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Critical Reflections on Building a Community of Conversation about Water Governance in Australia

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ABSTRACT: Water governance has emerged as a field of research endeavour in response to failures of current and historical management approaches to adequately address persistent decline in ecological health of many river catchments and pressures on associated communities. Attention to situational framing is a key aspect of emerging approaches to water governance research, including innovations that build capacity and confidence to experiment with approaches capable of transforming situations usefully framed as 'wicked'. Despite international investment in water governance research, a national research agenda on water governance was lacking in Australia in the late 2000s as were mechanisms to build the capacity of interdisciplinary and transdisciplinary research and collaborative policy practice. Through a two-year Water Governance Research Initiative (WGRI), we designed and facilitated the development of a community of conversation between researchers concerned with the dynamics of human-ecological systems from the natural sciences, humanities, social sciences, policy, economics, law and philosophy. The WGRI was designed as a learning system, with the intention that it would provide opportunities for conversations, learning and reflection to emerge. In this paper we outline the starting conditions and design of the WGRI, critically reflect on new narratives that arose from this initiative, and evaluate its effectiveness as a boundary organisation that contributed to knowledge co-production in water governance. Our findings point to the importance of investment in institutions that can act as integrative and facilitative governance mechanisms, to build capacity to work with and between research, policy, local stakeholders and practitioners.

KEYWORDS: Water governance, learning systems, knowledge systems, networks, Australia

INTRODUCTION

Whilst it must be acknowledged that influencing water policy poses challenges to researchers in the natural sciences (e.g. Briggs, 2006), we perceive an arguably larger (and less acknowledged) challenge faced by a wide range of researchers from different disciplines engaged in what can be described as 'water governance research'. This includes researchers with interests in the dynamics of human-ecological systems, such as those in the humanities, social sciences, policy, economics, law and

philosophy. In Australia, attention to the social and institutional dimensions of the water reform agenda has been given very little attention relative to other capacities, and as a whole, the engagement of these disciplines in the processes of governance has been largely inadequate (Sofoulis, 2013). While some changes in the political economy of research funding may have encouraged a growth in interdisciplinary research studies with the normative goal of increasing their policy relevance (Hussey and Dovers, 2007; Ison, 2008; Oughton and Bracken, 2009), they are largely based on a belief in scientific and technical rationality. Even in the context of interdisciplinary projects and funding, the fundamental biophysical rationale is rarely questioned, social aspects are framed as 'consultation', and may be on the periphery of what is considered the 'real research'. It is rare for truly interdisciplinary or transdisciplinary research in water to begin from a position of genuinely engaging with multiple perspectives and exploring assumptions and framing.

Within water policy it is recognised that many challenges are exceptionally complex (Hussey and Dovers, 2007; Ison et al., 2007). Multiple stressors occur in any given situation through combinations of ecological, cultural, social, technological, climatic and institutional dynamics. Unfortunately, progress in policy reform and innovation seems to be slow and there is little evidence that the governance system is creating the momentum to build the capacity for learning and adaptation that will help meet current and future challenges. A 2011 OECD report on multilevel water governance found that across 17 countries studied there are persistent problems in the sector in areas of water policy and reform (OECD, 2011). These problems, which include institutional fragmentation, funding gaps and deficiencies in vertical and horizontal policy integration, and coordination, have led to policy/framing and implementation/praxis failure. Additionally, there is a lack of capacity for water management, particularly at subnational levels and for local actors. These governance problems have led authors of the report to conclude that there is widespread multilevel governance failure in the water sector, characterised by controversy and ongoing degradation in the natural resources base (OECD, 2011).

The implementation difficulties experienced by South Africa since the inception of the progressive and wide-reaching national water reform enshrined in the 1998 National Water Act constitute prominent examples (Schreiner, 2013). These observations led the OECD (2011) report to conclude that many water crises are primarily crises in good governance. Similarly, a recent analysis by the Ramsar Convention into the state of the world's wetlands reported that there continues to be a negative trend in almost every indicator of wetland health, with loss and degradation of wetlands and their biodiversity continuing at a rate of up to 1.5% a year globally (SCBD, 2014; in Gardner et al., 2015). Information about the causes of wetland loss is generally understood and widely available and policy frameworks on national and international levels have existed for many years, but the capacity and motivation for implementation is patchy and, overall, has failed to prevent widespread decline (Finlayson, 2012).

Among the many social and cultural constraints to improving water governance, is the recursive and self-perpetuating relationship between traditional institutions, discourse and practice that hinder transformative change. Culturally, humans experience different material relationships and meanings that mediate our interactions with water (Strang, 2005), some of which can dominate over others (e.g. water as material wealth). Adapting to the challenges of current complex water issues requires recognition of the socially constructed nature and multiple framing choices in a given situation. We have argued for moving towards a praxis model of water governance as exemplified by research on social learning understood as both process dynamic and alternative governance mechanism (Wallis et al., 2013; Ison et al., 2015a). Within this praxis-based approach, water researchers and practitioners learn to reflect on the 'traditions of understanding' (Ison, 2010) or 'mental models' (Godden et al., 2011; Pahl-Wostl et al., 2011) that evolve through personal histories, education, and professional and life experiences. Ison (2010) suggests that most water professionals and experts lack awareness of the ways in which they frame their practices. He argues that many of the opportunities for improved water governance are lost because there is little reflection on framings, which leads to the perpetuation of

practices that are no longer relevant. Practices further become embedded in physical and technological infrastructure, established institutions (e.g. Wallis and Ison, 2011a) and language (Ison et al., 2015b) which create path dependencies that are difficult to alter. Likewise, Pahl-Wostl et al. (2011: 846) conclude: "Failure (or reticence) to implement integrated and adaptive approaches may not be related to the principle of integration itself but rather to a natural but constraining adolescence in the mental models that frame the implementation process".

