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The politics of adaptive governance: water reform, climate change, and First Nations' justice in Australia's Murray-Darling Basin

[Carina A. Wyborn](#)^{1,2}, [Lorrae E. van Kerkhoff](#)^{1,2}, [Matthew J. Colloff](#)^{1,2}, [Jason Alexandra](#)^{1,3} and [Ruby Olsson](#)^{1,2}

ABSTRACT. Adaptive water governance scholarship aspires to flexible and responsive governance that is inclusive and supports learning and collaboration among a wide range of stakeholders. Much of this scholarship assumes that polycentric arrangements will facilitate these characteristics as different nodes of decision making adapt and respond to challenges within their arena of authority. However, in the case of both adaptive water governance and polycentricity, there are growing questions as to whether the reality matches the theoretical ideal. Drawing on a case study of Australia's Murray-Darling Basin, we introduce the concept of a polycentric spectrum to distinguish between systems that resist change from those that enable more adaptive transformative change. In our case study, an overarching national agenda of water reform has generated a perpetual cycle of reviews and inquiries into water governance. We examined 34 reviews conducted since 2004, asking whether, how, and to what extent these recommendations are enabling governance adaptation and transformation versus maintaining conventional paradigms. Our analysis revealed problem-solving logics that have dominated water governance for decades to stymie efforts to move toward the more adaptive and transformative forms of governance required to address two key areas of reform: climate change and First Nations' water justice. Despite an acknowledged need for substantive reforms, inquiry recommendations perpetuate technocratic (for climate change) or administrative rationalist (for First Nations) approaches. We argue that the reform agenda needs to be directed away from governments as the sole agents of change through deliberate and strategic efforts to engage local level and non-state actors who are central to adaptive water governance. This would require debate about reforms to move beyond how water is allocated and optimized to address how power is redistributed in the system. Our analysis questions whether polycentricity alone is sufficient to enable normatively desirable adaptive water governance, suggesting the need for future work to consider whether other organizing concepts, such as water justice might be required.

Key Words: *governance logics climate change; polycentric governance; trade-offs; water justice; water politics*

INTRODUCTION

Globally, water governance regimes are stressed by increased demands on water resources alongside climate change induced reductions in supply. Adaptive water governance is heralded as a normative and practical aspiration to enable policy, legal, and management decisions that respond to changes in water resources or their surrounding social and political contexts (Cosens and Gunderson 2018). Adaptive water governance is an umbrella concept incorporating emergent, collaborative, and polycentric approaches seeking to build resilience in complex and uncertain contexts and to adapt to emerging threats and circumstances or new information (Folke et al. 2005, Chaffin et al. 2014, Cosen and Gunderson 2018). Although laudable in theory, practically these aspirations remain challenging due in part to the inherent contestation central to the governance of finite resources (Zurita et al. 2018), which often involves trade-offs between societal values (Akamani 2016, Cosens and Gunderson 2018). Given power disparities among resource users, conflict is largely inevitable when decisions about allocation and use are made (Dietz et al. 2003, Carlisle and Gruby 2019). Consequently, there are growing calls for transformative changes to foster integrated and systemic approaches to water governance (Moore et al. 2014, Pahl-Wostl 2017, 2020). Such transformative changes necessarily involve challenging power dynamics that are embedded within and reproduced by current governance arrangements (Scoones et al. 2020).

These challenges are evident in Australia's Murray-Darling Basin (MDB), in which a gap between original water recovery aspirations and actual water recovered suggests that water reforms

have stalled (Colloff and Pittock 2022). Water reforms have sought to address historical over-allocation of water for irrigation to restore the ecological condition of rivers and wetlands, leading to a conflict around the trade-offs between water for irrigation and the environment. These trade-offs will be exacerbated by climate change that is projected to dramatically reduce water supply (Alexandra 2021) and efforts to redress historical injustices to First Nations, who hold less than 1% of the water entitlements across the basin despite making up 5% of the population (Hartwig et al. 2021).

Governance in the MDB is polycentric in the sense that local, regional, and provincial scale governing entities (e.g., local councils, irrigation companies, catchment authorities, state governments) have traditionally aligned decision making with national policy (Marshall et al. 2013). Thus, governing has depended on a broad consensus about rules, policies, and values because no one party is in charge despite "multiple overlapping interests, responsibilities, and powers" (Abel et al. 2016). However, although the MDB has been heralded as a leading example of water reform (McLoughlin et al. 2020) and of polycentric water governance (Garrick et al. 2011), a closer look at the politics of reform suggests a different picture. The most recent reforms have operationalized a partnership between federal, state, and territory governments, effectively marginalizing the decision-making role of other governing entities. Persistent political conflict between the different governing entities, inconsistent progress toward water reform, and lack of action on key challenges suggest that the flexibility and adaptability said to characterize polycentric governance systems is largely absent. In

¹Institute for Water Futures, Australian National University, ²Fenner School of Environment and Society, Australian National University, ³Institute for Climate, Energy, and Disaster Solutions, Australian National University

this context, theoretical aspirations of adaptive water governance are desirable but elusive. This raises questions as to whether the current governance system can effectively address conflicts over water allocation, historical injustices to First Nations peoples, or projected climate change.

