KNOWLEDGE PRODUCTION AND USE IN COLLABORATIVE ENVIRONMENTAL GOVERNANCE: A CASE STUDY OF WATER ALLOCATION PLANNING IN SOUTH AUSTRALIA

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ABSTRACT

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By permitting the integration of multiple forms of knowledge through joint fact-finding, it is suggested that collaborative governance approaches can produce more holistic and place-based understandings of environmental problems and help to alleviate conflict among stakeholders over the knowledge that is used to make decisions. Despite the central role of knowledge in collaborative processes, research in the collaborative environmental governance field to-date has provided limited practical insight into what they can and cannot achieve or how processes should be structured and run to produce successful outcomes related to knowledge production and use.

This study seeks to address this gap in the literature through three specific research objectives: (1) to develop a theoretical framework for analyzing knowledge production and use in collaborative environmental governance; (2) to use the framework to analyze knowledge production and use in a real-world collaborative environmental governance process; and (3) to offer recommendations for designing or adapting collaborative environmental governance processes to better achieve the goals of collaboration related to knowledge production and use.
A multiple case study approach was used to analyze knowledge production and use in a collaborative water allocation planning process in South Australia. The findings affirm that a number of theorized process and outcome criteria associated with successful knowledge production and use are achievable in practice. Despite limited evidence that local actors were involved directly in producing knowledge within the processes that were examined, the findings showed that participants in at least one of the cases were able to achieve a high level of understanding and acceptance of the knowledge used to base policy decisions, as well as to build social capital among scientists and local participants. This paradox draws attention to limits of current theories in the collaborative environmental governance literature for designing and implementing successful collaboration and offers important insights for evaluating collaborative processes. The study also provides a preliminary set of recommendations for structuring and executing collaborative processes to achieve successful outcomes related to knowledge production and use. While the findings of this study relate most directly to the water allocation planning system in South Australia, they are also transferable to other collaborative institutions, particularly those that are nested within a more traditional top-down system of governance.
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CHAPTER ONE
INTRODUCTION

Research Context and Problem Rationale

Collaborative forms of environmental governance are generally promoted as a way of increasing the ownership and acceptability of decisions by various stakeholders involved in an issue (Blackstock and Richards 2007). They can also improve understanding of complex environmental systems (Allen and Kilvington 2005) and, ultimately, produce more effective solutions that are tailored to local conditions (Innes and Booher 2004). It has been suggested that more context-specific solutions are reached in part because collaboration promotes a greater sensitivity to and use of local knowledge in the process (Lane and McDonald 2005). Integrating local knowledge with conventional scientific knowledge can generate more place-based and adaptive understandings of environmental problems (e.g., Neis, et al. 1999; Folke, et al. 2005).

Through collaboration, proponents suggest, knowledge gains legitimacy because “it is established within an open context of engaged criticism between experts and non-experts” (Wallington, et al. 2008). According to Trachtenberg and Focht (2005), a key criterion of “procedural legitimacy” in a collaborative process is that it must allow for a fair consideration of the views of a full range of participants, including their empirical descriptions of the catchment. Similarly, Blackstock and Richards (2007) emphasize the importance of reasoned debate and reaching mutual understanding through the quality and persuasiveness of arguments rather than by coercion, deception or manipulation. By providing a forum to openly discuss and debate different perspectives, collaborative governance processes can increase the transparency of decisions (Lach, et al. 2005) and
can create the conditions under which participants can assess the quality of the (often uncertain) science that is used to support those decisions (Funtowicz and Ravetz 1993).

A considerable body of research explores how knowledge is produced and used, and the relationships that exist among “experts” and “non-experts” from a range of perspectives and in a variety of environmental issue contexts (e.g., Wynne 1992, Eden 1996; Petts 1997; Neis, et al. 1999; Rhoads, et al. 1999; Weible, et al. 2004; Petts and Brooks 2006, White and Hall 2006). Knowledge has been defined as “the capacity for effective action in a domain of human actions” (Spiegler 2003, p.535). While the term “knowledge” is commonly used interchangeably with “data” and “information”, some authors have distinguished between knowledge, information, and data and have attempted to describe the relationship between the three (e.g., Spiegler 2003; Michaels, et al. 2006). According to Spiegler (2003), data becomes information when it is “endowed with purpose”, and information is transformed into knowledge “when it adds insight, abstraction, and better understanding” (p.535). These ideas are reflected by Hillman and Brierley (2002), in the context of collaborative water governance, where they describe the decision making process as “an iterative progression from data acquisition through information-gathering and the establishment of a knowledge base to decision-making” (p.619).

A growing number of analysts have examined the integration of local and scientific sources of knowledge within both collaborative research (e.g., Castillo, et al. 2005; Fernandez-Gimenez, et al. 2006; Ballard, et al. 2008; Clark and Brake 2009; Johnson 2009; Giordano, et al. 2010) and collaborative management contexts (e.g., Fazey, et al. 2006; Kroon, et al. 2009; Raymond, et al. 2010; Spink, et al. 2010). Despite the promise
of collaborative forms of governance, researchers have identified particular challenges related to integrating different forms of knowledge in collaborative processes. Many of these challenges stem from underlying epistemological differences between positivist science and other types of knowledge (e.g., Eden 1996; Berkes 2004; Fazey, et al. 2006) and reflect strong opinions regarding forms of knowledge that are valid in environmental decision-making (e.g., Petts and Brooks 2006; Raymond, et al. 2010).

Numerous empirical studies have highlighted how “epistemological anxiety” (Innes and Booher 2010) among scientists and government officials towards local knowledge has prevented its use in different decision-making contexts (e.g., Wynne 1992; Murdoch and Clark 1994; Weible, et al. 2004; Giordano, et al. 2010). Discounting local knowledge can lead to outcomes that are driven by the science-based perspective of a central government agency rather than the shared understanding of problems and environmental systems that collaboration is intended to promote (Kapoor 2001; Berkes 2002). Conversely, other studies have questioned whether stakeholder involvement increases the technical quality of decisions by bringing local knowledge into decision making, or whether participation marginalizes “good science” by promoting decisions that are more publicly appealing but less technically correct (e.g., Beierle and Konisky 2001; McCloskey 2001; Lane and McDonald 2005). Previous studies have also highlighted practical challenges related to accessing and integrating local knowledge in environmental research and decision-making. Most commonly, these relate to the increased time and resource costs associated with non-scientist participation (Johnson 2009; Kroon, et al. 2009; Spink, et al. 2010).
These knowledge-related issues are indicative of a wider range of constraints that have been associated with collaborative governance approaches in the literature. While effective collaboration requires significant shifts in power among the various state and local actors involved, a number of empirical studies has shown that the role and influence of non-state actors in the process often remains uneven and highly contested (e.g., Fish, et al. 2010). A common criticism of collaborative processes is that they tend to favour dominant local interests at the expense of other local and non-local perspectives (e.g., Bradshaw 2003; Lane and McDonald 2005; Blackstock and Richards 2007; Margerum 2007). In this respect, McCloskey (2000) argues that representative democracy is undermined within collaborative processes where minorities can veto outcomes and ignore broader regional issues to serve local communities' interests.

At the same time, researchers have highlighted numerous cases of collaborative governance where the state has maintained the balance of power (Reed and Bruyneel 2010). In some circumstances, local actors may lack adequate tools or resources to participate meaningfully in the process. For example, Murdoch and Abram (1998) found that local actors in the United Kingdom lacked the capacity to understand and effectively debate housing projection figures produced by the government. It has also been argued that there are circumstances where the state must continue to take ultimate responsibility for decisions; for example, where blame or liability associated with an issue cannot be established because of significant uncertainty, poor data and or a lack of evidence (Fish, et al. 2010). These concerns highlight that where power is not genuinely devolved to local and non-state actors, a collaborative process may “simply serve to renew and re-emphasize state power (and the stronger groups of interest) in environmental politics,
rather than fundamentally changing the policy formulation or implementation process” (Fish, et al. 2010, p.5624).

In response to these types of concerns, as well as a dearth of empirical evidence of successful collaboration efforts, proponents of collaborative governance approaches are raising concern that an extensive gap remains between theory and practice (e.g., Jeffrey and Gearey 2006; Plummer and Armitage 2007). According to Jeffrey and Gearey (2006), collaboration (in the context of integrated water resources management) has substantive intuitive appeal but remains largely a normative concept. They argue that empirical evidence demonstrating the benefits of collaboration is either lacking or is poorly reported. Consequently, there is no blueprint or recipe book to inform the implementation of a collaborative process (Jeffrey and Gearey 2006). It has also been acknowledged that the basic assumption that collaboration leads to better resource management outcomes has not been adequately assessed (Bellamy, et al. 1999). Some scholars have cautioned against a broad endorsement of collaborative processes until their processes and outcomes have been more critically evaluated (e.g., Weible, et al. 2004; Blowers, et al. 2005). In particular, systematic evaluations of collaborative approaches have been recommended in order to gain practical insight into what they can and cannot achieve, their strengths and weaknesses and the most critical factors that influence their success (e.g., Bellamy, et al. 1999; Innes and Booher 1999; Blowers, et al. 2005; Koontz and Thomas 2006).

Despite the critical role that knowledge plays in environmental decision-making, and the epistemological and practical issues associated with integrating different forms of knowledge, specific criteria related to knowledge production and use have typically not
been included in frameworks for evaluating collaborative governance arrangements (e.g., Conley and Moote 2003; Sabatier, et al. 2005; Koontz and Thomas 2006; Ryan and Bidwell 2007; Rogers and Weber 2010). A notable exception exists in a branch of the collaborative environmental governance literature that has analyzed collaboration from a complex systems perspective (e.g., Folke, et al. 2005; Innes and Booher 2010).

Knowledge is a core concern from this point of view because it embraces environmental systems as inherently complex, dynamic and unpredictable and conceptualizes collaborative governance as a process of adaptive learning and problem solving. From this perspective, how knowledge is produced and used to make decisions is a fundamental issue.

Research in this area also emphasizes the importance of local knowledge in environmental decision-making. Authors such as Berkes (2004) and Folke, et al. (2005) argue that the use of local knowledge can help to produce a more complete information base and increase the capacity of environmental managers to cope with uncertainty and change. In their theory of collaborative rationality, Innes and Booher (2010) assert that a collaborative process must produce knowledge through joint fact-finding and an authentic dialogue among participants. The underlying basis of this approach is Habermas’ theory of communicative rationality (Habermas 1984) which argues that planning decisions should be socially determined through interaction and discussion among affected individuals, rather than be strictly based on scientific evaluation of what is rational (Murray 2005). Innes and Booher (2010) assert that systematic joint fact-finding and authentic dialogue in a collaborative process can create an agreed on base of information for decision-making and build social capital among participants. They subscribe to a co-
production model of public participation where “all publics are understood as potential contributors to all aspects of environmental planning decisions because the hard distinctions between expert and lay, scientific and political order, facts and values are rejected” (Corburn 2003, p.423). An inherent feature of this approach is that local knowledge is integrated with scientific knowledge at all stages of the collaborative process (Innes and Booher 2010).

While these ideas have drawn critical attention to the role of knowledge in collaborative environmental governance, the procedural and structural characteristics of collaborative processes that influence successful knowledge-related outcomes are not well specified. As a result, evaluations of actual collaborative processes to-date have provided limited practical insight into what they can and cannot achieve or how processes should be structured and run to produce successful outcomes related to knowledge production and use.

This research seeks to address the theoretical and practical challenges identified above, and to advance our understanding of knowledge production and use in collaborative environmental governance. The study has three specific objectives:

1. To develop a theoretical framework for analyzing knowledge production and use in collaborative environmental governance;

2. To use this framework to analyze knowledge production and use in a real-world collaborative environmental governance process; and
3. To offer recommendations for designing or adapting collaborative environmental governance processes to better achieve the goals of collaboration related to knowledge production and use.

In developing a theoretical framework for evaluating knowledge production and use in collaborative environmental governance, this study bridges a number of complementary bodies of literature concerned with collaborative governance, knowledge, and environmental decision-making. The framework identifies key outcome criteria related to knowledge production and use in collaborative governance processes. It also summarizes a range of criteria, identified in the literature, that are believed to be associated with successful knowledge production. Consistent with Ostrom’s (1990) perspective of frameworks, the set of criteria presented in this study is not intended to be used to derive a precise prediction. Rather, the framework points to a “set of variables and the types of relationships among variables that need to be examined in conducting any theoretical or empirical study of a particular type of phenomenon” (Ostrom 1990, p.192).

Through a case study of collaborative water governance in South Australia, the research analyzes and compares the desired and actual procedural elements and outcomes of collaboration and provides insight into the realistic expectations for knowledge production and use in collaborative processes. The case study also illuminates the critical structural and procedural factors related to knowledge production and use that are determinants of success in collaborative environmental governance. As jurisdictions increasingly rely on collaborative governance arrangements to address their environmental problems, understanding what they can and cannot achieve and the key
conditions influencing their success will be critical to determining when collaboration should be used and how to design, adjust, and execute a collaborative process to work effectively.

The study has been prepared as a manuscript option thesis. It presents stand-alone papers that address the objectives of the research and are written for publication in journals. In addition to introducing the purpose and objectives of the research, this chapter is intended to provide additional contextual information to supplement the material that is presented in the various papers. The remainder of this chapter is organized as follows. The next section provides a review of current concepts of collaborative environmental governance in the literature, followed by a description of the empirical context (i.e., water allocation planning in South Australia) for this research. An overview of the study methodology is then presented, including contextual information on the individual case study areas within South Australia and details about the data collection and analysis procedures used. The final section of the chapter explains the structure of the thesis.

**Characterizing Collaborative Governance**

Environmental problems have become increasingly complex and can no longer be framed as strictly technological or administrative challenges (Lebel, *et al.* 2006). Rather, they tend to be rooted in social and political issues as much or more than technological ones (World Resources Institute 2003; Lemos and Agrawal 2006). As a result, contemporary environmental issues such as climate change, waste management, and water allocation are challenging the ability of traditional state-led, top-down, science-driven approaches to
develop effective solutions. To address these types of problems, it is necessary to better understand the processes of governing, and, in particular, the relationships among the various actors involved (Imperial 1999). Governance is a useful concept for examining these processes and relationships. Generally, governance refers to “the structures and processes by which people in societies make decisions and share power” (Folke, et al. 2005, p.444).

There is broad consensus among academics and practitioners that local and non-government actors should be more directly involved in environmental governance (e.g., Bryant and Wilson 1998; Kapoor 2001; Lach, et al. 2005). The main rationale for such claims is that individuals who are directly affected by an environmental problem have a keener awareness of its symptoms and a direct interest or stake in proposed solutions (Funtowicz and Ravetz 1993). Integrating these perspectives into the environmental decision-making process can lead to a better understanding of a complex system, a shared understanding of the problem among participants, and more collective, informed and quality decisions (Innes, et al. 2004; Allen and Kilvington 2005). Moreover, there is a growing body of empirical evidence that demonstrates that involving local actors in identifying problems and developing solutions is critical to building the legitimacy and capacity needed to implement a policy effectively (Ostrom 1990; Fischer 2001). In response, collaborative approaches to environmental governance have become increasingly commonplace.

Collaborative environmental governance may be broadly defined as the sharing of power and responsibility among state and non-state actors in decision-making for environmental management (Carlsson and Berkes 2005). In Western democracies,
collaborative governance arrangements differ from traditional forms of governance in terms of their public participation objectives and underpinning democratic legitimacy. In many Western countries, the legitimacy of traditional governance systems is based on the theory and practice of representative democracy: a state agency’s actions are legitimate because they stem from the direction of elected representative bodies, which in turn provide oversight (Innes and Booher 2010).

In governance directed by the state, the objectives of public participation are typically to comply with legal requirements, to educate the public, and to obtain public support for agency proposals (Innes and Booher 2010). By comparison, collaborative governance has its roots in the theory of deliberative democracy (Parkinson 2003; Edwards 2007; Blau 2011). An overarching objective of collaborative governance processes is “to engage the public in joint learning and to build public capacity for problem-solving and adaptation” (Innes and Booher 2010, p.204). Importantly, collaborative governance processes are typically situated within or supplementary to other forms of governance. For example, in many Western countries, collaborative environmental governance processes supplement rather than replace the traditional forms of decision-making that occur through representative democratic institutions.

Scholars generally acknowledge that many different forms of collaboration can exist in practice (e.g., Moore and Koontz 2003; Sabatier, et al. 2005; Innes and Booher 2010). For example, Sabatier, et al. (2005) emphasize that “the collaborative watershed management approach is not a detailed blueprint, but rather a broad strategy for solving very complex sets of interrelated problems” (p.6). It includes several variants, such as “collaborative engagement processes”, “collaborative watershed partnerships” and
“collaborative superagencies” (Sabatier, et al. 2005). Similarly, Leach, et al. (2002) identify both “stakeholder partnerships” that meet periodically and indefinitely to address a suite of problems within an issue area defined by a broad topical theme (e.g., land use, public service provision) and advisory committees that operate over a finite period to address a specific project, program or regulation as examples of collaborative forums.

With a wide array of collaborative processes occurring in practice, an important issue for collaborative governance research is being able to distinguish cases of collaboration from stakeholder participation more broadly (Innes and Booher 2010). There clearly is no consensus on a formal definition of collaboration in the literature; however, there are some key characteristics that are commonly associated with collaborative processes. In the context of environmental governance, collaborations are typically viewed as place-based initiatives, focused on issues within a catchment or sub-catchment (Moore and Koontz 2003; Ryan and Klug 2005; Sabatier, et al. 2005). While Ansell and Gash (2007) regard collaboration as a process that is initiated by public agencies or institutions, most researchers agree that collaboration can also be initiated from the bottom-up at the community level (e.g., Ryan and Klug 2005; Innes and Booher 2010). There is broad consensus in the literature that collaborative processes involve multiple parties, including state and non-state actors, who have an interest or stake in the outcomes (e.g., Gray 1985; Conley and Moote 2003; Margerum 2008). Many analysts view collaboration as a forum that meets over a long-term or indefinite period; however, some acknowledge that a collaborative process can also be finite in duration, over a shorter term (e.g., Leach, et al. 2002; Innes and Booher 2010).
A critical aspect of collaborative processes, emphasized by many scholars, is that they provide a forum where participants are engaged directly in decision-making through a face-to-face, authentic dialogue (e.g., Cheng and Daniels 2003; Margerum 2008; Innes and Booher 2010). There is also general agreement in the literature that participants in a collaborative process aim to make decisions by consensus (even if consensus is not achievable in practice). These are key features that distinguish collaboration from other stakeholder participation processes where stakeholders are merely consulted by government agencies (Ansell and Gash 2007).

Importantly, a number of scholars also identify joint fact-finding and information exchange as defining characteristics of collaborative processes (e.g., Gray 1985; Cheng and Daniels 2003; Sabatier, et al. 2005; Innes and Booher 2010). According to Cheng and Daniels (2003), a key feature of collaboration is that it brings together and fosters mutual learning among technical experts and stakeholders. Innes and Booher (2010) contend that collaborative processes emphasize expert knowledge and reasoning based on argumentation. Therefore, a critical condition of a legitimate collaborative process is that participants are fully informed and able to express their views and be listened to (Innes and Booher 2010). These perspectives highlight knowledge as a fundamental concern in collaborative environmental governance. How knowledge is produced and used in collaborative processes is the focus of this study. The following section provides the empirical context for the research and describes the characteristics of the collaborative governance process that was analyzed as a case study.
Empirical Context

Water allocation planning offers a rich context in which to study knowledge production and use in collaborative environmental governance. In essence, water allocation is a process of assigning rights to the withdrawal and or use of water (Kreutzwiser, et al. 2004). At its core, water allocation planning is concerned with managing for the extraction of water from rivers and aquifers for agricultural, industrial, domestic and other purposes; however, planning can often include the management of infrastructure such as dams and weirs used to store and manipulate flows to supply water for extraction (Hamstead, et al. 2008). Water allocation systems involve the integrated development and application of legislation, regulation and policies, as well as hydrological and hydrogeological science, data management systems, and education, consultation, and conflict resolution processes. Water allocation systems regulate available water supplies in accordance with agreed-upon social, economic and environmental goals and objectives which are commonly defined across a range of scales including local (sub-catchment), catchment, and regional (Conservation Ontario 2003). Thus, water allocation planning is an inherently complex environmental governance issue involving significant technical, social and political challenges.

Around the world, the underlying paradigm for water resource development and management has changed dramatically in recent years. There has been a shift away from the traditional focus on supply-side solutions that involve taming the natural hydrological cycle and relying on physical infrastructure to satisfy growing demands for water (Gleick 2000). According to Gleick (2000), the old paradigm has failed for a range of environmental, economic and social reasons, including tightening budgets and the high
costs of infrastructure construction, growing environmental concerns, new technological advances, the changing nature of water demand, and the emergence of alternative approaches to management. New water management regimes reflect a growing emphasis on ecological values and meeting basic human needs. In the specific context of water allocation, protecting in-stream uses of water has become a high priority in many countries, leading to efforts to clarify and redefine the rights of consumptive users against others who value the maintenance of stream flows for ecological and recreational purposes (e.g., Miller, et al. 1997; Hillman 2005; Howard 2008).

A major challenge for modern water allocation regimes is to define ecological and other in-stream water requirements clearly enough to guide allocation decisions that balance competing demands and visions (Poff, et al. 2003). Determinations of environmental water requirements and associated sustainable levels of extraction can be the source of major disputes wherein water managers, water users and other stakeholders attempt to agree on a fair and efficient allocation of limited water supplies. This is illustrated in examples from Australia where providing water to the environment has become a highly controversial issue that has emerged as one of the most difficult aspects of the country’s recent water reforms (Pigram 2006). The use of disputed data and science by Australian government agencies to justify the reallocation of water from consumptive uses to the environment has damaged trust among water managers and users and raised substantial criticism of the water management policies (e.g., Kuehne and Bjornlund 2006; Pigram 2006; Hamstead, et al. 2008).

Measurability has been identified as a key impediment to accurately characterizing in-stream water needs and setting sustainable levels of use (Miller, et al. 1997; Johnson
In many catchments, the hydrological and ecological characteristics are poorly understood. Even where sophisticated hydrological models are available, they may be unreliable under conditions that are significantly different from those on which the model is based (Miller, et al. 1997; Arthington and Pusey 2003). To exacerbate the problem, records of actual water withdrawals and consumption are also frequently lacking.

Arguably, an even greater challenge to balancing human and environmental demands for water stems from a lack of consensus regarding what constitutes a “healthy” water environment (Hillman and Brierley 2002; Pigram 2006). In developed areas, water ecosystems are generally not in a pristine state. Past management and use of water has resulted in significant and often irrevocable changes (Hamstead 2009). In such altered river systems, realistic ecological outcomes, and associated requirements for flow quantity, timing, and quality are difficult to determine. Concepts such as ecosystem health are often viewed as properties that can be objectively measured and targeted. Carolan (2006) argues that ecosystem health is in fact a value statement that rests on beliefs about what we think nature should look like. This raises doubt about the ability of water management agencies and technical experts alone to set management objectives for a particular catchment and to subsequently determine the allocations of water required to achieve those objectives.

As a result of these types of challenges, governments and other agencies responsible for managing water are now struggling to redefine the boundaries between state and non-state control over how water resources are allocated and used. Many analysts have recommended the use of governance approaches where an understanding of resource conditions and decisions about the allocation of available water are determined
collaboratively among resource managers and water users (e.g., Lach, *et al.* 2005; Morris, *et al.* 2006). This reflects a broader trend in natural resources management towards catchment-scale arrangements, which provide opportunities to focus data collection, planning, and decision-making at more ecologically and hydrologically appropriate scales and to engage resource users and their knowledge more effectively (Dovers 2001). In the context of river rehabilitation, Brierley, *et al.* (2006) contend that the integration of scientific and local knowledge is required in order to generate grounded visions for a particular system under investigation, thereby ensuring that those visions are owned by the communities concerned. In South Africa, for example, scientists have worked with a range of water users to develop a consensus-based vision for the ecological health of Kruger National Park’s river ecosystems. In this case, qualitative stakeholder objectives were translated into quantitative management targets (Poff, *et al.* 2003).

In many countries around the world, collaborative governance is seen as an effective way to accomplish joint decision-making. By integrating multiple perspectives and sources of knowledge into decision making, it has been suggested that collaborative governance processes can lead to a better understanding of complex environmental systems, a common understanding of the problems among participants, and more collective, more informed and effective solutions (Innes, *et al.* 2004; Allen and Kilvington 2005). Collaboration may therefore offer a means of alleviating the tension and conflict over the knowledge that is used to make water allocation decisions.

**Water Policy in Australia**

Prior to the 1990s, water management policy in Australia was controlled by individual state governments and driven primarily by objectives related to population settlement and
economic development (Hussey and Dovers 2006). In recent decades, severe and recurring water scarcity and salinity problems have fostered a change in philosophy towards water management, and triggered significant changes to Australia’s water institutions (Hussey and Dovers 2006; Pigram 2006). The first comprehensive transformation occurred in 1994 when the state and federal government signed the Council of Australian Governments (COAG) water reform framework. The framework introduced a raft of reforms in the water sector as part of a broader micro-economic reform agenda and an associated national competition policy (Bjornlund 2003). The COAG water reforms of the 1990s addressed the need to reallocate water among various competing uses and specifically acknowledged the environment as a legitimate user of water. By linking reforms to a large national program for economic revitalization and development, the market and the private sector assumed significant roles in water management (McKay 2005). Actions stemming from the 1994 COAG agreement focused on productivity, reducing state subsidies, and prioritizing formal entitlements to water and using markets and property rights mechanisms to reallocate water (Hussey and Dovers 2006).

While significant progress towards more efficient and sustainable water management was achieved under the 1994 COAG water reform agenda, the need for further national water reform persisted. One major concern related to uncertainty over long-term access to water in many areas – a factor that was felt to be preventing water markets from delivering their full potential, and delaying the securement of adequate environmental flows in rivers and waterways (Pigram 2006). Others have pointed to inherent biases in water trading toward self-interest as a factor that limited the
effectiveness of the 1994 COAG reforms. As Loch, et al. (in press) explain: “left to their own devices…water markets would always reallocate too much to consumptive users and not enough to environmental flows”. A review of the COAG reforms in 2003 raised considerable concern about the pace of securing adequate water for the environment.

The need for continued water reform at the national level resulted in the National Water Initiative (NWI), which was adopted by COAG in June 2004. This new agreement extended the previous water reforms into an overarching national policy statement for water in Australia. The objective of the NWI is to develop a compatible, market, regulatory, and planning-based system for managing surface and groundwater resources for rural and urban uses that optimizes economic, social and environmental outcomes (COAG 2004). Under this initiative, Australian state governments have committed to (Commonwealth of Australia 2010):

- Preparing water plans with provision of water for the environment;
- Dealing with over-allocated or stressed water systems;
- Introducing registers of water rights and standards for water accounting;
- Expanding water trading;
- Improving pricing for water storage and delivery; and
- Meeting and managing urban water demands.

Statutory water plans provide the operational framework for delivering much of the agreement’s objectives (Gentle and Olszak 2007). Water plans are the primary mechanisms for determining, on a catchment or system basis, how much water can be allocated to consumptive purposes and for ensuring that sustainable levels of extraction
are achieved and maintained. In each catchment, catchment management authorities are required to determine environmental water needs, to define the amount of water available for consumption, and to decide how available water will be shared among existing and future water users (COAG 2004). In preparing plans, authorities are responsible for understanding, among other things, the available water supply within catchments and the needs of current, future and indigenous water users, and for identifying aquatic ecosystems of high conservation value and their water requirements. Assigning a prominent role in water planning to catchment management authorities was one of the key recommendations of the Wentworth Group of Concerned Scientists, an influential Australian environmental policy think-tank, whose members argued that “distant authorities do not have access to local knowledge required to develop and deliver innovative strategies” (TWG 2003, p.14). This reflects a broader priority in the NWI to engage water users and other stakeholders in achieving the objectives of the agreement by building confidence in the reform process, ensuring transparency in decision-making, and providing the public with sound information at key decision points (COAG 2004).

The empirical focus of this thesis research is on the statutory planning aspects of the NWI and in particular, the statutory water allocation planning process in South Australia (see below). The research presented in this dissertation was conducted in the context of the relevant water management institutions that were in place in Australia during the period of data collection from 2007 to 2008. Since 2008, water reforms in Australia have continued at a fast pace, in response to concerns about the inadequacy of previous actions to achieve their objectives and the severe drought conditions that continue to plague southern Australia. These recent water reforms in Australia are summarized below;
however, the implications of these changes on the research findings have not been assessed in this study.

**Recent Australian Water Reforms**

A 2009 assessment of NWI implementation was critical of the progress made by states towards returning overallocated or overused systems to environmentally sustainable levels (NWC 2009). Although pathways to return overallocated systems to sustainable levels of extraction were identified in the water plans that were reviewed for the assessment, few such systems had been successfully transitioned to within sustainable extraction limits (NWC 2009). Other analysts have highlighted reluctance by state authorities to even identify surface and groundwater systems as overallocated (Hamstead 2009). At the same time, widespread drought has continued to plague Australia and has resulted in critical environmental degradation in the Murray-Darling Basin and across southern Australia. High-profile cases of ecological decline, such as in the Lower Lakes and the Coorong in South Australia, have been linked to a combination of drought and unsustainable levels of extraction.

In the midst of these unprecedented challenges associated with the prolonged drought conditions, the Australian Government has recently expanded its role in water policy and management, especially within the Murray-Darling Basin. In April 2008, the Australian Government released a $12.9 billion *Water for the Future* plan. A key initiative under the plan is the *Restoring the Balance in the Murray–Darling Basin Program*, aimed at purchasing $3.1 billion worth of water entitlements over 10 years within the Basin to be used to protect or restore environmental assets. By the end of 2009, the government had purchased 766 gigalitres of water entitlements worth over $1.2
billion (Commonwealth of Australia 2010). The government’s decision to use a large-scale entitlement buy-back scheme in the Murray-Darling Basin has been linked to failures of state-led water planning efforts to adequately secure water for the environment (e.g., Loch, et al. in press).

The Commonwealth Water Act 2007 and 2008 Intergovernmental Agreement on Murray–Darling Basin Reform have introduced further institutional changes including establishing the Murray–Darling Basin Authority. The new authority has been given responsibility for developing a basin-wide plan by 2011 which will include environmentally-sustainable diversion limits for the basin’s surface and groundwater resources.

Water Allocation Planning in South Australia

The Water Resources Act 1997 established a comprehensive allocation and planning framework in South Australia that was consistent with the 1994 COAG water reforms. The framework featured water allocation plans as the primary tool for determining water access entitlements within prescribed catchments, taking into account all water resources and allowing for environmental and other public benefit outcomes. The Water Resources Act 1997 was replaced by the Natural Resources Management Act 2004 which broadened the scope of the planning framework to promote ecologically sustainable use and management of a range of natural resources within the State but retained the statutory requirements for water allocation planning. The South Australian government has identified this framework as the primary mechanism for meeting its commitments to statutory water planning under the NWI and achieving the objective of returning
overallocated and overused systems to environmentally sustainable levels of extraction (Government of South Australia 2005).

The *Natural Resources Management Act 2004* lays out the framework for “prescribing” the water resources within catchments where water supply and aquatic ecosystems are believed to be at risk (Figure 1.1). The legislation requires regionally-based Natural Resources Management Boards (NRM Boards) to prepare a water allocation plan for each of the prescribed water resources in their jurisdiction. Among other things, water allocation plans must (Government of South Australia 2005):

- Assess the needs of water-dependent ecosystems located within or downstream of the prescribed catchment;
- Provide for sustainable allocation and use of the available water;
- Determine how water will be allocated to licensed users in the form of personal property that is separate from land;
- Set out how water trading will apply in the catchment; and
- Provide for resource monitoring and evaluation arrangements.

The water allocation plans are statutory instruments, approved by the state government, and are used by the South Australian Department for Water (formerly the Department of Water, Land, and Biodiversity Conservation) to issue water allocation licenses, to manage the transfer of water licenses among users, and to permit various water-affecting activities (e.g., dam and bore construction) within the catchment. The legislation mandates the scope and contents of water allocation plans, the technical matters to be investigated in the preparation of the plan, and the process for preparing
water allocation plans. In addition to approving and administering the water allocation plans throughout the state, the Department for Water also provides technical support to the NRM Boards in preparing plans by supplying pertinent monitoring data and often conducting the required investigations. In some cases, the boards hire independent consultants to undertake some or all of the technical work.

Figure 1.1: Overview of the water allocation planning process in South Australia

The Natural Resources Management Act 2004 outlines specific requirements for public consultation at two stages in the plan development process – once at the outset on the proposed structure of the plan (a “concept statement”) and again to seek feedback on a draft version of the plan. In addition to these mandated requirements, many of the NRM
Boards have formed community advisory committees as a means of collaborating with key stakeholders within the catchment more directly in the development of water allocation plans. The committees are formed of water users, industry and interest-group representatives, and catchment residents chosen by the NRM Boards from individuals who have expressed an interest in participating. The number of participants on the advisory committees varies depending on the size of the prescribed area, as well as the number of water users and variety of water uses within the catchment. The committees are facilitated by a plan coordinator from the presiding NRM Board and are typically chaired by one of the community representatives. Committees typically meet face-to-face every one to three months; however, the frequency of meetings can vary depending on the stage of the planning process.