This research explores the development of a community of conversation designed to facilitate communication, collaboration and capacity building among water governance researchers and policy practitioners in Australia (see also Wallis et al., 2012). Called the Water Governance Research Initiative (WGRI), it attempted to address the perceived disconnect among, and between, research and policy communities by developing a network and providing opportunities for conversations, learning and reflection to emerge. The two-year initiative, from 2010 to 2012, was coordinated by the authors, and the design reflects our history and understanding of systemic praxis for 'governing' socio-ecological systems around water. The time frame and process design possibilities of the initiative were constrained, to a degree, by the starting conditions and context, which we describe in detail below. We understand governing to comprise the design and enactment of feedback processes between a social and ecological system in an unfolding co-evolutionary dynamic (Collins and Ison, 2009; Ison et al., 2015a); thus water governance research, for us, entailed any research that enhanced understanding and or transformation of this systemic dynamic. Our methodological preference is for open-ended, collaborative inquiry that engages with multiple forms of knowledge and in which learning plays a central role. As such, the WGRI was designed and framed as building a community of conversation to foster the emergence of communities of practice (CoP) and a learning system for water governance operating nationally in Australia. In our use of the concepts 'communities of…' we draw on Wenger (1998) and social theories of learning (Blackmore, 2010) but distinguish a nested set of 'communities': viz from a meta-level of *discourse* to *conversation* then *interest* and then *practice*. In adopting these design framings we were conscious from earlier research that it does not seem possible or desirable, to attempt to create CoP deterministically (Iaquinto et al., 2011).

The purpose of this paper is to: (i) critically reflect on the design constraints and opportunities posed by the initial starting conditions for the WGRI, (ii) demonstrate an approach to creating a community of conversation into fit-for-purpose water governance research and practice in a climate-changing world, (iii) reflect on what was achieved and the institutionalisation (or not) of the community of conversation in water governance research and practice in Australia, and (iv) draw out the international implications from our research.

CONCEPTUAL FRAMEWORKS AND RESEARCH DESIGN

The research aspect of the WGRI was designed as an inquiry nested within a broader systemic inquiry into water governance conducted by the authors from 2010 to 2014 (see Ison and Wallis, 2011; Wallis and Ison, 2011a; Wallis and Ison, 2011b; Wallis et al., 2013). Drawing on systemic thinking and practice, a systemic inquiry does not assume that researchers are independent observers following predetermined, outcomes-based, and often highly structured processes of project management. Rather, an inquiry is designed to create the circumstance for learning through engaging with a situation in multiple ways and through multiple framings to bring forth insights about a situation and different forms of knowledge. The inquiry creates the conditions for emergence of new knowledge and establishes connections between multiple causes and interdependencies. Researchers are not just facilitators or observers, but are positioned within the inquiry and act with awareness of their own assumptions, values, history and judgements.

In situations best framed as 'wicked', systemic responses are needed in thinking, practices and institutional arrangements (Ison and Watson, 2007). The WGRI was therefore established as a response

to these challenges as a purposefully designed learning system. Following Ison (2010), a learning system can be seen as an inclusive, open-ended and reflexive process of knowledge co-creation. In contrast to more formalised structures of learning, which are outcomes-based, a learning system recognises that each individual comes into the process with a unique history and worldview and existing forms of knowledge.

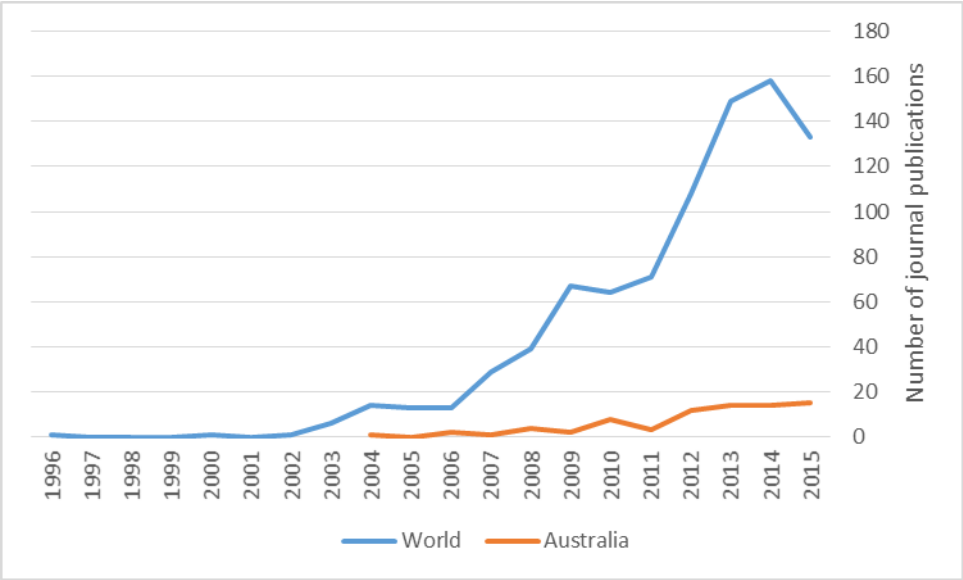
The design of the WGRI as a learning system was influenced by a desire to create a "community of conversation" (Wallis et al., 2012), an expanded framing to a 'community of practice' as conceptualised by Wenger (1998) based on an appreciation of the Latin roots of conversation [*con versare*] meaning to 'turn together'; similarly the Latin *communis*, from which 'community' is derived, can be understood as 'with exchange'. A community of conversation is simply a collection of people who have an ongoing and rich conversation about a domain of concern and which has the potential to shift towards a community of interest and, potentially, a CoP (Wallis et al., 2012). The WGRI was designed to build a network of participants engaged in meaningful, multi-perspective conversations over a two-year period, with multiple opportunities for engagement, both online and in person; from the start we appreciated that a two-year period of funding would limit the possibilities of moving from conversation towards practice. There are, however, lessons to be learned as in the work of Hornidge et al. (2011). To do this we draw on the material outcomes of four workshops and three surveys, as well as our own observations to critically reflect on the products and adequacy of our designing.

