behavior change (e.g. TPB), and the means by which behavior adoption travels through networks as represented by Diffusion of Innovations (Rogers 2003).

Social capital researchers are interested in understanding how our networks influence individual outcomes and – particularly relevant in areas where collaborative watershed groups are present – group outcomes such as successful watershed planning activities (Floress et al. 2011a). Morton (2011, 41) notes that "…it is not a critical mass of people that solves problems but the critical connections among them that matter most." In addition to achievements and outcomes, others define social capital as the norms of trust and reciprocity that exist in a social structure as a result of people interacting with each other (Coleman 1988; 1990; Focht and Trachtenberg 2005; Putnam 1995; 2000; Pretty and Smith 2003). In watershed management, trust has been discussed as both a property of an individual, such as the trust one has for various agencies and organizations, and of collaborative groups. These various perspectives – individual outcomes, group outcomes, and trust – are discussed here.

Individual Outcomes

People access the resources represented by social ties to take action (Lin 1999; 2001). Other social theories note that information-seeking and the influence of the people with whom an individual associates and admires are important components in adoption of new behaviors (Rogers 2003). Thus, a person who has social network resources to help them become aware of water quality or land management problems and actions that can remediate those problems might be more amenable to changing their behavior (Floress 2008). As Morton (2011, 41) points out, watershed management is not successful because people talk about issues, but because people, "…use their power and influence to change others' beliefs, opinions, and behaviors." The types of networks individuals have access to also influence behavior when considering farmer adoption of best management practices (BMP) that improve or protect water quality (Prokopy et al. 2008; Baumgart-Getz et al. 2012). Baumgart-Getz et al. (2012) identified four types of networks that impact BMP adoption: local (interactions with neighbors and local organizations); agency (degree of connections to agency personnel); business (connections to those in agribusiness); and University Extension (connections to an Extension office). In their statistical meta-analysis, they found that local and agency networks have the largest impact on BMP adoption. Similarly, in a study of the impact of social capital on farmer behavior, Floress (2008) found that people's interaction with organizations providing information and programs about water quality and land management within a watershed has a significant impact on behavioral outcomes. Morton (2011) notes the impact family members, agency relationships, organizational membership, and peers had on conservation practices in Iowa. An important finding was that farmers who are members of more organizations are less satisfied with their current conservation efforts than those who interact more with other farmers. Essentially, interaction with those outside of producers influenced a farmer's perception that they could take additional conservation measures. This finding is supported by that of Campbell et al. (2011) who found that farmers are more likely to adopt BMPs when they participate in a watershed group.

Group Outcomes

Much effort and time have been dedicated to assisting collaborative natural resource management groups to form and persist. The relationship between collaborative groups, social

capital, and positive management outcomes is well-established, to the extent that books are dedicated to the topic (see Morris et al. 2013). Watershed groups have been seen as an answer to many of the issues inherent in top-down management, and are ideally characterized by stakeholders from different sectors sharing power in setting direction for watershed management activities (Michaels 2001; Floress et al. 2009; 2011b). The structure of a group is important with regard to what they are able to achieve. For example, Moore and Koontz (2003) found that groups tended to be comprised of agency personnel, citizen members, or both, and that each type focused on different activities (developing a watershed plan, lobbying, and addressing broad goals, respectively). Others have found that groups can be open to anyone with interest, representative of various interests identified by a leader, or restricted to those who meet certain criteria (Dakins et al. 2005) and that affiliations with organizations can impact group accomplishments (Bidwell and Ryan 2006).

Because the presence of **weak ties** (weak relationships between members of a network (Granovetter 1973)) and **structural holes** (someone in a group who provides access to resources and people outside of the group (Burt 1992)) facilitate information access, broad networks accessible within a watershed group increase a group's ability to achieve change (Floress et al. 2011a). These networks have been characterized by Schneider et al. (2003) as spanning vertical structures, such as the hierarchical structure of government; ideological dispositions used to negotiate among different interests; access to expertise (Zafonte and Sabatier 1998); and local areas. Watershed managers are more successful if they identify their desired outcomes and purposefully invite stakeholders to participate in watershed planning and implementation activities to help them achieve their aims (Floress et al. 2011a). To that end, groups should be designed to include stakeholders at both the planning and implementation stages who will provide access to people, skills, ideas, and resources that are needed for the goals the group will address (Floress et al. 2011a).