The roles of the community advisory committees are typically “to provide a balanced and researched review of options for water allocation and water resource management in the [prescribed water resources area] and to make recommendations on these issues to the [NRM] Board, ensuring a balance of economic, social and environmental benefits” (River Murray Catchment Water Management Board 2005, p.4). The Natural Resources Management Act 2004 also requires water allocation plans to be reviewed and updated as needed every five years. In some cases, advisory committees are dis-banded following the preparation of a water allocation plan. More often, committees are maintained through subsequent plan review and update processes.

In summary, a collaborative governance approach is being used by the NRM Boards to develop water allocation policies and plans for the prescribed catchments within their jurisdiction.
• The advisory committees are initiated by the NRM Boards;

• Members of the advisory committees include irrigators, residents and other non-government stakeholders from the catchments;

• Participants are engaged directly in decision-making regarding policies for the water allocation plan and are not merely “consulted” by the NRM Boards on pre-determined policies;

• The advisory committees are formally organized and meet collectively;

• The committees endeavour to make decisions by consensus; and

• The focus of the advisory committees is on developing public policies for allocating water resources within the catchments.

The form of collaboration occurring in the South Australian water allocation planning system is especially consistent with the definition of collaborative governance offered by Ansell and Gash (2007). The nature of the committee process in South Australia is also consistent with Leach, et al.’s (2002) characterization of “advisory committees” in that they operate over a finite period to address a specific project, program or regulation. There are, however, some features of the case study context that do not fall squarely into existing typologies of collaborative governance. The water allocation regime in South Australia, as a whole, follows a more traditional top-down governance approach. As a result, the collaborative process being examined in this research is nested within a highly prescriptive regulatory framework that defines the issue, prescribes the terms of reference for technical investigations, as well as the scope of broader public engagement and policy options. Moreover, the knowledge needed to
develop the water allocation plans is largely generated by state agency scientists. These characteristics directly influence what is expected and what is achievable from the collaborative efforts.

**Methodology**

A case study approach was used to examine knowledge production and use in collaborative environmental governance. The problem under investigation demanded an ability to analyze issues in sufficient depth to understand the dynamics of the unique social and decision processes involved in the collaborative processes that were studied. A qualitative approach was chosen for its potential to achieve a detailed understanding of the phenomena being investigated from the perspective of people who are directly involved in the processes (Margerum 1999; Gerring 2007). Qualitative methods, including case studies, have largely dominated research on collaborative governance to-date.

A multiple case design (four case study catchments within South Australia) was used in this study in order to compare collaborative efforts across cases and to analyze how variations in individual processes and contexts may influence their outcomes (Conley and Moote 2003; Yin 2003). Collaboration within the case study catchments was being undertaken within the same institutional framework; therefore, the individual case studies shared several characteristics that helped to make the comparisons meaningful (Conley and Moote 2003).

The specific catchments within South Australia that were used as case studies for this research were selected using five main criteria. First, the responsible NRM Board
had to have recently completed or be in the process of developing a water allocation plan. Second, the NRM Board had to have formed a community advisory committee to collaborate with on the preparation of the plan. Third, the NRM Board had to be far enough along in the plan development process to have produced tangible outcomes (e.g., draft policies or a draft plan) that allowed for an investigation of the role of different types of knowledge in the collaborative governance process. Fourth, catchments of varying size were selected in order to examine the influence of geographic scale on the collaborative process. Lastly, planning participants, including advisory committee members and government agency policy and science staff, had to be accessible and willing to participate in the research, and key documents such as advisory committee meetings and process documents (e.g., meeting agendas and minutes) had to be accessible. Key informants from agencies responsible for water allocation planning in South Australia, including the Department for Water and two NRM Boards, were consulted on prospective case study areas and the extent to which they would satisfy these selection criteria.

Four prescribed water resources areas in South Australia that met the selection criteria were chosen as case studies for this research (Figure 1.2): the Barossa Valley (Barossa) Prescribed Water Resources Area; the Marne-Saunders (Marne) Prescribed Water Resources Area; the Eastern Mount Lofty Ranges (EMLR) Prescribed Water Resources Area; and the Western Mount Lofty Ranges (WMLR) Prescribed Water Resources Area.
The water resources (including surface water, groundwater, and watercourses) in each of the areas are “prescribed” under the *Natural Resources Management Act* and the respective NRM Boards were in the process of developing water allocation plans (Table 1.1). In each case, the agency responsible for preparing the plan had formed a community advisory committee to collaborate on the development of the plan. At the time of the data collection for this research (2007 to 2008), the planning process was well advanced in each of the four areas. Advisory committees had been active for at least two years and
draft policies were being developed and discussed by the committees. It is also important to note the geographic scale variations among the four cases: the EMLR and WMLR areas are significantly larger than the Barossa and Marne areas. The case studies considered in the research are complex. Therefore, this section provides additional contextual information to supplement the material about the cases that is presented in the following chapters.

Table 1.1: Summary of Selected Case Study Area Characteristics

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Size (km²)</th>
<th>Main Water Use(s)</th>
<th>Agency Responsible for Plan</th>
<th>Advisory Committee Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barossa</td>
<td>711</td>
<td>• Irrigated agriculture (grape vines)</td>
<td>Adelaide &amp; Mount Lofty Ranges NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>Marne</td>
<td>743</td>
<td>• Irrigated agriculture (lucerne, grape vines, olives)</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>EMLR</td>
<td>2,845</td>
<td>• Irrigated agriculture</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Two regionally-based committees (meeting jointly)</td>
</tr>
</tbody>
</table>
| WMLR       | 2,750     | • Irrigated agriculture (pasture, grape vines, fruit and nut trees)  
• Water supply for Metropolitan Adelaide | Adelaide & Mount Lofty Ranges NRM Board (with Department of Water, Land & Biodiversity Conservation) | Three regionally-based committees (periodic joint meetings) |

Sources: Adelaide and Mount Lofty Ranges NRM Board (2009); Adelaide and Mount Lofty Ranges NRM Board (2010); South Australian Murray-Darling Basin NRM Board (2009); South Australian Murray-Darling Basin NRM Board (2011)
The Barossa Prescribed Water Resources Area is centred approximately 60 kilometers north-east of Adelaide and covers a total area of approximately 711 square kilometers (Figure 1.2). Over 90% of water withdrawn from surface water, groundwater and watercourse sources is used for irrigation purposes. Imported water is also supplied to the region via the Barossa Infrastructure Limited (BIL) scheme. Further, some irrigators in the region hold River Murray water licences, which are delivered through SA Water infrastructure (Adelaide and Mount Lofty Ranges NRM Board 2009). Grape vines are by far the dominant irrigated crop in the Barossa Valley. Pasture and lucerne are among other significant irrigated crops in the area. Some water is also used for industrial, stock and domestic purposes. According to the current Barossa Valley Water Allocation Plan (Adelaide and Mount Lofty Ranges NRM Board 2009), there are approximately 560 water allocation licenses issued for the region which equate to just under eleven gigalitres per year of licensed water use. Approximately two-thirds of both the license and volume totals are for groundwater use.

The prescription of the water resources in the Barossa Valley has occurred in stages. The underground water resources of the Barossa Valley floor were first prescribed in 1989, followed by the prescription of the North Para River and its tributaries in 1992. All surface waters within the area were prescribed in 1998. In 2005, all watercourses and surface water in the Greenock Creek catchment were prescribed as part of the Barossa Prescribed Water Resources Area. The Adelaide and Mount Lofty Ranges NRM Board is responsible for preparing and updating a water allocation plan for the area. A water allocation plan for the Barossa was adopted in December, 2000. This plan was reviewed in 2004 and it was determined that a new plan was required for the area. At the time of
this research, the NRM Board was in the process of preparing the new water allocation plan, in collaboration with the North Para Water Allocation Plan Advisory Committee. At the time of the data collection for this research (September 2008 to July 2008), there were nine members of the advisory committee. The NRM Board and advisory committee were awaiting feedback from the Department for Water on a draft water allocation plan; therefore, the committee was meeting infrequently.

The Marne Saunders Prescribed Water Resources Area lies approximately 70 kilometres north east of Adelaide and encompasses the catchments of the Marne River and the Saunders Creek, as well as the groundwater within the area (Figure 1.2). The Marne area covers 743 square kilometers. Some water is used for stock and domestic, industrial, and intensive livestock purposes; however, the vast majority of water use (over 95 percent) is for irrigation purposes (South Australian Murray-Darling Basin NRM Board 2009). The primary irrigation enterprises in the Marne area include lucerne, grape vine, and olive growing. The total estimated water demand for licensed purposes in the entire Marne Saunders area is approximately 7.5 gigalitres per year. Almost 70 percent of this volume is related to demand from groundwater sources (South Australian Murray-Darling Basin NRM Board 2009). There are a number of water-dependent ecosystems in the Marne area that rely on surface and groundwater in the catchment. The surface water, watercourse water and wells within the Marne River and Saunders Creek were prescribed in 2003. At the time of this research, the South Australian Murray-Darling Basin NRM Board was in the process of preparing the first water allocation plan for the area, in collaboration with the Marne Saunders Water Resources Planning Committee, which is made up of a cross section of eight community members and water users in the
catchment. At the time of the field work for this research, the NRM Board and advisory committee were awaiting feedback from the Department for Water on a draft water allocation plan. As a result, the committee had been meeting infrequently.

The Eastern Mount Lofty Ranges (EMLR) Prescribed Water Resources Area is located approximately 50 kilometres south-east of Adelaide and occupies an area of 2,845 square kilometers (Figure 1.2). The area, which contains sixteen surface water sub-catchments, incorporates the eastern slopes of the Mount Lofty Ranges and the Murray Plains and lies within the Murray Darling Basin. Land use in the EMLR is dominated by grazing and cropping which account for 77 percent of the total area (South Australian Murray-Darling Basin NRM Board 2011). Other significant land uses include pasture production and irrigated horticulture (seven percent), as well as intensive uses, such as urban areas, mining, industry, and manufacturing (five percent). The total demand for existing water users in the EMLR area is estimated to be approximately thirteen gigalitres for surface water and 32 gigalitres for groundwater, based on maximum theoretical enterprise requirements (South Australian Murray-Darling Basin NRM Board 2011). The area contains wetlands of national significance and the confluence of two creeks that originate in the catchment is part of an internationally-listed Ramsar site: the Coorong and Lake Alexandrina and Albert Wetland.

The water resources of the EMLR area were prescribed in 2005. The area encompasses the Angas Bremer region, which was first prescribed in 1980 (under the then Water Resources Act 1976) and had its first plan approved in 1987. There have been four updates to the original Angas Bremer plan – most recently in 2001. At the time of this research, a water allocation plan was being prepared by the South Australian Murray
Darling Basin NRM Board for the entire EMLR area and would replace the existing Angas Bremer plan. The Board was working in collaboration with two Water Allocation Planning Community Advisory Committees, representing the northern and southern regions of the area. In practice, the two committees began meeting jointly shortly after the start of the planning process. At the time of the data collection for this research, the combined committees included nineteen representatives from the catchment community, who were meeting bi-monthly to develop draft policies for the water allocation plan.

The Western Mount Lofty Ranges (WMLR) Prescribed Water Resources Area is located immediately to the east and south of Adelaide and covers a total area of approximately 2,750 square kilometers (Figure 1.2). The area has been divided into eight surface water catchments and includes three major watercourses as they cross the Adelaide Plains to the Gulf of St. Vincent. A unique feature of the area is that over 75% of the State’s population depends on eight water supply reservoirs distributed throughout five of the WMLR sub-catchments. These reservoirs supply 60 percent of metropolitan Adelaide’s water requirements in an average year (Adelaide and Mount Lofty Ranges NRM Board 2010). In addition, there are an estimated 11,500 wells, 13,000 dams and 250 watercourse water extraction points in the WMLR area (Adelaide and Mount Lofty Ranges NRM Board 2010). A substantial portion of this water infrastructure supports nearly 15,500 hectares of irrigated agriculture within the catchment. Pasture is the main irrigated crop, comprising 39 percent of the total irrigated area. Grape vines also cover a significant portion (34 percent), as well as fruit and nut trees (eighteen percent; Adelaide and Mount Lofty Ranges NRM Board 2010). Other irrigated crops in the area include vegetables, flowers, berries and nurseries. Commercial forestry is also prominent in the
WMLR area, with over 15,000 hectares of forest production throughout the catchment. There are aquatic ecosystems in the WMLR area that are dependent on the water resources in the catchment. Notably, there are swamps in the southern region of the catchment which have been listed as critically endangered ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

The watercourses, surface water and groundwater in the WMLR area were prescribed in 2005. The McLaren Vale Prescribed Wells Area is located entirely within the boundaries of the larger WMLR area and was originally prescribed by regulation in 1998. The first water allocation plan for the McLaren Vale area was completed in 2000, with an updated plan adopted in 2007. The 2007 plan will continue to govern the licensing of groundwater in the area; however, the new WMLR water allocation plan will cover the watercourses and surface water resources in the McLaren Vale area.

At the time of this research, the WMLR plan was being developed by the Adelaide and Mount Lofty Ranges NRM Board, in collaboration with three community advisory committees: the Central Hills Water Allocation Plan Advisory Committee; the McLaren Vale Water Allocation Plan Advisory Committee (an existing committee that was formed to develop the previous McLaren Vale plans); and the Fleurieu Water Allocation Advisory Committee. At the time of data collection for this research, there were nine catchment representatives on the Central Hills committee, seven representatives on the McLaren Vale committee, and nine representatives on the Fleurieu committee. The individual committees had generally been meeting every one to two months to develop draft water allocation policies for the plan. Joint committee meetings were also held periodically (i.e., every three to six months) to review and discuss technical information
and policy issues across the entire catchment. While the Department for Water typically provides scientific and technical support to all of the water allocation planning processes in the state, for the WMLR plan, the NRM Board had also contracted with the department to assist in the actual development of the plan.

**Data Collection**

The methods used for data collection and analysis are summarized below and are further explained in the papers presented in Chapters Two, Three and Four. Data sources used in this research were considered to be closely relevant to the objectives of the project, accessible to the researcher, and varied enough to enable internal verification of results through cross-checking, wherever possible. The data sources included semi-structured interviews with participants in the case study processes, pertinent documents and personal observations. Interviews were a critical source of evidence for providing direct insight into the attitudes and interpretations of participants towards how knowledge was produced and used in the water allocation planning processes. Documents and personal observations were key sources of evidence for analyzing particular issues in the study (e.g., how local knowledge was used, scientists’ attitudes towards local knowledge, participants’ understanding of technical knowledge, and use of jargon in the processes) that allowed cross-checking with evidence from the interview data. They also provided important contextual information about the case study areas (e.g., institutional framework for water allocation planning, hydrological characteristics). Finally, living in South Australia for eleven months gave the researcher a first-hand understanding of the setting and context for the research – an invaluable source of knowledge that underlies the entire research project and helped to enhance the interpretation of the qualitative findings.
In total, 62 in-person interviews were conducted in South Australia between March and July 2008. The goal was to interview as many people directly involved in each of the water allocation planning processes as possible in order to capture a broad range of perspectives on the research issues. Initial contact was made with water allocation planning coordinators at the Adelaide and Mount Lofty Ranges NRM Board and the South Australian Murray-Darling Basin NRM Board, as well as with individuals in the Department for Water (called the Department of Water, Land and Biodiversity Conservation at the time of data collection for this research) who were involved in water allocation planning in the state. Through initial meetings with these key informants, an initial list of prospective interview participants was compiled.

Interviews were conducted primarily with members of the community advisory committees, but also with individuals from the Department for Water and the respective NRM Boards who were involved in the process as policy and scientific advisors (e.g., hydrologists, hydrogeologists, ecologists), or as coordinators of water allocation plan development for the four case study areas (Table 1.2).

Table 1.2: Characteristics of interview participants by sector category and catchment

<table>
<thead>
<tr>
<th>Sector Category</th>
<th>Barossa</th>
<th>Marne</th>
<th>WMLR</th>
<th>EMLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>State government</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Natural Resources Management Board</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Land Manager</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Industry / business</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>9</strong></td>
<td><strong>26</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>
Most interviews were 60 to 90 minutes long and followed a semi-structured format. The semi-structured format provides structure to canvass the attitudes of participants on all topics in a consistent way, while still affording enough flexibility to be able to tailor the wording of scheduled questions for a particular subject and to permit pursuing unscheduled probes that may arise from issues raised during the interview process itself (Berg 2008).

The purpose of the interviews was to assess the attitudes and interpretations of participants about how knowledge was produced and used in the collaborative process of developing water allocation policies. Specific questions were also included to measure participants’ attitudes towards the role of local knowledge in water allocation planning and to give them an opportunity to comment openly about the strengths and weaknesses of the process. A preliminary set of questions was tested with six participants involved in two water allocation planning areas not included in this research project to assess whether the questions were understandable to participants and to test the approximate length of the interview. Based on the experience with the test interviews, a revised interview schedule was prepared and used in the case study interviews (Appendix One). In general, all interview questions were asked in order, according to the schedule. During most interviews, scheduled questions were omitted where topics of interest were covered in responses to related questions. Follow-up questions were frequently asked to substantiate statements and to explore unscheduled, but related, topics.

All of the interviews were digitally recorded. Following standard practices, written notes were also made during the interviews as back-up to the audio record and to highlight any non-verbal cues expressed during the interview. All of the interviews were
transcribed by the researcher. Textual content was recorded verbatim, with the exception of major digressions from the research topic (e.g., discussing the previous night’s football game); in such cases, only a brief note on the topic and time of the conversation was noted in the transcribed text. Nonverbal and emotional elements of the interview, as detected from the audio record or written notes from the interview, were also recorded in the transcription in the form of notes. Completed transcripts for each interview were sent to the participants for feedback to verify the accuracy of the data and to ensure fair representation of their views.

The University of Guelph’s Research Ethics Board gave permission to conduct the interviews. Interview participants were informed about the subject and purpose of the research in an introductory email or telephone call used to arrange interview meetings, and again verbally before the start of the interviews. Consent to digitally record interviews was also acquired prior to the start of each interview. The majority of interview participants requested to remain anonymous in the reporting of study results.

One hundred and thirty-seven documents were collected and analyzed across the case study catchments (Appendix Two). Federal and state legislation, regulations and policies provided important information on the institutional context for water allocation planning in South Australia. Information on hydrological, ecological, water use, and socio-economic characteristics in the case study areas was gleaned from documents such as draft water allocation plans and public fact sheets. Other document sources, including meeting agendas and minutes, advisory committee presentations and discussion papers, provided valuable data for several variables in the analysis that could be cross-checked against evidence gained from the other data sources. Most of the documents used in this
research were obtained from key informants in the case study areas. Copies of legislation, regulations, policies, and other public documents were collected from libraries and government agency websites and offices during the field work in South Australia.

Personal observations by the researcher of case study areas were made during the field visit to South Australia from August 2007 to July 2008. Written field notes and a digital camera were used to document the observations. Between February 2008 and July 2008, eleven community advisory committee meetings (Appendix Three) were attended covering all of the case study areas, including six in the Western Mount Lofty Ranges area, three in the Eastern Mount Lofty Ranges area, and one each in the Barossa Valley and Marne-Saunders areas. The meetings provided an opportunity to introduce the research project to the committees, to speak with members about the water allocation planning process and to arrange interviews with willing participants. They also afforded a chance to directly observe the dynamics of the committee process, including discussion about resource conditions, water use issues, proposed water allocation policies, and how different sources of knowledge were being integrated during the collaborative process of developing the water allocation plan.

Other related events were also attended during the field visit, including a water management conference in Adelaide, Australia (April 2008), a series of lectures about water management in the Murray-Darling Basin (October 2008), and an internal government meeting on the implications of the National Water Initiative (NWI) for groundwater management in South Australia (May 2008). These events provided additional understanding of the context for water management and water allocation in South Australia.
Data Analysis

Interview transcripts, documents and personal observation notes were analyzed using QSR NVivo 8, a qualitative data analysis software package. This tool helped to systematize data analysis and facilitated the storage and management of data. Additional details about the analytic methods used in this study are presented in the papers comprising Chapters Two, Three and Four. To avoid unnecessary repetition, the following summary is intended only as an overview of the analytic methods used in the entire study.

Overall, the research followed a directed content analysis approach. Content analysis uses codes to systematically identify patterns and structures within text, which can then be used to make replicable and valid conclusions about data (Berg 2008; Gooch and Warburton 2009). Directed content analysis uses a pre-determined framework as the basis for an initial coding structure, and then explores the data deductively. As a result, analytic coding is largely guided by existing theories and concepts relevant to the research focus. However, as with conventional content analysis, the method also allowed for new themes to emerge inductively from the data (Berg 2008). This flexibility made directed content analysis particularly well suited to this project, which included some elements that were firmly grounded in concepts from the existing literature and others that were more exploratory in nature.

Organization of the Thesis

There are four remaining chapters in the thesis. Chapters Two, Three and Four present stand-alone manuscripts that address distinct elements and objectives of the research project. Due to the format of the thesis, some repetition among the chapters was
unavoidable. Not only were the theoretical context, case study areas and research methods common among the papers, but also each one extends from and builds upon the results and ideas presented in the previous papers.

Chapter Two presents a paper entitled *Foundations for Successful Knowledge Production and Use in Collaborative Environmental Governance*. It proposes a theoretical framework for analyzing knowledge production and use in collaborative environmental governance and uses the framework to evaluate four water allocation planning cases in South Australia. In doing so, this paper addresses the first and second research objectives of the thesis. The manuscript was written for the audience of the journal *Water Alternatives* in a slightly revised form (e.g., with formatting changes and minor revisions), to be submitted following the successful defence of the thesis.

Chapters Three and Four further address the second objective of the thesis. While the first paper (Chapter Two) considers the integration of multiple sources of knowledge as one of several important procedural criteria in collaborative processes, the remaining papers more closely examine the role of local knowledge in the case study catchments.

Chapter Three presents a paper entitled *The Use of Local Knowledge in Collaborative Environmental Governance: a Case Study of South Australian Water Allocation Planning*. This paper characterizes how local knowledge has been incorporated into the case study processes. It compares actual experience with theorized outcomes and identifies the key factors that appear to be influencing its integration. This manuscript was prepared for the *Journal of Environmental Management*, to be submitted following the successful defence of the thesis.
Chapter Four is a paper entitled *Conceptualizations of Local Knowledge in Collaborative Environmental Governance*. It examines participants’ attitudes about what local knowledge is and what its role should be in water allocation planning and compares these views with current conceptualizations in the literature. This paper was prepared for the journal *Geoforum*, to be submitted following the successful defence of the thesis.

The final chapter recaps the major research findings contained in the previous chapters and considers the collective contributions of the study. It provides an opportunity to critically reflect on the theoretical framework that guided the research and to offer recommendations for designing or adapting collaborative environmental governance processes to improve outcomes related to knowledge production and use (thereby satisfying the third research objective). Chapter Five also considers the strengths and weaknesses of the research and identifies issues that warrant further investigation.

A series of appendices at the end of the thesis provide the interview guide used in the study, a list of case study documents analyzed in the study, and a list of community advisory committee meetings attended by the researcher.

**References**


CHAPTER TWO

FOUNDATIONS FOR SUCCESSFUL KNOWLEDGE PRODUCTION AND USE IN COLLABORATIVE ENVIRONMENTAL GOVERNANCE

Abstract

By permitting the integration of multiple forms of knowledge through joint fact-finding, collaborative governance approaches can produce more holistic and place-based understandings of environmental problems and help to alleviate conflict among stakeholders over the knowledge that is used to make decisions. Despite the crucial role of knowledge in environmental decision-making, previous research provides limited practical insight into the knowledge-related outcomes that can be achieved through collaboration, or the associated determinants of success. In this study, a multiple case study approach was used to analyze knowledge production and use in a collaborative water allocation planning process in South Australia. A theoretical framework based on current literature was developed and used to systematically evaluate and compare knowledge-related process and outcome criteria across four planning catchments. Data sources included 62 semi-structured interviews, pertinent documents and personal observations. Most of the theorized outcomes were achieved across the study catchments; however, only one of the cases appeared to generate widespread acceptance among participants of the knowledge that was used to develop the water allocation plan. Comparing process criteria across the cases revealed key factors that appeared to influence their outcomes. Ultimately, community participants across the cases had limited involvement in technical investigations, suggesting the need to re-examine expectations about the potential for joint fact-finding within collaborative processes that are limited in scope and duration and nested within broader state-driven processes.
**Introduction**

Water management regimes are evolving in response to a growing emphasis on ecological values, meeting basic human needs, and re-evaluating the ties between economic growth and water use. Protecting in-stream uses of water has become a high priority in many countries, leading to efforts to clarify and redefine the rights of consumptive users against others who value the maintenance of stream flows for ecological and recreational purposes. In this context, how knowledge about water resources is produced and used to make water allocation decisions has become a critical issue. Knowledge can be the source of major disputes, as water managers, water users and other stakeholders attempt to determine the fair and efficient allocation of limited supplies. This is illustrated in examples from Australia where the use of disputed data and science by government agencies to justify the reallocation of water from local consumptive uses to the environment has damaged mutual trust among water managers and users and raised substantial criticism of water management policies (Kuehne and Bjornlund 2006; Pigram 2006).

These types of challenges have prompted recommendations for more collaborative approaches to water governance, where an understanding of water conditions and decisions about the allocation of available water are determined collectively among resource managers and water users (e.g., Lach, *et al.* 2005; Morris, *et al.* 2006). Collaborative governance has been broadly defined as the sharing of power and responsibility among state and non-state actors in decision-making for environmental management (Carlsson and Berkes 2005). Collaboration exists in many forms that have been distinguished in previous literature based on factors such as the duration of
processes, the scope of issues that they address, the institutional level at which they operate, and the composition of participants (e.g., Leach, et al. 2002; Moore and Koontz 2003; Margerum 2008).

The attention to collaborative forms of water governance reflects a broader trend in environmental governance towards integrated, catchment-scale arrangements, which provide opportunities to focus data collection, planning, and decision-making at more ecologically and hydrologically appropriate scales and to engage resource users and their knowledge more effectively (Dovers 2001). By integrating conventional scientific knowledge with alternative forms of knowledge (e.g., local, traditional), it has been suggested that collaboration can produce a more contextualized and adaptive base of knowledge for addressing environmental problems (Neis, et al. 1999; Berkes, et al. 2000; Folke, et al. 2005; Lane and McDonald 2005). It can also help to alleviate the tension and conflict over the knowledge that is used to make decisions (e.g., Margerum and Whithall 2004; Fernandez-Gimenez, et al. 2006).

In practice, researchers have identified particular challenges related to integrating different forms of knowledge in a collaborative process. Difficulties stem from the underlying differences between positivist science and local knowledge (Eden 1996; Berkes 2004; Jackson and Morrison 2007), and strong opinions about the forms of knowledge that are valid in environmental decision-making (Raymond, et al. 2010). Several empirical studies have highlighted the reluctance of scientists and government officials to consider local sources of knowledge in different decision-making contexts (e.g., Wynne 1992; Murdoch and Clark 1994; Weible, et al. 2004; Petts and Brooks 2006; Giordano, et al. 2010). Within a collaborative process, discounting the knowledge
held by local participants can lead to outcomes based on imposed, coerced community
consensus rather than shared understanding and ownership that collaboration is intended
to achieve (Kapoor 2001; Berkes 2002). Previous studies have also highlighted some
practical challenges with accessing and integrating local knowledge within environmental
research and decision-making – most commonly, the increased time and resource costs
associated with non-scientist participation (Johnson 2009; Kroon, et al. 2009; Spink, et
al. 2010).

Despite the crucial role that knowledge plays in environmental decision-making,
and the challenges associated with integrating different forms of knowledge, criteria
related specifically to knowledge production and use have typically not been included in
frameworks for evaluating collaborative governance arrangements (e.g., Conley and
Moote 2003; Sabatier, et al. 2005; Koontz and Thomas 2006; Ryan and Bidwell 2007;
Rogers and Weber 2010). Where the role of knowledge in collaboration has been
explicitly considered (e.g., Imperial 1999; Innes and Booher 2010), related process and
outcome criteria are not well specified. Consequently, evaluations of actual collaborative
processes to-date have provided limited practical insight into what they can and cannot
achieve or how processes should be structured and run to produce successful outcomes
related to knowledge production and use.

In this article, we draw from complementary bodies of literature concerned with
collaboration, knowledge, and environmental decision-making to develop a theoretical
framework for evaluating knowledge production and use in collaborative governance
processes. The framework is used to evaluate the collaborative processes involved in the
development of water allocation plans in four South Australian catchments. By
systematically evaluating real-world cases of collaboration, this study contributes to the collaborative environmental governance literature by providing insight into whether theorized process and outcome criteria for successful knowledge production and use are achievable in practice.

*A Framework for Evaluating Knowledge Production and Use*

Our framework for analyzing knowledge production and use in collaborative processes is grounded in related bodies of literature concerning knowledge, environmental decision-making, and collaborative environmental governance. Recent research and practice in these fields has highlighted the potential benefits associated with collaborative approaches, including outcomes related to knowledge production and use and the conditions under which they may be achieved. Based on this review, we propose a set of five characteristics related to collaborative processes and their outcomes that are indicators of successful knowledge production and use (Table 2.1).

**Table 2.1: Characteristics of successful knowledge production and use in collaboration**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Indicator Criteria</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effective communication among participants</td>
<td>Facilitators are involved in the process with “interactional expertise”</td>
<td>Allen and Kilvington 2005; Booher and Innes 2005; Carolan 2006</td>
</tr>
<tr>
<td></td>
<td>Use of technical jargon is avoided or adequately managed in the process</td>
<td>Jacobs, <em>et al.</em> 2005</td>
</tr>
<tr>
<td></td>
<td>Scientists communicate the methods, assumptions and uncertainty of their investigations to community participants</td>
<td>Funtowicz and Ravetz 1993; Innes 1998; Hillman and Brierley 2002; Ballard, <em>et al.</em> 2008</td>
</tr>
<tr>
<td>Characteristic</td>
<td>Indicator Criteria</td>
<td>Sources</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Boundary experiences (e.g., field trips, workshops) are used to promote common understanding of issues among participants</td>
<td></td>
<td>Feldman, <em>et al.</em> 2006</td>
</tr>
<tr>
<td>Participation by relevant and significant interests</td>
<td>All relevant interests (including indigenous) within the catchment are represented in the process</td>
<td>Innes and Booher 1999; Berkes, <em>et al.</em> 2000; Kapoor 2001; Trachtenberg and Focht 2005</td>
</tr>
<tr>
<td></td>
<td>Scientists are involved “at the table” in discussions of knowledge and related policies</td>
<td>Petts 1997; Innes 1998; Michaels 2001; Fernandez-Gimenez, <em>et al.</em> 2006</td>
</tr>
<tr>
<td>Joint fact-finding</td>
<td>Process is incorporating information from a variety of sources, including the collection and utilization of local knowledge</td>
<td>Neis, <em>et al.</em> 1999; Berkes 2004; Cowie and Borrett 2005; Trachtenberg and Focht 2005</td>
</tr>
<tr>
<td></td>
<td>Efforts are made to promote understanding of and dialogue about knowledge among participants</td>
<td>Lane and McDonald 2005; Blackstock and Richards 2007; Wallington, <em>et al.</em> 2008; Innes and Booher 2010</td>
</tr>
<tr>
<td>Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understanding and acceptance of knowledge among participants</td>
<td>Participants understand the knowledge upon which decisions are based</td>
<td>Dietz, <em>et al.</em> 2003; Innes and Booher 2004; Dilling 2007; Johnson 2009</td>
</tr>
<tr>
<td></td>
<td>Participants are aware of the limitations and uncertainty in the knowledge</td>
<td>Innes 1998; Hillman and Brierley 2002; Jacobs, <em>et al.</em> 2005; Ballard, <em>et al.</em> 2008</td>
</tr>
<tr>
<td></td>
<td>Participants accept and agree to the knowledge base upon which policy decisions are based</td>
<td>Innes, <em>et al.</em> 2004; Petts and Brooks 2006; Dilling 2007; Wallington, <em>et al.</em> 2008; Johnson 2009</td>
</tr>
<tr>
<td>Enhanced social capital</td>
<td>Participants have increased their knowledge about resource and ecological conditions in the catchment</td>
<td>Petts 1997; Margerum 1999; Dietz, <em>et al.</em> 2003; Berkes 2004; Ballard, <em>et al.</em> 2008</td>
</tr>
<tr>
<td></td>
<td>Participants have increased their knowledge about others’ perspectives of resource use and its allocation in the catchment</td>
<td>Berkes 2004; Castillo, <em>et al.</em> 2005; Folke, <em>et al.</em> 2005; Fernandez-Gimenez, <em>et al.</em> 2006</td>
</tr>
</tbody>
</table>
### Process Criteria

*Effective Communication among Participants*

The literature highlights three procedural factors that can promote effective communication among scientist and non-scientist participants in a collaborative process. Effective leadership and facilitation have been identified as a critical element for successful collaboration (Margerum 1999; Leach and Pelkey 2001; Blackstock and Richards 2007). In particular, some researchers have highlighted the importance of having individuals with “interactional expertise” involved to enable the exchange and integration of different forms of knowledge (Carolan 2006). A coordinator is needed who can enhance communication among scientists and non-scientists by providing access to technical information (e.g., helping to communicate information in an understandable way) and promoting the integration of local knowledge in the process (Allen and Kilvington 2005; Booher and Innes 2005; Jacobs, *et al.* 2005). Second, the use of technical or local jargon must be avoided or effectively managed. Jacobs, *et al.* (2005) assert that the use of jargon is one of the most significant barriers to collaborative research and integrating science into decision-making.