STARTING CONDITIONS AND NETWORK ACTIVITIES

The WGRI began within a complex institutional setting; it was as much opportunistic as purposefully created as is often the case with policy initiatives (Roe, 2013). The opportunity arose because of pioneering research in water governance led by the authors in the state of Victoria, Australia.[1] The WGRI thus grew out of a series of informal workshops within a Victorian-based network of water governance researchers. These initial events established some interest in a programme of 'systemic and adaptive governance research', mainly focusing on water and climate change adaptation governance and the potential for social learning to play a transformative role (summarised in WGRI, 2009). The workshops also helped to identify some gaps in the contribution of water governance research to policy in Australia. First, the subject of water governance itself was poorly understood and not given much weight in the policy sphere. Second, our experience that water governance research in Australia seemed disconnected to policy and was falling behind in relation to the rest of the world (particularly in Europe, where one author has extensive experience in water governance research). A bibliometric analysis of articles in the Scopus database with the phrase 'water governance' shows a growing area of international scholarship from the early 2000s but concomitantly very limited research under this framing within Australia (Figure 1). Third, there was no national research agenda for water governance (as is still the case). Fourth, there were very few purposefully designed opportunities for cross-disciplinary conversation and collaboration among concerned researchers and between researchers and policy. Fifth, there was a lack of support for early career researchers (ECRs) seeking to develop skills and capacity in this multi/inter/transdisciplinary research space (see Patterson et al., 2013).

[1] See the special issue of Water Resources Management co-edited by Godden et al., (2011): Water governance in a climate changing world: Appraising systemic and adaptive effectiveness.

Figure 1. Bibliometric analysis of the phrase 'water governance' appearing in title, abstract or article text, for Australia and the rest of the world (Source: Scopus).

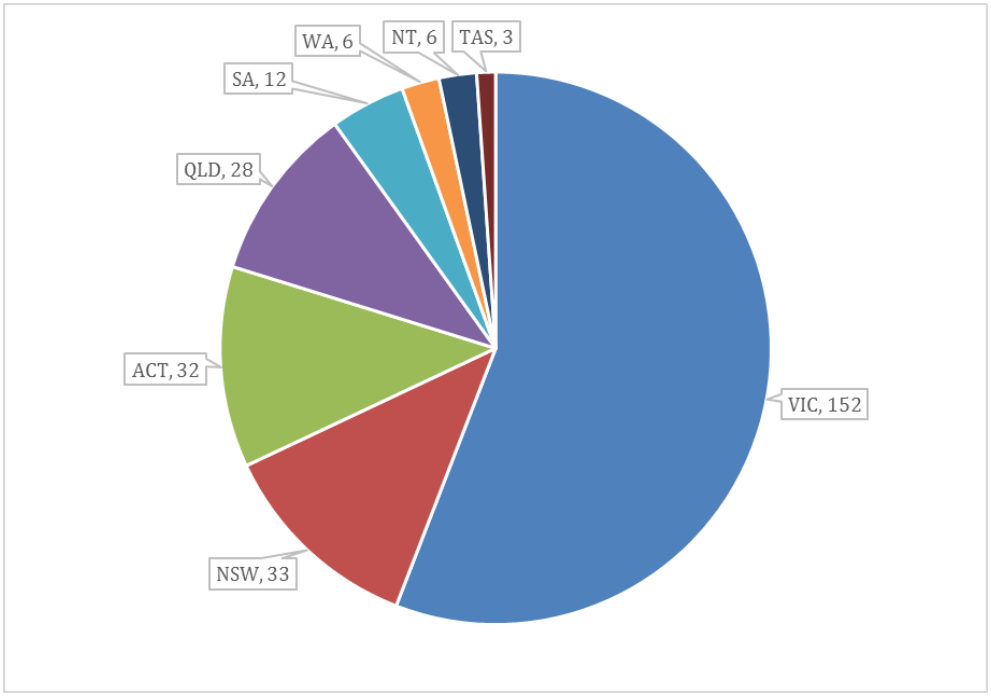


When formalised, WGRI became a theme of the National Climate Change Adaptation Research Facility (NCCARF) Water Resources and Freshwater Biodiversity Adaptation Research Network (www.nccarf.edu.au/water/node/5); the particular network within which WGRI sat was one of eight networks funded by NCCARF. While the WGRI was coordinated by the authors, who also established some of the initial process design parameters, it evolved through the collective endeavour of those involved. The stated objectives were to create a community of conversation about water governance in Australia, build collaborative research links, create opportunities for co-researching and information-sharing, and provide opportunities for ECRs to participate in a national network of researchers and research users.

The WGRI was constrained, to some degree, by the time frame and funding available through the NCCARF network. The main body of funding supported network activities over two years from 2010 to 2012, while additional sponsorship from Federal Government enabled a specific workshop for ECRs to be held and travel support provided. The limited funding available and the location of network participants across Australia meant that events were held in eastern Australian locations (Melbourne or Canberra), which would have limited participation from people based in Western Australia and other rural and remote areas. Most participants were from Victoria, probably reflecting the location of the network coordinators and existing networks established from previous events (Figure 2). A substantial proportion of the funding was spent supporting travel and accommodation for some participants, including post-graduate students and ECRs.

The WGRI was not designed to provide formal pathways to policy; however, it was informally aligned with contemporary water reform issues that the National Water Commission (NWC) was dealing with at the time of inception. The NWC was an independent statutory authority established in 2004 to advise the Australian Government and the Coalition of Australian Governments (COAG) on national water reform. Representatives from the NWC participated in all WGRI activities, and met with the coordinators to discuss further opportunities, but then the conservative, climate-change sceptical federal government made a decision to close the NWC at the end of 2014. NCCARF itself was significantly de-funded in 2013.

Figure 2. Location of Water Governance Research Initiative (WGRI) network members, by Australian state and territory.