Trust

Trust – both of other stakeholders and policy makers - has been said to be vital for collaborative approaches to watershed management (Focht and Trachtenberg 2005). Building trust has been identified both as a goal of collaboration (Leach et al. 2002) and an outcome (Leach and Sabatier 2005; Lubell 2005). Leach and Pelkey (2001) found that trust was an important outcome for a group, and others have noted that trust can extend from one participant to others in the community (Hibbard and Lurie 2006). Multiple studies of collaborative groups have assessed the degree of trust group members have in each other and determined it is a necessary component for achieving environmental outcomes, but others have found that people will cooperate even in the absence of trust (Raymond 2006). Davenport et al. (2013) note that landowners will be more likely to positively assess conservation programs when they are promoted by conservation professionals who are already known by the landowner. Likewise, watershed residents who are trusted by their neighbors can facilitate behavior change in their communities (Davenport and Seekamp 2013; Fabricius et al. 2007).

Social networks, social capital, and trust are important concepts for watershed managers to consider at both the individual and group levels. With regard to individual behavior change, managers can identify highly connected people, agencies, and organizations in a community, and use those connections to influence change. At the group level, those convening a collaborative initiative should consider the types of stakeholders, problems, practices, and likely solutions that will be addressed, and form groups that will facilitate easier access to necessary resources. Finally, trust can be an explicit goal or an unintended outcome of watershed management, whether it is to increase the trust stakeholders have of those delivering conservation programs or to build trust among group participants.

Shifting from Individual Attributes: The Importance of Institutions in Watershed Governance

While much of the success of watershed management is dependent upon changes in individual behavior, **institutions** have an important role in supporting these actions (Heberlein 2012).

Institutions, according to North (1990, 3) are "the humanly devised constraints that shape human interaction." Institutions may be composed of formal rules, such as constitutions that are written and legally enforceable or informal social norms that use enforcement mechanisms outside legal and bureaucratic channels (Pahl-Wostl 2009). Institutions can also be categorized as public, private or civic (Agrawal and Perrin 2008). Institutions differ from organizations which refer to groups of people pursuing a common interest (North 1990). Formal and informal institutions and organizations constitute key components of resource regimes that mediate human interactions with various natural resources (Young 1982). The concept of **governance** is increasingly used to refer to the structures and processes through which various individuals, institutions and organizations interact in the formulation and implementation of policies (Pahl-Wolst 2009; Plummer and Fennell 2009).

In recent decades, the institutional mechanisms for resource management have been undergoing a transition from reliance on state institutions and regulatory mechanisms to decentralized and collaborative mechanisms that promote participation and interaction among institutions representing states, markets, and communities in the resource management process. This transition is particularly evident in the governance of domestic and international watersheds (Bruch et al. 2005). While the turn toward collaboration is an appropriate response to the growing interest in resource governance, and an important step toward integrating the human dimensions into resource management regimes, a more fundamental change in thinking is needed to account for the uncertainty and complexity in watershed management (Healey 1998; Pahl-Wostl et al. 2007). The true integration of the human dimensions into watershed governance institutions requires recognition of complexity and the need to prioritize learning in the resource management process. Institutions for watershed management are evolving, and could be designed to enhance efficiency, equity and sustainability of complex watersheds in the face of uncertainty.

Conventional watershed governance institutions have traditionally adopted a command-and-control approach, characterized by top-down decision-making by centralized institutions, and the use of fixed, static regulations (Karkkainen 2005). This approach to watershed management also relied heavily on technical approaches to ensuring the controllability and predictability of watersheds (Pahl-Wostl et al. 2007), and emphasized economic outcomes, particularly industrial and economic development (Healey 1998). Karkkainen (2005) has noted that the command-and control approach to watershed management assumes that sovereign states have the capacity to formulate and enforce appropriate rules. Indeed, where resources are available and resource management problems are relatively simple, the use of centralized institutions can be effective (Dietz et al. 2003). However, the use of command-and-control mechanisms often leads to several adverse consequences in the management of complex resource management problems. Centralized institutions, relying on static rules that are based on assumptions of predictability and controllability of watersheds are a poor fit for the complex and dynamic nature of watersheds. Given the dynamic and non-linear interactions among the multiple components of watersheds, such institutions lack the flexibility required for constant adaptation to changing watersheds (Healey 1998).