There is growing consensus that uncertainty needs to be openly discussed in decision-making processes (e.g., Funtowicz and Ravetz 1993; Dietz, *et al.* 2003). In a collaborative process, information only becomes “shared knowledge” among all

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Indicator Criteria</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trust has been generated among technical experts and community participants</td>
<td>Conley and Moote 2003; Innes and Booher 2004; Hillman 2005</td>
</tr>
</tbody>
</table>
participants if there is sufficient discussion about its meaning and accuracy (Innes 1998). For example, Ballard, et al. (2008) identify discussions about scientific bias, rigour, and uncertainty as important elements of community-based forestry initiatives. Therefore, effective collaboration requires knowledge providers to be open about the level of uncertainty and predictive validity of their sources (Hillman and Brierley 2002).

Recent studies of collaborative research initiatives have also demonstrated the benefits of scientists and local participants interacting in activities such as field trips and training workshops (Castillo, et al. 2005; Ballard, et al. 2008). Feldman, et al. (2006) describe such “boundary experiences” as a way of facilitating the translation of information and ideas and building a sense of community among participants by helping them to transcend their individual perspectives.

Participation by Relevant and Significant Interests

There is consensus in the collaborative environmental governance literature that a legitimate collaborative process should include representation of all relevant and significant interests in the issue (e.g., Innes and Booher 1999; Kapoor 2001; Conley and Moote 2003). The process must allow for a fair consideration of the views of a full range of participants, including their perceptions of environmental conditions within the catchment (Trachtenberg and Focht 2005). In this context, scholars and practitioners are increasingly recognizing the benefit of engaging representatives of indigenous communities through collaboration (e.g., Berkes, et al. 2000; TRaCK 2010).

Further, Innes (1998) contends that in a collaborative process, technical experts should not be handing over facts and offering professional opinions at an arms length. Instead, scientists should be “at the table”, participating directly in discussions about
information and policy issues. Previous research has suggested that involving scientists directly in a collaborative process can benefit both scientist and non-scientist participants (Petts 1997; Fernandez-Gimenez, et al. 2006). For example, Petts (1997) noted that a community advisory forum for a local waste management issue in the United Kingdom was highly dependent on information gained through direct communications with scientists. Michaels (2001) found that a Massachusetts watershed technical advisory group ceased to function as an effective vehicle for information exchange once technical personnel withdrew from the process.

*Joint Fact-finding*

Sufficient and relevant sources of information are needed to develop effective solutions to environmental problems. Generally, collaboration is expected to promote a broader information base for decision making by integrating local sources of knowledge with external sources of expertise (Berkes 2004; Cowie and Borrett 2005). “Joint fact-finding” is a label that has been given to collaborative ways of deciding on the knowledge used to make decisions (Innes and Booher 2010). Joint fact-finding is premised on the view that phenomenon can only be understood in context and cannot be isolated or studied in a strictly abstract way (Innes and Booher 2010). In practice, knowledge is established in a collaborative process through the synthesis of available data and information sources and anchored in the holders’ beliefs and commitments (Michaels, et al. 2006). If properly conducted, joint fact-finding is likely to produce a base of knowledge that is more robust than that which can be produced through independent expert analysis (Innes and Booher 2010).
Trachtenberg and Focht (2005) contend that in management contexts where high uncertainty exists, all relevant sources of knowledge should be considered, with adequate reasons provided for ultimately acting on one account over the others. A major challenge with this approach is that landholder knowledge about local resource use and the environment is seldom available on a collective basis (Allen and Kilvington 2005) and that most planning processes lack a formal mechanism to collect and incorporate such information (Hillman and Brierley 2002). Neis, et al. (1999) suggest that the systematic collection of knowledge from resource users as part of a collaborative management regime could substantially improve the basis for management decisions.

To effectively integrate and use multiple sources of knowledge, a collaborative process must provide a forum to openly discuss and debate the different perspectives. Blackstock and Richards (2007) emphasize the importance of reasoned debate and reaching mutual understanding through the quality and persuasiveness of arguments rather than by coercion, deception or manipulation. Dialogue about knowledge in a collaborative process can weed out dubious findings, make explicit underlying assumptions and biases held by the knowledge providers, and dismiss unsupported claims (Innes and Booher 2010). In this sense, knowledge gains legitimacy “where it is established within an open context of engaged criticism between experts and non-experts” (Wallington, et al. 2008). Therefore, one of the most important elements of a collaborative process is that it includes a well-structured dialogue among scientists and community participants about knowledge of the environment and human-environment systems in the management area (Dietz, et al. 2003). Petts (1997) found that members of a community advisory forum on local waste management preferred opportunities to
engage in discussion with experts on technical issues as opposed to one-way presentations by scientists. Critical debate and argumentation of knowledge is crucial to social learning (Lane and McDonald 2005), builds trust and social capital among participants and promotes understanding and acceptance of information (Innes and Booher 2004). According to Innes and Booher (2010), “dialogue over time around the information adapts it and refines it and helps to build broader and deeper shared knowledge on the topic” (p.153).

**Outcome Characteristics**

*Understanding and Acceptance of Knowledge among Participants*

Collaboration can increase understanding and acceptance among participants of the knowledge that is used to make decisions (Innes and Booher 2004). Reliable and credible information on resource conditions has been identified as a necessary foundation for successful management (Ostrom, *et al.* 1999; Fernandez-Gimenez, *et al.* 2006). However, for information to be meaningful and used effectively, it must be understandable, and end-users, including the public, must be confident in its quality (Dietz, *et al.* 2003; Dilling 2007; Johnson 2009). Petts and Brooks (2006) stress that scientific information is not automatically accepted by the public. Rather, the credibility and trustworthiness of information is critically evaluated and judged by those affected by, or otherwise interested in, the management issue. Ultimately, participants’ acceptance of and agreement to the base of knowledge that is used to make decisions will strongly influence whether a collaborative process is able to generate community ownership of problems and solutions (Wallington, *et al.* 2008). For example, Syme, *et al.* (1999) found that individuals were more willing to modify their demands for water during times of
scarcity if they felt that adequate knowledge was available about the environment, including a clear indication of what can be withdrawn before serious degradation occurs. Other research has demonstrated how doubts among participants about the credibility of information can act as a barrier to successful resource management (e.g., Dietz, et al. 2003; Evans 2006; Kuehne and Bjornlund 2006).

A critical element that has been associated with the understanding and acceptance of knowledge in a collaborative process is awareness among participants of the level of rigour and inherent biases and uncertainty associated with the knowledge that has been produced and used to make decisions (Ballard, et al. 2008). Genuine consent relies on participants being fully informed (Trachtenberg and Focht 2005) and significant tension can manifest in a process if there are inconsistent expectations regarding the level of certainty of technical information (Hillman and Brierley 2002). For instance, in the context of water allocation in Tanzania, Lankford, et al. (2004) found that researchers were more willing to accept the scientific basis for policies than other stakeholders who were less aware of the constraints affecting the technical investigations (e.g., time, resources) and the resulting uncertainty of their findings. Thus, there is a need in a collaborative process for sufficient disclosure and discussion of the technical information to ensure that participants are able to make an informed decision about its reliability and quality (Innes 1998; Jacobs, et al. 2005).

**Enhanced Social Capital**

Another commonly-cited benefit of collaboration is that it builds social capital (i.e., civic relationships of trust, goodwill, and engagement) within the community (Dietz, et al. 2003; Hillman 2005). Through collaboration, participants learn new ideas, become aware
of each other’s perspectives and recognize that others’ views are legitimate. Ultimately, a successful collaborative process can build considerable trust among the participants in the community (Innes and Booher 2004). To assess the outcomes of river rehabilitation projects, Hillman (2005) emphasizes the need to not only evaluate improved river condition but also growth in the “stock of goodwill and skill in the community” (p.159). In fact, mutual learning and trust building among participants have been identified by several researchers as critical indicators of success in collaborative initiatives (e.g., Petts 1997; Innes and Booher 1999; Margerum 1999; Conley and Moote 2003; Berkes 2004; Blackstock and Richards 2007).

**Summary**

The framework outlined above provides a systematic basis for evaluating the key process and outcome characteristics relevant to knowledge production and use within collaborative governance arrangements. In this study, the framework is used to analyze cases of collaborative water governance in South Australia.

**Collaborative Environmental Governance in Context: South Australian Experiences**

Over the past two decades, Australian governments have made major reforms to their water management institutions in response to ecological, economic and social pressures caused by severe and recurring water shortages (Pigram 2006; Connell 2007; Stoeckel and Abrahams 2007; Hamstead, et al. 2008). The reform process reached an important milestone in 2004 when the Council of Australian Governments (COAG) signed the National Water Initiative (NWI), a comprehensive water policy statement for the country. Among other things, the NWI committed state governments to addressing over-allocated
or stressed water systems within their jurisdictions (Commonwealth of Australia 2010). Under the agreement, statutory water plans were identified as the primary mechanism for determining how much water within catchments is available for consumptive uses, and for ensuring that sustainable levels of extractions are achieved and maintained (Gentle and Olszak 2007). Responsibility for water planning has been assigned to catchment-based management authorities. In developing plans, these authorities must understand, among other things, the available water supply in catchments and the needs of current and future water users, including indigenous users (COAG 2004). Additionally, they are responsible for identifying aquatic ecosystems of high conservation value and accounting for their water requirements. A key priority of the NWI is to engage water users and other stakeholders in achieving the objectives of the agreement (COAG 2004).

In South Australia (Figure 2.1), the commitments to water planning under the NWI are being implemented through a water allocation planning framework established under the *Natural Resources Management Act 2004*. Under the Act, regionally-based Natural Resources Management Boards (NRM Boards) are required to prepare water allocation plans for the water resources within their jurisdiction that are deemed to be at risk and have been “prescribed” through regulation. The legislation outlines the required scope and contents of plans, as well as the technical matters to be investigated in the preparation of the plan. Water allocation plans are required to be reviewed and updated as needed every five years.

The plans are used by the state Department for Water (formerly the Department of Water, Land and Biodiversity Conservation) to direct the issuance of water allocation licenses, to manage the trading of water licenses, and to permit water-affecting activities
(e.g., dam and bore construction) within the area. The state government also provides technical support to the NRM Boards in preparing plans by supplying environmental monitoring data. Scientists in the Department for Water also undertake the majority of required technical investigations.

**Figure 2.1: Location of the case study areas**

According to the *Natural Resources Management Act 2004*, NRM Boards must broadly consult with the public on the proposed structure of the plan (a “concept
statement”) and on a draft version of the plan. In addition to these legislated public consultation requirements, many NRM Boards have formed community advisory committees to collaborate with stakeholders more directly on the preparation of the plan. The committees typically include water users, industry and interest-group representatives, and residents from the catchment and are run by a plan coordinator from the responsible NRM Board.

In summary, a collaborative process is being used by the NRM Boards to develop water allocation plans for the prescribed resources within their jurisdiction. As noted previously in the paper, collaboration can take many forms. The specific form of collaboration occurring within the South Australian system is consistent with the perspective on collaboration offered by Ansell and Gash (2008), which emphasizes joint decision making among state and non-state actors. This South Australian example is also consistent with Leach, et al.’s (2002) characterization of “advisory committees” in that they operate over a finite period to address a specific project, program or regulation.

Most importantly, however, in characterizing collaboration for water allocation in South Australia is the fact that the system that has been established is nested within a more traditional, top-down governance approach. Collaboration that is occurring through the advisory committee processes is situated within a highly prescriptive legislative framework that defines the issue, prescribes the terms of reference for technical investigations, as well as the scope of broader public engagement and policy options. Moreover, the knowledge needed to develop the water allocation plans is largely generated by state agency scientists. Relative to the evaluative framework presented above, this clearly has implications for the collaboration processes and their outcomes.
Methods

An in-depth analysis of collaborative processes was required in order to further understand the issues of interest in this study. A qualitative case study approach enabled us to consider the unique characteristics of the case study locales and collaborative processes, as well as to examine the interests, attitudes, and knowledge of a range of individuals who were involved directly in the processes (Margerum 1999; Gerring 2007). Multiple cases were selected in order to compare collaborative efforts across cases and to analyze how variations in collaborative processes and contexts may influence their outcomes (Conley and Moote 2003; Yin 2003).

Four catchments were selected as case studies in South Australia: Western Mount Lofty Ranges (WMLR); Eastern Mount Lofty Ranges (EMLR); Marne Saunders (Marne) and Barossa Valley (Barossa) Prescribed Water Resources Areas (Figure 2.1). These catchments were selected on the basis that (1) a water allocation plan was being developed, (2) the responsible NRM Board had formed a community advisory committee to collaborate with on the preparation of the plan, (3) the planning process had produced tangible outcomes (e.g., draft policies or a draft plan), (4) the catchments varied in size to allow us to examine the influence of geographic scale on the collaborative process, and (5) planning participants, including advisory committee members and government agency staff were accessible and willing to participate in the research. The main characteristics of the four case study areas are described below and are summarized in Table 2.2.
Table 2.2: Summary of Selected Case Study Area Characteristics

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Size (km²)</th>
<th>Main Water Use(s)</th>
<th>Agency Responsible for Plan</th>
<th>Advisory Committee Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barossa</td>
<td>711</td>
<td>• Irrigated agriculture (grape vines)</td>
<td>Adelaide &amp; Mount Lofty Ranges NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>Marne</td>
<td>743</td>
<td>• Irrigated agriculture (lucerne, grape vines, olives)</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>EMLR</td>
<td>2,845</td>
<td>• Irrigated agriculture</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Two regionally-based committees (meeting jointly)</td>
</tr>
<tr>
<td>WMLR</td>
<td>2,750</td>
<td>• Irrigated agriculture (pasture, grape vines, fruit and nut trees)</td>
<td>Adelaide &amp; Mount Lofty Ranges NRM Board (with Department of Water)</td>
<td>Three regionally-based committees (periodic joint meetings)</td>
</tr>
</tbody>
</table>


The Adelaide and Mount Lofty Ranges NRM Board was responsible for water allocation plans in the Barossa and WMLR areas. The Barossa Prescribed Water Resources Area is centred approximately 60 kilometres north-east of Adelaide and covers a total area of 711 square kilometers (Figure 2.1). The prescription of the water resources has occurred in stages. Groundwater beneath the Barossa Valley floor was first prescribed in 1989, followed by the prescription of the North Para River and its tributaries in 1992. All surface waters within the area were prescribed in 1998. In 2005, all watercourses and surface water in the Greenock Creek sub-catchment were prescribed as part of the broader Barossa Prescribed Water Resources Area. A water allocation plan for the Barossa was adopted in December 2000. In 2004, this plan was reviewed and it
was determined that a new plan was required for the area. At the time of this research, the NRM Board was in the process of preparing the new water allocation plan, in collaboration with the North Para Water Allocation Plan Advisory Committee. The committee included nine members representing the catchment community.

In addition to surface water and groundwater sources, imported water is also supplied to the region via the Barossa Infrastructure Limited (BIL) scheme. Some irrigators in the region also hold River Murray water licences, which are delivered through SA Water infrastructure (Adelaide and Mount Lofty Ranges NRM Board 2009). There are 560 water allocation licenses issued across the area which equate to approximately eleven gigalitres per year of licensed water use. Approximately two-thirds of both the license and volume totals are for groundwater use (Adelaide and Mount Lofty Ranges NRM Board 2009). Over 90% of water use in the Barossa area is for irrigation purposes. Grape vines are by far the dominant irrigated crop, with some water used for pasture and lucerne.

The Western Mount Lofty Ranges (WMLR) Prescribed Water Resources Area covers approximately 2,750 square kilometers to the immediate east and south of Adelaide (Figure 2.1). The area includes eight surface water catchments and three major water courses. Eight reservoirs are distributed through five of the catchments, supplying 60 percent of metropolitan Adelaide’s water requirements in an average year (Adelaide and Mount Lofty Ranges NRM Board 2010). Within the WMLR area, there are also approximately 11,500 wells, 13,000 dams and 250 watercourse extraction points, a major portion of which are used to irrigate 15,500 hectares of agricultural crops (Adelaide and Mount Lofty Ranges NRM Board 2010). Pasture is the main irrigated crop, comprising
39 percent of the total irrigated area; however, grape vines (34 percent) and fruit and nut trees (eighteen percent) also cover a significant portion (Adelaide and Mount Lofty Ranges NRM Board 2010). Commercial forestry is prominent in the WMLR area, with over 15,000 hectares of forest production throughout the catchment. There are also aquatic ecosystems in the WMLR area that are dependent on the water resources in the catchment, including swamps in the southern portion of the catchment which have been listed as critically endangered ecological communities under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

The watercourses, surface water and groundwater in the WMLR area were prescribed in 2005. The boundary of the WMLR area encompasses the McLaren Vale Prescribed Wells Area which was originally prescribed in 1998. The first water allocation plan for the McLaren Vale area was completed in 2000, with an update adopted in 2007. The 2007 plan will continue to govern the licensing of groundwater in the McLaren Vale area; however, the new WMLR water allocation plan will cover its watercourses and surface water resources. At the time of this research, the WMLR plan was being developed by the Board, in collaboration with three community advisory committees: the Central Hills Water Allocation Plan Advisory Committee (nine members); the McLaren Vale Water Allocation Plan Advisory Committee (seven members); and the Fleurieu Water Allocation Plan Advisory Committee (nine members). The committees met independently during the planning process, although joint committee meetings were also held periodically to review and discuss technical information and policy issues across the entire catchment. While the Department for Water typically provides scientific and technical support to all of the water allocation planning processes in the state, for the
WMLR plan, the Board had also contracted with the department to assist in the development of the plan itself.

The Marne and EMLR catchments were within the jurisdiction of the South Australian Murray-Darling Basin NRM Board. The Marne Saunders Prescribed Water Resources (Marne) Area covers an area of 743 square kilometers and lies approximately 70 kilometres north east of Adelaide (Figure 2.1) and encompasses the catchments of the Marne River and the Saunders Creek, as well as the groundwater within the area. The water resources within the Marne area were prescribed in 2003. At the time of this research, the Board was in the process of preparing the first water allocation plan for the area, in collaboration with the Marne Saunders Water Resources Planning Committee, which included eight community members and water users in the catchment. The total estimated water demand for licensed purposes in the entire Marne area is approximately 7.5 gigalitres per year. Almost 70 percent of this volume is from groundwater sources (South Australian Murray-Darling Basin NRM Board 2009). Some water is used for stock and domestic, industrial, and intensive livestock purposes; however, the vast majority of water use (over 95 percent) is for irrigation (South Australian Murray-Darling Basin NRM Board 2009). The primary irrigation enterprises in the Marne area include lucerne, grape vine, and olive growing. There are also water-dependent ecosystems in the Marne area that rely on surface and groundwater in the catchment.

The Eastern Mount Lofty Ranges (EMLR) Prescribed Water Resources Area is located approximately 50 kilometres east of Adelaide and covers 2,845 square kilometers (Figure 2.1). The area, which contains sixteen surface water sub-catchments, incorporates the eastern slopes of the Mount Lofty Ranges and the Murray Plains and lies within the
Murray Darling Basin. Land use in the EMLR is dominated by grazing and cropping which account for 77 percent of the total area (South Australian Murray-Darling Basin NRM Board 2011). Other significant land uses include pasture production and irrigated horticulture (seven percent), as well as intensive uses, such as urban areas, mining, industry, and manufacturing (five percent). The annual volumetric demand by existing water users in the EMLR area is estimated to be approximately 13 gigalitres from surface water and 32 gigalitres from groundwater, based on maximum theoretical enterprise requirements (South Australian Murray-Darling Basin NRM Board 2011). The area contains wetlands of national significance and the confluence of two creeks that originate in the catchment is part of an internationally-listed Ramsar site: the Coorong and Lake Alexandrina and Albert Wetland.

Water resources in the EMLR area were prescribed in 2005. The area encompasses the Angas Bremer region, which was first prescribed in 1980 (under the then Water Resources Act, 1976) and had its first plan approved in 1987. The Angas Bremer plan was most recently updated in 2001. At the time of this research, a water allocation plan was being prepared for the entire EMLR area and would replace the existing Angas Bremer plan. The Board was working in collaboration with two separate Water Allocation Planning Community Advisory Committees, representing the northern and southern regions of the area; however, the two committees began meeting jointly shortly after the start of the process. The combined committee included nineteen representatives from the catchment.
**Data Collection and Analysis**

Semi-structured interviews, pertinent documents and personal observations of advisory committee meetings were used to examine knowledge production and use in the case study processes. Between March and July 2008, 62 interviews across the four study catchments were completed with members of the community advisory committees, and with state department and NRM Board personnel who were involved in the process as policy and scientific advisors (e.g., hydrologists, hydrogeologists, ecologists) or as water allocation plan coordinators. A summary of the participants interviewed for the study is provided in Table 2.3. Respondents were asked to provide insights into the water allocation planning process, in general, and into specific issues pertaining to the evaluative framework (Table 2.1). Interviews ranged between 60 and 90 minutes and were digitally recorded and transcribed verbatim.

Table 2.3: Characteristics of interview participants by sector category and catchment

<table>
<thead>
<tr>
<th>Sector Category</th>
<th>Barossa</th>
<th>Marne</th>
<th>WMLR</th>
<th>EMLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>State government</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>NRM Board</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Land Manager</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Industry / business</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>9</strong></td>
<td><strong>26</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

A total of 137 documents were analyzed for the study. Agendas and minutes from the community advisory committee meetings provided records of committee discussions about technical information. Draft water allocation plans, policy discussion papers and
technical investigation reports were also key sources of information on how knowledge was produced and used in the process. They also provided contextual information on hydrological, ecological, water use, and socio-economic characteristics in the study catchments.

Between February and July 2008, the lead author attended a total of eleven advisory committee meetings covering all of the case study areas. At these meetings, he was able to directly observe the dynamics of the committee process, including the presentation and discussion of technical information and associated water allocation policy issues. Observations were recorded as written notes and included in the analysis.

Interview transcripts, documents and observation notes were analyzed using QSR NVivo 8, a qualitative data analysis software package which helps to systematize analytical procedures and facilitates storage and management of data. All data were reviewed line-by-line and coded into analytic categories corresponding to the indicator criteria in the evaluative framework (Table 2.1). Evaluative conclusions were then made for each of the indicator criteria by assessing the coded evidence from all pertinent data sources. In many cases, multiple sources of data were used to evaluate individual elements allowing the cross-checking of evidence and internal verification of findings. To preserve the detail and richness of the qualitative data through the analysis, categorical conclusions (e.g., ‘successful’ versus ‘unsuccessful’) based on formal aggregation rules have not been made for the evaluation criteria. Instead, the details of the evidence used to reach conclusions about the case study outcomes and processes are retained and reported in the study results.
Results

Effective Communication among Participants

Facilitator with Interactional Expertise

Facilitators with interactional expertise appeared to be present in all of the case study areas; however, the form and relative effectiveness of the facilitators differed across the catchments. Each of the nine interview participants in the Marne case and eighteen participants in the EMLR case identified the plan coordinator from the NRM Board as the main facilitator. Typical comments from the committee members about these individuals included “good broker between the committee and the scientists” and “really practical – has the technical knowledge but also the broader perspective”, indicating that they had brought interactional expertise to the process. This was confirmed by the lead author’s observations at meetings of each advisory committee, as well as in references in the meeting minutes of both processes.

Unlike the Marne and EMLR cases, the other study catchments did not appear to have a dedicated leader and facilitator. In the interviews for both cases, participants identified a range of individuals who helped to facilitate communication among scientists and community members in the process, including committee chairpersons, NRM and department representatives, and individual committee members with relevant subject area expertise. Despite the lack of a single leader, seven of nine interview participants in the Barossa case and twenty of twenty-six participants in the WMLR case felt that their discussion about technical information had been effectively facilitated. Only one participant in the Barossa case and six in the WMLR case identified major problems with the facilitation of technical discussions in the process. In the WMLR catchment,
participants expressed frustration that department policy staff present at committee meetings were often unable to address important technical issues during discussions. A farmer and committee member in the Barossa case pointed to staff turnover at the NRM Board and department – an issue also apparent in the advisory committee meeting minutes – as a problem. To effectively facilitate the process, he felt that at least five years of experience was needed to understand the catchment and its residents.

Avoiding or Managing Technical Jargon

An analysis of the interview data indicated that the use of technical jargon was generally avoided or adequately managed in all of the cases. Seven of nine interview participants in each of the Barossa and Marne cases, eleven of eighteen participants in the EMLR case and sixteen of twenty-six participants in the WMLR case described the use of “good, understandable language” by scientists and an effort to use terms consistently. This was confirmed through a review of public discussion papers, draft plans and technical reports. These documents typically included glossaries with explanations of key terms, abbreviations, and units of measurement. Community participants also reported having a good understanding of technical and landholder jargon through previous experiences, and indicated that committee members would simply ask if a technical term needed to be clarified. To avoid an excessive use of jargon in the EMLR process, the plan coordinator described “sitting down with scientists to go through their presentations, making sure they weren’t too technical”.

There was some evidence that technical jargon was an issue in the WMLR process. Ten of the twenty-six participants who were interviewed, including agency and community representatives, expressed concern about the highly technical language used
by department scientists when communicating with the WMLR advisory committees. Participants also reported the inconsistent use of certain terms among department presenters. Communication issues related to the use of jargon were also evident in our analysis of documents and personal observations of the WMLR case. There were references in the minutes of WMLR meetings to problems related to technical terminology and the need for the use of clearer and more consistent definitions in public documents related to the plan. Frustration was also observed among community representatives over technical terms at a number of WMLR committee meetings.

*Communication of Uncertainty and Limits of Knowledge*

There was clear evidence in the meeting minutes for each of the study catchments that there were regular discussions among committee members and scientists about the methods and data sources used in the technical investigations, as well as the assumptions and sources of uncertainty in the information. Similarly, most of the planning and technical documents that were reviewed contained descriptions of investigation methods and knowledge gaps and limits. The department and NRM Board representatives interviewed in each catchment also felt that methods, data sources and levels of uncertainty associated with the technical information had been adequately explained to the committees. For example, the plan coordinator in the Marne case explained that “for each major piece of technical work, the author came along and went through what they did, how they did it and why”. Similarly, a department hydrogeologist working in the WMLR catchment recalled that “we’ve outlined the inaccuracies and there hasn’t been any attempt to put it over on them, saying things we don’t know”.

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Despite evidence of attention to study methods and sources and levels of uncertainty in all of the catchments, three of nine interview participants in the Barossa case, seven of eighteen participants in the EMLR case and thirteen of twenty-six participants in the WMLR case expressed some concern about how technical methods, assumptions and uncertainty had been communicated in the process. For example, one community representative in the WMLR process commented that the technical experts were “not ready to admit too many limits and are trying to be confident about what they’ve done”. Another committee member and farmer in the WMLR area explained that “it’s not misinformation, but when they just show a map, they’re not really telling the whole story”. A common view among participants in the Barossa, EMLR and WMLR cases was that some scientists were much more open about their methods and uncertainties than others. In the Marne catchment, the committee participants interviewed were universally satisfied with the communication of the limits and uncertainty of technical knowledge in their process.

Use of Boundary Experiences

Interviews and meeting minutes indicated that boundary experiences were used to a limited extent in the Marne, EMLR and WMLR cases. Early in the process, the Marne advisory committee attended a field trip to investigate low flow dam bypasses in a nearby catchment. The meeting minutes of the EMLR committee referenced a field trip to learn about significant wetland habitats within the area. The Central Hills and Fleurieu committees in the WMLR catchment also used field trips to investigate issues relating to their policy discussions. The Central Hills committee toured a sub-catchment within the area to develop a more practical understanding of how different aquatic habitat types had
been characterized within the plan. There was no evidence that such an event had been organized during the current planning process in the Barossa area.

The analysis of the interview data also revealed that participants across the cases generally recognized the benefits of field trips to the process for sharing information and building a practical understanding of water allocation issues. This was confirmed by our observations of the Central Hills sub-catchment tour where we witnessed technical experts from the NRM Board and department sharing ideas and discussing issues informally with the committee throughout the tour. Participants across all of the cases expressed frustration at the lack of events organized in their catchments. A community representative on the McLaren Vale committee in the WMLR catchment described the importance of “seeing the practical side” of the water allocation issues and was critical that his committee was “making all these decisions by sitting around tables eating minties”. Notably, there were a few participants across the cases who questioned the value of committee field trips, particularly given the time constraints on both department personnel and community representatives. They felt that committee participants should already have a practical understanding of issues in their catchment. One participant in the EMLR case remarked that diagrams and photos presented at committee meetings had been sufficient for their needs.

**Participation by Relevant and Significant Interests**

*Representation of All Relevant Interests*

About half of participants in each of the cases were generally satisfied with the composition of the advisory committees and felt that the major water use sectors and geographic regions within the catchments were adequately represented. However,
participants in each catchment also expressed some concern about the absence of key interests from the process. Each of the four plan coordinators acknowledged that Aboriginal communities within the catchment had not been sufficiently engaged. A NRM Board representative on the Marne committee described this as a “big failing of the process”, particularly given the recent commitments by Australian governments under the National Water Initiative to provide water for cultural and spiritual purposes.

A common opinion among participants across all of the cases was that some committee members were not effective representatives of their sectors. For example, a farmer involved in the Barossa planning process felt that too many of the committee members were from large companies rather than individual irrigators, meaning that they were “one-step removed from the on-the-ground running of a property” and were contributing “second or third-hand knowledge rather than first-hand”. Further, participants in each case identified specific water use sectors that were absent from the committee process, such as olive growers or public water suppliers. While participants in the EMLR case generally felt that industry and existing water users were well represented in the process, four of the eighteen participants who were interviewed suggested that environmental and social interests in the catchment were missing. Conversely, two of the nine participants interviewed in the Marne case expressed that the membership of their committee was somewhat skewed towards non-licensed water users and environmental interests and voiced concern that the committee’s endorsement of the proposed policies and their technical basis provided a false sense of security and was probably not representative of the broader community.
Scientists “At the Table”

The meeting minutes from each case indicated that technical experts from the department and respective NRM Boards interacted on a regular basis with all of the advisory committees. Our analysis of the interview data, however, revealed that the participants’ satisfaction with the level of involvement of scientists in the process varied considerably among the individual cases. Seven of nine interview participants in the Marne case and fourteen of eighteen participants in the EMLR case were highly satisfied with how technical experts had been engaged in the process. As a farmer and member of the Marne committee stated, “the right people were there to present the various components”. In contrast, over half of the seventeen community participants interviewed in the WMLR catchment were critical of the lack of opportunity to question and to discuss technical issues directly with the scientists. In the Barossa area, even though a department groundwater scientist was involved as a member of the advisory committee, six of the nine participants interviewed criticized the lack of involvement of surface water experts in the process.

Committee members in the WMLR and EMLR catchments raised two noteworthy issues in our interviews related to the quality of scientists’ participation in the process. First, committee members in both areas felt confused by multiple scientists presenting and interacting with the committee at different times on similar topics. This was also apparent in the meeting minutes that we reviewed from each case. A farmer on one of the WMLR committees commented that “at times, we don’t know who we’re listening to or where they’re coming from. If the same people are feeding you information regularly, you can question and get to know those people”. In the WMLR area, almost half of the
seventeen community participants who were interviewed criticized the poor communication skills of some of the scientists involved in the process, which limited their ability to discuss technical issues when they had opportunities to meet face-to-face with the experts.

**Joint Fact-finding**

*Incorporating Knowledge from a Variety of Sources*

The technical investigations in all of the cases were conducted almost exclusively by scientists in the Department for Water. An analysis of technical reports and planning documents from each catchment also revealed that the investigations primarily relied on government data sources, such as department gauging stations to estimate surface water flow and runoff, Bureau of Meteorology stations for rainfall data, and department borehole data to determine well locations and yields. This was confirmed by interview participants in all of the cases.

The document and interview data did provide examples in all of the cases where investigators used multiple sources of information, including community and landholder data, to determine features such as allocation limits for fractured rock aquifers, fish species distribution, stock and domestic water requirements, and surface water dam capacities. In a few of these instances, landholder knowledge was collected in a systematic way to supplement or help validate other data and information sources. For example, a mail survey of catchment residents organized by the Marne advisory committee was used along with mapping, aerial photography, and published data to estimate stock and domestic water demand in the catchment. In the WMLR case, a limited number of workshops were held with irrigators to ground-truth the department’s
theoretical crop requirement figures and water demand estimates for individual sub-catchments. In other cases, existing sources of local data (e.g., stream flow data collected by a community catchment group in the EMLR catchment) were used to fill gaps in department data sources.

Participants across all of the study catchments also reported that the technical investigations were conducted independently of the committee. In fact, the technical reports and meeting minutes reviewed from each of the cases revealed that investigations were often initiated, and in some cases completed, prior to the committees even being formed. For example, the Barossa committee largely relied on information produced during the catchment’s previous water allocation planning process. Similarly, a study of environmental water requirements in the Marne catchment was completed before the advisory committee process was initiated. The common practice in all of the cases was to present the technical information to the committees at or near the completion of the technical investigations to inform their discussions and decisions on water allocation policies. As a NRM Board participant in the WMLR process described, “the committees were more involved in how information was used in a policy sense”.

Only three of twenty-six interview participants in the WMLR case and two of eighteen participants in the EMLR case raised concerns about the exclusive reliance on the department for technical knowledge in the process. They expressed apprehension related to a perceived conflict of interest in the government conducting the technical investigations and approving the plan. An industry representative on one of the WMLR committees felt that the technical aspects of the plan were “not getting the level of independence that the process deserves” and would have preferred to have had
consultants conducting the technical investigations rather than public servants. One participant in each of the WMLR and EMLR cases were concerned about being forced to accept the results of the department’s investigations because it was the sole source of information in the process. According to a farmer on the EMLR committee, “it’s the only opinion we get and no one’s got the financial resources to argue that it’s not right”.