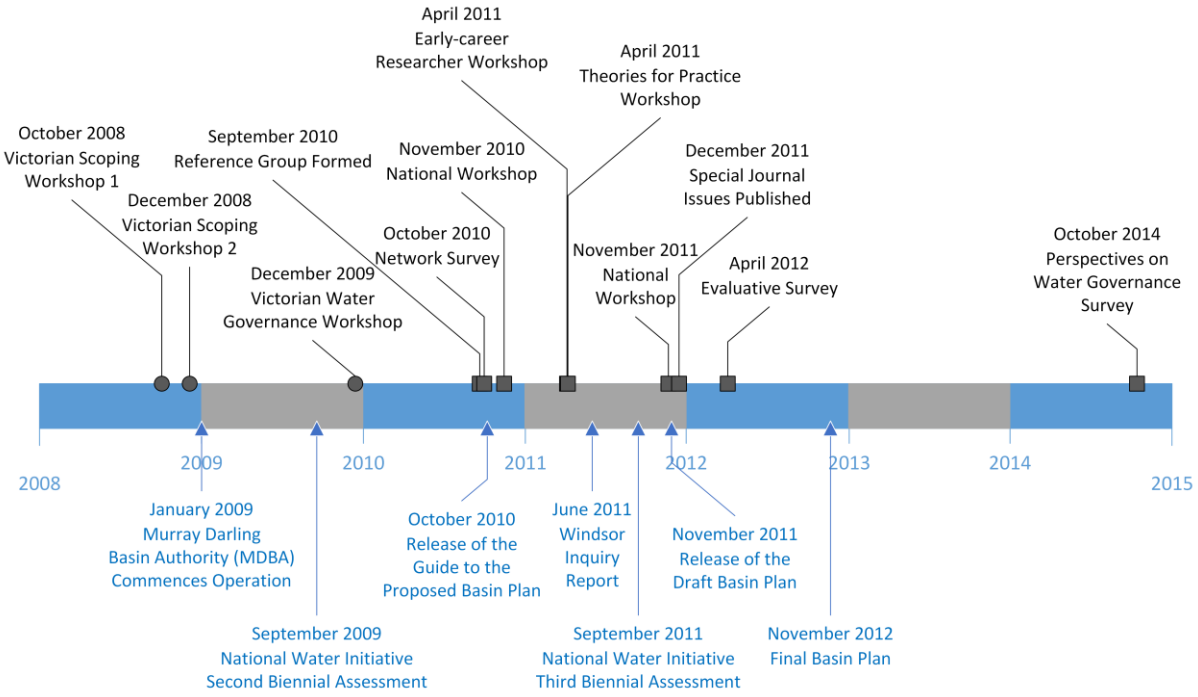


Note: Vic, Victoria; Tas, Tasmania; NT, Northern Territory; WA, Western Australia; SA, South Australia; Qld, Queensland; ACT, Australian Capital Territory/Canberra; NSW, New South Wales.

Despite these constraints, a conducive set of design possibilities were apparent throughout the initiative as the WGRI sought to achieve national coverage of water governance issues, something hitherto missing in the Australian context where historically and constitutionally water/rivers constitute a state-based issue. The reform of the Murray-Darling Basin (Australia's largest river system) was a central theme, which dominated water policy considerations at the time (e.g. see Figure 3 for a timeline of milestones in Australian water reform). Climate change adaptation was another key theme, with attention directed to the role of adaptive governance processes and institutions. Other emerging national water governance themes at the time included the development of water resources in northern Australia, coal-seam gas development, water-sensitive urbanism, community involvement in water governance, and realising the cultural water rights of Indigenous Australians. The WGRI provided a window of opportunity to build and connect research capability to address some of these issues.

Over its duration, the WGRI grew to more than 300 members in its network database and over 150 water governance researchers and practitioners from across Australia actively participated in its activities (Figure 3). The majority of network members were primarily involved in research and came from a wide variety of disciplinary backgrounds. There were also members from government policy, industry and NGO sectors (Figure 4). More than 40 members of the network provided substantive contributions as workshop presenters and/or as members of a National Researcher Reference Group. The reference group was established to help build the network and to ensure that the network had national representation and that it was informed by a spectrum of ideas, disciplinary backgrounds and professional experience. We invited representatives from each State and Territory to join, based on their expertise in water governance. They supported the growth of the WGRI nationally, informed the design of network activities and promoted the network to researchers and policy practitioners in their region.

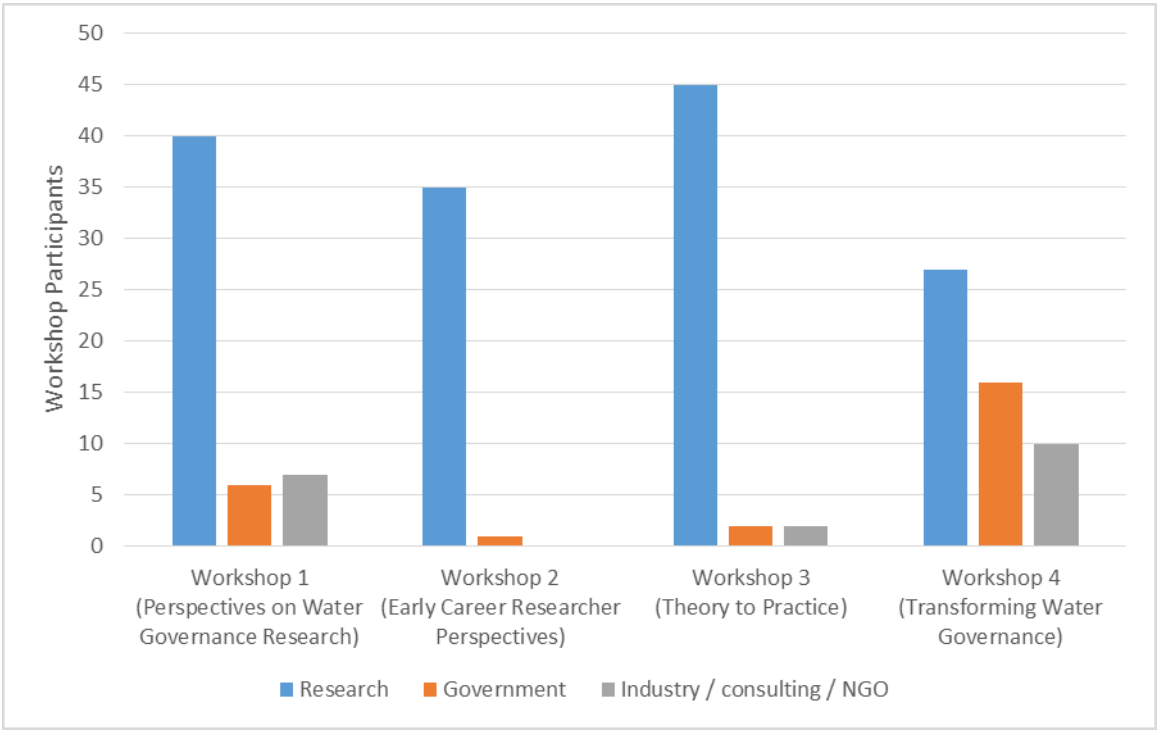
Figure 3. Outline of major activities of the Water Governance Research Initiative in relation to significant milestones in Australian water reform, 2008-2014.