The issue of fit or match between the spatial and temporal scales of social and ecological systems and the institutions for resource management has received considerable attention in the resource management literature in general (e.g. Cash et al. 2006; Folke et al. 2007), and watershed management in particular (e.g. Kerr 2007). Karkkainen (2005) identifies the problem of mismatch in the scales at which decisions are made using centralized institutions and the scales at which watershed management problems occur as another shortfall of the command-and-control approach to watershed management. Watershed boundaries rarely match the boundaries of political jurisdictions within which they are managed (Davenport and Seekamp 2013). While the delineation of watershed boundaries is itself a politically contested issue (Blomquist and Schlager 2005), the reliance on sovereign states as political jurisdictions may be too small in the case of international transboundary watersheds, or too large in the case of domestic watersheds

(Karkkainen 2005). The mismatch between the ecological scales of watersheds and the jurisdictional scales of the watershed management institutions could potentially result in a lack of fit between policy interventions and the problems to be addressed (Kerr 2007). For instance, centralized institutions often adopt one-size-fits-all solutions based on generalizations that reflect poor knowledge on particular local cultures and ecosystems (Acheson 2006; Lebel et al. 2007).

A related shortfall discussed by Karkkainen (2005) is the mismatch in the resources and capacities required for the sustainable management of complex watersheds and the resources actually available to centralized institutions as single or dominant actors in watershed management. Centralized institutions often face resource constraints, such as funding and personnel shortages that render them ineffective (Lebel et al. 2007). Command-and-control approaches have also been critiqued for their inefficiency (Dietz et al. 2003), the lack of incentive to change they provide, and their poor record on the sustainable management of water resources (Acheson 2006; Darghouth et al. 2008). Additionally, centralized institutions often lead to inequitable outcomes that exert disproportionate adverse impacts on communities while offering opportunities for capture by dominant power structures (Lebel et al. 2007).

Recognition of these widespread shortfalls in the conventional command-and-control approach to watershed management has resulted in the turn toward participatory approaches such as community-based and collaborative watershed management. This approach to watershed management is consistent with the growing emphasis on **co-management** in the broader arena of resource management. Co-management refers to institutional arrangements for joint resource management involving the sharing of power, rights and responsibilities between state representatives and non-state actors, such as resource users at the local level (Yandle 2003; Carlsson and Berkes 2005). Unlike community-based conservation that emphasizes local community control over institutions and procedures for resource management, co-management necessarily involves the role of state representatives in the resource management process (Borrini-Feyerabend 2003).

The turn toward collaborative watershed management offers several benefits that represent an important step toward integrating the human dimensions into watershed management institutions. Collaboration promises to enhance equity in watershed management, both procedurally in terms of providing opportunities for adequate representation and meaningful participation as well as non-discriminatory access to justice by all stakeholders (Bruch 2005), and substantively in terms of the consideration of all interests in the search for practical solutions to shared problems (Wondolleck and Yaffee 2000). Collaboration is also associated with efficiency in the resource management process. Efficiency can result from the pooling together of resources by the multiple stakeholders, allocation of tasks according to the skill set of each stakeholder, and the avoidance and resolution of conflicts in the decision-making and implementation process (Carlsson and Berkes 2005). The collaborative approach to watershed management also promises to enhance the effectiveness of the decision-making process by enhancing the quality of decisions based on the integration of the dispersed knowledge among the diverse stakeholders, as well as building a sense of ownership and commitment of stakeholders to the successful implementation of decisions (Wondolleck and Yaffee 2000; Bruch 2005). Ultimately, collaborative watershed management provides opportunities for building the capacity of communities and organizations involved in the ongoing learning and problem-solving process, as well as enhancing the sustainability of the resource base (Wondolleck and Yaffee 2000; Plummer and Armitage 2007).