_Effort to Promote Understanding of and Dialogue about Knowledge among Participants_

There was evidence across all of the cases that a substantial effort was made to educate participants about the technical information being produced and used in the process. Key technical components, such as identifying environmental water requirements, were generally presented to committees multiple times during the planning process. This was revealed in the meeting minutes for each case and was confirmed by interview participants and our personal observations at advisory committee meetings. The data showed examples in all of the cases of NRM Board and department representatives following up on technical questions or requests for additional information from committee members at subsequent meetings. For example, in the EMLR catchment, due to concern by the committee of modeled surface water management boundaries, finer scale maps of the proposed boundaries were produced so that members could consider what they would “mean on the ground”. It was also evident from the interviews and meeting minutes for each case that additional presentations and discussions were organized, as required, to help committees to understand technical issues. A department representative in the WMLR catchment explained that they had “offered as many meetings as required” and had “certainly made the hydrologists, hydrogeologists, and ecologists available to the committees”. A WMLR committee member confirmed, “we’ve
been encouraged to ask for additional presentations, so there haven’t been any restrictions”.

The extent to which participants had the opportunity to question, challenge and debate technical information in the process varied considerably among the cases. All of the interview participants in the Marne case were highly satisfied with the extent to which technical information was examined and discussed by the committee. Discussions about knowledge at Marne committee meetings were described as negotiable, with ample opportunity to question and debate technical information. Participants in the Marne case also pointed to missed deadlines and lengthy meetings during the process as evidence of their close examination of technical knowledge. A community representative on the committee reflected that they had “gone over due dates because we were getting into the details and sorting it out so that everyone was happy before leaving the table”. Lengthy and repeated discussions about technical information by the committee were also evident in the meeting minutes from the Marne case. Participants in the Marne case also emphasized the willingness of department scientists to review their technical information and re-run hydrological models in response to requests and challenges from the committee.

In contrast, about four of the nine interview participants in the Barossa case and seven of the eighteen participants in the EMLR case expressed serious concerns related to the lack of time the committee had to adequately digest and discuss technical information. Participants in both catchments attributed this shortcoming of the process to the time constraints of committee meetings. A farmer on the Barossa committee commented, “we only had two hours at meetings, had an agenda to stick to and really
didn’t get that into [the technical] part of it”. Under these circumstances, participants in both the Barossa and EMLR cases acknowledged the need for the committee to eventually end discussions, make decisions and “get on with things”. According to an industry representative from the Barossa process, “the chairs allowed debate [about the technical information] but also had to remain mindful of the boundaries and deliverables of the process”.

In the WMLR catchment, criticism about time pressures and inadequate discussion of technical information was widespread among advisory committee members. The department and NRM Board participants interviewed in the WMLR case acknowledged the constraints that the tight timelines had placed on the process in terms of explaining and discussing the technical information with the committees. A comment by one of the NRM Board representatives was illustrative of the situation: “everything is happening so quickly and people are being bombarded with all of this information – it would have been nice to have more time”. An observation by the chair of one of the WMLR committees reinforced further insights gleaned from planning documents, meeting minutes and personal observations into how technical information was presented to and discussed by committees in the WMLR case: “The science is often rolled into proposed policies and rules. So you get straight into gut reactions to policies instead of having discussion around technical issues and understanding. As far as trying to manage a structured process of introducing the information and then providing an opportunity to discuss it and debate it and then resolving a position – we’ll there’s a two-stage process there that you have to run. In our case, it’s been lumped together”.

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There was a notable exception in the WMLR case where additional discussion and debate by the Central Hills committee over the technical information produced and used in the process was driven by the committee members. As a result of extensive existing development of water resources within the area, including reservoirs supplying water to the city of Adelaide, future water allocations in the Central Hills area were expected to be significantly more constrained by the plan than the other areas of the WMLR catchment. Participants described extra meetings being held between the Central Hills committee and department scientists to allow for additional discussion of contentious information and related policy issues. Reflecting on the outcomes of this additional dialogue, one of the Central Hills committee members explained that “we might not totally agree, but we have challenged and forced them to go back and re-think, re-present”.

**Understanding and Acceptance of Knowledge**

*Participants’ Understanding of Knowledge*

The analysis of the interview data revealed that participants across all of the study catchments were generally satisfied with their level of understanding of the knowledge being used to inform their water allocation policy decisions. We also witnessed a strong familiarity by many committee members with the technical information at advisory committee meetings in the Marne and WMLR catchments. Participants across the cases qualified their level of understanding in some way. Some felt that they had only understood the technical details on certain topics or geographic areas. One committee member in the EMLR area admitted to being selective in his efforts to understand the technical information and “shutting off on some things”, depending on the topic or who was speaking. Only one committee member in each of the Barossa, WMLR, and EMLR
catchments admitted to having a limited understanding of the technical information. A farmer in the EMLR area explained that he strictly understood “the basics” of the technical information and felt contented to “leave that to the hydrologists”.

*Participants’ Awareness of Knowledge Limits and Uncertainty*

Participants in each of the study catchments were universally aware of limitations and uncertainty associated with the knowledge that had been produced and used to make water allocation policy decisions. This was clearly evident from interviews and confirmed in our review of advisory committee meeting minutes and personal observations of committee meetings in each case. Many participants associated their high level of understanding of the technical information with being aware of its limits and gaps – “understanding enough to know about the holes in the science” according to one committee member in the WMLR catchment. A common concern with the available information in each study catchment was a lack of monitoring data and the overall poor accuracy of the technical information. Some participants described deficiencies in data and knowledge for particular areas of their catchment (e.g., the Fleurieu Peninsula in the WMLR catchment) or specific aspects of the water resources (e.g., fractured rock aquifer systems) or their use (e.g., estimates of water demand by stock and domestic users). A major limitation of the technical information, highlighted mainly by participants in the larger EMLR and WMLR catchments, was the inability of regional scale modeling to capture the local variability that exists at finer scales. Even within the smaller catchments, however, some community representatives cautioned that technical information produced by the department was inconsistent with the knowledge of local landholders. For example, one farmer in the Barossa catchment described having 73 years
worth of rainfall data for his property that would “show a different picture to what they look at”.

**Participants’ Acceptance of Knowledge**

The extent to which participants were willing to accept and agree to the knowledge that was produced and used to base decisions in the process varied substantially among the study catchments. This was revealed primarily in the interview data but also observed at meetings of the respective advisory committees. In the Marne area, each of the committee participants who were interviewed was accepting of the technical knowledge, despite its widely recognized limits. Agreement among the Marne participants to the set of information on resource conditions and water use within the catchment that formed the basis for their recommended policies was highly contingent on adopting an adaptive approach to water allocation planning. Recognizing the urgency to improve management of the water resources in their catchment, participants in the Marne case expressed the need to proceed with water allocations based on the best available knowledge – “drawing a line in the sand”, according to a farmer on the advisory committee – but also emphasized the need to continue monitoring and studying the resource and the importance of evaluating and potentially adjusting policies in the future.

Less than half of interview participants shared this perspective in the remaining three catchments – four of nine participants in the Barossa case, seven of eighteen participants in the EMLR case, and eleven of twenty-seven participants in the WMLR case. One of the rare examples in the WMLR case was a NRM Board participant who reflected that the catchment had been an unmanaged system for a long time and that it was now critical to establish an initial baseline of water use and get a management
regime in place. Although tested and robust modeling processes had been used to produce the best knowledge possible in the available timeframe, they felt that an effective water allocation planning system required the ability to ground-truth the technical information and re-visit the allocation policies in the future.

The more common opinion in the Barossa, EMLR and WMLR areas, particularly among community representatives, was that much of the technical information was too broad brush to support a meaningful and defendable plan. A few of the agency representatives in these catchments expressed similar reservations. One of the NRM Board participants in the WMLR case commented, “we seem to be developing some policy without complete science – that’s a risk to us and the department”.

Enhanced Social Capital

Knowledge of Resource Conditions

Each of the nine participants who were interviewed in both the Barossa and Marne cases said that their involvement in the water allocation planning process had significantly increased their understanding of water resource conditions in the catchment. A few participants in each area described having some previous understanding from living or working in the area, but that the process helped to build on this knowledge. For example, one farmer and committee member in the Barossa catchment felt that the process had confirmed what they had previously observed and “put it into technical terms”. Similarly, the plan coordinator in the Marne catchment said that she had gained a more specific, in-depth understanding of water and ecological conditions in the catchment through her involvement in the process.
While most participants in the WMLR and EMLR catchments also described gaining knowledge about resource conditions through the process, three participants in each of these larger catchments indicated that their knowledge of resource conditions had not changed substantially. One WMLR catchment farmer and committee member admitted to being highly skeptical of the technical information available for the area and therefore felt that he had not gained a good understanding of the water resources in the catchment. An industry representative in the EMLR area attributed his failure to adequately learn about the water resources to the large size of the catchment and his unfamiliarity with its geography.

Knowledge of Others’ Perspectives

Our analysis of the interview data revealed mixed results among the cases regarding whether participants had increased their awareness and understanding of others’ perspectives towards water in the catchment. These findings were substantiated by observations of the advisory committee meetings that we attended. Seven of nine participants interviewed in the Marne case and eleven of eighteen participants in the EMLR case felt strongly that they had gained this type of knowledge through the process. Community representatives in each case described gaining a better understanding of water use issues faced by other sectors or in other areas of the catchment than their own. An industry representative on the EMLR committee cited an enhanced personal knowledge of government perspectives and issues as a positive outcome of the process. The comments of a few participants in the Marne and EMLR catchments suggested that the process of others’ perspectives had influenced their deeper core values towards water allocation. For example, one committee member – a catchment resident and non-irrigator
in the Marne case – claimed to have gained strong empathy for water users in the catchment through their interaction on the committee and in the process had changed his previously held view of irrigation as a “wasteful and illegitimate practice”.

In contrast, four of nine interview participants in the Barossa area felt that they had not been enlightened through the process regarding other participants’ water use issues and practices. These individuals claimed to have been familiar with water use issues among various sectors in the catchment prior to their involvement in the water allocation planning process. In the WMLR area, fourteen of twenty-six interview participants admitted to having a limited understanding of the issues faced by water users in other parts of the large catchment. Community representatives in the WMLR case also expressed concern that the department representatives lacked an appreciation of some of the unique practical issues associated with water use by different sectors or in specific locations within the catchment.

Across all of the cases, the department and NRM Board participants acknowledged that the process had drastically improved their knowledge of the practical problems faced by water users as well as the social implications associated with the water allocation issues being addressed.

Trust among Participants

The analysis revealed conflicting evidence regarding the level of trust that had been gained among scientists and community participants in the cases. While we witnessed positive working relationships in all of the community advisory committees based on the meetings attended, the interview data showed variable outcomes among the cases. All nine participants interviewed in the Marne case reflected positively on the level of trust
achieved through the process. They described a casual relationship, familiarity and high level of trust among the group and observed that community representatives and scientists alike were open to asking each other questions during and outside of committee meetings.

Over half of the participants in each of the other three cases expressed concern about trust among participants; however, most of the concerns related to an underlying and pre-existing personal distrust of government in general, rather than to specific issues with participants directly involved with the advisory committees. For example, one viticulturalist and member of the EMLR committee emphasized that he had gained high respect for the NRM Board and department scientists involved in the process but held strong disdain for the government officials, or “faceless men downtown”.

The structure and organization of the WMLR process appeared to create barriers to building trust among its participants. A large number of department scientists were engaged inconsistently with the WMLR advisory committees, which left many community participants feeling less familiar with the technical experts involved in the process than in the other areas. Another source of distrust for a few of the community representatives in the WMLR case stemmed from a perceived conflict of interest in the department both conducting the technical investigations and being involved in developing the water allocation policies. Several WMLR committee members cited a lack of connection between the individual sub-catchment advisory committees as a barrier to developing more trust among the community participants through the process.
Discussion and Conclusions

Collaboration is purported to offer numerous benefits related to knowledge production and use. However, previous evaluations of collaborative governance in practice have provided only limited insight into whether, and under what conditions, such outcomes can actually be achieved. In this study, we have attempted to bridge this gap by applying a framework of theorized process and outcome criteria to systematically evaluate knowledge production and use in four case studies of collaborative water allocation planning in South Australia.

Comparing Potential and Actual Outcomes

For information to be meaningful and used effectively in environmental decision-making, end-users, including the public, must understand it and have confidence in its quality (Dietz, et al. 2003; Dilling 2007; Johnson 2009). Previous research on collaborative governance processes has suggested that collaboration can increase the understanding and acceptance among participants of the knowledge that is used to make decisions (Innes, et al. 2004). We found only partial evidence of this among our four cases. Our findings indicated that most participants in each of the cases understood the knowledge used to inform their water allocation policy decisions and were also keenly aware of its limits and gaps. Only participants in the Marne case, however, also demonstrated an acceptance of and agreement to the knowledge that formed the basis for their recommended policies. The majority of participants in the other three cases felt that the technical information currently available for their catchment was too broad brush to support a defendable plan. This represents a potentially significant barrier to the successful implementation of water allocation plans within these catchments, given the argument that participants’ agreement
to the base of knowledge used to make decisions will strongly influence whether a collaborative process is able to generate broader community ownership of problems and solutions (Wallington, et al. 2008). Previous case studies have demonstrated how doubts among participants about the credibility of information can act as a barrier to the successful implementation of environmental policy (e.g., Dietz, et al. 2003; Evans 2006; Kuehne and Bjornlund 2006).

Another important outcome of collaborative governance processes is that they can enhance social capital (i.e., civic relationships of trust, goodwill, and engagement) within the community (Dietz, et al. 2003; Hillman 2005). With a few noted exceptions, the majority of participants in all of our cases had increased their understanding of water resources and ecosystems in their catchments, and better understood the perspectives of others towards water use and water allocation issues. There was also evidence that trust was built among the catchment representatives, NRM Board personnel and department scientists who were directly involved in each of the advisory committee processes. These findings are consistent with previous studies which have shown that collaboration can lead participants to become more aware of each other’s perspectives and recognize that others’ views and knowledge are legitimate (e.g., Castillo, et al. 2005; Fernandez-Gimenez, et al. 2006; Giordano, et al. 2010). For example, in a study of community-based forestry organizations in the United States, Ballard, et al. (2008) found that local participants had gained a better understanding of the local ecosystem and the scientific process and scientists had developed a greater appreciation of the value of local knowledge. Social capital generated among participants in our case studies has the potential to enhance knowledge production and use during future water allocation
planning cycles. Mutual learning and trust building among scientists and non-scientists has been identified as critical ingredients for future collaboration (e.g., Berkes 2004; Folke, et al. 2005), including promoting the more effective integration of different sources of knowledge.

**Determinants of Success**

Comparing the evaluations of the process criteria across the cases allowed us to consider how variations among the processes may have influenced the knowledge-related outcomes that were achieved. As reported above, participants across the cases generally understood, and were aware of the limits of, the knowledge produced and used to develop the water allocation plan. In each process, we found evidence of a concerted effort by the NRM Boards and department to educate community representatives about the technical information pertaining to water resource and ecological conditions in the catchment. During presentations and discussions about technical information, there was evidence in each case that scientists were generally open and clear about the methods of their investigations and the uncertainty and limits associated with the results. Further, technical terminology, or ‘jargon’, was generally avoided or explained when necessary. With the exception of the Barossa case, field trips were successfully used in each process to build understanding among participants of contentious or complex technical and policy issues. These findings support claims that such “boundary experiences” can facilitate the translation of information and ideas and build a sense of community among participants by helping them to see beyond their individual perspectives (Feldman, et al. 2006).

Our analysis also revealed that the Marne and EMLR catchments each had a “dedicated, active and strong coordinator” (Bellamy and Johnson 2000) who was able to
act as an effective broker between scientists and non-scientists in the process. Though the Barossa and WMLR advisory committees also had various participants who offered “interactional expertise” (Carolan 2006), they appeared to lack a clear leader and facilitator. These differences may help explain why participants in the Marne and EMLR processes appeared to have achieved a comparatively higher level of awareness and understanding of each others’ perspectives than in the other cases. These findings underscore the importance of strong leadership within collaborative processes and are consistent with previous assertions in the literature that an effective facilitator can enhance communication among scientists and non-scientists by helping to communicate technical information in an understandable way and promoting the integration of local knowledge in the process (Allen and Kilvington 2005; Booher and Innes 2005; Jacobs, et al. 2005).

The degree to which relevant and significant interests within the catchment were represented in the cases was mixed. There was evidence in each of the cases that scientists were directly involved in advisory committee discussions about knowledge. Consistent with previous research, we found that having technical experts “at the table” helped to build understanding and trust both among scientist and non-scientist participants (e.g., Petts 1997; Fernandez-Gimenez, et al. 2006). Our findings also highlighted the importance of involving individual scientists recurrently through the process and for participating scientists to be able to communicate effectively with non-scientists.

The results indicated that licensed water users, who stood to be directly regulated under the new water allocation plan, were well represented on the Barossa, EMLR and
WMLR committees. In contrast, participation by licensed water users on the Marne advisory committee was limited. This raises doubt as to whether the Marne process allowed for a fair consideration of the views and knowledge of a full range of interests in developing the plan. In terms of the outcomes we evaluated, it also puts into question the Marne committee members’ high level of acceptance relative to the other cases of the knowledge produced and used in the process – two participants voiced strong concerns that the committee’s views may not reflect those of irrigators in the catchment.

There was no evidence that Aboriginal communities were engaged in the collaborative processes that we examined. All of the water allocation plan coordinators expressed strong concern about this omission, particularly in light of recent commitments nationally in Australia to provide water for cultural and spiritual purposes and to include Indigenous representation in water planning. This finding is consistent with a widespread criticism in the literature that expectations of indigenous participation in water management institutions are not being met and confirms the need for further research to better understand the barriers and incentives to indigenous participation in the water sector (Jackson and Morrison 2007).

Overall, the deficiencies we observed related to stakeholder representation within the case study processes draw attention to previous research on collaboration that has demonstrated negative consequences of inadequate representation (e.g., Lane and McDonald 2005). For example, in the context of collaborative restoration efforts in the Great Lakes Basin, Beierle and Konisky (2001) attribute implementation failures in part to important stakeholder groups missing from the collaborative planning stages of the process.
Collaboration is widely promoted in the literature as a means of producing a broader information base for decision making through joint fact-finding and integrating local sources of knowledge with external sources of expertise (e.g., Berkes 2004; Cowie and Borrett 2005; Innes and Booher 2010). We found that the technical investigations in each case were primarily conducted by department scientists, and that community participants had little direct involvement in their design and execution. Further, there was limited evidence in each case of local knowledge (e.g., landholder records) being accessed and used in the investigations. For the most part, technical information was provided to participants at or near the completion of investigations which the committees considered in developing their respective policies. At the same time, our analysis revealed that there was little expectation on the part of most participants that community representatives would have a direct role in producing technical knowledge for the plan. For example, our interviews with community participants in each case suggested that most were satisfied with the extent of their involvement in the technical investigations. Moreover, a lack of direct involvement in the technical investigations also did not appear to prevent advisory committee participants in the Marne case from accepting the knowledge that was used as the basis for their recommended policies.

These findings contrast with current ideas in the literature about how local participants in a collaborative process should be engaged in knowledge production. The lack of involvement of community participants in the technical investigations may reflect characteristics of collaboration in South Australian water allocation planning that distinguish it from other forms of collaboration that allow more direct involvement of local actors in knowledge production. For example, collaborative processes that are
broader in scope and duration are typically engaged throughout the entire policy cycle, from problem definition and policy adoption to implementation and assessment (Leach, et al. 2002). Community participants in such processes often have an opportunity to be involved in the planning, design and execution of technical studies. In contrast, the community advisory committees in South Australia were initiated by the NRM Boards to focus specifically on developing a water allocation plan. These committees were situated within a broader legislated process that defined the issue, the range of policy options, and the terms of reference for technical investigations. The development of the plans was a short to medium-term exercise and, in all but the one case, time was found to be a severe constraint on the committee process. Sufficient time is widely viewed as an essential ingredient for successful collaboration in the literature (e.g., Petts 1997; Margerum 1999; Johnson 2009). Given these constraints, our findings suggest that it was never intended for advisory committee members to be directly involved in producing the required technical information for the water allocation plans.

Working with a pre-determined set of technical information runs the risk that participants in a collaborative process will end up considering a relatively narrow and potentially biased range of policy options (Reed 2008). To mitigate this risk, Wynne (1992) suggests that scientific knowledge should be debated and negotiated in public, as part of environmental policy discourse. In this study, the Marne process was the only case where we found clear evidence that the committee had ample opportunity to question and debate the technical information produced by the department. There was also evidence that during the Marne process, the results of technical investigations were reviewed and in several instances re-visited in response to questions and challenges from committee
members. In this sense, the process of synthesizing available information to develop water allocation policies in the Marne case could be described as “dialectical”, in that participants (both scientific and non-scientific) had the opportunity to “challenge each other’s assumptions and force self-reflection” (Innes and Booher 2010). This was a distinguishing feature of the Marne process that may help to explain its consistent success across all of the outcome criteria that we assessed. These findings affirm claims in the collaborative environmental governance literature that critical debate and argumentation of knowledge is a critical condition for successful collaboration, in that it can promote social learning, build trust and social capital and lead to understanding and acceptance of information among participants (e.g., Lane and McDonald 2005; Innes and Booher 2010).

In addition to the criteria that we evaluated in our framework, we also found evidence of contextual features of the case study areas that had influenced the collaborative processes and their outcomes. The potential for significant water allocation restrictions under the future plan prompted one of the advisory committees in the WMLR catchment to push for additional discussions of technical information during the process. There was also evidence that differences in geographic scale among the case study catchments may have influenced their knowledge-related outcomes. Previous research has highlighted the importance of geographic scale in environmental governance (e.g., Blomquist and Schlager 2005; Bulkeley 2005; Cheng and Daniels 2005). Hillman (2005) contends that scale is at the heart of environmental decision-making and that it can constrain both outcomes and processes. From a technical perspective, it is necessary to ensure that information is produced that is congruent with the scale at which planning and
management decisions are being made (Trudgill and Richards 1997; Dietz, et al. 2003). In this study, a strong criticism among participants in the larger case study areas of the technical knowledge was the inability of regional-scale modeling to capture the local variability that exists at finer scales. As a result, many participants felt that the technical information was too coarse to support a defendable water allocation plan for their catchment.

Scale can also influence the ways in which participants interact with one another in the process. From this perspective, Cheng and Daniels (2003; 2005) have demonstrated that stakeholders engaged in collaboration at a smaller geographical scale are more likely to view one another as part of a shared, place-based group. We found evidence of this in our cases, where the large size of the EMLR and WMLR catchments was identified by participants as barriers to building their understanding of resource conditions and their awareness of others’ perspectives across the catchment. Setting the appropriate geographic scale for a particular type of collaborative process, or vice versa, is clearly a difficult challenge. Our findings suggest that scale raises particular concerns related to knowledge production and use and warrants further examination in future research.

Conclusion

Our concern with knowledge production and use in collaborative governance reflects a broader apprehension among researchers in the environmental governance field that a significant gap exists between the promises of collaborative processes in theory and what they can achieve in practice (e.g., McCloskey 2000; Jeffrey and Gearey 2006; Plummer and Armitage 2007). This study responds to calls from proponents of collaboration for more systematic evaluations of collaborative approaches in order to gain practical insight.
into what they can and cannot achieve, their strengths and limitations and the critical factors that influence their success (e.g., Bellamy, et al. 1999; Innes and Booher 1999; Blowers, et al. 2005; Koontz and Thomas 2006).

Importantly, our evaluation of four South Australian water allocation planning processes demonstrated that a number of theorized process and outcome criteria related to successful knowledge production and use can be achieved through collaboration in practice. The study also reinforces how critical dialogue about knowledge among participants in a collaborative process is necessary to reach acceptance of and agreement to a base of knowledge for decision-making. At the same time, the fact that collaboration in this case was nested within a more traditional top-down governance approach appeared to have limited the potential for authentic “joint fact-finding” (Innes and Booher 2010) in the process. The prescriptive nature of the planning framework precluded local actors from contributing to the technical investigations that produced virtually all of the knowledge that was used to base policy decisions. These findings contribute valuable insight to a growing body of literature focused on articulating the limitations of collaborative governance processes (e.g., McCloskey 2000, Beierle and Konisky 2001; Margerum and Whithall 2004; Fish, et al. 2010), and in particular, forms of collaboration where the state maintains a significant and influential role (e.g., Berkes 2002; Ryan and Klug 2005; Reed and Bruyneel 2010)

References

Adelaide and Mount Lofty Ranges NRM (Natural Resources Management) Board. 2009.

*Water Allocation Plan: Barossa Prescribed Water Resources Area.* Eastwood,
South Australia: Adelaide and Mount Lofty Ranges Natural Resources Management Board.


Leach, W.D., N.W. Pelkey, and P.A. Sabatier. 2002. Stakeholder partnerships as collaborative policymaking: evaluation criteria applied to watershed management in


CHAPTER THREE

THE USE OF LOCAL KNOWLEDGE IN COLLABORATIVE ENVIRONMENTAL GOVERNANCE: A CASE STUDY OF SOUTH AUSTRALIAN WATER ALLOCATION PLANNING

Abstract

Collaborative approaches to environmental governance can lead to more effective solutions that are tailored to local conditions in part because they promote a greater sensitivity to and use of local knowledge in the process. Integrating scientific and local knowledge in a collaborative process can also help to reach acceptance and agreement among participants to a base of knowledge for decision-making, and build social capital within the community. Given this potential, a key priority for research on collaborative environmental governance is to more closely examine the incorporation of local knowledge into collaborative planning processes. In this study, a multiple case study of water allocation planning in South Australia is used to characterize how local knowledge has been incorporated into a collaborative process and to identify factors that have influenced the integration of local knowledge with other types of knowledge (e.g., scientific). We determined that local knowledge has been used in water allocation planning primarily at the later stages of the process (i.e., conducting technical investigations and developing policies) rather than the earlier stages of framing the policy issues and scoping the required technical investigations. We found that participant attitudes, along with factors such as time and resource constraints and the absence of effective outreach and data collection and management tools, have limited the incorporation of local knowledge into the collaborative cases that were examined. Our findings provide insight into strategies to promote greater integration of local knowledge
into environmental decision-making. At the same time, the study suggests the need to re-examine expectations for joint fact-finding within collaborative governance processes, particularly within forms of collaboration that are nested within highly prescriptive, regulatory frameworks.

Introduction
Collaborative approaches to environmental governance have been promoted as a means of incorporating local knowledge into environmental planning and management decisions (e.g., Lane and McDonald 2005). Through “joint fact-finding” (Innes and Booher 2010), collaboration offers a means of dealing with complex and controversial environmental issues, particularly where there are significant technical and information challenges. According to Innes and Booher (2010), “information must be embedded in lay understandings if it is to be relevant” for decision-making (p.170). Local knowledge, generally defined as “practical, collective, and strongly rooted in a particular place” (Geertz 1983), fills an important gap in environmental planning by providing knowledge about context, and offering practical, experience-based insights from individuals who have first-hand experience with the issue (Innes and Booher 2010). By integrating local knowledge into decision-making, collaboration can promote greater ownership and acceptability of decisions by various actors involved in or affected by an environmental problem (Blackstock and Richards 2007). Local knowledge can help to develop a better understanding of complex environmental systems (Allen and Kilvington 2005), and can lead to more effective solutions that are tailored to local conditions (Innes and Booher 2004).
In order to realize this potential, some researchers in the collaborative environmental governance field have theorized that dialogue among technical experts and local actors should occur through all stages of a collaborative process – from framing the problems and identifying research needs, to conducting technical investigations and setting policy (e.g., Evans 2006; Petts and Brooks 2006; Innes and Booher 2010). Further, it is suggested that local knowledge should have a more substantial role in the process than merely complementing scientific knowledge. Instead, a “co-production model” (Corburn 2003) of public participation is proposed, where all actors are viewed as potential knowledge contributors to all aspects of environmental decisions.

In practice, researchers in the environmental management field have identified barriers to integrating different forms of knowledge in environmental decision-making. Problems stem from the underlying differences between positivist science and other forms of knowledge (e.g., Eden 1996; Berkes 2004; Fazey, et al. 2006) and strong opinions regarding which forms of knowledge that are valid (e.g., Petts and Brooks 2006; Raymond, et al. 2010). Previous studies have also identified administrative challenges related to accessing and integrating local knowledge into environmental research and decision-making, including increased time and resource costs associated with non-scientist participation (Johnson 2009; Kroon, et al. 2009; Spink, et al. 2010).

These types of challenges are symptomatic of a wider concern in the collaborative environmental governance literature – namely that an extensive gap remains between collaboration in-theory and in-practice (e.g., Jeffrey and Gearey 2006; Plummer and Armitage 2007). More systematic evaluations of collaborative processes have been recommended in order to understand what they are capable of achieving, their strengths
and weaknesses and the factors that influence their success (e.g., Bellamy, et al. 1999; Innes and Booher 1999; Blowers, et al. 2005; Koontz and Thomas 2006). A growing body of empirical research in the collaborative environmental governance field has demonstrated the successful integration of local knowledge within participatory and collaborative research contexts (e.g., Corburn 2003; Castillo, et al. 2005; Fernandez-Gimenez, et al. 2006; Ballard, et al. 2008; Clark and Brake 2009; Johnson 2009; Giordano, et al. 2010). Considerably less attention has been paid to how local knowledge is incorporated into collaborative environmental planning processes (Innes and Booher 2010).

In this paper, we seek to address this gap by systematically analyzing how local knowledge is incorporated into a real-world collaborative planning process. Based on a qualitative, multiple case study of water allocation planning in South Australia, this study provides insight into (1) the extent to which local knowledge has been incorporated at different stages of the collaborative process and (2) the critical factors that are influencing the collection and integration of local knowledge in the process.

Local Knowledge and Collaborative Environmental Governance

Local knowledge has been defined as “the body of knowledge held by a specific group of people about their local environmental resources” (Giordano, et al. 2010, p.1719). It is often characterized as a form of knowledge held by non-scientists, based on local wisdom and experiences (Ballard, et al. 2008) and influenced by local norms and institutions, and social and cultural values (Blowers, et al. 2005; Fernandez-Gimenez, et al. 2006). In the context of environmental management, local knowledge is often compared with the
expertise of government resource managers who possess knowledge based on the
conventions of Newtonian science (e.g., Ballard, et al. 2008).

It has been suggested that such a sharp distinction between scientific and local
knowledge does not exist in reality (Raymond, et al. 2010). Rather, different sources of
knowledge are related across a series of dimensions, including the nature of the process
used to generate knowledge (e.g., formal versus informal), the level of expertise (i.e.,
 novice versus expert), the way in which knowledge is articulated (i.e., tacit versus
 explicit), the influence of traditional culture and norms, and the scales at which
knowledge relates (e.g., local versus generalized; short-term versus long-term)
(Raymond, et al. 2010). For this study, we have adopted this broader conceptualization of
knowledge and consider local knowledge to be the knowledge held by individuals about
their environment, encompassing sources ranging from tacit knowledge based on lived
experience to explicit knowledge based on science.

Collaborative environmental governance may be broadly defined as the sharing of
power and responsibility among state and non-state actors in decision-making for
environmental management (Carlsson and Berkes 2005). Collaborative governance
processes exist in many forms and have been distinguished based on factors such as their
duration, the scope of issues that they address, the institutional level at which they
operate, and the composition of participants (Leach, et al. 2002; Moore and Koontz 2003;
Margerum 2008).

Researchers in the environmental planning and management fields have identified
multiple ways that local knowledge can contribute in collaborative processes. Several
authors have argued that local knowledge has a critical role in framing environmental
problems and issues (e.g., Fazey, et al. 2006; Petts and Brooks 2006). Innes (1998) contends that local knowledge is viewed by many actors as authentic indicators of problems. For example, it can provide valuable insight into social and public health dimensions of an issue (de Lemos 2006). In this way, collaboration can help to build a more holistic understanding of a problem (Margerum and Whithall 2004). Considering all perceptions of an issue, including local, not only ensures that the full nature of the problem is understood but it also increases the likelihood that the problem is viewed in a collective way by the different actors involved (Rogers 2006).

Another reason cited in the literature for integrating local knowledge early in a collaborative process is that it can help to scope the technical investigations that are needed to understand a particular issue. Local actors can help to establish research agendas (Castillo, et al. 2005) by offering insights into the types of studies that need to be done or updated (Innes 1998). They can also provide input into how technical investigations should be conducted. In the context of European water policy, van Ast and Boot (2003) suggest that local knowledge can help reveal hydrological-economic relationships and identify the scales at which issues should be addressed. In a study of knowledge integration to support soil salinity monitoring, Giordano, et al. (2010) identified multiple benefits of local actors contributing to the design of a participatory monitoring program, including increasing the acceptability of locally-based information by decision makers and managers and an increased awareness among farmers about the value of their own knowledge. Overall, integrating local knowledge early in an environmental governance process can support the emergence of a shared understanding of a problem and agreement on the methods that should be used to investigate the
problem – both important outcomes that can reduce the risk that analyses and proposed solutions will be contested or rejected by the general public later in the process (van Ast and Boot 2003).