The main face-to-face activities of the WGRI included four workshops on: (1) different perspectives on water governance research; (2) experiences of ECRs; (3) bringing theory into practice; and (4) transforming water and climate change adaptation governance (see also Figures 3 and 4). The design of these workshops is detailed in Wallis et al. (2012), and were intended to draw on diverse, multiple perspectives and to continually engage participants in interactive processes that were conducive to conversation. For example, at the first workshop participants used 'conversation mapping' in groups of six to eight persons to identify emergent issues and research opportunities relating to water governance in Australia. The steps to good conversation mapping are outlined in Open University (2006). A conversation map is a representation of the complexity of an original trigger question as perceived by the participants which, when well facilitated, enables active listening, the generation of multiple perspectives and can be effective in acknowledging and minimising power differentials.

As the aim of the network was to facilitate knowledge co-creation and communication, the outcomes of each workshop were continually communicated to the group and used to inform the design of the next phase of activities. Interspersed with the face-to-face interaction, communication with the network was continued through group emails, a series of online surveys and circulated briefing papers that summarised outcomes of each workshop. An initial online survey (in October 2010; n=39) was sent to the group to ascertain the profile of the network, determine the level of existing engagement in collaborative water governance research, and identify background issues facing water governance research and practice in Australia. Following each national workshop, anonymous online evaluation surveys were sent to the participants to assess views on the procedural aspects, content and approach to the workshops. In 2014, a further survey was sent to the network to elicit perspectives on changes and developments in water governance from 2012 to 2014. The outcomes of each workshop were reported back to the network in the form of briefing papers (WGRI, 2009, 2010, 2011, 2012) that can be seen as a form of co-produced knowledge as they were based on the conversation maps and recorded data from workshop participants.

Figure 4. Breakdown of Water Governance Research Initiative (WGRI) workshop participants by sector.



CRITICAL REFLECTION ON WATER GOVERNANCE NARRATIVES

One of the fundamental challenges to the praxis of water governance in Australia is a lack of recognition of the importance and therefore, legitimacy of water governance research as an area that requires attention and investment. By critically reflecting on the themes that emerged from the WGRI, and the design parameters, we do not seek to evaluate in any deterministic sense, but to offer insights for future policy and practice innovation that will surely be needed as Australia's river system are perturbed by climate change, ongoing situational framing failure and the vicissitudes of operating in a federal system. Narratives drawn from the workshop conversations and initial survey are divided into three sections below: improving the conditions for cross-disciplinary water governance research; improving water governance institutions and practice; and adaptive management, leadership, and commitment.

Improving the conditions for cross-disciplinary water governance research

The network of researchers that participated in the WGRI expressed frustration at the difficulties in undertaking cross-disciplinary research in this field. The difficulties arise both from lack of support and in bridging the language and communication divides between disciplines (as previously discussed in the literature; e.g. Brewer, 1999; Scholz and Steiner, 2015). As two participants noted:

> [A] major problem is one of shared terms which have very different meanings among disciplines. Thus, the contribution of key disciplines is lost because others believe they have that issue 'covered'. They do, but not in the same way – there are gaps which can be beneficially filled.

> [There is a] difficulty developing an understanding of governance since it is such a broad concept that is explored in a multitude of different ways in literature and practice, and does not have a neat 'disciplinary home'.

On reflection, these quotes highlight to us that seemingly similar disciplines involved in 'water governance' can generate misunderstandings around terms and meanings because of assumptions that they are used in the same way, whereas the same assumption might not result from more disparate disciplines. The term 'governance' itself had several different interpretations among workshop participants; however, the conversation-oriented design led to a high degree of accommodation (rather than consensus) of these different understandings.

Network members indicated an enthusiasm for engaging in more interdisciplinary and transdisciplinary research, but identified a range of barriers to realising this. 'Interdisciplinary' research was defined in the survey as "research that involves attempts to frame questions and methodologies in a way that integrates and creates interaction between different disciplines", while 'transdisciplinary' research was defined as "attempts to join-up the language and concepts of many disciplines to create a new set of concepts". Surveyed researchers in the network reported that they were seeking to develop their capabilities in interdisciplinary (68%, n=35) or transdisciplinary (54%, n=35) research. Barriers identified included a lack of dedicated funding and leadership, prevailing reward structures, and the dominant 'silo' culture of many organisations including universities. One survey respondent commented that "Even though the organisation I belong to says it supports collaboration, the project-funding model I work [in] does not give me the time or the funding to more actively pursue collaboration". This reflects the constraints imposed by project-based funding, and often contract-based employment, that many researchers experience.