In spite of its promise, collaborative approaches to land and water resources management are frequently bedeviled with a range of conceptual and implementation shortfalls. One of the key factors accounting for failure in collaborative initiatives is the lack of political will and interest on the part of governments and their representatives to sustain collaborative processes (Berkes 2010; Akamani et al. 2015). Effective collaboration requires the willingness of governments to sacrifice power (Ruhl 1999), as well as the willingness to provide the resources, incentives and opportunities for participation (Wondolleck and Yaffee 2000).

Yet governments are often reluctant partners (Chomchai 2005), resulting in collaborative processes that sometimes lead to the strengthening of state control (Berkes 2009). Collaborative initiatives have not been successful in addressing equity issues, such as reducing poverty and empowering marginalized groups (Berkes 2009; Akamani and Hall 2015). Collaborative processes and their outcomes often strengthen the control of powerful local elite while suppressing the values and interests of less powerful actors (Reed 2008; Cinner et al. 2012). Collaborative initiatives are often constrained by the lack of adequate resources, including funding, logistics, and personnel on the part of agencies and communities (Wondolleck and Yaffee 2000). The lack of skilled personnel, such as trained facilitators and mediators in negotiation processes, could have adverse consequences on the quality of the process.

At the community level, the poor may have limited access to the media and other sources of information, limited literacy and skills for participation, and limited access to other resources required to access opportunities for participation (Chomchai 2005). The collaborative approach is also not a panacea to every watershed management problem. Individuals and organizations may not be interested when more promising alternative channels exist for pursuing their interests. The existence of multiple competing interests and organizational mandates, as well as non-negotiable positions may result in a gridlock in negotiation and consensus-building processes. Consequently, collaborative processes are often challenged by a loss of interest in sustaining such processes (Healey 1998; Reed 2008). Importantly, the promotion of stakeholder participation through collaborative approaches has been critiqued as inadequate in managing complex and dynamic watersheds due to the lack of explicit recognition of this complexity and the need for learning and adapting to change (Healey 1998; Akamani and Wilson 2011).

Designing Effective Collaborative Watershed Management Institutions

Sustainable watershed management requires innovative institutional mechanisms that can provide the awareness, interest, resources and opportunities for stakeholders to engage in collective responses aimed at building resilience and reducing vulnerabilities in the face of the multiple drivers of change to which watersheds are constantly exposed (Akamani 2014a). This section presents a set of recommendations for integrating the human dimensions into watershed management institutions while enhancing equity, efficiency, sustainability and resilience.

Creating Awareness about the Complexity of Watersheds

The conventional command-and-control approach to watershed management reflects older assumptions that separated humans from nature, and emphasized human ability to understand, control and predict natural processes (Akamani 2014b). Greater awareness among policy makers and ordinary citizens of the dynamic interdependence between the human and biophysical components of watersheds, as well as the uncertainties and unpredictability that characterize such coupled social-ecological systems, is needed to inform more sustainable watershed management policies. Such an awareness calls for watershed management policies and institutions that aim at building the resilience of the social-ecological system rather than maximizing short-term economic benefits. For instance, the emerging concept of adaptive co-management that combines the multi-level linkages of collaboration with the learning focus of adaptive management (Berkes 2009) holds promise for building the resilience of complex watersheds (Akamani 2014a).

Using Diverse Sources of Knowledge

The generation of accurate, context-specific, and policy-relevant knowledge on complex social-ecological systems is needed for enhancing success in watershed management. The reliance on reductionist science and engineering in the conventional command-and-control approach to watershed management tended to marginalize the social sciences, thus yielding knowledge that offers a partial understanding of social-ecological systems. Social and ecological vulnerabilities have resulted from policies based on such incomplete knowledge generated from reductionist science (Ludwig et al.

1993; Holling 1993; Holling and Meffe 1996). Managing watersheds from a social-ecological systems perspective calls for greater recognition of the social sciences through multidisciplinary and interdisciplinary collaboration between the social and biophysical sciences (Gelt 2000; Beschta 2000), as well as recognition of the importance of local and traditional ecological knowledge in watershed management.