Wynne (1992) emphasizes the importance of complex differences among farming practices within small areas that reflect micro-conditions not typically accounted for in scientific studies. For this reason, many researchers contend that local knowledge should contribute directly to technical investigations (e.g., Neis, *et al.* 1999; Innes, *et al.* 2004; Johnson 2009). Local actors can provide new information to the process (Innes, *et al.* 2004) which may help, for example, to fill critical data gaps in state environmental monitoring programs (Giordano, *et al.* 2010). Many also view an important role for local knowledge in qualitatively evaluating the validity of model predictions and analysis assumptions and findings (e.g., Petts 1997; Clark and Brake 2009; Johnson 2009). For example, Neis, *et al.* (1999) advocate for a critical role for resource users’ knowledge in fisheries assessments, which may serve to either corroborate or to refute scientific findings.

Lastly, local knowledge is viewed by many in the literature as having an important role in identifying solutions to environmental problems, including determining appropriate policies and management actions (Fazey, *et al.* 2006; Kroon, *et al.* 2009). In part, this has to do with applying practical insight to ground-truth proposed rules and actions (Spink, *et al.* 2010). Innes (1998) contends that local actors can contribute to planning decisions by helping to determine how proposed policies would play out in practice at the local level. Local knowledge can also help to predict the implications of proposed measures on affected stakeholders and their communities. Due to the trade-offs
inherent to most modern environmental issues, decision-makers must understand the implications of different management options on various (and often competing) valued outcomes in an area (Dietz, et al. 2003). In this way, local knowledge can offer critical insight into the social system within which measures will be implemented, and it can promote a better appreciation of the possible indirect costs of different programs or rules (van Ast and Boot 2003; Newig, et al. 2005). In the process, policy makers can also acquire information that can help to gauge the potential of the local community to accept their proposed measures (Newig, et al. 2005).

Some authors, concerned specifically with the process of knowledge production, have drawn a distinction between knowledge, information, and data and have attempted to describe the relationship between the three (Spiegler 2003; Michaels, et al. 2006). According to Spiegler (2003), data becomes information when it is “endowed with purpose”, and information is transformed into knowledge “when it adds insight, abstraction, and better understanding” (p.535). These ideas are reflected by Hillman and Brierley (2002), in the context of collaborative water governance, where they describe the decision making process as “an iterative progression from data acquisition through information-gathering and the establishment of a knowledge base to decision-making” (p.619). Michaels, et al. (2006) further articulate the process of knowledge production in environmental decision-making and propose a cyclical depiction of the relationship between data, information, and knowledge. In their cycle: information needs are derived from knowledge through *framing*; information informs data gathering through *systematizing*; data is transformed into information through *analysis*; and information becomes knowledge through *synthesis* (Michaels, et al. 2006).
Building on these ideas, we defined four stages of a collaborative process for the purpose of characterizing the contributions of local knowledge in our South Australian case studies.

- **Framing the problem and identifying information requirements** – determining what the problem is and establishing what information is needed to address it.

- **Establishing research protocols** – selecting research methods, scope, and scale, and identifying relevant data sources.

- **Conducting technical investigations** – analyzing and interpreting available data sources.

- **Establishing the knowledge base for decision-making** – synthesizing available information sources into knowledge and developing policies.

**Collaborative Environmental Governance in South Australia**

In response to severe and prolonged water shortages and to growing interest in preserving and restoring functioning aquatic ecosystems, Australian governments have recently undertaken a series of sweeping reforms to their water management institutions (Pigram 2006; Connell 2007; Stoeckel and Abrahams 2007; Hamstead, *et al*. 2008). A critical milestone in the continuing reform process was reached in 2004 when the Council of Australian Governments (COAG) established the National Water Initiative (NWI). The new agreement extended the previous water reforms into a comprehensive Australian water policy statement. Under the NWI, Australian state governments have committed to, among other things, preparing water plans with provision of water for the environment and dealing with over-allocated or stressed water systems (Commonwealth of Australia
Statutory water plans are the primary tools for determining, on a catchment basis, how much water is available for consumptive purposes, and for ensuring that sustainable levels of extractions are achieved and maintained (Gentle and Olszak 2007).

A prominent role in water planning was assigned to catchment-based management authorities within each state. In developing plans, they are responsible for understanding, among other things, the available water supply in catchments and the needs of current, future and indigenous water users. Additionally, they must identify aquatic ecosystems of high conservation value and their water requirements (COAG 2004). Gaining access to local knowledge appears to have been a significant factor in assigning primary responsibility for water planning to catchment management authorities. On this issue, the Wentworth Group of Concerned Scientists, an influential Australian environmental policy think-tank, argued that “distant authorities do not have access to local knowledge required to develop and deliver innovative strategies” (TWG 2003). This reflects an overarching priority of the NWI to engage water users and other stakeholders in achieving the objectives of the agreement (COAG 2004).

In South Australia (Figure 3.1), the commitments under the NWI related to water plans are being met through a legislated water allocation planning framework. The Natural Resources Management Act 2004 outlines a process for “prescribing” water resources in the state that are deemed to be at risk and requires regionally-based Natural Resources Management Boards (NRM Boards) to prepare a water allocation plan for each of the “prescribed” water resources in their jurisdiction. Once prepared, plans are approved by the state government, and are used by the Department for Water (formerly the Department of Water, Land and Biodiversity Conservation) to guide the issuance
water allocation licenses, to manage the trading of water licenses, and to permit various water-affecting activities (e.g., dam and bore construction) within the area.

**Figure 3.1: Location of the case study areas**

The legislation mandates the scope and contents of water allocation plans and the technical matters to be investigated in the preparation of the plan. The state government also provides technical support to the NRM Boards in preparing plans by providing environmental monitoring data. Scientists in the Department for Water also undertake
most of the required technical investigations, although in some cases, the boards have hired independent consultants to undertake some or all of the technical work for the plan.

The *Natural Resources Management Act 2004* also sets out the process for preparing water allocation plans, including specific requirements for public participation. According to the Act, NRM Boards must consult with the public once at the outset of the process on the proposed structure of the plan (a “concept statement”) and again later in the process to seek feedback on a draft version of the plan. Many of the NRM Boards have voluntarily formed community advisory committees to collaborate with stakeholders more directly and regularly through the preparation of water allocation plans. The committees are facilitated by a plan coordinator from the presiding NRM Board and are typically chaired by a representative from the catchment community. The NRM Boards select a mix of interested water users, industry and interest-group representatives, and residents from the catchment to participate on the advisory committee. The *Natural Resources Management Act 2004* requires that water allocation plans be reviewed and updated as needed every five years. In some cases, advisory committees are disbanded following the preparation of a water allocation plan, although some committees are maintained through subsequent plan updates.

In sum, a collaborative process is being used by NRM Boards in South Australia to develop water allocation plans for prescribed catchments within their jurisdictions. The advisory committee process outlined above has many of the key features identified by Ansell and Gash (2007) in their definition of collaboration. First, the focus of the process is on developing public policy. Second, the committees are engaged directly in decision-making, rather than merely being “consulted” by the boards. Third, the advisory
committees include non-government, catchment representatives as members. Last, the committees are formally organized and meet regularly and collectively. Notwithstanding the collaborative nature of the advisory committees, another important characteristic of the process worth highlighting is that it is nested within the broader, highly prescriptive legislative framework for water allocation planning in South Australia. This clearly has implications for the collaboration processes and their outcomes.

**Methods**

A qualitative approach using multiple case studies was chosen for its potential to achieve a detailed understanding of the phenomena being investigated from the perspective of people who are directly involved in the process (Margerum 1999; Gerring 2007). A common criticism of case study research is its limited ability to produce generalizable findings. By studying four individual catchments within the South Australian context, we were able to replicate our analytical methods, adding robustness to the findings. The multiple case design also allowed us to compare collaborative efforts across cases and to assess how variations in individual processes may have influenced their outcomes (Conley and Moote 2003; Yin 2003).

We chose the case study areas within South Australia using five criteria. First, the responsible NRM Board had to have recently completed or be in the process of developing a water allocation plan. Second, the NRM Board had to have formed a community advisory committee to collaborate with on the preparation of the plan. Third, the NRM Board had to be advanced enough in the plan development process to have produced tangible outcomes (e.g., draft policies or a draft plan). Fourth, the catchments
had to be of varying size to allow an examination of the influence of geographic scale on the process. Lastly, planning participants, including advisory committee members and government agency policy and science staff, had to be accessible and willing to participate in the research, and key documents such as advisory committee meetings and process documents (e.g., meeting agendas and minutes) had to be accessible. Four catchments were selected based on these criteria (Figure 3.1). The relevant features of the case study areas are described below and summarized in Table 3.1.

Table 3.1: Summary of Selected Case Study Area Characteristics

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Size (km²)</th>
<th>Main Water Use(s)</th>
<th>Agency Responsible for Plan</th>
<th>Advisory Committee Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barossa</td>
<td>711</td>
<td>• Irrigated agriculture (grape vines)</td>
<td>Adelaide &amp; Mount Lofty Ranges NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>Marne</td>
<td>743</td>
<td>• Irrigated agriculture (lucerne, grape vines, olives)</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>EMLR</td>
<td>2,845</td>
<td>• Irrigated agriculture</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Two regionally-based committees (meeting jointly)</td>
</tr>
<tr>
<td>WMLR</td>
<td>2,750</td>
<td>• Irrigated agriculture (pasture, grape vines, fruit and nut trees) • Water supply for Metropolitan Adelaide</td>
<td>Adelaide &amp; Mount Lofty Ranges NRM Board (with Department of Water, Land &amp; Biodiversity Conservation)</td>
<td>Three regionally-based committees (periodic joint meetings)</td>
</tr>
</tbody>
</table>

Sources: Adelaide and Mount Lofty Ranges NRM Board (2009); Adelaide and Mount Lofty Ranges NRM Board (2010); South Australian Murray-Darling Basin NRM Board (2009); South Australian Murray-Darling Basin NRM Board (2011)
The Barossa Prescribed Water Resources (Barossa) Area is located 60 kilometres north-east of Adelaide and covers a total area of approximately 711 square kilometres (Figure 3.1). There are 560 water allocation licenses issued for the region which equate to just less than eleven gigalitres per year of licensed water use (Adelaide and Mount Lofty Ranges NRM Board 2009). Approximately two-thirds of both the license and volume totals are for groundwater use. In addition to the local water sources, imported water is supplied to the region via the Barossa Infrastructure Limited (BIL) scheme. Some irrigators in the region also hold River Murray water licences, which are delivered through SA Water infrastructure. Over 90% of water withdrawn from surface water, groundwater and watercourse sources is used to irrigate crops, including grape vines (by far the dominant irrigated crop in the Barossa Valley), as well as pasture and lucerne. Some water is also used for industrial, stock and domestic purposes.

The water resources in the Barossa area have been prescribed in stages over time. Groundwater on the Barossa Valley floor was first prescribed in 1989, followed by the prescription of the North Para River and its tributaries in 1992. All surface waters within the area were prescribed in 1998. In 2005, watercourses and surface water in the adjacent Greenock Creek catchment were added. At the time of this research, the existing water allocation plan for the Barossa area had been reviewed and it was determined that a new plan was required. The Adelaide and Mount Lofty Ranges NRM Board was working with the nine members North Para Water Allocation Plan Advisory Committee to develop the new plan.

The Marne Saunders Prescribed Water Resources (Marne) Area covers 743 square kilometers to the north east of Adelaide (Figure 3.1) and includes the catchments of the
Marne River and the Saunders Creek, as well as the groundwater within the area. Over 95 percent of water use in the Marne area is for irrigation purposes (South Australian Murray-Darling Basin NRM Board 2009), primarily lucerne, grape vine, and olive growing. The total estimated water demand for licensed purposes in the Marne area is 7.5 gigalitres per year, with approximately 70% of the use from groundwater sources (South Australian Murray-Darling Basin NRM Board 2009). There are also a number of water-dependent ecosystems in the Marne area that rely on surface and groundwater in the catchment. Water resources in the Marne area were prescribed in 2003. During this research, the South Australian Murray-Darling Basin NRM Board was preparing the first water allocation plan for the area, in collaboration with the eight members of the Marne Saunders Water Resources Planning Committee.

The Eastern Mount Lofty Ranges (EMLR) Prescribed Water Resources Area is 50 kilometres east of Adelaide, covering 2,845 square kilometers (Figure 3.1). The area contains sixteen surface water sub-catchments and sits within the Murray Darling Basin. Grazing and cropping account for 77 percent of total land use in the area. Pasture production and irrigated horticulture account for seven percent and urban areas, mining, industry, and manufacturing just five percent (South Australian Murray-Darling Basin NRM Board 2011). The estimated water demand by existing water users in the EMLR area is 13 gigalitres from surface water and 32 gigalitres from groundwater (South Australian Murray-Darling Basin NRM Board 2011). The area contains wetlands of national significance and the Coorong and Lake Alexandrina and Albert Wetland, part of an internationally-listed Ramsar site, are dependent on two creeks that originate within the catchment.
The water resources of the entire EMLR area were prescribed in 2005. This area encompasses the Angas Bremer region, which was first prescribed in 1980 and had its first plan approved in 1987. There have been four updates to the original Angas Bremer plan, most recently in 2001. The first water allocation plan for the broader EMLR area was being prepared by the South Australian Murray Darling Basin NRM Board, in collaboration with two Water Allocation Planning Community Advisory Committees, representing the northern and southern regions of the area. Combined, the two committees included nineteen representatives from the catchment community.

The Western Mount Lofty Ranges (WMLR) Prescribed Water Resources Area is located immediately to the east and south of Adelaide and covers an area of approximately 2,750 square kilometers (Figure 3.1). The area includes eight surface water catchments and three major watercourses. Over 75% of the South Australia’s population depends on eight water supply reservoirs located within WMLR catchments. Together, these reservoirs supply 60 percent of metropolitan Adelaide’s water requirements in an average year (Adelaide and Mount Lofty Ranges NRM Board 2010). There are also an estimated 11,500 wells, 13,000 dams and 250 watercourse water extraction points, supporting irrigated agriculture throughout the WMLR area (Adelaide and Mount Lofty Ranges NRM Board 2010). Pasture (39 percent of the total irrigated area), grape vines (34 percent), and fruit and nut trees (18 percent) are the main irrigated crops (Adelaide and Mount Lofty Ranges NRM Board 2010). Vegetables, flowers, berries and nurseries are also irrigated in the WMLR area. Commercial forestry is prominent – over 15,000 hectares of forest production throughout the catchment. There are also a range of water-dependent ecosystems in the WMLR area, including swamps in
the southern region of the catchment which have been listed as critically endangered ecological communities under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

Most of water resources in the WMLR area were prescribed in 2005; however, the McLaren Vale Prescribed Wells Area, located within the boundaries of the larger WMLR area, was originally prescribed in 1998 and had an initial water allocation plan completed in 2000. A plan for the entire WMLR area was being developed by the Adelaide and Mount Lofty Ranges NRM Board, in collaboration with three community advisory committees: the Central Hills Water Allocation Plan Advisory Committee (nine members); the McLaren Vale Water Allocation Plan Advisory Committee (seven members); and the Fleurieu Water Allocation Plan Advisory Committee (nine members). The committees met individually through the planning process and jointly on occasion to discuss technical information and policy issues relevant to the entire catchment. In addition to providing scientific and technical support to the Board during the process, the Department for Water also assisted directly in the development of the WMLR plan.

Data Collection and Analysis

Documents were the main source of evidence for analyzing how local knowledge has been incorporated into the plan development processes. In total, 137 documents were analyzed for this study. Minutes of advisory committee meetings provided records of community participants contributing their knowledge in the process. Draft water allocation plans, policy discussion papers and technical investigation reports were also main sources of information on how local knowledge was incorporated.
Interviews and personal observations in each of the study catchments provided alternative sources of data that allowed us to cross-check the evidence from the documents and strengthened the internal validity of our results. Sixty-two in-person interviews were conducted in South Australia between March and July 2008 with members of the community advisory committees, and with Department for Water and NRM Board personnel who were involved in the process as policy and scientific advisors (e.g., hydrologists, hydrogeologists, ecologists) or as water allocation planning coordinators. A summary of the participants interviewed for the study is provided in Table 3.2.

**Table 3.2: Categories of interview participants by catchment**

<table>
<thead>
<tr>
<th>Affiliation</th>
<th>Barossa Valley</th>
<th>Marne Saunders</th>
<th>Western Mount Lofty Ranges</th>
<th>Eastern Mount Lofty Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Department</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>NRM Board</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Land Manager</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>Industry / business</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>9</strong></td>
<td><strong>26</strong></td>
<td><strong>18</strong></td>
</tr>
</tbody>
</table>

Most interviews lasted between 60 and 90 minutes and followed a semi-structured format. Participants were asked to offer their impressions about how local knowledge was being incorporated into the current planning process and to highlight the factors they felt have influenced its collection and use. The semi-structured format provided enough structure to canvass the perceptions of participants in a consistent way, while still
affording the flexibility to pursue other relevant topics that arose during interviews. All of the interviews were digitally recorded and transcribed verbatim by the lead author.

Personal observations provided another perspective on the study issues and were used to cross-check evidence from the other data sources. From February 2008 to July 2008, the lead author attended a total of eleven community advisory committee meetings covering all of the case study areas. The meetings provided an opportunity to observe directly the dynamics of the committee process, including contributions of committee members’ knowledge to discussions about resource conditions and policy issues. Observations were recorded as written notes and included along with the interview transcripts and document texts in the coding analysis.

All of the data sources were analyzed using QSR NVivo 8, a qualitative data analysis software package. This tool helped to systematize our analysis procedures and facilitated storage and management of data. The analysis of how local knowledge has been incorporated into the case study processes followed a directed content analysis approach, which involves deductively coding data using a pre-determined analytic framework (Berg 2008; Gooch & Warburton 2009). However, as with conventional content analysis, the method also allowed for new themes to emerge inductively from the data (Berg 2008). All data were reviewed line-by-line and coded into one of the four analytic stages of the collaborative process described earlier in the paper: framing the problem and identifying information requirements; establishing research protocols; conducting technical investigations; and establishing the knowledge base for decision-making. A fifth stage, related to engaging the broader catchment community, emerged inductively through the analysis.
Factors influencing the integration of local knowledge in the case study catchments were inductively derived from the data, using the constant comparison method (Seale 2004; Berg 2008). All data were reviewed line-by-line and coded into a series of themes. By comparing and reflecting on the evidence within the initial themes, the codes were combined and re-grouped into a final set of four factors that appear to be influencing the incorporation of local knowledge in the South Australian cases.

**Results**

**Incorporation of local knowledge in the South Australian case studies**

The analysis revealed that local knowledge was incorporated to varying degrees at each of the four stages of our analytic framework. We also found evidence that local knowledge had helped to inform strategies for engaging the broader public in the water allocation planning process. References to the use of local knowledge were found in 99 of the 137 document sources that were analyzed across the four cases. In addition, 45 of the 62 interview participants responded to questions related to how local knowledge was used in the development of the plan. Personal observations of local knowledge being integrated into the process were made at eight of the community advisory committee meetings that we attended. The distribution of each of these data sources across the four study catchments is summarized in Table 3.3. The findings for each of the analytical stages are described individually below. A comparison of results across case study areas did not reveal major differences. Thus, differences among the cases are not emphasized.
### Table 3.3: Data sources referencing the incorporation of local knowledge by case study area

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Barossa Valley</th>
<th>Marne Saunders</th>
<th>Western Mount Lofty Ranges</th>
<th>Eastern Mount Lofty Ranges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documents</td>
<td>22</td>
<td>19</td>
<td>34</td>
<td>24</td>
</tr>
<tr>
<td>Interviews</td>
<td>7</td>
<td>8</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>Personal Observations</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
<td><strong>28</strong></td>
<td><strong>53</strong></td>
<td><strong>41</strong></td>
</tr>
</tbody>
</table>

1. **Framing the Problem / Determining Knowledge Requirements**

The results indicated that local knowledge has had a minimal role in framing the water allocation problem(s) in each catchment. Further, there was limited evidence across all four cases that local knowledge had influenced decisions about what knowledge was needed to support the development of water allocation plans. Across all of the study catchments, references to the input of local knowledge at this early stage of the process were found in only sixteen (of 99) document sources and two (of 45) interview transcripts. We found two to three references in the meeting minutes from each case related to requests by committee members for additional information from scientists to help inform their discussions about particular policy issues. For example, in the Marne case, the committee requested that additional research be completed in order to better understand the effects on the frequency of dams filling up if low-flow bypass systems were to be installed. Document and interview data across the cases indicated that these types of suggestions and requests were implemented by the department staff and therefore appear to have influenced the scope of technical work undertaken in the process.
There were also a few examples where advisory committee members identified local issues that required further investigation during the planning process. Often, these suggestions related to specific local environmental characteristics (e.g., rainfall, water levels) or water use requirements that were not captured in the catchment-level studies undertaken by the department. It was unclear whether this type of input influenced the planning process, as demonstrated in an interview with a farmer on the EMLR committee who stated, “I mean it’s been raised a number of times about the flooding that actually happens down a Langhorne Creek and how important that is around over-land flow. So, whilst that hasn’t been included yet in the science, it has actually got the issue up on the radar”.

We found a notable example in the documents of a formal process being used to seek early input into water allocation plan issues from the broader catchment community in both the Barossa catchment and the Angas Bremer sub-catchment of the EMLR area. These catchments had pre-existing water allocation plans and their respective NRM Boards had undertaken a formal plan review prior to the commencement of the current planning process. In each case, licensed water users were given the opportunity to contribute to the plan review. In the Barossa catchment, the Board initiated the review “by listening to water users in the region to develop an understanding of their perceptions of the strengths, achievements and local experiences of the current Water Allocation Plan” (Northern Adelaide & Barossa Catchment Water Management Board 2004, p.1).

2. Establishing Research Protocols

Local knowledge also had a relatively minor role in determining how technical investigations were conducted in each of the cases. Evidence of the incorporation of local
knowledge at this stage was found in twenty-four (of the 99) document sources. About half of these sources were from the Barossa case, mostly citing a state-run irrigation reporting program had been developed with input from individual irrigators and local industry groups and has become a key source of information for estimating water demand in the catchment. There were also a few examples found in documents from across the cases of advisory committee members providing advice on data collection procedures, monitoring program design and monitoring site selection, and methods for estimating water use for livestock and domestic purposes. An example of this type of contribution was also provided by one interview participant in each of the Marne and EMLR catchments. In one case, a former farmer and member of the Marne committee described an instance of local input into resource monitoring in the catchment: “I’ve been involved with Water Watch and with the Marne and we helped [one of the department hydrogeologists] pick out certain bore sites that weren’t being used. So we’ve monitored the level of water in there”.

3. Conducting Technical Investigations

We found evidence across the four study catchments that local knowledge had a more significant role in conducting the required technical investigations. Over half of the total data sources, including 51 documents and twenty-nine interview transcripts, included evidence of local knowledge contributing to the technical investigations. The various contributions of local knowledge at this stage of the process generally fit into one of two categories: first, providing supplementary sources of data for the investigations and second, in providing feedback on technical data and the results of the investigations.
There was evidence in the technical reports and planning documents from each case that data collected by local landholders and community groups have been used in technical investigations conducted by department scientists and independent consultants. For example, recorded observations from private dams and bores have fed into assessments of surface and groundwater capacity. In a surface water assessment of a sub-catchment in the EMLR area, streamflow data from a local community group were used as a supplementary source in an area of the catchment without a department gauging station. In this case, the report referenced other streamflow data from the same source being omitted because the period of record was considered by the investigator to be too short or to have too much missing data. These findings in the document data were corroborated by interview participants in each case. A department representative on the Marne committee highlighted the importance of local data in estimating dam capacity in the catchment: “We got a few contoured surveys from wineries where there were 200 megalitre dams and it was critical that, in the scheme of things, if we were out by fifteen percent on a 200 megalitre dam, it was significant, versus if we were out by fifteen percent on a two megalitre dam”.

In most instances, landholder and other community data used in technical investigations had been accessed through the broader community rather than the community advisory committees. There were, however, several examples in the advisory committee meeting minutes from each case of committee participants contributing to the technical investigations by reviewing and providing feedback on technical investigation findings during the course of the planning process. In most cases, this occurred in the form of committee members questioning data sources and challenging study outcomes.
based on their in-depth knowledge of conditions on their property or local catchment. Interview participants in each case confirmed this type of contribution in the process. For example, the plan coordinator in the Marne catchment recalled, “even things like dividing areas up into management zones – the hydrologists draw lines on maps based on what they know, but the locals can also go, ‘no, that area tends to be very salty or the yield is pretty poor’. [The committee] would look at a lot of those things that we brought along and be a reality check, I suppose”.

We also found evidence, primarily in the committee meeting minutes and interviews from the EMLR and Marne cases, of participants requesting that additional modeling be undertaken by department scientists in order to test their underlying assumptions about hydrological or water use characteristics within individual sub-catchments (e.g., the extent of dam development in a particular area). The plan coordinator in the EMLR area described a typical scenario: “For example with the buffer distances [between bores], someone will say, ‘I’m within this distance and I’m getting impacted’. So, the technical people will go back and have a look at their assumptions, at their calculations, at their drawdowns, etc. and then say, ‘okay, we made this assumption and perhaps this bit is wrong, so we need to change it’”.

An important finding was that, in many cases, the input of local knowledge at this stage in the process was facilitated by organized efforts to collect information from landholders and water users in the catchments. There was evidence that this had occurred to some extent in all of the study catchments. Telephone, mail and in-person surveys were conducted with landholders to obtain information on water use, groundwater salinity and property characteristics (e.g., surface water dam locations and dimensions).
In a few instances, community-based programs had been established to track irrigation water use and water salinity. A prominent example from the WMLR case was a series of workshops held in potentially over-allocated sub-catchments to verify departmental water use estimates. The organizer, an industry representative on the WMLR committee, described one of the workshops: “We went into the Mitchell Creek sub-catchment and met with three growers face-to-face and discussed the issues with their particular information in front of them. What we found is that the reality of what was happening on the ground was somewhat different from what the [department’s] model suggested – and the department has been able to amend their model”.

Another important finding across all of the cases was that local knowledge had contributed primarily to technical investigations related to determining water demand in the catchments. We found that a range of mechanisms, including water use reporting, landholder surveys, stakeholder workshops, advisory committee meetings and broader public consultation forums, had been used across the cases to obtain community input on various aspects of water use, such as stocking rates and stock water requirements, domestic water requirements, irrigation rates and individual crop water requirements, and industrial and public water supply needs. In our interviews, an accurate picture of water demand was identified by most participants as a critical knowledge gap to understanding sustainable allocation limits. Further, department scientists, planning coordinators, and community participants alike acknowledged an important role for local knowledge in estimating water demand. There was comparably less evidence of local knowledge contributing directly to technical investigations of other issues such as water resource capacity or environmental water requirements.
4. Establishing the Knowledge Base / Developing Policies

Local knowledge also contributed significantly to developing water allocation policies in each of the study catchments. Supporting evidence for this conclusion was found in over half of the total data sources, including 44 documents and 30 interview transcripts, distributed across all four of the cases. Contributions at this stage of the process primarily related to advisory committee members “ground-truthing” the policies, numeric thresholds, and other figures (e.g., theoretical water requirements for various crops) to be included in the water allocation plan.

A common example found in advisory committee meeting minutes from each of the case study catchments and observed first-hand by the researcher at committee meetings in the Barossa and Marne catchments was of participants criticizing “generic rules” and emphasizing the need to consider on-the-ground variability with respect to local environmental conditions (e.g., rainfall, surface water runoff), as well as sector-specific and property-specific water use practices and needs. Such references also appeared in the interview texts. A department representative in the WMLR case characterized the contributions of the advisory committee members: “We’ve presented them with the technical information and a range of policy options that we could use in the plan to address certain issues – for example, low flow bypasses on dams to provide flow to the environment that we need downstream. They’ve given me a better understanding of how some of those policy options may actually work on the ground and whether they will or won’t, and some of the other things we need to consider when we’re looking at those different options”.
There was also evidence across the four cases that committee members had provided insight on the practicality of proposed policies, including the burdens and costs to water users of different requirements and the likelihood that irrigators would comply with proposed rules. One of the department hydrogeologists believed that the input of the Marne advisory committee had been “mainly on the impact of various options – for example, different rules for stock bores versus irrigation bores. Their insights provide ideas that I haven’t thought of – the theoretical compared to how it works on the ground”. This type of contribution to the process was also emphasized by committee members, typified by one of the catchment representatives in the Barossa case: “A lot of the policies come down to social decisions as well – whether we can allow this or it needs to be that. So, a lot of the policies have needed that sort of assessment. It’s not by any means just a matter of arithmetic on the water resource. We’ve had to produce that stuff in discussion – it’s come out of our heads”.

5. Engaging the Broader Community

Evidence was found in twenty-one documents and three interviews from across the cases that advisory committee members have helped to inform strategies for engaging the broader public in the water allocation planning process. While most of the evidence of this type of contribution was found in data from the Barossa and WMLR catchments, a few references were also contained in meeting minutes and observations from the Marne and EMLR areas. In each of the cases, the advisory committees provided input on the structure of community consultation, including the location, timing, size and format of events. For example, in the minutes of a Barossa committee meeting, it was noted that “local irrigators have shown a preference for early morning meetings during daylight
saving, whereas dairy and broad-acre farmers prefer meeting after 8:00 pm”. At a meeting of the Marne advisory committee, we observed committee members recommending to the Board that they avoid public consultation on the draft plan over December and January, when most vineyard operators would be harvesting their grapes. Data from the WMLR case also showed that committee members in that process helped to identify key stakeholders to consult with on different plan issues and advised on approaches to advertising the plan in order to reach particular stakeholder groups.

There was also evidence that the committees provided advice on how to effectively communicate water allocation planning issues to the broader community. This included identifying particular topics that would be of most interest to the community, as well as highlighting issues that were likely to be contentious among different stakeholder groups. In describing the role of the advisory committee in the plan development process, one of the plan coordinators in the WMLR catchment commented, “The other thing that [the committee members] really do is provide an indicator of community issues, so it can help you prepare for the consultation process by working out some of the things that are likely to cause a big stir”. The committees also provided advice on what technical information should be shared with the broader community. For example, the minutes from a Marne committee meeting early in the planning process noted that the committee discussed “how to balance the volume of information provided to stakeholders during consultation, with the goal of allowing informed responses without overwhelming respondents with excessive detail”.

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Factors influencing the role of local knowledge

Factors influencing the incorporation of local knowledge into the case study processes were inductively derived from the data, using a constant comparison method (Seale 2004; Berg 2008). The analysis suggested four key factors that appeared to have influenced, to varying degrees, the incorporation of local knowledge in the case study areas. We have labelled these inter-related factors ‘participant attitudes’, ‘nature of local knowledge’, ‘mechanisms to collect and integrate local knowledge’, and ‘time and resource capacity’. We compared the findings across the study catchments and key differences among the cases are reported.

Participant Attitudes

There was evidence in 31 interview transcripts from across the cases and five documents from the Barossa and EMLR cases that participant attitudes had influenced the role of local knowledge in the process. Interview respondents in each catchment emphasized the perceived weaknesses that many participants associated with local knowledge, in particular its lack of quality and consistency, its subjectivity and general concerns that local (non-scientific) sources are not grounded in rigorous, scientific methods. Notably, these views were expressed by participants across all sectors (state and local) and backgrounds (scientific and non-scientific). One of the planning coordinators in the WMLR catchment described how scientists’ attitudes about the role of local knowledge in their technical investigations had constrained its use in the process: “I think technical people are very wary about using anecdotal information. They like hard data and what the committee generally provides isn’t hard data”. Reservations about the subjective nature of local knowledge were also raised by interview participants in each of
the study catchments. For example, in considering the merits of a more formal avenue for community input into technical investigations, one of the department scientists working in the EMLR catchment commented, “I think there are some dangers in that because some of the community members have very strong views on things that are not based on good science and if they had a formal opportunity to influence our investigations, I can see a lot of conflicts occurring”.

Surprisingly, one of the strongest opinions against using local knowledge in the water allocation planning process was expressed by one of the community advisory committee chairpersons: “In terms of a proper process, [community monitoring programs] are absolutely a waste of time. There’s only one process and that is something that lives within the boundaries of scientific method. Monitoring has got to be done in a very professional, scientific way. If there’s a question-mark over something, it’s just ignored”.

The unwillingness of some landholders to collect, record and report observations on their properties for the purposes of water management was also identified as a significant barrier to accessing local knowledge. This was underscored by references in documents from the Barossa case to non-compliance with irrigation monitoring and reporting requirements within the catchment. Lack of time and added costs were suggested by interview participants as the main reasons why some landholders were resistant to collecting and sharing information, along with a view among some that resource monitoring should be a government responsibility. Interview participants also commented that some landholders were reluctant to share their information because of concerns about how it would be used. An industry representative and member of the WMLR committee
observed that “a lot of the resistance comes out of suspicion really – that ‘big brother’ is going to come along and limit them somehow or another”.

**Nature of Local Knowledge**

The analysis revealed that some of the inherent characteristics of some sources of local knowledge have limited their use in each of the water allocation planning processes. We found evidence of this in thirty interview transcripts from across the four cases, as well as four documents from the Barossa, EMLR, and WMLR cases, and our personal observations at committee meetings in the EMLR, Marne, and WMLR cases. A major concern that was apparent among participants across all of the cases related to the lack of continuity and consistency in many local data sources. As a committee member in the EMLR catchment explained: “There’s a role for local knowledge, but it’s also inherently an imperfect process because if you’ve got volunteers, it’s going to be very challenging to get continuous data that is generated with the same degree of rigour that’s going to be needed”.