For those engaged in social and cultural research, there was an expressed frustration at the ongoing dominance of the 'hard' sciences within the water governance sphere. There was a need identified for more opportunities for better-coordinated social science research with more purposeful interaction with water managers/organisations and biophysical science. As one participant explained:

> A key issue for me is that although there is growing recognition of the need for more social and cultural knowledge to be applied in water planning and management, there is still a strong core of scientistic fundamentalism, a profound belief in the essential correctness and proper dominance of the scientistic fundamentalism… [and] the scientific rational world view, which makes it easy to dismiss hermeneutic, philosophical, spiritual, narrative and situated knowledges as merely 'subjective' and a waste of time and funding that detracts from 'real action' on water.

This reflects a concern that water governance research can be misunderstood or dismissed by a management culture accustomed to commissioning research with clearly bounded questions and a systematic 'objective' analysis. We can conclude from this narrative that water governance research in Australia, despite being an area of considerable interest, lacks institutional support, is dominated or limited by a preference for 'hard' research approaches, and suffers from fragmentation of research approaches and common meanings. Improving these conditions was agreed to be a priority area of activity among network participants.

Improving water governance institutions and practice

Participants in the WGRI discussed at length the implications of Australia's complex institutional framework around which water continues to be plagued by ambiguous roles and responsibilities, conflicts and power struggles. Although decision-making around water in a federal jurisdiction is always likely to be highly contested (Connell, 2011), a federal legal structure that has clear guiding principles for managing decision-making across and between jurisdictions is an important touchstone. Participants also communicated that throughout the water reform processes there has been a continuation of policies at cross purposes without a vision of how conflicting imperatives can be managed, and what types of outcomes the community want for rivers, wetlands and landscapes.

Participants in the WGRI were concerned that community engagement in water governance continues in a top-down fashion, lacking genuine integration of different values into the processes of

decision-making. A majority of respondents to the initial survey (91%, n=35) claimed that engagement of stakeholders in policy-making and implementation was either done 'not well' or done only 'moderately'. Likewise, conversation mapping in workshop 1 revealed several converging viewpoints on this issue:

> Social inclusion is an issue because multiple values shape objectives and diverse backgrounds.
>
> Consultation of communities with stakeholders (particularly water users and suppliers) and poor differentiation of interests within communities is an issue because of the way that trust of community affects water planning.

Specific areas of concern for the WGRI were the genuine engagement of, and learning from, indigenous people in water governance, how problems are framed in relation to concepts of social justice, and the mistrust and division between rural and urban areas. Water governance researchers, it was argued, must learn to engage with, and prioritise, complex value systems and transfer values and norms into framing. Through conversation mapping, participants claimed that more research is needed into how to communicate and integrate values into decision-making processes, when and how to engage communities and stakeholders in planning processes and how to ensure that engagement processes are accessible to different stakeholders.

The governance of environmental flows was also raised in the discussions. Participants expressed concern that in a market-based system, there is a risk that 'rules' based (higher security) flows can be replaced with tradeable entitlements, to the detriment of river ecology. One conversation highlighted that "separation of water into environmental and consumptive does not match landscape process and people's perceptions". Several research priorities were identified, including exploring how co-management and collaboration, together with robust planning frameworks, can improve the effectiveness of environmental flows for both human and ecological needs. This involves understanding community values and expectations of environmental water, preferably through case studies where water allocations have generated a social consensus. There was also enthusiasm for more research into the measurement of both the ecological and social benefits of those allocations.

Adaptive management, leadership and vision

There was a sentiment that water reforms have improved the administrative framework for managing water and, most importantly, the development of environmental water allocations through government buybacks (although this only applies to the Murray-Darling Basin). However, the predominant sense was that any gains made in the sector are vulnerable to changing political contexts and there was little optimism that the system will support environmental values in the (likely) event of future drought conditions. Participants' comments to this effect included:

> The [Sustainable Diversion Limits] established in the Basin Plan are highly compromised and there is strong pressure to wind back environmental water recovery. Lack of leadership and commitment by governments is seriously hampering water governance (Survey respondent 2014).
>
> There have been some good developments in the area of environmental water allocation but I suspect these are due mainly to the relatively wet climatic conditions since about 2009 [rather] than any real political commitment to improvements in this area (Survey respondent 2014).
>
> How to make adaptive management work across a number of areas of water governance, such as environmental flows, water planning, research and knowledge, and water policy, as the reform process still has a long way to go; without the ability to adapt and integrate between these areas much will be lost (Survey 2010).

Although the ideas of adaptive management have become more widely accepted and integrated into policy and planning, there is still much work to be done to make it work in practice. An institutional

commitment and policies supporting adaptive management may set an important groundwork for collaborative and adaptive practices to emerge, given appropriate investment in developing collaborative practices (Mackay et al., 2014). However, the use of a 'project' framework for design and implementation of interventions with short time frames, and narrow focus and targets, works against adaptive governance (Allan, 2009). Linked to this theme was a perception among participants of capacity constraints in enacting adaptive water governance in Australia.

Recent developments in Australian water governance point to a continued weakening of capacity on a national level, particularly the closure of both the independent National Water Commission, which has had responsibility for overseeing and auditing the progress of the NWI reforms, and the COAG Standing Council on Environment and Water, the institutional mechanism through which 'cooperative federalism' was to be enacted. The policy under the Liberal Coalition government, elected in 2013, is influenced by a highly productivist agenda for irrigated agriculture and it now seems that despite the substantial financial investment and effort put into the water reform process (AUD12.9 billion over 10 years; DEWHA, 2010), the future of river health and sustainability of important ecological systems is still very much in doubt (Byron et al., 2014).

EVALUATION AND REFLECTION ON LEARNING SYSTEM DESIGN

In the context of severe, prolonged drought and concurrent with national governance reforms, the WGRI fostered a national network of researchers and practitioners. The WGRI formally concluded at the end of 2012, although some further informal interactions between participants continued to occur. For example, ECR participants in the WGRI engaged in auto-ethnographic inquiry into what it meant to follow a career pathway in transdisciplinary water governance research, published in Patterson et al. (2013). The workshop designed specifically for ECRs was a particularly important and successful part of the WGRI, creating a dedicated platform to enable peer learning. It is highly recommended that future initiatives like WGRI include a specific stream and encouragement for ECRs.