Building Motivation for Collective Action

A range of economic and non-economic incentives are needed to motivate diverse stakeholders to be actively involved in collective responses to problems in complex watersheds. This might entail adopting broad watershed management goals that address the livelihood concerns of stakeholders, improving upon the quality of decision-making processes as mechanisms for building trust and social capital, and the enhancement of social learning among the diverse stakeholders. Social learning refers to learning that occurs among social groups as a result of social interaction processes (Reed 2008; Reed et al. 2010). The adequate representation of all stakeholders, early involvement of stakeholders in the watershed planning process, and the use of skillful facilitators and mediators are some of the measures that could enhance the quality of the deliberation processes (Reed 2008).

Providing Opportunities and Resources

Empowering stakeholders to be actively involved in watershed management processes will require the provision of opportunities and resources for participation. Enabling legislative and regulatory frameworks are needed to institutionalize collaborative processes and to guarantee the rights of stakeholders, particularly marginalized groups, to access information and to participate in decision-making processes. However, it is not enough to have the opportunity to participate. Stakeholders must also have the capacity to participate fully in collaborative processes (Reed 2008). This calls for various mechanisms for capacity-building, including training on how to participate in collaborative processes, and the provision of various forms of resources, such as funding and logistics. To ensure equity, special attention needs to be paid to marginalized groups who are often constrained from accessing the information, opportunities and resources for participation in collaborative processes.

Using Individual and Institutional Attributes in Watershed Management

There are multiple methods by which a watershed manager can use social and institutional information in the watershed planning and implementation processes. Prokopy et al. (2009) and Genskow and Prokopy (2011) developed a system for collecting social data for projects funded by Clean Water Act §319 funds (grants dedicated to prevention and remediation of nonpoint source pollution) based upon individual and project level data. Their system includes assessing changes in the awareness, attitudes, behaviors, and constraints of individuals targeted by watershed management efforts (Table 1). They also include a set of indicators associated with increasing the organizational capacity of watershed projects that measure the resources projects that have received 319 funds.

Davenport and Seekamp (2013) also recognized the complex and interwoven factors impacting the ability an individual has to engage in actions to protect water resources, and developed a framework that incorporates individual level variables similar to those Prokopy et al. (2009) developed, relational variables such as networks and shared definitions of resource concerns, organizational variables including engaging diverse stakeholders in collaborative processes, and programmatic variables such as coordinating goals across institutional boundaries (Davenport and Seekamp 2013). Davenport (2013) includes perceptions related to fairness and legitimacy in the Social Measures Monitoring System developed for Minnesota watershed projects. Table 2 includes a selection of variables from Minnesota's system, with the addition of risk perception.

Regardless of the framework or approach used, managers would ideally collect social information in the same manner water quality, habitat, and other environmental indicators are collected: at the outset

Table 1. Social Indicators Planning and Evaluation System (adapted from Genskow and Prokopy 2011).

Indicator Category	Outcomes	Indicators
Awareness	• Increase awareness of technical issues and behaviors	• Consequences of water pollutants • Types of pollutants • Pollutant sources • Appropriate practices
Attitudes	• Change attitudes to facilitate behavior change	• General water quality attitudes • Willingness to take action
Constraints	• Reduce constraints to behavior change	• Constraints to behavior change
Capacity	• Increase capacity to leverage resources • Increase capacity to support appropriate practices	• Resources leveraged as a result of project funding • Funding available to support practices • Technical support available for practices • Ability to monitor practices
Behavior	• Increase adoption of water quality relevant behaviors	• Percentage of critical area receiving treatment • Percentage of target audience implementing practices

Table 2. Capacity Indicators (adapted from Davenport 2013).

Individual Capacity	Relational Capacity	Organizational Capacity	Programmatic Capacity
• Awareness of problems and consequences • Concern about problems and consequences • Perceived control and efficacy for protection and restoration of water resources • Sense of responsibility for problems, consequences, and solutions • Personal norms related to behavior • Social norms related to behavior • Attitudes and beliefs • Ability to take action • Behavior adoption and change	• Inclusive social networks • Shared identity • Connectedness and trust • Positive social interactions • Collective action	• Diversity of members • Effective leadership • Access to information • Clearly defined mission and identity • Meaningful engagement • Collaborative decision making process • Conflict management • Accountability for problems, consequences, and solutions • Positive community influence • Effective engagement	• Clear goals and objectives • Adequate resources • Evidence based programs • Effective citizen engagement • Program coordination across boundaries • Program outcomes (ecological, social, economic) monitored and used for adaptation • Programs build capacity • Programs are effective in protecting and restoring resources

of projects to provide a baseline set of data and focus project goals, and throughout implementation to evaluate progress and adapt as necessary.