Department and NRM Board representatives from each of the study catchments also raised the issue that landholder observations are often recorded in forms that are incompatible with modeling approaches used by the department scientists. Some interview participants specifically cited the incompatibility of local observations with the time and spatial scales of catchment-level modeling and policy development – the difficulty in taking account of “micro-scale” or one-off situations over time. A department representative working in the WMLR catchment commented: “What the farmer sees, what the community sees, how much water there was, when did the creek run – that’s important, but it’s very hard to plug in a perceived flow rate into larger scale
management. That’s not to discount it, but it’s challenging. For example, I may have seen the water running at my creek, but I don’t have a reasonable way of translating that into a reasonable yield for the catchment I live in”. Another significant concern raised by department and NRM Board participants in all of the cases related to the challenge of integrating qualitative observations into technical investigations based on modeling and quantitative data.

*Mechanisms to promote, collect and integrate local knowledge*

Twenty-two interview participants across the Marne, EMLR, and WMLR catchments highlighted the importance of promoting the collection and reporting of local knowledge and the need for mechanisms and tools to collect and store data in an accessible format. We also found evidence of this factor in documents from each case and in our recorded observations from committee meetings in the Marne and WMLR catchments.

A significant concern highlighted in each of the study catchments was the need for mechanisms to facilitate the collection and integration of local sources of knowledge into the planning process. As the plan coordinator in the Marne case expressed, “we don’t really have a framework that’s set up to work with that type of information – ‘okay, I’m going to go and talk to Joe and see what he’s doing on his place and what’s there’ – how do we build that information into what we’re doing?” One of the plan coordinators in the WMLR further articulated the challenge: “I think part of the problem is what you do with the data and how you manage it. You can take account of it, but bear in mind that there are potentially greater margins of error versus fully accredited, collected data, which also gets down to the really technical science people being willing to accept that just because the data isn’t quite as high quality as they might like, it doesn’t necessarily mean that it’s
not useful. So, there’s that as well that needs to be overcome”. The need to validate local sources of data was stressed as a critical issue across the study catchments. A few participants highlighted the example of a community water quality monitoring program in South Australia (“Waterwatch”) that includes a system of evaluating and rating the quality of the data (Waterwatch Australia 2006). The report of a salinity audit study of farm dams in the EMLR catchment provided an example of how a validation system for community data had been used in practice: “On a few occasions salinity recordings were accepted from the community, and these recordings were only accepted from those that had undertaken training in water quality monitoring within the past six months and who had a demonstrated capacity to meet the standards of monitoring and testing protocols consistent with the [South Australian Murray-Darling Basin] NRM Board’s Community Monitoring Framework, Bureau of Rural Science’s [Community Stream Sampling and Salinity Mapping] project and Waterwatch S.A.’s ‘Data categories’ for water quality” (Lundstrom 2008, p.2).

There were also recommendations contained in both document and interview sources of the need for tools, such as web-based systems, to support the collection and reporting of landholder data. For example, a study report on water demand in the EMLR catchment included the following recommendation: “Individual users know where they get their water from and may have a good idea of how much they use. A mechanism for combining all of the users’ knowledge of their water use would provide a good indication of overall [stock and domestic] water use in the Eastern Mount Lofty Ranges. Web-based mapping applications could provide a framework for collecting individual properties estimate of stock and domestic water demand. Such applications could also allow for
improved mapping of bore/well locations and dams used for stock and domestic supply” (South Australian Murray-Darling Basin NRM Board 2008, p.17).

Six interview participants from the Marne, EMLR, and WMLR catchments, including department, NRM Board, and community representatives, highlighted the importance of promoting the role of local knowledge in sustainable water management to landholders and other community members. This need stems from a perceived lack of incentive for landholders to collect and contribute their local knowledge to the process. According to one community participant in the Marne case, “they need to understand what they’re getting out of it”. A NRM Board participant in the WMLR case reflected on this issue: “We can develop a level of acceptance [of community monitoring] if they understand the reasons behind it. If they provide a report and never see the info come out again, I think they’d be upset. We’ve got to make sure we use that information and put it back out into the community again – in further investigations and decision-making processes”.

The Angas Bremer catchment was highlighted by four participants in the EMLR catchment as an example where the community manages its own irrigation reporting. In this case, participating irrigators are provided aggregated information about water use in the catchment back within a month of submitting their water use records, in the form of published updates and presentations at public meetings. According to the plan coordinator in the EMLR catchment, “they get constant feedback of how their information is being used, so they can see the benefit of what they’re doing”. Notably, the Angas Bremer catchment has had a water allocation plan since 1987 and a community water management committee in place since 1980.
**Time and resource capacity**

Eighteen interview participants across the four catchments identified time and resource constraints as key factors limiting the collection and utilization of local knowledge in the process. We found evidence of this factor in all of the cases; however, constraints related to time and resource capacity appeared to be most pronounced in the WMLR case – over half of the interviewees who raised these concerns were participants in the WMLR process. Time pressures and insufficient human and financial resources have limited the ability of the department and NRM Boards to collect local knowledge in a systematic and comprehensive way, particularly in the WMLR case. According to a department scientist working in the WMLR catchment, “we haven’t used much community-based information for this water allocation plan and that’s a by-product of the time we’ve had to do it”.

Constraints caused by the amount of time and resources that were available to develop the plan were also acknowledged by community participants in the WMLR process. A farmer and member of one of the WMLR advisory committees commented, “I think there’s a time factor too – they’re under so much pressure to get this water plan up, that to spend resources to gather [landholder information] – they don’t have many people on the ground, and if you all of the sudden decide to come to all the people in this little catchment here to see what data they’ve got, you might spend a month. I don’t think they’ve got the resources to do that”. Similarly, an industry consultant and member of the WMLR committee observed, “some people have records and are saying to [the department], ‘are you accessing this information because it’s critical to your bigger picture?’ But they’re not – they’re basing it on models and saying that’s the only thing
they’ve got. They really need to access that information. I would suggest that there’s
huge political pressure to get this plan done, so there really isn’t the time necessary”.

Participants in the EMLR and WMLR catchments also highlighted the influence of
time and resource pressures on the willingness and ability of individual landholders to
assume additional monitoring and reporting responsibilities. A comment from a NRM
Board participant in the WMLR process reflected the feeling among several community
participants: “There are always costs and time issues associated with monitoring.
Landholders have so many other things that they have responsibility for. Add another
level of reporting and it’s going to be seen as onerous”. Evidence of concern about the
costs of monitoring was also found in a document from the Barossa case. A licensed
water user, who was surveyed by the NRM Board as part of a review of the existing
water allocation plan, was not in favour of requirements for additional monitoring,
claiming that “additional monitoring and metering costs money, and should be the
responsibility of the Department” (North Adelaide and Barossa Catchment Water
Management Board 2004).

Discussion and Conclusions

The purpose of this study was to improve understanding of the role of local knowledge in
collaborative environmental governance. Through a multiple case study of water
allocation planning in South Australia, we have gained practical insight into how local
knowledge is incorporated into real-world collaborative planning processes and have
illuminated some critical factors that appear to influence the extent of integration.
We found evidence in all of the South Australian study catchments that local knowledge was incorporated, to varying degrees, at multiple stages of the collaborative process. It factored most prominently in conducting the technical investigations needed to inform water allocation policy decisions. Local knowledge has mainly contributed to investigations by supplementing sources of departmental data and helping to ground-truth the findings of investigations that are completed at broader, regional scales. Previous research has highlighted that complex differences among farming practices within a small area, including differences in local environmental characteristics, may not be reflected in scientific investigations (e.g., Wynne 1992). In this respect, our findings are consistent with recent studies which have demonstrated the usefulness of local knowledge in qualitatively assessing the validity of scientific predictions and their underlying assumptions (e.g., Clark and Brake 2009; Johnson 2009).

It has also been suggested that integrating local knowledge into environmental decision-making can lead to effective and workable solutions that are more tailored to local conditions (e.g., Dietz, et al. 2003; Fazey, et al. 2006; Spink, et al. 2010). In this study, we found that community representatives on the advisory committees in each case had an influential role in synthesizing the available information sources and developing water allocation policies. Based on their detailed understanding of local areas and water use practices, committee members helped to ground-truth policies by providing insight into the practicality of proposed measures and the likelihood that water users would accept and comply with the rules. The results also showed that the knowledge of committee members has helped to inform strategies for communicating with key stakeholders and the broader catchment community during the development of the plan.
These findings are consistent with previous research which has shown that local actors can provide insight into the unique social system in which measures will be implemented and can help to gauge the level of acceptance of proposed policies (e.g., Newig, et al. 2005). Essentially, local knowledge has been used in our water allocation planning cases to forecast how proposed actions will play out in practice at the local level (Innes 1998).

Previous research has highlighted the importance of involving local actors and their knowledge throughout the decision-making process (e.g., Evans 2006; Petts and Brooks 2006; Innes and Booher 2010). A purported benefit of engaging local actors early in a decision-making process is that it can help establish a more holistic and common understanding of the problem (Innes, et al. 2004; Margerum and Whithall 2004), as well as agreement on what knowledge is required to address the problem (van Ast and Boot 2003). Importantly, we found very limited evidence in any of the water allocation planning cases that local knowledge had contributed at the early stages of the process. Local actors had virtually no involvement in affecting how water allocation issues were framed, influencing the types of technical investigations that were undertaken, or determining how data and information was collected.

We searched for factors that had influenced how local knowledge was integrated into the case study processes. The analysis indicated that the attitudes of participants towards local knowledge may have limited its role. Many participants, including state and local participants across the four case studies, perceived weaknesses associated with local knowledge, including concerns about its quality and consistency, its parochial nature and a general concern that local knowledge is not grounded in rigorous and objective scientific methods. Participants’ perceptions of local knowledge and its role in
environmental management have been highlighted previously in the literature as a barrier to effective knowledge integration (e.g., Petts and Brooks 2006; Innes and Booher 2010; Raymond, et al. 2010). Unwillingness on the part of landholders to contribute their knowledge to the process was also highlighted by participants in all of the study catchments as a significant barrier to incorporating local knowledge into water allocation planning. This finding is consistent with previous research that has shown that landholders can be resistant to sharing their knowledge because of the perceived costs versus benefits of providing the information (Giordano, et al. 2010), or because of fear of how the information might be used against them by regulatory agencies (Allen and Kilvington 2005; Fernandez-Gimenez, et al. 2006; Clark and Brake 2009; Johnson 2009).

We found that a lack of time and resources have limited the ability of NRM Board and department personnel, particularly within the WMLR catchment, to access and integrate local knowledge into the process. Participants in WMLR case were highly critical of the prescribed (and according to some, politically driven) schedule for producing the water allocation plan for the catchment. Technical investigations were often initiated (or in some cases completed) prior to advisory committees even being formed. Where investigations were undertaken concurrent with advisory committee discussions of policies and plan issues, cramped meeting agendas and limits on participants’ time often prevented in-depth discussions of details, such as study methods, assumptions and available data sources. At the same time, a limited number of state and local agency personnel were tasked with conducting the technical investigations, coordinating the advisory committees and broader public consultations, and writing policies for multiple water allocation plans. Constraints related to limited time and
resources have been associated with collaboration generally (e.g., Margerum and Whithall 2004) and with integrating local knowledge, in particular (e.g., Johnson 2009; Kroon, et al. 2009). Spink, et al. (2010) have cautioned that integrating knowledge can be time and resource intensive and that it requires strong institutional commitment in order to be effective.

An underlying reason why local knowledge may not have contributed more substantially in the collaborative processes that we examined – particularly at the earlier stages – could be due to the nature of the broader institutional framework in which they are nested. Overall, water allocation planning in South Australia is driven by a legislated process that not only defines the issues to be addressed in a plan, but also prescribes the required technical investigations and the scope of potential policy solutions. Moreover, the technical investigations to support the development of plans are almost exclusively conducted by state department scientists. Such conditions unavoidably constrain a collaborative process and may prevent the full realization of some of the desired outcomes of collaboration, including the extensive integration of local knowledge in the process. Previous studies of knowledge integration (e.g., Fernandez-Gimenez, et al. 2006; Giordano, et al. 2010) have largely focused on what Leach, et al. (2002) describe as “collaborative partnerships”, which are often broad in scope and duration and are typically engaged throughout the entire policy cycle, from problem definition and policy adoption to implementation and assessment. Under these conditions, the opportunities for local knowledge to contribute to framing problems and designing research are comparably greater than in circumstances such as those examined in this paper.
Despite the apparent constraints on collaboration within the South Australian water allocation planning framework, our findings point to potential strategies to increase the incorporation of local knowledge into the planning process over time. In South Australia, NRM Boards are required to review and potentially update water allocation plans every five years. Where we did find evidence of local knowledge being integrated earlier in the planning process was in catchments with previously-established water allocation plans and seasoned and/or actively involved community groups and committees. For instance, as part of the five-year plan review process in the Barossa catchment and Angas Bremer catchment (now part of the larger EMLR area), the respective NRM Boards sought input from the public about water allocation issues in the catchment, including knowledge gaps and research needs. Furthermore, community monitoring programs (e.g., irrigation reporting) have been established in both areas that played an important role in the current planning process, particularly in helping to estimate water demand and to understand certain characteristics of the resources, such as water salinity.

These examples underscore the advantages to a collaborative process of accessing local knowledge in a structured and consistent way. Several interview participants in our study suggested the need for mechanisms to promote and facilitate the collection and use of local knowledge in the process. This mirrors similar recommendations in recent research on knowledge integration. Practical tools are needed to make it easier to collect, submit and store local knowledge, thereby reducing effort and costs for landholders and government staff alike. Mechanisms are also required to translate the implicit forms of local knowledge into more explicit and structured forms, making it more compatible with other sources (Fazey, et al. 2006; Giordano, et al. 2010). Additionally, it is important to
have a process in-place for validating local data sources in order to provide assurance of the quality of the data (Neis, et al. 1999; Giordano, et al. 2010). Lastly, an important issue raised by interview participants in our study was that efforts are required to promote the benefits of local knowledge for sustainable water management to landholders and other community members who may be either apathetic or resistant to sharing their knowledge with the government so that they can better understand “what they’re getting out of it”. This finding is consistent with Clark and Brake (2009) who found that landholders were willing to share their local knowledge for the purposes of groundwater research on the understanding that they would get useful additional information about their water resources in exchange.

Joint fact-finding that integrates local knowledge with scientific knowledge throughout the collaborative process, has been purported to offer numerous benefits for environmental planning and management, such as building a robust base of knowledge for decision-making and enhancing social capital among participants (Innes and Booher 2010). While the successful integration of different forms of knowledge has been demonstrated in participatory and collaborative research contexts (e.g., Corburn 2003; Castillo, et al. 2005; Fernandez-Gimenez, et al. 2006; Ballard, et al. 2008; Clark and Brake 2009; Johnson 2009; Giordano, et al. 2010), the potential for incorporating local knowledge into collaborative planning processes has not been systematically assessed. In this paper, we have begun to address this critical gap in the collaborative environmental governance literature by systematically analyzing how local knowledge is incorporated into a collaborative water allocation planning process in South Australia. The research contributes important insight into the role of local knowledge in collaborative planning.
The findings suggest that the overarching institutional framework in South Australia is significantly limiting the role of local knowledge in the water allocation planning process. In this way, our study points to the need to re-examine expectations of how local knowledge can be integrated in a collaborative process that is nested within a broader, prescriptive institutional framework. In these types of settings, our findings suggest that local knowledge contributes primarily in a complementary role to scientific knowledge – supplementing scientific information and validating scientific findings and resulting policy options. Moreover, these forms of collaboration appear to provide a minimal opportunity to integrate local knowledge at the earlier stages of framing the problem or scoping research requirements.

References


Adelaide and Mount Lofty Ranges NRM (Natural Resources Management) Board. 2010. 


CHAPTER FOUR

CONCEPTUALIZATIONS OF LOCAL KNOWLEDGE IN COLLABORATIVE ENVIRONMENTAL GOVERNANCE

Abstract

A major challenge to integrating local knowledge into collaborative environmental governance processes stems from the underlying differences between positivist science and local knowledge; these differences often result in strong differences of opinion regarding which forms of knowledge are valid in environmental decision-making. Previous research on these issues has mainly focused on the attitudes of scientists towards local knowledge. Studies of the views of local and non-scientific actors regarding their own knowledge are much less common. Through a qualitative case study of water allocation planning in South Australia, we analyzed participants’ conceptualizations of local knowledge and the role of local knowledge in collaborative governance. We found that participants defined local knowledge broadly across a number of dimensions and that many acknowledged variability in the nature and quality of different types of local knowledge. While most recognized the value of local knowledge in supporting technical investigations and developing policies, very few participants identified a role for local knowledge in the early stages of the collaborative process (i.e., in framing problems or establishing research protocols). Previous studies have identified the attitudes of scientists and resource managers toward local knowledge as a significant barrier to its effective use in environmental decision-making. This study suggests that local and non-scientific actors share similar reservations about local knowledge and highlights the need for researchers and practitioners to take into account the attitudes of
all types of participants when considering how to overcome the epistemological challenges related to integrating local knowledge into collaborative management.

**Introduction**

A commonly cited benefit of collaborative approaches to environmental governance is that they promote the integration of local knowledge into planning and management decisions. In broad terms, local knowledge can be defined as “practical, collective and strongly rooted in a particular place” (Geertz 1983). Conceptually, the advantages of considering this type of knowledge in environmental decision-making are compelling. It enhances the ability to make informed decisions that are tailored to specific contexts (Allen and Kilvington 2005; Booher and Innes 2005). By filling critical data gaps in government monitoring networks and databases, local knowledge can also help to produce a more complete information base and increase the understanding of complex environmental systems (Berkes 2004; Fazey, *et al.* 2006). At the same time, integrating a variety of knowledge types, including local knowledge, can also help to build a more holistic understanding of the problem among stakeholders (Margerum and Whithall 2004). Collaborative processes, it has been suggested, enable local actors to place their knowledge in the broader context of what state actors know, and vice versa (Innes, *et al.* 2004). As a result, local actors can feel empowered and are more likely to view the collaborative process and its outcomes as legitimate and fair (Syme and Nancarrow 1996; Spink, *et al.* 2010). Ultimately, integrating scientific and local knowledges into environmental management can produce more grounded understandings of particular systems that are owned by the community concerned (Brierley, *et al.* 2006; Petts and Brooks 2006). This contextualized knowledge, in turn, can lead to problem-specific
responses (Lach, et al. 2005) that are more likely to be accepted and supported by the public (van Ast and Boot 2003).

In practice, a significant barrier to incorporating local knowledge into collaborative processes is “epistemological anxiety” (Innes and Booher 2010) involved in the rejection of local knowledge by scientists and other environmental management professionals. The anxiety stems from the underlying differences between positivist science and local knowledge (Eden 1996; Berkes 2004) which can result in strong differences of opinion regarding which forms of knowledge are valid in environmental decision-making (Raymond, et al. 2010). Numerous previous studies have highlighted the reluctance of scientists and other government officials to consider local sources of knowledge in different environmental governance contexts (e.g., Wynne 1992; Murdoch and Clark 1994; Weible, et al. 2004; Giordano, et al. 2010). In collaborative governance processes, discounting local knowledge can lead to outcomes based on imposed, coerced community consensus rather than shared understanding and ownership that collaboration is intended to achieve (Kapoor 2001; Berkes 2002).

To address these epistemological challenges, Raymond, et al. (2010) have argued that participants need to be more aware of both their own and others’ epistemic positions. Previous research in this area has mainly focused on the attitudes of scientists towards local knowledge (e.g., Eden 1998; Weible, et al. 2004; Petts and Brooks 2006), and the relationship between members of the public and science (e.g., Wynne 1993, White and Hall 2006). Studies of the views of local and non-scientific actors regarding their own knowledge are much less common. Consequently, it remains unclear what local participants in collaborative governance processes think about local knowledge and how
their attitudes compare with those of scientists and other state actors who privilege scientific information.

In this study, we use a qualitative case study of collaborative water allocation planning in South Australia to document participants’ conceptualizations of local knowledge. Specifically, we explore the following research questions: (1) how do participants define local knowledge, (2) what do participants think the role of local knowledge should be in the water allocation planning process, and (3) do views about local knowledge vary among different types of participants? In answering these questions, this paper contributes to better understanding the epistemological challenges of integrating local knowledge into collaborative environmental governance, by providing insight into the attitudes of all participants towards local knowledge and its role in the process.

**The Nature of Local Knowledge and its Role in Collaborative Environmental Governance**

**What is Local Knowledge?**

Knowledge can be defined as “the capacity for effective action in a domain of human actions” (Spiegler 2003, p.535). Adequate knowledge of environmental conditions has been highlighted as a critical ingredient for successful resource management (Ostrom 1990). For example, Hillman and Brierley (2002) have identified a range of information required to manage environmental flows, including an understanding of river conditions and the links between different flow parameters and ecological functions. It is widely acknowledged in the environmental management literature that local actors can possess detailed knowledge of local environmental conditions (Bryant and Wilson 1998). In fact, many local, non-scientists can be local experts (Petts and Brooks 2006). Local knowledge
can be broadly defined as “the body of knowledge held by a specific group of people about their local environmental resources” (Giordano, et al. 2010, p.1719); however, there are different perspectives in the literature about the nature of local knowledge and who can possess local knowledge that require further unpacking of the idea.

Conventionally, local knowledge has been conceived as knowledge held by non-scientists that is based on local wisdom, experience, and practices that are adapted to the local ecosystem (Ballard, et al. 2008). Corburn (2003) asserts that local knowledge is rarely instrument dependent. Instead, non-scientists typically assess interactions with their local environment through perceptions derived from everyday, lived experience (Rhoads, et al. 1999), which in turn shapes their local knowledge using common sense, casual empiricism, and thoughtful speculation about a local context (Fischer 2001; Petts and Brooks 2006). In addition to experience, many researchers have also stressed the influence of social and cultural values, norms and institutions in shaping local knowledge (Blowers, et al. 2005; Fernandez-Gimenez, et al. 2006). In the context of river restoration, Howard (2008) highlights that local communities hold sophisticated views about restoration activities that are built on a range of personal, historical, social, cultural and economic factors.

A number of researchers qualify local knowledge based on the length of individuals’ or communities’ relationships with their local environments (e.g., Fazey, et al. 2006; Ballard, et al. 2008). Fazey, et al. (2006) distinguish between experts and non-experts in recognition that the former have acquired extensive knowledge through their experiences, which in turn affects what they observe and how they organize, represent and interpret that information. Traditional ecological knowledge (TEK) is often characterized in the
literature as a unique form of local knowledge, on the basis that indigenous peoples hold a long-standing and holistic vision of human-environment interaction (Bryant and Wilson 1998) that is built upon knowledge accumulated through trial and error adaptation over time, through multiple generations (Berkes, et al. 2000; Fernandez-Gimenez, et al. 2006).

It has been widely suggested that a distinguishing characteristic of local knowledge is that it does not conform to technical rationality (Habermas 1970), particularly the search for causal models and use of universal theories, principles, and tools for establishing the “truth”. In the environmental management literature, local knowledge (including TEK) is commonly juxtaposed with “conventional” science, based on traditions of Newtonian science and the expertise of government resource managers (e.g., Ballard, et al. 2008). Science as objective, verifiable, and tested using accepted methods is contrasted with local knowledge based on common sense and lived experience (Petts and Brooks 2006).

Some researchers contend that sharp boundaries between scientific and local knowledge do not exist in reality. Murdoch and Clark (1994) argue that it is difficult to distinguish between “people’s science” and “scientists’ science” because the knowledge that various actors possess is a result of “knowledge encounters” where local and scientific perspectives get mixed up. In the environmental management literature, Raymond, et al. (2010) highlight the convergence of the local knowledge of farmers and scientific knowledge in Western culture due to increased participation by farmers in formal academic training and learning. There is also increasing recognition among environmental management scholars that local knowledge can encompass more than just anecdotal, unrecorded observations and experiences. It can include recorded
measurements by landholders of environmental conditions on their property (Fazey, et al. 2006). Importantly, local knowledge can also be held by scientists and technicians working in local offices (Giordano, et al. 2010). Thus, individuals can hold both “local” and “scientific” knowledge, and in some cases may find it difficult to untangle the two.

Raymond, et al. (2010) argue that pigeon-holing knowledge as “scientific” or “local” is overly simplistic and may constrain efforts to effectively identify and integrate multiple sources of knowledge in practice. Instead, they categorize types of knowledge along different dimensions, including whether it is local versus generalized, the level of formal processes used to generate knowledge, the extent of expertise (i.e., novice versus expert), the extent to which knowledge is articulated (i.e., tacit versus explicit), and the extent to which knowledge reflects traditional culture and norms (Raymond, et al. 2010).

In this paper, we provide insight into how participants in a collaborative process conceive of local knowledge. By thinking about knowledge along these dimensions, rather than according to sharply defined boundaries, we suggest that participants conceptualize local knowledge more broadly to reflect the heterogeneity that exists in reality.

**How Can Local Knowledge Contribute to Collaborative Environmental Governance?**

Collaborative environmental governance may be broadly defined as the sharing of power and responsibility among state and non-state actors in decision-making for environmental management (Carlsson and Berkes 2005). Collaboration exists in many forms which have been distinguished based on factors such as their duration, the scope of issues that they address, the institutional level at which they operate, and the composition of participants (Leach, et al. 2002; Moore and Koontz 2003; Margerum 2008).
There is general consensus in the environmental management literature that local knowledge has a prominent role in collaborative processes. “Joint fact-finding” (Innes and Booher 2010) has been advocated as a central component of collaboration and emphasizes the importance of using the knowledge of local actors closest to an environmental issue to assist in making environmental planning and management decisions (e.g., Kapoor 2001; Berkes 2004; Petts and Brooks 2006; Innes and Booher 2010). It has been suggested that local knowledge has a potential role in identifying and scoping environmental problems and issues (e.g., Fazey, et al. 2006; Petts and Brooks 2006). According to Rogers (2006), considering all perceptions of an issue can ensure that the full nature of the problem is understood and that it becomes an integrated, collective problem. Some analysts have highlighted an important role for local knowledge in helping to scope the technical investigations that are needed to understand a particular issue and inform future policy decisions (Innes 1998; Fazey, et al. 2006), and in determining how such investigations should be conducted (Clark and Brake 2009; Giordano, et al. 2010). For example, in the context of European water policy, van Ast and Boot (2003) contend that by helping to understand relationships between hydrological and economic variables, public participation can help to identify the most appropriate scales at which major economic issues should be considered.

There is growing agreement in the literature that local knowledge can contribute directly to technical investigations (e.g., Neis, et al. 1999; Innes, et al. 2004; Johnson 2009). In this role, local actors can contribute new data and information to processes (Innes, et al. 2004) and can qualitatively evaluate the validity of assumptions and findings (e.g., Petts 1997; Clark and Brake 2009; Johnson 2009). Several researchers
have also highlighted an important role for local knowledge in identifying required
management actions and setting appropriate policies to deal with complex environmental
problems (e.g., Innes 1998; Fazey, et al. 2006; Kroon, et al. 2009). Local participants can
offer practical insights that help to ground-truth different policy or management options.
A key contribution in this respect is helping to predict the implications of proposed

While there are multiple ways that local knowledge can contribute in a collaborative
process, some researchers have emphasized the importance of integrating local
knowledge throughout a collaborative process (e.g., Evans 2006; Petts and Brooks 2006;
Innes and Booher 2010). Further, authors in the environmental planning literature have
asserted that local knowledge should have more than a supporting role to scientific
knowledge in a collaborative process (Petts and Brooks 2006; Innes and Booher 2010).
Instead, a “coproduction model” of public participation (Corburn 2003) is advocated. In
relation to knowledge production under the coproduction model, “all publics are
understood as potential contributors to all aspects of environmental planning decisions
because hard distinctions between expert and lay, scientific and political order, and facts
and values are rejected” (Corburn 2003, p.423). This approach reflects an interpretive
view of knowledge, whereby phenomenon can only be understood within context and
cannot be isolated or studied in a strictly abstract way (Innes and Booher 2010).

Despite the potential for local knowledge to contribute in collaborative governance
processes, previous empirical research has identified barriers preventing the effective
integration of different sources of knowledge in practice. Innes and Booher (2010) have
highlighted epistemological anxiety involved in the rejection of local knowledge by
scientists and other environmental professionals. In Western culture, positivist ways of knowing remain dominant (Fazey, et al. 2006; Innes and Booher 2010). Central agencies continue to rely on accepted scientific practices and are not prepared to consider alternative knowledge claims (Berkes 2002). Scientists’ and resource managers’ perceptions of local knowledge and their reluctance to consider local knowledge as a legitimate basis for environmental decision-making have been well documented in the environmental management literature (e.g., Wynne 1992; Rhoads, et al. 1999; Weible, et al. 2004; Giordano, et al. 2010; Raymond, et al. 2010). Conversely, the attitudes of local and non-scientific actors towards their own knowledge remain unclear. Raymond, et al. (2010) assert that to address the epistemological challenges of integrating different forms of knowledge into environmental decision-making, participants need to be more aware of their own and others’ epistemological positions and how these positions influence knowledge integration. This study provides important insights into these issues by examining the attitudes of participants in a collaborative process towards local knowledge and how the attitudes of local actors compare with those of other actors involved.

**Empirical Context**

Water allocation planning offers a rich context in which to study knowledge integration in collaborative environmental governance. It is an inherently complex activity involving numerous technical, social and political challenges. Moreover, the ways in which knowledge is produced and used in modern water allocation regimes can strongly influence communities’ acceptance of decisions, and ultimately the success of policies because assessments of variables such as resource capacity, environmental water
requirements, and reasonable use requirements dictate the volumes of water that are available for human consumptive uses.

Over the past two decades, Australian governments have initiated a series of major reforms to their water management institutions, primarily aimed at reallocating water among competing uses and ensuring adequate environmental flows in rivers and other waterways. A critical milestone in the ongoing reform process was the agreement of the state and federal governments in June 2004 to the National Water Initiative (NWI), an overarching national policy statement for managing water in Australia. Under the NWI, statutory water plans are the primary mechanisms for ensuring that sustainable levels of extraction are achieved and maintained within catchments (Gentle and Olszak 2007). Catchment-based authorities were assigned a prominent role in water planning – they are required to assess environmental water needs, to define the amount of water available for consumption, and to decide how available water will be shared among existing and future water users (COAG 2004).

In the state of South Australia (Figure 4.1), commitments to water planning under the NWI are being met through a water allocation planning framework under the *Natural Resources Management Act, 2004* (Government of South Australia 2005). The legislation requires regionally-based Natural Resources Management Boards (NRM Boards) to prepare water allocation plans for each of the “prescribed” water resources in their jurisdiction, where water supply and or aquatic ecosystems have been deemed to be at risk. The water allocation plans are statutory instruments, approved by the state government, and are used by the Department for Water (formerly called the Department of Water, Land and Biodiversity Conservation) to issue water allocation licenses, to
manage the transfer of water licenses among users, and to permit activities such as dam and bore construction within catchments.

**Figure 4.1: Location of the case study areas**

The *Natural Resources Management Act, 2004* sets out the scope and contents of water allocation plans, the technical matters to be investigated in the preparation of plans, and the process for preparing water allocation plans. In addition to approving and administering water allocation plans throughout the state, the department also provides
technical support to the NRM Boards in preparing plans by supplying pertinent data and often conducting the required investigations. In some cases, the boards hire independent consultants to undertake some or all of the technical work.

The Act also prescribes specific requirements for public consultation at two stages in the plan development process – once at the outset on the proposed structure and contents of the water allocation plan (a “concept statement”) and again to seek feedback on a draft version of the plan. In addition to these legal consultation requirements, many of the NRM Boards have formed advisory committees as a means of collaborating more directly with stakeholders within the prescribed water resources areas on the development of water allocation plans. Typically, the committees are formed of water users, industry and interest-group representatives, and catchment residents chosen by the NRM Boards from individuals who have expressed an interest in participating. The committees are facilitated by a plan coordinator from the presiding NRM Board and are chaired by one of the community representatives. The role of the advisory committee, as described in one catchment, is “to provide a balanced and researched review of options for water allocation and water resource management in the [prescribed water resources area] and to make recommendations on these issues to the [NRM] Board, ensuring a balance of economic, social and environmental benefits” (River Murray Catchment Water Management Board 2005, p.4).

In sum, a collaborative approach is being used by NRM Boards in South Australia to develop water allocation plans for prescribed catchments within their jurisdictions. The form of collaboration occurring through the advisory committee process outlined above is especially consistent with the definition of collaboration offered by Ansell and Gash.
(2007) in that the committees (1) are focused on developing public policy, (2) are engaged in decision-making (i.e., not just “consulted” by a public agency), (3) include non-state actors as members, and (4) are formally organized and meet collectively. Another feature of the process worth highlighting is that the advisory committees are functioning within a highly prescriptive legislative framework.

**Methods**

A qualitative case study approach was used to account for the unique public perceptions and knowledge requirements related to water allocation planning in South Australia. Case studies are able to uncover the texture and detail of a study locale, and the interests, attitudes, and knowledge of individuals involved directly in a collaborative environmental management process (Margerum 1999; Gerring 2007). Previous studies of knowledge integration have used qualitative methods to enable an in-depth examination of the dynamics of the unique social and decision processes involved (e.g., Wynne 1993; Petts 1997; Fernandez-Gimenez, *et al.* 2006; Ballard, *et al.* 2008).