Fostering and sustaining new meta-narratives around water governance is a fundamental and long-term challenge that is perpetually hindered by short-term, peripheral (if any) funding and little political commitment. Within these self-reiterating constraints and considering the two-year period of funding for the WGRI, it was (and is) unlikely that the network would be self-sustaining in the long term. However, feedback from participants indicated that connections and research links were created and these may have impacts on trajectories of discourse and research into the future.

Bringing members of the water governance research community together in a community of conversation had the potential to promote cross-disciplinary communication, reflective awareness and a platform for new knowledge to emerge. Several rounds of evaluation were undertaken through surveys, and the responses indicate that participants appreciated the opportunity for cross-disciplinary discussions. Several respondents commented that this opportunity, particularly between the arts and sciences, was rare. Many also commented that they now saw the value in collaboration. For example, one participant noted that:

> It provided a platform for collaboration between researchers who may not have otherwise met. I did start to see it as the beginning of what had the potential to become a community of conversation/practice but for now it was a network/platform from which to build on.

Another participant appreciated the "inclusive and interactive nature of workshops and forums". Although conversely, there were some situations in which less-experienced participants felt disempowered in group situations. However, developing a specific workshop for ECR participants was well-received as a way to build confidence and empower less-experienced participants to contribute to subsequent conversations.

The practice of water governance continues to falter due to a lack of critical interrogation about the nature of scientific knowledge and appropriateness in the way that it is applied in the policy context. Water policy tends to be dominated by the traditional Western positivist belief in the objectivity, rationality and independence of scientific knowledge production and linear process of knowledge transfer into policy and then implementation. The traditional model conceptualises knowledge as an object that is developed in highly structured research institutions through the traditional means of codified disciplinary structures and methodologies, which can then be passed between independent users, i.e. the container metaphor of communication described by Krippendorff (1993).

However it has become widely recognised that in the case of highly complex 'wicked' problems (Rittel and Webber, 1973; Nowotny et al., 2003; APSC, 2007; Head, 2008; Ison et al., 2015a), this model is not suitable or desirable or reflective of the socially dynamic and fluid nature of knowledge processes in society and policy development. We argue that nonlinear, more socially distributed conceptualisation of knowledge production and transfer are more appropriate to water governance research and policy. Cornell et al. (2013: 61) argue that rather than framing knowledge production as 'science' (even in its broadest sense) in relation to sustainability it is more appropriate to use a framing of 'knowledge systems', which encompasses all of the "agents, practices and institutions that organise the production, transfer and use of knowledge" (see also Cash, 2006; Cash et al., 2003). Rather than knowledge production being primarily located in scientific institutions through structured disciplines, knowledge occurs in many heterogeneous locations, through various practices and principles (Gibbons et al., 1994; Nowotny et al., 2003; Ison et al., 2011). Knowledge is not an object to be captured; but rather as produced or constructed through social interaction.

Despite the availability of communication technologies, and the ease with which it can now take place, there are systemic problems in fostering the emergence of systems for knowledge co-creation, particularly between researchers and policy; and between knowledge and action (Pahl-Wostl et al., 2010; Ison et al., 2015a; Laing, 2015). Many scientists do not have the skills or capacity to engage with policy, and do not see it as their role. Policy practitioners often lack the time, skills, funding and internal incentives to keep up with research or pursue academic advice (Head, 2015). These disincentives are even more pronounced in situations that are politically fragile, contested and challenge the status quo (Laing, 2015; Head, 2015).

Investing in the development of institutionalised, ongoing mechanisms for communication and building relationships is among the most productive strategies for knowledge co-creation (Head, 2015). According to Head (2015) in a review of information exchange between academics and the Australian Public Service, there is no single method universally preferable, but various integrative mechanisms include: face-to-face interaction (e.g. through regular meetings), networks, interactive workshops, web-based communications and communities of practice. It was toward this objective that the WGRI was conceived and developed as one institutional mechanism outside of government, which could facilitate communication for water researchers and practitioners. Emphasis was placed on the design of the network and a series of facilitated but open-ended multidisciplinary events over the two-year funding period so as to create opportunities for interaction that could enhance relationship building and knowledge exchange. An aim was that this mechanism would contribute to the process of opening up knowledge systems for water governance in Australia.

The learning system approach to the WGRI allowed conversations to emerge in an unpredictable and unconstrained manner, eliciting ideas that may not have surfaced in a more structured and outcomes-focused setting. In future design of learning systems we recommend that there is adequate consultation prior to the face-to-face sessions to allow input from the learning community to inform framing from the beginning. In this case, a survey of the network prior to the first workshop was instrumental. The benefits of learning systems can be difficult to capture and substantiate in terms of concrete outcomes. Circulating briefing papers based on the narratives in the workshops was also useful. It is hoped that the WGRI demonstrates how a community of conversation can be developed to

generate interdisciplinary conversations needed within the practices of managing water in a wicked governance situation; however, our experience offers fewer insights into how these processes can be institutionalised and sustained over time in a complex political and institutional landscape.

INSTITUTIONALISING AND SUSTAINING WATER GOVERNANCE RESEARCH

Despite the worldwide growth in research relating to water governance (Figure 1), breaking out of constrictive research traditions and institutional contexts to legitimise water governance (as discourse, conversation, interest and practice) in Australia is still extremely difficult. At a national level, it was evident that the WGRI failed to broadly institutionalise new narratives and practices in water governance research, largely as a result of the short time frame and limited funding available. A period of two years was not enough to sustain ongoing conversation among researchers and with policy-makers. In the state of Victoria, where the WGRI coordinators were based and where prior workshops extended the length of engagement to four years, we contend that there was evidence of significant interest in water governance research and innovative practices, for instance as shown by the greater number of Victorian-based participants in the national network. The data in Figure 4 also show increasing participation in the WGRI activities over time by non-researchers i.e. by policy-makers and others; with continuing investment including support known to facilitate the emergence of CoPs (Iaquinto et al., 2011) this trend may have been sustained.