The process of collecting social information occurs at several scales and at different points in the planning and implementation cycle. Researchers have noted that the role of stakeholder engagement can shift over time in watershed projects given the power-sharing constraints agencies face, particularly with regard to implementation of project decisions. For instance, in projects dependent upon federal funding – particularly in agricultural watersheds – stakeholders might have a high degree of involvement in visioning, setting direction for a project, and developing goals, but very little power over how implementation projects are carried out due to the necessity of abiding by agency criteria (Floress et al. 2011b; Thompson and Floress 2012). For example, cost-share practices on agricultural lands are subject to Natural Resources Conservation Service criteria. Table 3 illustrates how participation goals, methods of collecting information, and the degree of decision-making power a collaborative group has might change over the course of a project depending on the reality of agency constraints. Other projects might have the ability to engage in co-management. It is vital that projects determine at the outset the degree of power they are able to extend to stakeholders at each stage of the planning and implementation process, and clearly communicate this information to participants. Perceptions of trust, legitimacy, and fairness can be quite negative if stakeholders expect greater power in implementation decision-making than can reasonably be afforded by watershed managers.

Table 3. Potential changes in stakeholder involvement and project activities over time.

	----------Planning Stage----------			
	Early Planning	**Mid-Planning**	**Implementation**	**Evaluation**
Goals of Stakeholder Activities	• Assess individual capacity indicators • Develop organizational and relational capacity	• Focus planning efforts • Develop organizational and relational capacity • Develop effective programs	• Collaborative group members engage in program delivery	• Determine whether plan has achieved goals – assess all capacity indicators
Project Activities	• Visioning, surveys • Focus group • Collaborative group meetings	• Collaborative group meetings • Capacity indicators used to inform implementation plan and programs	• Field days • Peer to peer networking/ neighbor visits • Other program activities appropriate to audience	• Follow up surveys • Focus groups/ interviews with group members • Institutional analysis
Stakeholder Decision-Making Control	• High – set project direction	• High – continue to set direction; share power for goal development	• Low/medium – some conservation programs have specific requirements	• Low – evaluation plan should be detailed in the watershed plan

Social Data Application Example: Eastern Marathon County Lakes, Wisconsin

This section will provide a brief overview of how a watershed project can use social data to increase adoption of behaviors. A county-wide planning process to protect 11 small lakes in Central Wisconsin was undertaken in 2010. A variety of ecological and social data were collected, including the Prokopy et al. (2009) social indicators described above (awareness, attitudes, constraints, behaviors), trusted information sources, characteristics of landowners, and perceptions of lake issues. The purpose was to develop targeted outreach strategies appropriate for the lake residents. First, the social scientist researcher on the technical team consulted with the lakes' planning grant recipient to understand the local issues. A mail survey was conducted of all landowners in the surface and ground watersheds, and audiences were segmented based upon project team input and statistical methods. Following is a description of one target audience – consumptive wildlife recreationists – and the strategies developed to impact behavior.

Consumptive wildlife recreationists made up almost 73% (n=215) of the individuals who participated in the survey. Of those, 112 owned shoreline property and 42 of the shoreline property owners had never heard of having a vegetated shoreline. Moreover, 27 of the lakeshore owners believed having vegetation along the shoreline didn't apply to their property. They noted that their biggest barriers to having a vegetated shoreline were not knowing where to get assistance, cost, and time. By using the information sources this population viewed as most trustworthy (lake groups and sportsmen's clubs) and messaging that resonates with consumptive wildlife recreationists, the project can appeal directly to the target audience, and start with a simple behavior.