Case study areas within South Australia were chosen on the basis that (1) a water allocation plan was being developed in collaboration with a community advisory committee, (2) the process had advanced enough to have produced draft policies or a draft plan and (3) advisory committee members and agency staff involved in the process were accessible and willing to participate in the research. Four catchments were selected as case studies using these criteria: Western Mount Lofty Ranges (WMLR); Eastern Mount Lofty Ranges (EMLR); Marne Saunders (Marne) and Barossa Valley (Barossa)
Prescribed Water Resources Areas (Figure 4.1). Their main characteristics are described below and are summarized in Table 4.1.

Table 4.1: Summary of Selected Case Study Area Characteristics

<table>
<thead>
<tr>
<th>Study Area</th>
<th>Size (km²)</th>
<th>Main Water Use(s)</th>
<th>Agency Responsible for Plan</th>
<th>Advisory Committee Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barossa</td>
<td>711</td>
<td>• Irrigated agriculture (grape vines)</td>
<td>Adelaide &amp; Mount Lofty Ranges NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>Marne</td>
<td>743</td>
<td>• Irrigated agriculture (lucerne, grape vines, olives)</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Single committee</td>
</tr>
<tr>
<td>EMLR</td>
<td>2,845</td>
<td>• Irrigated agriculture</td>
<td>South Australian Murray Darling Basin NRM Board</td>
<td>Two regionally-based committees (meeting jointly)</td>
</tr>
<tr>
<td>WMLR</td>
<td>2,750</td>
<td>• Irrigated agriculture (pasture, grape vines, fruit and nut trees) • Water supply for Metropolitan Adelaide</td>
<td>Adelaide &amp; Mount Lofty Ranges NRM Board (with Department of for Water)</td>
<td>Three regionally-based committees (periodic joint meetings)</td>
</tr>
</tbody>
</table>


The Barossa Prescribed Water Resources Area is located north-east of Adelaide and covers an area of approximately 711 square kilometers (Figure 4.1). In 2009, an estimated 11 gigalitres of water were allocated to 560 licenses in the Barossa area, approximately two-thirds of which were for groundwater use (Adelaide and Mount Lofty Ranges NRM Board 2009). Over 90% of water use in the area is for agricultural purposes – primarily to irrigate grape vines, but also pasture and lucerne. Water is also used for industrial, stock and domestic purposes. A water allocation plan for the Barossa was first
adopted in December 2000. At the time of this research, the Adelaide and Mount Lofty Ranges NRM Board was responsible for updating this plan for the area. The Board was preparing the new water allocation plan in collaboration with the nine members of the North Para Water Allocation Plan Advisory Committee.

The Adelaide and Mount Lofty Ranges NRM Board was also responsible for preparing a water allocation plan for the Western Mount Lofty Ranges (WMLR) Prescribed Water Resources Area. The WMLR area covers approximately 2,750 square kilometers to the immediate east and south of Adelaide (Figure 4.1). The area includes three major watercourses and eight surface water catchments. Eight reservoirs are distributed through five of the catchments, supplying over 75% of the State’s population, including 60 percent of metropolitan Adelaide’s water requirements in an average year (Adelaide and Mount Lofty Ranges NRM Board 2010). Within the WMLR area, there are also approximately 11,500 wells, 13,000 dams and 250 watercourse extraction points, a major portion of which are used to irrigate 15,500 hectares of agricultural crops (Adelaide and Mount Lofty Ranges NRM Board 2010). Pasture is the main irrigated crop (39 percent of the total irrigated area) followed by grape vines (34 percent) and fruit and nut trees (eighteen percent) (Adelaide and Mount Lofty Ranges NRM Board 2010). There are also over 15,000 hectares of commercial forest production throughout the catchment. Aquatic ecosystems are dependent on water in the WMLR area, including critically endangered swamps (listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999) in the southern portion of the catchment.

Most of the water resources in the WMLR area were first prescribed in 2005. The McLaren Vale Prescribed Wells Area, contained within the larger WMLR area, was
originally prescribed in 1998. The new WMLR water allocation plan encompassed the McLaren Vale plan which had been most recently updated in 2007. The Board had formed three community advisory committees to collaborate with in the development of the WMLR plan: the Central Hills Water Allocation Plan Advisory Committee (nine members); the McLaren Vale Water Allocation Plan Advisory Committee (seven members); and the Fleurieu Water Allocation Plan Advisory Committee (nine members). While these committees met separately during the planning process, periodic joint committee meetings were held to discuss technical information and policy issues relevant to the entire area. In addition to providing technical support during the process, the Department for Water had also been contracted by the Board to assist in the preparation of the plan.

The water resources within the Marne area were prescribed in 2003. During this study, the South Australian Murray-Darling Basin NRM Board was preparing the first water allocation plan for the area, in collaboration with the Marne Saunders Water Resources Planning Committee. The committee included eight representatives of the catchment community. The area covers 743 square kilometers to the north east of Adelaide (Figure 4.1). It encompasses the catchments of the Marne River and the Saunders Creek, including the groundwater within the area. Water demand for licensed purposes in the Marne area has been estimated to be 7.5 gigalitres per year, with approximately 70 percent from groundwater sources (South Australian Murray-Darling Basin NRM Board 2009). The large majority of water use in the area (over 95 percent) is for irrigation purposes, including lucerne, grape vine, and olive growing (South Australian Murray-Darling Basin NRM Board 2009). Some water is also used for stock
and domestic, industrial, and intensive livestock purposes. The Marne area also contains several water-dependent ecosystems.

The Eastern Mount Lofty Ranges (EMLR) Prescribed Water Resources Area incorporates the eastern slopes of the Mount Lofty Ranges and the Murray Plains and lies within the Murray Darling Basin. It is located approximately 50 kilometres east of Adelaide and covers 2,845 square kilometers (Figure 4.1). With the exception of the Angas Bremer region, which was prescribed in 1980, the water resources in the EMLR area were first prescribed in 2005. At the time of this study, the South Australian Murray-Darling Basin NRM Board was preparing a water allocation plan for the entire EMLR area which would encompass the existing Angas Bremer plan. Two Water Allocation Planning Community Advisory Committees were formed to represent the northern and southern regions of the area. Together, the committee included nineteen representatives from the catchment community.

Land use in the EMLR catchment is mainly dominated by grazing and cropping (77 percent of the total area). Other land uses include pasture production and irrigated horticulture (seven percent), as well as urban areas, mining, industry, and manufacturing (five percent) (South Australian Murray-Darling Basin NRM Board 2011). Demand for water in the EMLR area is estimated to be approximately 13 gigalitres for surface water and 32 gigalitres for groundwater (South Australian Murray-Darling Basin NRM Board 2011). The area contains wetlands of national significance and the confluence of two creeks that originate in the catchment is part of an internationally-listed Ramsar site: the Coorong and Lake Alexandrina and Albert Wetland.
Data Collection and Analysis

Interviews with participants involved with the advisory committees in the four catchments were used to determine how they defined local knowledge and viewed its role in water allocation planning. Relevant documents and personal observations in the case study catchments were used to cross-check evidence from interviews and to strengthen the internal validity of our results. Importantly, we analyzed four catchments in order to capture a diverse range of experiences. In reporting the results we do not compare findings in this paper according to the catchments. Instead, we treat the data collectively.

In-person interviews were conducted in South Australia between March and July 2008 with a broad spectrum of people directly involved in the water allocation planning processes. This allowed us to capture a range of perspectives (e.g., government and community participants; scientists and non-scientists) about local knowledge and its role in the process. In total, 62 interviews were completed across all of the catchments. Interview participants included catchment representatives on the advisory committees, as well as state and local agency personnel who were involved in the process as policy and scientific advisors (e.g., hydrologists, hydrogeologists, ecologists) or as water allocation plan coordinators. A summary of the participants interviewed for the study is provided in Table 4.2.

Most interviews lasted between 60 and 90 minutes and followed a semi-structured format. Participants were asked to define local knowledge and to comment on the role it should play in water allocation planning. All of the interviews were digitally recorded and transcribed verbatim by the lead author. Nonverbal and emotional elements of the
interviews, as detected during the interviews and captured by audio record and written notes from the interviews, were also recorded in the transcription in the form of notes.

Table 4.2: Characteristics of interview participants

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Department Representative</th>
<th>NRM Board Representative</th>
<th>Catchment Representative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Science Background¹</td>
</tr>
<tr>
<td>Barossa Valley</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>(9 interviews)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marne-Saunders</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>(9 interviews)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Mount Lofty Ranges</td>
<td>5</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>(26 interviews)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Mount Lofty Ranges</td>
<td>3</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>(18 interviews)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>11</td>
<td>10</td>
<td>21</td>
</tr>
</tbody>
</table>

¹ “Science Background” distinguishes catchment representatives who have received formal training through a university or college program in the natural sciences (e.g., chemistry), social sciences (e.g., geography), or applied sciences (e.g., agricultural science, engineering).

A total of 137 documents were reviewed for this study; thirteen of these were found to be directly relevant to the topic and were included in the analysis. The documents related to the advisory committee processes, including meeting agendas and minutes, and provided some evidence of participant attitudes towards local knowledge that we used to cross-check findings based on the interview data. Other documents, including water
allocation plans, policy discussion papers and technical reports provided contextual
information on hydrological, ecological, water use, and socio-economic characteristics in
the case study areas.

Detailed personal observations in the case study catchments were also used to cross-
reference evidence from the other data sources. From February 2008 to July 2008, the
lead author attended a total of eleven community advisory committee meetings covering
all of the case study areas. At these meetings, he was able to observe directly the
dynamics of the committee process, including contributions of committee members’
knowledge to discussions about resource conditions and policy issues. Observations were
recorded as written notes which were included along with the interview and document
texts in the coding analysis.

Interview transcripts, documents and personal observation notes were analyzed
using QSR NVivo 8, a qualitative data analysis software package. This tool helped to
systematize our analysis procedures and facilitated storage and management of the data.
Using a qualitative content analysis approach, themes related to how participants defined
local knowledge and view its role in water allocation planning were derived inductively
from the data. All data were reviewed line-by-line and coded into a series of themes. By
comparing and reflecting on the evidence within the preliminary set, codes were
expanded, combined or re-grouped to develop final sets of themes for defining local
knowledge and its role in water allocation planning.

Participants’ views about the definition of local knowledge and its role in water
allocation planning were compared across different types of participant. Participants were
compared according to their affiliations (i.e., department, NRM Board, or catchment
Differences in attitudes between state agency scientists and local actors towards knowledge have been well documented in the literature (e.g., Wynne 1992; Rhoads, et al. 1999; Fernandez-Gimenez, et al. 2006; Raymond, et al. 2010). We have also isolated NRM Boards in our comparison based on claims that such catchment-based agencies are better situated than centralized agencies to access local knowledge (Hussey and Dovers 2006). Catchment representatives were also distinguished according to whether they had received previous training in a natural science, a social science, or an applied science discipline at a university or college. This comparison was made to reflect recent assertions in the environmental management literature that local and scientific knowledge are converging in Western culture due to increased participation by local actors in formal academic training and learning (Raymond, et al. 2010).

**Results**

The results of the analysis are presented below. The coding results are illustrated and substantiated with selected quotations from the interview texts and documents to help illustrate the findings. We have modified interview quotations as necessary to protect participant identities.

**Participant definitions of local knowledge**

During interviews, participants were asked to define local knowledge; 47 of the 62 interview participants provided a response. Coding of their responses revealed seven different dimensions by which Department for Water (department), NRM Board and catchment representatives conceptualized local knowledge (see Table 4.3).
Table 4.3: Number of interview participants identifying different dimensions of local knowledge

<table>
<thead>
<tr>
<th>Dimension of Local Knowledge (Total number of participants) (n=47)</th>
<th>Type of participant</th>
<th>Department Representative (n=9)</th>
<th>NRM Board Representative (n=6)</th>
<th>Catchment Representative Science Background (n=16)</th>
<th>Catchment Representative No Science Background (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geographic boundaries (n=42)</td>
<td>7</td>
<td>6</td>
<td>14</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Time (n=28)</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Environment (n=35)</td>
<td>7</td>
<td>4</td>
<td>11</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Land management (n=17)</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Community (n=12)</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Anecdotal vs. recorded knowledge (n=24)</td>
<td>6</td>
<td>3</td>
<td>9</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Limitations (n=12)</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

1 The dimension categories are not mutually exclusive. Many of the interview participants described local knowledge across multiple dimensions.

Most participants (42 of 47 respondents) across all types of participant related local knowledge to a defined geographic area. They described knowledge being based on an undefined or loosely defined area, such as a community, a “patch”, or a “local environment”. Some related local knowledge to a more defined boundary including a
“property”, a “catchment”, and “within a few kilometers” or “within five to ten kilometers”. A few participants raised the notion of local knowledge existing at multiple scales – from the property scale, to the catchment, to the entire state. For example, one of the plan coordinators said, “Local knowledge is probably people’s immediate area – the small section of the catchment that they live in, local knowledge of the way the stream operates, of groundwater in a ten kilometer radius of their property. There are people with broader local knowledge who work throughout the region. They’ve got a broader knowledge and understanding of how local characteristics can vary”.

Many participants also associated temporal boundaries with local knowledge (28 of 47 interview respondents). This dimension was identified by most of the catchment representatives without a science background (13 of 16 respondents) and by half of the participants in each of the other categories. The benefits of long-term and on-going experience in an area were highlighted. Catchment representatives, in particular, identified a minimum length of time needed to acquire substantial local knowledge, for example, to understand land management practices on a particular property. A dairy farmer on one of the advisory committees commented, “It doesn’t matter if I want to go cropping here. I mean, it would take you ten years to understand how to crop. If I buy a farm down in the Mallee, in a wheat or cereal growing area – you just haven’t got that knowledge and experience”.

In terms of subject matter, 35 of 47 respondents across all types of participants related local knowledge to environmental conditions, such as climate, hydrology (e.g., water levels, surface water run-off, stream flows, flooding), and ecology. Seventeen (of 47) respondents, half of whom were catchment representatives without a science
background, identified knowledge of land management practices as an important component of local knowledge. This included knowledge about soil, crop yields, pest management, water needs and water use efficiency on a property, as well as practical knowledge about the economics of farming and land management and an awareness of farm practice changes in an area over time.

Knowledge of “what’s going on in the community” was identified by twelve of the 47 respondents as another sphere of local expertise. This included an awareness of people’s attitudes towards water management issues and knowledge of community members who are valuable sources of information. The perspective was reflected in comments mainly from participants who have been most directly involved with the community advisory committees, including the plan coordinators and the committee members. Only one of the nine department representatives expressed this view.

The analysis revealed a final set of dimensions in participants’ conceptualizations of local knowledge related to the nature and utility of its different forms. About half of participants (24 of 47 respondents), including fifteen of the 32 catchment representatives, distinguished between landholders’ anecdotal observations and their recorded data (e.g., rainfall records, water use metering). While acknowledging that these different forms can be complementary, participants viewed recorded data as superior and expressed concerns about purely anecdotal knowledge. While this revealed that many participants acknowledged variability in the quality of different types of local knowledge, over a quarter of participants (12 of 47 respondents) specifically associated limitations with local knowledge. This included four of sixteen catchment representatives with a science background and three of sixteen catchment representatives without a science background.
Many of the perceived shortcomings of local knowledge raised by catchment representatives related to its limited perspective – its purveyors being focused on their “own patch” and unaware of what is happening upstream or downstream of their properties. A similar concern was expressed about local knowledge being oriented in the past and susceptible to short-term memory. Three of the nine department representatives and four of the six NRM Board representatives expressed practical concerns about local knowledge being difficult to collect and challenging to integrate into catchment-level investigations and policy development. In this respect, one of the plan coordinators commented, “When people say ‘things aren’t stressed in my local area’, I think they’re referring to that very, very small area and in some cases we can’t go down to that level of policy. We can’t write policy at such a small scale”. Interestingly, none of the department scientists involved in the case study processes expressed such reservations when they were asked to define local knowledge. Instead, these views were expressed by other participants, including several committee members both with and without scientific backgrounds.

Overall, the analysis showed that local knowledge is conceptualized by participants on a number of inter-related dimensions. While participants from different sectors and backgrounds described local knowledge using different terms (e.g., “patch” versus “property”, “pools with fish” versus “water-dependent ecosystems”), their ideas about what local knowledge is were generally consistent. Building on these conceptualizations of local knowledge, the next objective of the study was to understand participants’ views about how local knowledge should be used in water allocation planning.
Participants’ views of the role of local knowledge

Most interview participants (55 of 62) responded to questions related to role of local knowledge in water allocation planning. The analysis revealed that participants identified a role for local knowledge, to varying degrees, at five stages of the collaborative process: framing issues; planning required research; conducting technical studies; developing policies; and communicating with the broader catchment community (Table 4.4).

Table 4.4: Number of interview participants referencing a role for local knowledge at different stages of collaborative process

<table>
<thead>
<tr>
<th>Process Stage</th>
<th>Department Representative (n=8)</th>
<th>NRM Board Representative (n=6)</th>
<th>Catchment Representative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framing Issues (n=3)</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Planning Research (n=5)</td>
<td>0</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Conducting Technical Investigations (n=45)</td>
<td>8</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>Developing Policies (n=22)</td>
<td>3</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Communicating (n=5)</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

1 The categories are not mutually exclusive. Many of the interview participants described a role for local knowledge across multiple stages in the process.
Most participants (45 of 55 respondents) believed that local knowledge could contribute to the technical investigations conducted during the plan development process. This view was expressed by all of the department and NRM Board representatives and the majority (31 of 41) catchment representatives. Participants described how local knowledge could help to refine, for example, regional scale hydrologic models and broad assumptions about crop water requirements, to better reflect local conditions where there can typically be high variability in soil conditions, micro-climate, rainfall and water use across very short distances. In this way, local knowledge could help to “ground-truth” department data and models, adding practicality to the results. One of the plan coordinators reflected on local knowledge providing a “sounding board” for the technical information: “I mean the locals, they’re living there, they see what’s going on, and they have a really good perspective and understanding of their patch. That’s incredibly valuable and can tell us a lot about things at a small scale”. Similarly, a comment by one of the advisory committee members reflects the views of the majority of catchment representatives: “This is a very complex region, so you try to find general trends in systems and in the end, you usually end up over-simplifying. I think it’s very important to use that local knowledge – that’s what community consultation has got to be about is using that local knowledge”. Similar views were evident among department, NRM Board, and catchment representatives at an advisory committee meeting attended by the lead author, where participants discussed a proposal to verify department water use estimates with irrigators in certain catchments.

Local knowledge can also contribute to technical investigations by supplementing or filling-in data and information gaps. Participants indicated that local knowledge could
help to reveal historic trends in the area, provide continuity of data over time, and
generally provide data over-and-above departmental sources, which would help to create
a more accurate picture of the water resources. According to one advisory committee
member: “[accessing local knowledge] is a great hope for the process. If we can conceive
of a way in which data can be collected in a way that’s to a standard that’s satisfactory for
scientific purposes and starts to build a body of knowledge based on quantifying local
knowledge and perception – it’s a vast opportunity I think. In a complex area like this,
government will never be able to put in sufficient resources and monitoring points to
satisfy the community. So, is there any alternative really?” The idea of using local
knowledge as a supplementary source of data is also reflected in some of the water
allocation policies that were developed through the process. For example, the Marne
water allocation plan includes the following statement: “The Renmark Group aquifer is
currently poorly understood and so an adaptive management approach is very important
here. To this end, licensed users of this aquifer will be required to carry out more
intensive monitoring of the impact of use on aquifer response” (South Australian Murray-

In addition to supporting technical investigations, a large minority of participants
(22 of 55 respondents) believed that local knowledge could contribute to developing
water allocation policies. This view was expressed by approximately half of department
and NRM Board representatives and sixteen of 41 catchment representatives. In this role,
participants felt that local knowledge was useful for providing a “reality check” on the
potential effect, practicality and relevancy of policies. It was acknowledged that advisory
committee members can also provide insight into the social and economic impacts of
policy options, including gauging the reaction of people in the catchment. A comment from an advisory committee member generally reflects the views of how local knowledge can contribute in this respect: “You can’t just dump a policy on an area. As the people who live there, we’re the only ones who can determine if the policy is relevant in the local area”.

Surprisingly, very few interview participants expressed that local knowledge should have a significant role in either framing water allocation issues or in planning the research needed to support policy development. Only two catchment representatives, both with a science background, and one NRM Board representative conveyed that local knowledge could contribute in this way. As one committee member commented, “anecdotal stuff can sometimes actually pinpoint other areas that maybe need more monitoring or research”. Only three committee members, each with a science background, and two NRM Board participants felt that local knowledge could help with activities relating to planning data collection and research, such as identifying priority areas for additional monitoring or providing input into community monitoring programs or the boundaries of technical investigations.

The view of one of the NRM Board plan coordinators was more representative of the vast majority of participants: “What we need to address in the plan is very specific and to get that information, you probably need somebody with some technical background to work out where you need to target that. So the community – I don’t really see that it would be their role to inform what investigations need to be undertaken and where those sites should be”. Another NRM Board representative explained that “unless you’ve got community members with fairly detailed technical knowledge, it’s going to be
difficult for them to make really useful contributions to how you develop the model, and where it should be, and what scale it should be at”.

Five respondents, including one NRM Board representative and four catchment representatives, specified that an important role of advisory committee participants could be to provide advice on communicating and consulting with the broader catchment community during the development of the plan. In this respect, local knowledge could provide an indicator of community issues, advice on how to communicate the technical information to the community and preferred media outlets to reach particular stakeholder groups – helping the government to “sell the plan to the community”. One of the advisory committee members commented, “They can do some good modeling, but management is so much more than modeling. Management is bloody difficult because of being able to come up with something that is socially acceptable and sell it to the community – and probably convince the Minister. It’s all of those sorts of things. Well, scientists aren’t going to do that”.

**Discussion and Conclusions**

The purpose of this study was to examine how participants in collaborative environmental governance processes conceptualize local knowledge. We analyzed these issues through a case study of water allocation planning in South Australia. Using semi-structured interviews, document analysis and direct observations, we collected data representing the views of a broad range of individuals towards local knowledge, including state and local actors, scientists and non-scientists. Our main research questions included (1) how do participants define local knowledge, (2) what do participants think
the role of local knowledge should be in the water allocation planning process, and (3) do views towards local knowledge vary among different types of participants?

The study revealed that participants in South Australian water allocation planning have a multi-faceted perspective of local knowledge, reflecting many of the ideas of local knowledge that are evident in the environmental management literature. Most suggested that local actors possess a detailed understanding of their local environment (e.g., stream flow, water levels), land management practices for their particular crop or industry, and their local community. Our findings were consistent with views in the literature about who holds local knowledge. Nearly 90 percent of participants described an individual’s local knowledge relating to a discrete geographic area, centred on one’s own property and immediate community or catchment. This is consistent with ideas from research on knowledge integration, where geographic location and spatial scale is typically used to distinguish local knowledge from other more general and regional forms (e.g., Corburn 2003; Raymond, et al. 2010). Interestingly, a number of participants also acknowledged that some individuals can possess local knowledge at multiple scales. For example, someone who works throughout a region may have detailed knowledge of a number of local sites and may also possess a broader understanding of how local environmental characteristics or land management practices can vary. In a collaborative process, particularly covering a larger area, a participant with this form of knowledge could potentially provide “interactional expertise” (Carolan 2006), helping to bridge the gap between different sources of knowledge and facilitating a common understanding among participants from across the management area.
Almost two-thirds of participants highlighted the length of an individual’s relationship with a particular area or land management practice as an important indicator of the depth of knowledge that someone might hold. The notion of someone possessing expert knowledge, acquired only after a long-term and intimate connection with an area, has been discussed previously in the environmental management literature (e.g., Bryant and Wilson 1998; Fazey, et al. 2006; Ballard, et al. 2008) and appeared to resonate with participants, particularly the community representatives without a scientific background, in our study.

Another important finding from our analysis is that participants acknowledged variability in the nature and quality of different sources and types of local knowledge. For example, half of the participants interviewed distinguished between recorded measurements (e.g., rainfall, bore water levels) and anecdotal observations. A quarter of participants raised concerns about limitations associated with local knowledge, including references to the subjective and parochial nature of some sources, inconsistencies in data collection, and the incompatibility of micro-scale observations with regional scale modeling and policy making. The fact that department and NRM Board representatives expressed these views is not surprising. Reservations held by scientists and other environmental professionals towards local knowledge and its use in environmental decision-making have been well established in the literature (e.g., Wynne 1992; Rhoads, et al. 1999; Weible, et al. 2004; Giordano, et al. 2010; Raymond, et al. 2010).

Importantly, our findings suggest that local actors, including non-scientists, share similar reservations towards local knowledge. In fact, the participants who distinguished between anecdotal and recorded knowledge and who highlighted limitations associated with local
knowledge generally, tended to be representatives from the catchment communities, rather than department or NRM Board scientists.

How participants in the case studies conceptualized local knowledge helps to understand their views about the role of local knowledge in water allocation planning. The majority of participants, across all types of participants, felt that local knowledge could contribute to the technical investigations undertaken in the process, both by supplementing government sources of data and by ground-truthing study assumptions and regional modeling results based on their detailed and finer scale knowledge of the catchment. These findings affirm previous contentions in the environmental planning and management literatures that local knowledge can contribute valuable data for technical studies and can also serve to qualitatively evaluate the validity of scientific assumptions and predictions (Petts 1997; Innes, et al. 2004; Johnson 2009).

Nearly half of participants identified a role for local knowledge in developing water allocation policies, foremost by helping to assess the relevancy, practicality, and implications of proposed measures for affected communities. These views were expressed across all types of participants across the four cases. Again, these results affirm ideas in previous research about how local knowledge can contribute to environmental decision-making. For example, Newig, et al. (2005) suggest that local knowledge provides insight into the “social system” in which a proposed measure will be implemented (e.g., social costs of implementation) and can also offer valuable information to help assess a local community’s acceptance of a proposed measure. In our study, NRM Board and catchment representatives, most closely involved in communicating the water allocation plan to the community, also identified another
related role for local knowledge which, to-date, has not received as much attention in the environmental management literature as other topics. Participants highlighted how local knowledge can inform effective strategies for communicating with key stakeholders and the broader public in the catchment during the plan development process. For example, local knowledge can be used to identify crucial stakeholders within the catchment, provide an indicator of important community issues, and help to determine the appropriate media outlets to reach certain stakeholder groups.

In contrast to a significant, albeit subsidiary, role for local knowledge in conducting technical studies and developing policies, few participants in our study expressed that local knowledge could contribute at the early stages of the collaborative process, including helping to frame planning issues and scoping and designing required technical investigations. This finding contrasts sharply with recommendations in the literature that local knowledge should be integrated throughout collaborative processes (Evans 2006; Fernandez-Gimenez, et al. 2006; Petts and Brooks 2006; Innes and Booher 2010). One possible explanation for these findings is that participants’ views could be influenced by the nature of collaboration in our case study areas. Water allocation planning in South Australia is driven by a legislated process that prescribes the timelines for plan development, the terms of reference for technical investigations and the scope of community engagement and policy options. Collaboration through the community advisory committees is nested within this broader legislated process. These conditions unavoidably influence the collaborative process and may prevent the implementation of (or even the expectation of) some of the normative principles of collaboration, including the engagement of local actors and their knowledge early in the process. In contrast to the
state-directed nature of collaboration in our South Australian case, previous research on knowledge integration in collaborative contexts has largely focused on “citizen directed” or “hybrid” examples of collaboration (Moore and Koontz 2003; Margerum 2008) involving on-the-ground actions, such as monitoring and research (e.g., Castillo, *et al.* 2005; Fernandez-Gimenez, *et al.* 2006; Ballard, *et al.* 2008). These forms of collaboration are often broader in scope and duration and are typically engaged throughout a project cycle, from problem definition and research design to implementation and assessment (Leach, *et al.* 2002). Under these conditions, a clearer role for local knowledge in helping to frame problems and design research may be more apparent to participants.

The views among participants in our study towards knowledge may also reflect contentions in the environmental management literature that local knowledge and scientific knowledge are converging in Western culture, as evidenced in examples of collaboration where local actors share a positivist philosophy with their scientist counterparts (Raymond, *et al.* 2010). Supporting this argument, most participants in our study appeared to privilege scientific knowledge as the means of preserving the “technical fidelity” (Lane and McDonald 2005) of decisions and viewed a role for local knowledge only insofar as it can complement, by filling data gaps or by ground-truthing the outputs of scientific investigations.

Participant’s views in our South Australian case studies echo practical concerns in the environmental management literature that local knowledge is not “universally sound” (McCloskey 2001), that it may be subjective and biased (Fazey, *et al.* 2006) and may reduce the “technical fidelity” of decisions (Lane and McDonald 2005). A common view
in the literature is that government actors – and scientists in particular – hold
“epistemological anxiety” (Innes and Booher 2010) towards local knowledge and fail to
acknowledge its potential for contributing to and enhancing environmental management
efforts (e.g., Wynne 1993, Fischer 2001; Petts and Brooks 2006). These types of views
have been well documented in the environmental management literature (e.g., Petts and
Brooks 2006; Rhoads, et al. 1999; Weible, et al. 2004) but are not often attributed to non-
scientist and local participants in collaborative initiatives. Our case study of collaborative
water allocation planning in South Australia suggests that such epistemological anxieties
towards local knowledge are also shared by local actors. While most participants
acknowledged the value of local knowledge in supplementing technical investigations
and developing policies, a significant minority, many of whom were local actors and non-
scientists, expressed strong concerns about the variable quality and reliability of local
knowledge in the water allocation planning context.

This study answers calls in the environmental management literature to examine the
epistemological positions of the various participants involved in environmental decision-
making processes (Raymond, et al. 2010). Our findings provide important insights into
the attitudes of local participants in a collaborative process towards local knowledge and
affirm epistemological anxiety – among both state and local actors – as a formidable
barrier to incorporating local knowledge into collaborative processes in practice. This
study indicates that attention needs to be paid to the epistemological perspectives of all
participants when considering how to overcome the challenges of integrating local
knowledge into collaborative governance processes. At the same time, this study points to
the need for researchers in the collaborative environmental governance literature (e.g.,
Petts and Brooks 2006; Innes and Booher 2010) to re-examine expectations for joint fact-finding in collaborative processes, particularly within forms of collaboration that are operating within highly prescriptive, regulatory frameworks.

References


McCloskey, M. 2001. Is this the course you want to be on?: comments from the closing session of the 8th International Symposium on Society and Resource Management. *Society and Natural Resources*, 14: 627-634.


CHAPTER FIVE

CONCLUSIONS

This chapter recaps the major research findings contained in the previous chapters and considers the collective contributions of the study. It provides an opportunity to critically reflect on the theoretical framework that guided the research and address the third objective of the research, to offer recommendations for designing or adapting collaborative environmental governance processes to improve outcomes related to knowledge production and use. The final section of the chapter considers limitations of the study methods, along with ideas for future research.

Purpose and Objectives

The purpose of the research was to extend understanding of knowledge production and use in collaborative environmental governance. Four real-world cases of collaboration were examined in order to gain practical insight into what collaborative processes can and cannot achieve with respect to knowledge production and use, as well as the structural and procedural factors that influence their success. The study had three specific objectives:

1. To develop a theoretical framework for analyzing knowledge production and use in collaborative environmental governance;

2. To use this framework to analyze knowledge production and use in a real-world collaborative environmental governance process; and
3. To offer recommendations for designing or adapting collaborative environmental governance processes to better achieve the goals of collaboration related to knowledge production and use.

The findings of the study were organized into three chapters that are presented in manuscript form. Though intended to be stand alone publications, the individual papers are related to one another and to the overall research objectives. The order of the chapters was purposeful – each one extends from and builds upon the results and ideas presented in the previous papers. A summary of the major findings of the research is provided below.

**Major Findings**

In Chapter Two, a set of outcome and process criteria was presented. These were derived from the collaborative environmental governance literature (e.g., Margerum 1999; Berkes 2004; Trachtenberg and Focht 2005; Innes and Booher 2010), as well as related bodies of research concerned with the production and use of knowledge in environmental decision-making (Petts 1997; Neis, et al. 1999; Fernandez-Gimenez, et al. 2006; Ballard, et al. 2008). This theoretical framework was used to systematically evaluate four collaborative water allocation planning processes in South Australia. The evaluation found that a number of theorized outcomes of collaboration related to knowledge production and use were achieved, including improved understanding by participants of the knowledge used to make decisions (e.g., Johnson 2009), and enhanced social capital among scientists and non-scientists engaged in the process (e.g., Berkes 2004; Hillman 2005). The analysis also showed that several of the key process criteria, recommended in the literature to
promote successful knowledge production and use, were also present. These included elements related to effective communication among participants (e.g., Jacobs, et al. 2005), direct engagement of technical experts in the process (e.g., Innes 1998; Michaels 2001; Fernandez-Gimenez, et al. 2006), and the use of specific strategies to promote collaborative knowledge production, such as integrating local knowledge and undertaking field trips and other “boundary experiences” for scientist and non-scientist participants (Feldman, et al. 2006).

Notably, there was only one case – the Marne catchment – where the collaborative process resulted in participants accepting and agreeing to the base of knowledge that informed their recommended water allocation policies (e.g., Innes, et al. 2004; Wallington, et al. 2008). A comparison of process characteristics across the four cases suggested a few key factors that have been highlighted in previous research which may have influenced the outcomes. These included the relative duration of the processes (e.g., Johnson 2009; Kroon, et al. 2009), the involvement of a dedicated coordinator with interactional expertise (Carolan 2006), the opportunities for catchment participants to discuss and challenge technical information (e.g., Lane and McDonald 2005; Blackstock and Richards 2007; Innes and Booher 2010), and the representation of community interests on the advisory committees (e.g., Innes and Booher 1999; Berkes, et al. 2000; Trachtenberg and Focht 2005). The comparative analysis also revealed geographic scale as a potential contextual factor influencing the collaborative processes and their outcomes within the study catchments.