Internationally, the OECD released a set of principles on water governance (OECD, 2015) that mirror many of the concerns and opportunities raised through the WGRI community of conversation. In particular, Principle 8 (see Box 1) draws attention to the need to innovate in water governance practices, including through social learning and fostering science-policy interfaces. This indicates that a demand for innovative water governance research and communities of conversation among researchers and policy practitioners is still apparent.

Box 1. OECD Principles on Water Governance – Principle 8 (OECD, 2015: 11)

"Promote the adoption and implementation of innovative water governance practices across responsible authorities, levels of government and relevant stakeholders, through:

a) Encouraging experimentation and pilot-testing on water governance, drawing lessons from success and failures, and scaling up replicable practices.
b) Promoting social learning to facilitate dialogue and consensus-building, for example through networking platforms, social media, Information and Communication Technologies (ICTs) and user-friendly interfaces (e.g. digital maps, big data, smart data and open data) and other means.
c) Promoting innovative ways to co-operate, to pool resources and capacity, to build synergies across sectors and search for efficiency gains, notably through metropolitan governance, inter-municipal collaboration, urban-rural partnerships, and performance-based contracts.
d) Promoting a strong science-policy interface to contribute to better water governance and bridge the divide between scientific findings and water governance practices".

Pahl-Wostl et al. (2011: 846) described the state of water management and practice as on a cusp midway between two paradigms: the 'prediction, control paradigm' and the 'integrated adaptive paradigm'. The prediction, control paradigm conceptualises the challenges of water as knowable and manageable through rational regimes of scientific and technical understanding. This paradigm has become established through the historical expansion of large-scale projects of river regulation and water storage development, predominantly for the purposes of irrigation, flood protection and

hydroelectricity. Molle et al.'s (2009) exploration of the 'hydraulic mission' shows how the acceleration of river modification and water infrastructure development over the last two centuries has been intricately linked with the political economies of development, scientific progress, nationalism and power in many parts of the world. The legitimacy of the rationale driving the hydraulic mission has become institutionalised, and supported by the biophysical scientists and engineers who are professionally and epistemologically committed. The legacy of this developmental trajectory has been a global trend of political, social and physical infrastructural developments committed to highly modified and over-allocated water regimes.

Despite the need articulated by the OECD (2015), and the activities of the WGRI, Australian water governance research has failed to be effectively institutionalised; nationally, Australia sits on the paradigmatic cusp that Pahl-Wostl et al. (2011) identify. History suggests that Molle et al.'s (2009) 'hydraulic mission' will reassert itself because of the knowledge/knowing political ecology in which researchers and policy-makers operate i.e. limited, highly competitive, research funding, loss of conducive national institutions (e.g. NWC), metrics-dominated Universities and the potential re-emergence of a dysfunctional federalism with respect to water policy and governance. Given this context what would be needed to institutionalise communities of conversation, and to facilitate the emergence of communities of practice so as to enable a shift towards a new paradigm? In Australia, this requires time, long-term investment of resources, and broad participation. Our WGRI research points to the importance of greater investment in institutions that can act as integrative and facilitative governance mechanisms, innovations that can build capacity to work with and between research, policy, local stakeholders and practitioners. For example, boundary organisations (e.g. Hoppe et al., 2013) are one way of institutionalising such arrangements for longer-term participation. These may involve continuing to invest in innovative governance mechanisms, such as partnerships, knowledge brokers, networks and NGO participants in different contexts. This is a need that will be greater in Australia, and other countries as exigencies of climate change take effect.

CONCLUSION

This research highlights views among Australian water governance researchers and practitioners that establishing water governance that is fit-for-purpose in complex, uncertain socio-ecological contexts requires a recognition and legitimacy of diverse learning histories and environments. Furthermore, improving water governance requires integration, innovation and experimentation with different institutional mechanisms to build the capacity and skills for interdisciplinary research and adaptive and systemic thinking. As Ingram (2011) highlights, water professionals appear unable to protect water resources despite public concern, and connections are not made with other contemporary issues, such as climate change adaptation. Organisational leaders must create the conditions for this to occur. As Folke et al. (2005: 447) point out "learning that helps develop adaptive expertise (an individual's ability to deal flexibly with new situations) and processes of sense-making are essential features in governance of complex social-ecological systems, and these skills prepare managers for uncertainty and surprise".

In terms of transferability to other contexts, the WGRI has shown that bringing people together for the purpose of developing connections can be done in a relatively low-cost way (and participants noted a preference for lower cost, more frequent interactions) but requires ongoing commitment. Senior managers need to create opportunities for both formal and informal interactions and invest in developing capacity for researchers to take part in interdisciplinary practice, and to reflect and document their experiences in order to learn from them. We suggest that a model for career progression in the water sector should prioritise having skills and capacity for working, through conversation and other modalities (Ison et al., 2011) and, ultimately, collaborative practice based on conceptual explication and reciprocity, including the appreciation of difference. Co-production of knowledge between different stakeholders is one emerging perspective on navigating complexity

(Reyers et al., 2015). Situations of complexity and uncertainty require effective engagement rather than avoidance whether through reductionism or inappropriate framing choices. This may be achieved if the necessity to develop beyond initial disciplinary training and engage with the 'messiness' of water situations is seen as a natural and expected skill to be developed, whether in research, government and private-sector organisations.

There needs to be investment into developing better communication that can lead to growing understanding and mutual respect between the arts and sciences. This is not just limited to the arts in terms of the humanities and social sciences, but the recognition of all the different ways of knowing and experiencing the relationship between natural and human worlds – thus not just recognising the socio-ecological condition of our world, but also allowing research and policy to experience it and integrate it into life in many different ways. There is also a need to recognise that investment is needed in more innovative, creative and experimental methods and pathways in both science and the arts so that complex, intractable problems can be approached in new and potentially exciting and rewarding ways.

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