One barrier to change, in this instance, is that individuals didn't know where to go for help. The first simple behavior could be to call a partner organization. Information overload should be avoided when communicating with audiences, particularly audiences relatively uninformed about watershed management issues in general and a local project in particular. Making the message and behavior relevant and easy to digest is key to successful behavior change. It was recommended that the project use mass media and lake groups to highlight the message that "shoreline vegetation makes hunting and fishing better, and there are places to help you", provide contact information for a project partner, and ask lakeshore owners to contact the organization (Figure 2). Short-term outcomes from this simple strategy would be increased knowledge of where to get help, increased knowledge that shoreline vegetation is related to fishing and hunting, and increased calls for help. Medium-term outcomes include changes in behavior (e.g. increased vegetated shoreline), and long-term outcomes would include changes in environmental conditions such as decreased pollutants entering lakes and healthier fish populations.

Conclusion

This article has made clear the importance of incorporating social science into watershed management. Much of what managers need to do in order to achieve successful implementation requires social science expertise to translate social and institutional information into actionable program activities. Much like ecological indicators, social science indicators will differ watershed by watershed. In large scale watershed projects, institutional analysis methods can be employed to understand the breadth of current program offerings and the degree to which they are coordinated with others offered in the watershed. To increase adoption of water-relevant behaviors, watershed management plans should include communication strategies that are targeted toward specific audiences, such as in the Eastern Marathon County Lakes example above.

Solving issues associated with water quality and quantity will not be accomplished with simple technical fixes. It is our hope that this article provides readers a background in the social science of watershed management, and tools and resources that can be used to understand stakeholders and make watershed plan implementation more successful. However, it is important to note that this article should not be used as a substitute for direct consultation with an expert. The best way to get

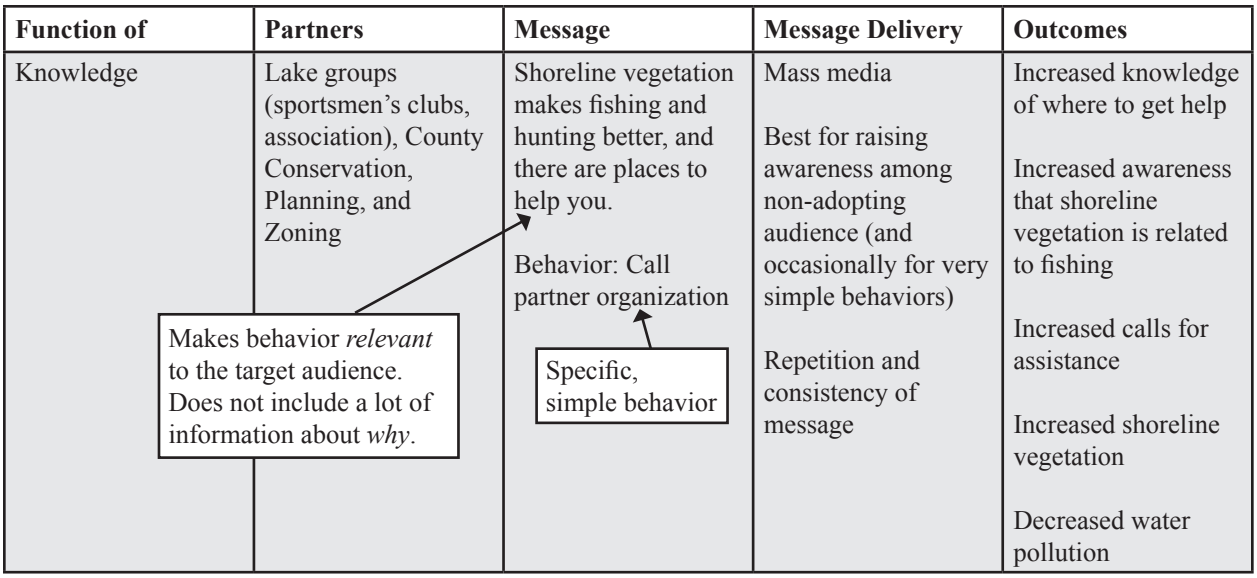

Figure 2. Where to get help: Illustration of using social data in watershed plans.

good information for use in watershed management is to consult directly with someone with expertise in this field of study. Local universities, state environmental management agencies, and private consultants usually have staff members who are able to assist watershed projects with their data collection and strategy development needs.

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