Importantly, the evaluations of the case study structures and processes revealed that technical investigations, conducted by scientists in the Department for Water, were the
primary (and in most cases, exclusive) source of information for water allocation plan development. The findings highlighted the fact that advisory committee participants had minimal involvement in the technical investigations. This finding was inconsistent with assertions in the collaborative governance literature that local actors and their knowledge should be engaged in joint fact-finding as part of a collaborative process (e.g., Innes and Booher 2010). Chapter Two suggested the need to further examine the roles of local actors and their knowledge in collaborative governance arrangements. More specifically, it raised the question: at what stages and in what ways can local knowledge be incorporated into a collaborative process?

A key finding from Chapter Two is that local knowledge plays important roles in collaborative water governance, but in different ways at various stages. Chapter Three therefore focused on how local knowledge was incorporated into the four case study processes. First, using an analytical framework informed by research concerned with collaborative environmental governance (e.g., Innes 1998; Newig, et al. 2005), knowledge production (Speigler 2003; Michaels, et al. 2006) and the integration of different forms of knowledge in environmental management (e.g., Neis, et al. 1999; Castillo, et al. 2005; Petts and Brooks 2006; Giordano, et al. 2010), this study systematically assessed the extent to which local knowledge contributed at different stages of the water allocation planning process in each case study catchment. The results showed that local knowledge had contributed to the technical investigations, primarily as supplementary data sources and as a means of validating the findings. Community advisory committee members also helped to ground-truth policy options by providing insight into the practicality of proposed measures and the likelihood that water users
would accept and comply with the rules. The analysis revealed that local knowledge had helped to inform strategies for communicating with key stakeholders and the broader catchment community during the development of the plan. In contrast, there was scant evidence across all of the cases that local knowledge had contributed at the earlier stages of the process, in terms of affecting how water allocation issues were framed, identifying the knowledge needed to develop the plan, or influencing how data and information were to be collected. These findings challenged previous assumptions in the collaboration literature that local actors and their knowledge should be engaged throughout the collaborative process (Evans 2006; Fernandez-Gimenez, et al. 2006; Innes and Booher 2010) and that knowledge should be integrated with scientific knowledge consistent with a “co-production model” of public participation (Corburn 2003).

Chapter Three also provided further insight into four factors, highlighted previously in the environmental management literature, which appeared to influence the extent that local knowledge was integrated into the four case study processes. One important factor was the existence of mechanisms to promote and facilitate the systematic collection and use of local knowledge in the process. The findings emphasized the need for practical tools to make it easier and more cost efficient to collect, submit and store local knowledge, to translate local knowledge to make it more compatible with other sources (Fazey, et al. 2006; Giordano, et al. 2010) and to validate local data sources in order to provide assurance to participants of the quality of the data (Neis, et al. 1999; Giordano, et al. 2010). The study also reinforced how limited time and resources can constrain the ability to collect and integrate local knowledge into an environmental planning process (e.g., Johnson 2009; Kroon, et al. 2009; Spink, et al. 2010). The unwillingness of
landholders to contribute their knowledge to the process was found to be significant barrier to accessing local knowledge for water allocation planning. This issue has previously been identified in a number of environmental management contexts (e.g., Allen and Kilvington 2005; Fernandez-Gimenez, et al. 2006; Clark and Brake 2009; Johnson 2009). Importantly, this analysis highlighted the need to communicate the importance of local knowledge for sustainable water management to landholders and other community members who may be either apathetic or resistant to sharing their knowledge with the government so that they can better understand “what they’re getting out of it”. Lastly, scientists and non-scientists across the four case studies perceived limitations with local knowledge, including a concern that local knowledge was too parochial and subjective, and not grounded in rigorous and objective scientific methods. These types of reservations with local knowledge have been previously highlighted as a critical barrier to integrating local knowledge into environmental decision-making (e.g., Petts and Brooks 2006; Innes and Booher 2010).

An important finding that emerged from Chapter Three is that several participants in the case study catchments appeared to hold negative perceptions of local knowledge and expressed strong reservations about using local knowledge as a basis for water allocation policy decisions. In Chapter Four, the views of participants towards local knowledge and its role in the cases were examined in greater depth. The analysis revealed that participants in South Australian water allocation planning hold multi-faceted perspectives of local knowledge that are broader and more fluid than the dominant conceptualizations of local knowledge in the environmental management literature (e.g., Fischer 2001; Corburn 2003; Innes and Booher 2010). In characterizing local knowledge, most
participants acknowledged high variability in the nature and quality of different sources and types of local knowledge. Participants made clear that they had strong reservations towards local knowledge, including the subjective and parochial nature of some sources, inconsistencies in methods of measuring and recording observations, and the incompatibility of micro-scale observations with regional scale modeling and policy making. Previous research has documented strong reservations among scientists and resource managers towards local knowledge (e.g., Rhoads, et al. 1999; Weible, et al. 2004; Petts and Brooks 2006). Importantly, in this study, these views were shared by state and local, non-scientist participants across the four case study catchments. Further, state and local participants in each case felt that local knowledge could contribute to water allocation planning mainly by supplementing departmental data sources for technical investigations and by ground-truthing technical study results and proposed policy options. In contrast to normative claims in the collaborative environmental governance literature that local knowledge should be integrated throughout a collaborative process (e.g., Innes and Booher 2010), few participants in any of the South Australian case studies felt that local knowledge had a role at the earlier stages of the planning process.

**Contributions**

**Academic Contributions**

This research responds to calls in the collaborative environmental governance literature for more systematic evaluations of collaborative approaches in order to gain practical insight into what they can and cannot achieve, their strengths and limitations and the factors that influence their success (e.g., Bellamy, et al. 1999; Innes and Booher 1999;
Blowers, et al. 2005; Murray 2005; Jeffrey and Geary 2006; Koontz and Thomas 2006). The research was guided by a comprehensive set of theoretical process and outcome criteria for evaluating knowledge production and use in collaboration. The framework linked insights from the collaborative environmental governance literature (e.g., Berkes 2004; Trachtenberg and Focht 2005; Blackstock and Richards 2007; Innes and Booher 2010), as well as complementary bodies of research in the environmental management field concerned with the role of knowledge in environmental decision-making (e.g., Castillo, et al. 2005; Evans 2006; Fernandez-Gimenez, et al. 2006; Petts and Brooks 2006; Ballard, et al. 2008; Johnson 2009). The framework was applied to a case study of collaborative water governance in South Australia. The findings of the case study provide a number of important theoretical contributions to the collaborative environmental governance literature (e.g., Berkes 2004; Margerum 2007; Innes and Booher 2010; Reed and Bruyneel 2010), as well as related bodies of research in the environmental management literature (e.g., Fischer 2001; Corburn 2003; Ballard, et al. 2008; Raymond, et al. 2010).

First, the findings help to articulate how institutional arrangements can influence how knowledge is produced and used in collaborative processes. It is generally acknowledged that collaborative approaches function within an overarching framework of legislation, regulation, policy and defined stakeholder roles (Murray 2005). While collaboration involves the “scaling out” of responsibilities and power to local actors by the state, authors in the collaborative governance literature recognize (and increasingly recommend) that the state retains key roles within collaborative arrangements that can ultimately maintain its influence over decisions and environmental policy direction.
Previous research has raised concerns related to the relationship between knowledge and power within collaborative arrangements between state and local actors (e.g., Imperial 1999; Berkes 2002). In the South Australian cases, a legislative framework directed how water allocation planning was undertaken, including the technical investigations that were required to support planning decisions. Moreover, state agency scientists were primarily responsible for conducting the technical investigations. This research suggests that, when a collaborative process operates within this type of overarching institutional structure, the prospects for local actors to engage in joint fact-finding with state scientists and resource managers are severely limited.

Second, this study provides important insight into the role of local knowledge in collaborative planning processes. While the successful integration of scientific and local knowledge has been demonstrated in participatory and collaborative research contexts (e.g., Corburn 2003; Castillo, et al. 2005; Ballard, et al. 2008), scholars in the collaboration literature have stressed the need for a closer examination of how local knowledge contributes to collaborative planning processes (Fernandez-Gimenez, et al. 2006; Innes and Booher 2010). This study provides insight into how local knowledge contributes to collaborative planning processes that operate within highly prescriptive institutional frameworks. The findings suggest that there are practical limits to the role of local knowledge within these forms of collaboration. The study indicates that local knowledge contributes in a mainly subsidiary role to scientific knowledge, supplementing state data sources and ground-truthing technical study findings and policy options. The findings also suggest that local actors and their knowledge have a minimal role at the
early stages of the planning process, in framing the problem or establishing knowledge needs and research protocols.

Third, this study provides insight into the attitudes of participants in collaborative processes towards local knowledge. Previous research has documented strong reservations among scientists and resource managers towards local knowledge (e.g., Rhoads, et al. 1999; Weible, et al. 2004; Petts and Brooks 2006). “Epistemological anxiety” (Innes and Booher 2010) on the part of scientists and other professionals towards local knowledge has been identified as a formidable barrier to integrating local knowledge into collaborative governance processes. This study provides further insights into these types of epistemological challenges by shedding light on the attitudes of collaboration participants, including local actors, towards local knowledge and its role in the collaborative process. The findings suggest that participants hold a more complex, multi-dimensional view of local knowledge than most conceptualizations of local knowledge in the environmental management literature (e.g., Fischer 2001; Corburn 2003; Innes and Booher 2010). Importantly, this study suggests that both state and local actors blur the boundaries between scientific and local knowledge. Participants in the case study catchments acknowledged that local knowledge could include both experiential knowledge and observations measured using scientific instruments. Some participants also asserted that local knowledge could be held by individuals at a variety of spatial scales.

This study suggests that local actors recognize limits to the value of local knowledge and have reservations about the subjective and parochial nature of some sources. The research also indicates that state and local participants share the view that
local knowledge should have a primarily complementary relationship with scientific knowledge in collaborative planning, with a minimal role at the early stages of the process, in scoping policy issues and technical work. Again, this raises questions as to whether normative ideals for integrating local knowledge through joint fact-finding (Innes and Booher 2010) and a “co-production model” of public participation (Corburn 2003) are feasible, or even desired, by participants in a collaborative process that functions within a prescriptive and science-based regulatory framework.

Fourth, the evaluation of the South Australian cases affirmed that a number of theorized process and outcome criteria associated with successful knowledge production and use are achievable in practice. Despite the limited involvement of local actors in producing knowledge within the collaborative processes that were examined, the findings showed that the processes had generated understanding (and in one case, acceptance) of the knowledge used to base policy decisions and had built social capital among state scientists and local participants. This paradox draws attention to limits of current procedural theory in the collaborative environmental governance literature for designing and implementing successful collaboration (e.g., Innes and Booher 2010) and offers important insights for evaluating knowledge production and use in collaborative processes.

Communicative rationality theory has been criticized for failing to account for the influence of external factors, such as existing institutional frameworks, on collaborative processes (Murray 2005). This study showed that joint fact-finding, a cornerstone of Innes and Booher’s (2010) concept of collaborative rationality, was not achieved within collaborative processes that functioned within a prescriptive, overarching institutional
framework. However, the cases examined in this research achieved successful outcomes related to knowledge production and use despite the fact that the collaborative processes fell short of joint fact-finding and authentic dialogue. Moreover, state and local actors alike expressed strong reservations towards local knowledge and seemed to reject the notion of using a socially constructed base of knowledge to make their policy decisions. Margerum (2008) has challenged fellow researchers in the collaborative environmental governance field to focus and sharpen their analyses of collaboration by ensuring that they take into account the distinct qualities of different forms of collaboration (Margerum 2008). This study suggests the need to re-examine and adapt current procedural theory in the collaborative environmental governance field to account for (1) the attitudes of participants – including state and local actors – towards local knowledge and its appropriate role in environmental decision-making and (2) the influence that overarching institutional frameworks may exert on knowledge production and use within collaborative processes.

**Recommendations for Practice**

Collaborative approaches are increasingly being used by government agencies to integrate stakeholder input more directly and continuously into their environmental planning and decision-making. For example, the province of Ontario, Canada has recently introduced a prescriptive regulatory framework for drinking water source protection that is being implemented by local catchment agencies in collaboration with stakeholder advisory committees (Ontario Ministry of the Environment 2010). In Washington State, the Watershed Planning Act lays out a formal process whereby local governments and communities can collaborate to plan for water needs and uses within
their catchment (Ryan and Klug 2005). Similarly in Australian states, responsibilities for water planning have been assigned to catchment-based agencies and community advisory committees under the direction of a national water policy and state regulatory regimes (Pigram 2006; Hussey and Dovers 2006). These three examples have in common a state-directed regulatory framework that to varying degrees:

- defines the scope of the issues that can be addressed through statutory planning;
- defines the scope and form of public engagement and policy options;
- prescribes timelines for preparing plans;
- defines the scope of technical information required to develop the plan; and
- prescribes the terms of reference for conducting technical investigations.

This study has shown that these forms of collaboration are constrained in some important ways because they function within a prescriptive regulatory framework. In the South Australian cases examined in this study, we found that these conditions limited the ability of participants to contribute to the production of technical information, and ultimately limited the integration of local knowledge into the process, particularly at its early stages.

With governments increasingly relying on this form of collaboration to engage citizens in addressing environmental problems, the need to understand how processes should be structured and run to deal with these kinds of challenges, and to produce successful outcomes, has become critical. In response, this study offers recommendations for structuring and executing collaborative processes that are nested within a more
traditional top-down system of governance, to promote successful outcomes related to knowledge production and use.

1. Involve facilitators with “interactional expertise”

A dedicated and effective facilitator is critical to the success of a collaborative process (Margerum 1999; Leach and Pelkey 2001; Blackstock and Richards 2007). This study revealed the essential role of the plan coordinator in promoting successful outcomes from the process related to knowledge production and use. In the Marne and EMLR cases, all of the committee participants identified the plan coordinators from the Natural Resources Management (NRM) Board as the main facilitators and described these individuals as being effective brokers between the committee and the department scientists. Importantly, participants emphasized that the plan coordinators possessed technical knowledge as well as a practical knowledge of social, economic, and water use issues within the catchment.

These findings emphasize the importance of involving a facilitator with “interactional expertise” (Carolan 2006) in a collaborative process. Where local participants have limited opportunities to engage to discussions related to technical information, an effective facilitator must be able to optimize the exchanges between scientists and local participants by helping to communicate the outputs of the technical investigations in an understandable way and by encouraging participants to ground-truth the findings based on their intimate knowledge of resource use and environmental conditions within their catchment. To effectively facilitate this exchange, an individual must be an effective communicator, and have a technical background related to the
issue(s), as well as sufficient experience in the local area to understand the catchment and its residents.

2. Involve scientists “at the table” in discussions of knowledge and related policies.

In a collaborative process, technical experts should not simply be handing over facts and offering professional opinions at an arms length in a collaborative process. Having scientists “at the table” and directly engaged in discussions about information and related policy issues can help to build understanding and trust among scientist and non-scientist participants, as well as understanding and acceptance of knowledge in the process (Innes 1998). In this study, department and NRM Board scientists were actively engaged in all of the case study processes; however, only participants in the Marne case expressed satisfaction with how experts interacted with the committees.

Criticisms by participants in the other study catchments provide specific insights into how scientists should participate in a collaborative process. First, committee members were confused by multiple scientists presenting and interacting with the committee at different times on similar topics. On this issue, a farmer on one of the WMLR committees commented that “at times, we don’t know who we’re listening to or where they’re coming from. If the same people are feeding you information regularly, you can question and get to know those people”. Participants also criticized the poor communication skills of some of the scientists involved in the process. This limited their ability to discuss technical issues when they had opportunities to meet face-to-face with the experts.

These findings suggest that the benefits of having technical experts directly engaged in discussions with other participants in a collaborative process can be enhanced (1) by
involving individual scientists recurrently through the process and (2) by ensuring that all of the scientists who are interacting with local participants in the process are able to communicate effectively with non-scientists. These issues are especially important within a formal process with tight timelines, where the opportunities for local participants to interact face-to-face with technical experts may be limited.

3. Create opportunities to collect and utilize local knowledge.

Collaboration can generate a broader information base for decision making by promoting the collection and use of local sources of knowledge (Lane and McDonald 2005; Innes and Booher 2010). A major challenge with this approach is that landholder knowledge about local resource use and the environment is seldom available on a collective basis and that most jurisdictions lack the formal mechanisms required to collect and incorporate such information (Neis, et al. 1999; Fazey, et al. 2006; Giordano, et al. 2010). This study revealed that efforts to access and incorporate local knowledge into the water allocation planning process were severely limited, in large part because of limited time and resource afforded under the overarching regulatory framework.

Despite these constraints, there were examples across all of the cases of local knowledge being accessed in a strategic way. Tools such as water user surveys and workshops in the broader catchment communities were used to access local knowledge in a short period to either fill critical data gaps or to validate questionable or controversial investigation findings. The members of the community advisory committees were also used, to varying extents, to help ground-truth the results of technical studies and proposed policies, based on their detailed knowledge of environmental conditions and resource use within the catchment. In addition to these short-term, target efforts to access local
knowledge, there were examples in the Barossa catchment and Angas Bremer catchment (a sub-catchment within the EMLR area) of community monitoring programs that had been established in response to previous water allocation plans. For example, an irrigation reporting system had been established in the Barossa Valley that was now contributing valuable data needed to estimate water demand within the catchment. In general, practical tools should be established to make it easier to collect, submit and store local knowledge. Participants across all of the cases emphasized the importance of having a process in-place for validating local data sources in order to provide assurance to participants of the quality of the data. They also asserted that greater effort is needed to promote the benefits of local knowledge for environmental management to landholders and other community members who may be either apathetic or resistant to sharing their knowledge with the government.

Given the tight timeframe and prescriptive nature of water allocation planning in South Australia, the opportunities to integrate local knowledge early in the process were also limited. The study findings suggest that opportunities may exist for local knowledge to help frame issues or inform the scope and design of technical investigations where an existing water allocation plan is scheduled for review and updating. In both the Barossa and Angas Bremer catchments, early local input from the catchment community was sought at the plan review stage, through established advisory committees and a broader public engagement process. These mechanisms provided opportunities for local actors to raise issues of concern to consider in the future plan, as well as knowledge gaps and future information needs.
4. Provide opportunities for participants to debate knowledge.

One of the most important elements of a collaborative process is that it includes a well-structured dialogue among scientists and community participants about knowledge of the environment and human-environment systems in the management area (Blackstock and Richards 2007; Wallington, et al. 2008; Innes and Booher 2010). The prescriptive and time-limited water allocation planning process in South Australia did not afford local participants opportunities to engage directly in the process of producing the technical knowledge needed to develop the plan. For the most part, technical information was provided to participants at or near the completion of investigations which the committees considered in developing their respective policies.

Even though prospects for local participants to engage in discussions of knowledge were limited in three out of four of the study catchments, this study demonstrated how advisory committee members were still able to add value to technical investigations, by filling knowledge gaps and ground-truthing scientific findings based on their intimate knowledge of environmental, economic and social conditions within their catchment. At the same time, the findings affirm the critical importance of discussion and critical debate of knowledge to promote acceptance of and agreement to a set of information to base decisions (e.g., Innes and Booher 2004; Lane and McDonald 2005). The Marne catchment was the only case in this study where participants generally accepted and agreed to the base of knowledge that was used to make water allocation policy recommendations. The Marne process was also the only case where there was clear evidence that the committee had ample opportunity to question and debate the technical information produced by the department.
There was also evidence that during the Marne process, the results of technical investigations were reviewed and in several instances re-visited by department scientists in response to questions and challenges from committee members. While authentic joint fact-finding may not be feasible (or even expected) within collaborative processes that are operating under a prescriptive regulatory framework, this study emphasizes that local participants must have opportunity to question and debate the technical information produced in the process. For these deliberations to be meaningful, scientists need to be willing and able to revisit the results of their technical investigations in response to questions, challenges, and suggestions from local participants.

5. Provide adequate time and resources.

It is generally understood that engaging local and non-scientific participants in a collaborative process can require significant time and resources (Johnson 2009; Kroon, et al. 2009; Spink, et al. 2010). Given the limited time available to conduct the technical investigations, department scientists working in the case study catchments commented that sufficient resources were not available to collect local knowledge in a comprehensive and systematic way. This study suggests that, while participants may not expect to be involved directly in the technical investigations, having opportunities to discuss and challenge the technical findings was critical. Importantly, in the Marne case, where participants had reached agreement on the base of knowledge used to make policy decisions, there was a significantly greater amount of time to develop the water allocation plan than in the other areas. This afforded the Marne committee more opportunities to discuss the technical information and allowed the department scientists time to re-examine and adjust their modeling where appropriate.
This study also highlighted how contextual factors, such as the geographic scale or resource use intensity within a catchment, can increase the amount of time and resources needed to run a successful collaborative process. For example, in a large and diverse catchment such as the WMLR area, multiple advisory committees were formed to ensure adequate geographic and sector representation across the catchment. More time and resources should have been allocated to the WMLR process to ensure that participants gained a greater understanding of each other’s perspectives, as well as the conditions and policy issues throughout the entire catchment. We also found that in areas where resource use is intense and the potential impacts of future policy most severe, local participants more carefully scrutinized technical information and demanded more opportunities to meet with scientists to discuss their methods and findings. For a collaborative process to be effective and produce beneficial outcomes (or avoid negative outcomes), this study highlights the importance of allocating time and resources to a collaborative process that are commensurate with its unique circumstances and needs.

**Study Limitations and Ideas for Future Research**

The problem under investigation in this study demanded an ability to analyze issues associated with knowledge production and use in sufficient depth to understand the dynamics of the unique social and decision processes involved in real-world collaboration. Therefore, a qualitative case study approach was chosen for its potential to achieve a detailed understanding of the collaborative processes being investigated from the perspective of individuals who were directly involved (Margerum 1999; Gerring 2007). A widely acknowledged trade-off of conducting an in-depth analysis of a small number of cases is limitations in the generalizability of the study findings (Yin 2003).
While the methodology permitted analytical generalizations to the bodies of scholarship used to guide the research, the ability to generalize the empirical results to other collaborative governance contexts is limited.

To test the generalizability of the study findings, it would be worthwhile to use the theoretical framework developed in this project to evaluate and compare cases of collaboration with different contextual or procedural characteristics. Comparative studies have been highlighted as a key theme for future research in the environmental governance field (Davidson and Frickel 2004). A useful analysis that would extend directly from this research would be to evaluate and compare knowledge production and use in highly prescriptive, state-directed collaborative processes with more informal, bottom-up collaborations, or between new and long-standing collaborative processes. Previous research in the collaborative environmental governance literature on collaborative watershed partnerships (e.g., Leach, *et al.* 2002; Innes, *et al.* 2004) and collaborative research initiatives (Corburn 2003; Fernandez-Gimenez, *et al.* 2006) has demonstrated the successful integration of local and scientific knowledge. These types of cases form the basis for claims that local knowledge should contribute throughout collaborative processes (e.g., Innes and Booher 2010) and that local knowledge should hold equal weight to scientific knowledge in addressing environmental problems (Corburn 2003). This study challenges these normative principles and suggests that collaborative processes that are operate within a traditional, top-down governance structure are severely constrained in terms of how local actors can contribute to and influence knowledge production and use. A comparative analysis of different forms of collaboration would help to further our understanding of what collaboration is capable of
achieving, as well as structural and procedural features of collaborative process that can promote success.

There were also aspects of the specific research design used in this study that limited the scope of its conclusions. First, the analysis focused on the community advisory committee process. The study did not analyze the collaborative processes and their outcomes within the context of the broader water allocation planning catchment communities. For example, interviews were held with the majority of committee participants in each case, including state and local actors. This provided a broad range of perspectives on the processes that were examined and reduced problems of sampling bias that have been associated in the literature with qualitative case studies of collaborative initiatives where only one or two participants are interviewed (e.g., Lubell and Leach 2005; Sabatier, et al. 2005). However, the study did not examine the perspectives of individuals in the broader catchment community who, although not directly involved with the advisory committee, stood to be affected by the outcomes of the process. Conley and Moote (2003) identify this as a common shortcoming among previous evaluations of collaborative processes.

By focusing primarily on the advisory committee process, this study did not provide insights related to collaborative governance from the perspective of the broader community. In particular, it did not assess whether collaboration has led to a common understanding and acceptance within the broader catchment community of the knowledge used to make water allocation policy decisions. Findings from the Marne case highlighted the relevance of this issue to evaluating the ultimate success of a collaborative process in promoting understanding and acceptance among stakeholders and the general public of
environmental decisions. At least two participants in the Marne process were skeptical that the advisory committee’s acceptance of the department’s technical information would be shared within the broader catchment community. This suggests that a priority for future research is to analyze the perspectives of affected, non-participants towards knowledge production and use in collaborative governance processes.

A future study could also broaden the evaluation of outcomes related to knowledge production and use in collaboration to include other related outcome criteria. Some analysts have emphasized the importance of considering all outcomes together in evaluations of collaborative processes (e.g., Innes and Booher 1999), rather than evaluating a narrowly defined outcome. Broadening the scope of outcomes assessed in a future study could provide insight, for example, into the relationship between awareness among participants of the limits of available knowledge and recommendations for adaptive policies, or whether processes that integrate local knowledge produce knowledge and related policies that are more robust and tailored to local conditions.

A final consideration for future research extending from this study is the possibility of using a different methodological approach. While a qualitative case study was suited to the research questions and objectives of this study, some of the research ideas noted above might lend themselves to an approach that combines qualitative techniques (e.g., interviews, personal observation) with more quantitative methods of data collection and analysis. For example, a survey could be used to assess the perceptions of the broader catchment community towards the knowledge used as the basis for policies in a collaborative process. Similarly, surveys could be used, in concert with selected interviews and document sources, to analyze and compare collaborative outcomes across
a number of cases. Such approaches could offer an alternative and potentially interesting perspective on knowledge production and use in collaborative environmental governance.

References


1. What is your occupation?

2. Do you live and or work in the catchment? If so, for how long?

3. What is your role in the water allocation planning process?

4. How do you use water? What is your water source(s)? Will you be a water license holder under the new water allocation plan?

5. How would you describe your level of knowledge about water? Is it based on practical experience and or formal education?

6. How do you feel the water allocation planning process is going as a whole? Can you identify any particular positive aspects or drawbacks?

7. How, if at all, has the process helped you to develop a better understanding of the hydrology and ecology of the water resources in the catchment?

8. How, if at all, has the process increased your level of respect and understanding of the perspectives and knowledge of other stakeholders in the catchment?

9. How, if at all, has the process increased your level of trust in others to manage the water in the catchment effectively?

10. To what extent would you say that you understand and accept the knowledge upon which the water allocation policies are based?

11. How has the community advisory committee been engaged in the investigations to produce the required technical information for the water allocation plan?
12. Are you satisfied with the degree to which the technical information has been examined and discussed by the community advisory committee? Do you feel that there has been a sufficient effort to reach understanding and agreement on the information, including reconciling different sources of evidence? Have the methods and assumptions used in the investigations, and the limitations and uncertainty of the knowledge been discussed?

13. Has the process allowed for the collection and integration of knowledge from a variety of sources?

14. What do you consider to be local knowledge? Is it a valid source of knowledge for water allocation planning?

15. Has there been a conscious effort in the process to access and use the knowledge of the advisory committee, as well as other representatives in the catchment?

16. Are you satisfied with the extent to which scientists have attended advisory committee meetings and been directly engaged in committee discussions?

17. Has the advisory committee process been representative of the whole catchment community? Are there significant voices in the community that were missing? Have indigenous interests been represented in the process?

18. Do you think that the use of ‘jargon’ by participants (either scientific or non-scientific) has been a barrier to understanding information and different perspectives?

19. Are there people involved in process who help to facilitate the sharing and understanding of information that was discussed by the committee?
20. Apart from regular meetings, has the advisory committee undertaken any activities, such as field trips, that have helped to build a more common understanding of water resources and issues among the participants?

21. Are there any other aspects of the advisory committee process that you would like to comment on? Any specific strengths, drawbacks, or suggestions for improvement?
APPENDIX TWO – LIST OF CASE STUDY DOCUMENTS

South Australia

South Australia Natural Resources Management Act 2004
State Natural Resources Management Plan 2006

Barossa Valley Prescribed Water Resources Area

Plan and Policy Consultation Documents


**Technical Reports**


Other Documents


Eastern Mount Lofty Ranges Prescribed Water Resources Area

Plan and Policy Consultation Documents


South Australian Murray-Darling Basin Natural Resources Management Board. 2007. 

South Australian Murray-Darling Basin Natural Resources Management Board. 2007. 

South Australian Murray-Darling Basin Natural Resources Management Board. 2009. 

**Technical Reports**


**Other Documents**


Marne Saunders Prescribed Water Resources Area

Plan and Policy Consultation Documents


Murray Bridge: South Australian Murray-Darling Basin Natural Resources Management Board.

South Australian Murray-Darling Basin Natural Resources Management Board. 2009. 
Your feedback is vital: feedback form for the draft Marne Saunders Water Allocation Plan. Murray Bridge: South Australian Murray-Darling Basin Natural Resources Management Board.

South Australian Murray-Darling Basin Natural Resources Management Board. 2009. 
Frequently asked questions about the draft Marne Saunders Water Allocation Plan. Murray Bridge: South Australian Murray-Darling Basin Natural Resources Management Board.

Technical Reports


Other Documents


Western Mount Lofty Ranges Prescribed Water Resources Area

Plan and Policy Consultation Documents


Technical Reports


**Other Documents**


Adelaide and Mount Lofty Ranges Natural Resources Management Board. Minutes of Central Hills Water Allocation Planning Advisory Committee meetings (16 meetings from August 2006 to June 2008).


## APPENDIX THREE – SUMMARY OF ATTENDED CONFERENCES, WORKSHOPS AND COMMUNITY ADVISORY COMMITTEE MEETINGS

<table>
<thead>
<tr>
<th>Start Date (d/m/y)</th>
<th>Event and Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>24/10/07</td>
<td>Water Wednesday seminar at University of Adelaide, SA</td>
<td>The session included presentations on water management issues affecting the River Murray that provided context for my case study. It was also an opportunity to speak informally with other researchers concerned with water management in South Australia.</td>
</tr>
<tr>
<td>12/02/08</td>
<td>Western Mount Lofty Ranges Water Allocation Planning Committees Joint Meeting, Flagstaff Hill, SA</td>
<td>This regular joint meeting of the three advisory committees provided an opportunity to observe presentations and discussions regarding technical information, as well as interactions among department scientists and community representatives. It was also a chance to speak informally with attendees about the process.</td>
</tr>
<tr>
<td>22/02/08</td>
<td>Eastern Mount Lofty Ranges Community Advisory Committees meeting, Mount Barker, SA</td>
<td>This regular meeting of the northern and southern advisory committees provided an opportunity to observe presentations and discussions regarding technical information, as well as interactions among department scientists and community representatives. It was also a chance to speak informally with attendees about the process.</td>
</tr>
<tr>
<td>29/02/08</td>
<td>North Para (Barossa) Water Allocation Plan Advisory Committee meeting, Tanunda, SA</td>
<td>This special meeting of the committee provided an opportunity to observe discussions regarding the draft plan. It was also a chance to speak informally with participants about the process.</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
<td>Location</td>
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<tr>
<td>03/08</td>
<td>This special meeting of the committee to discuss disputed technical information provided an opportunity to observe debate among scientists and community representatives regarding knowledge. It was also a chance to speak informally with participants about the process.</td>
<td>Norton Summit, SA</td>
</tr>
<tr>
<td>14/04</td>
<td>The conference was an opportunity to attend a range of presentations on water management issues and to speak informally with other water researchers and practitioners. I also presented a paper regarding community-based research in Ontario, Canada.</td>
<td>Adelaide, SA</td>
</tr>
<tr>
<td>09/05</td>
<td>This regular meeting of the advisory committees provided an opportunity to observe presentations and discussions regarding technical information and draft policies, as well as interactions among department scientists and community representatives. It was also a chance to speak informally with attendees about the process.</td>
<td>Mount Barker, SA</td>
</tr>
<tr>
<td>13/05</td>
<td>This internal staff meeting provided additional context for the case study. It was also an opportunity to speak informally with agency officials concerned with water management in South Australia.</td>
<td>Adelaide, SA</td>
</tr>
<tr>
<td>14/05</td>
<td>This regular meeting of the committee provided an opportunity to observe discussions regarding draft policies. It was also a chance to speak informally with participants about the process.</td>
<td>Norton Summit, SA</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
<td>Location</td>
</tr>
<tr>
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</tr>
<tr>
<td>03/06/08</td>
<td>Central Hills Water Allocation Planning Advisory Committee meeting</td>
<td>Norton Summit, SA</td>
</tr>
<tr>
<td>11/06/08</td>
<td>Western Mount Lofty Ranges Water Allocation Planning Committees Joint Meeting</td>
<td>Flagstaff Hill, SA</td>
</tr>
<tr>
<td>20/06/08</td>
<td>Eastern Mount Lofty Ranges Community Advisory Committees meeting</td>
<td>Mount Barker, SA</td>
</tr>
<tr>
<td>25/06/08</td>
<td>Marne-Saunders Water Resources Planning Committee meeting</td>
<td>Mount Pleasant, SA</td>
</tr>
<tr>
<td>07/07/08</td>
<td>Central Hills Water Allocation Planning Advisory Committee field trip</td>
<td>Verdun, SA</td>
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</tbody>
</table>