Australia's Water Act (Commonwealth 2007) ushered in a new framework for water planning in the basin that mandated adaptive responses to climate risks including through iterative reviews and revisions (Alexandra 2021). As a result, one of the primary mechanisms for assessing, evaluating, and (potentially) adapting water governance in the MDB is cyclic reviews and inquiries. These are either mandated through statutory requirements for evaluative reviews and revisions to statutory plans, or ad hoc responses to political pressures, socioeconomic concerns, or ecological crises. We report on an analysis of 558 recommendations of 34 reviews and inquiries conducted since 2004 when all Australian governments agreed to a broad policy framework for water reform known as the National Water Initiative (NWI).

We examine the MDB as a case study to illustrate how competing problem-solving logics within a polycentric system challenge adaptive water governance. Our point of departure assumes that water governance in the MDB needs to transform to address persistent trade-offs and emerging challenges of climate change and water justice.

Conceptual framing: polycentric spectrum

Polycentric arrangements are key features of adaptive water governance (Huitema et al. 2009, Pahl-Wostl et al. 2009, Akamani 2016). Polycentricity has various definitions, from the descriptive and structural in which “the constituent enterprises are sufficiently autonomous that they cannot be directed by any single center” (Marshall et al. 2013:200) to the more prescriptive, in which “multiple governing authorities at different scales that do not stand in hierarchical relationship to each other but are engaged in self-organization and mutual adjustment” (Morrison et al. 2019:1). Within water governance, Pahl-Wostl (2020) found that polycentric systems had high adaptive capacity and were more likely to support transformative change. Within broader adaptive governance scholarship, polycentricity is often normative, for example, as “a form of social coordination in which actions are coordinated voluntarily by individuals and organizations with self-organizing and -enforcing capabilities” (Lee, cited in Olsson et al. 2006:2) that “provide for collaborative, flexible, learning-based approaches to managing ecosystems” (Olsson et al. 2006:2). Polycentricity of this form is regarded as a desirable enabler of effective adaptive governance. However, others have suggested that a more nuanced consideration of the tensions between the aspiration and the reality of polycentricity is needed, calling for further research on the social and environmental outcomes of different manifestations of polycentricity and for more research on how power asymmetries are reproduced and amplified within polycentric systems (Morrison et al. 2017, Carlisle and Gruby 2019).

We argue that various forms of polycentricity can be understood as situated along an adaptive governance spectrum. This is not the simplistic monocentric-polycentric spectrum critiqued by Morrison et al. (2019). Rather, we propose a spectrum in which all governance arrangements can be described as structurally

polycentric (cannot be directed by any single center) but differ according to the degree to which that structure demonstrates functions that would enable or support adaptive governance. There are several functions of polycentricity (Carlisle and Gruby 2019); we focus particularly on the logics underpinning governance and in our case study, the way review recommendations indicate support for certain governance ideals. We draw on Dryzek’s (2013) discourses of environmental problem-solving, specifically administrative rationalism (to which we add techno-rationalism), economic rationalism, and democratic pragmatism to characterize different logics on the spectrum. As discourses, they are normative by indicating how environmental problem solving should be done and are political by invoking and reproducing particular patterns of power relations. Understanding these discourses provides an entry-point by which to consider competing institutional logics driving different approaches to governance (Franco-Torres et al. 2021).

At one end of the spectrum is administrative rationalism in which units within polycentric structures attempt to address water governance complexities via conventional administrative and techno-rationalist logics. Dryzek (2013:75) describes administrative rationalism, as “...emphasiz[ing] the role of the expert rather than the citizen or producer/consumer [and] stresses social relationships of hierarchy rather than equality or competition.” In a polycentric context, administrative rationalism is indicated when interactions between organizations tend to be formulated by rules, legislation, or formal agreements that privilege particular kinds of technical expertise. Problem-solving in a context of conflicting interests and fundamental trade-offs is idealized as achieved through transparency, accountability, and rigorous enforcement of agreements and rules. Power needs to be retained within the various centers to ensure organizations can defend their interests in ongoing struggles of contestation and arbitration. Efforts toward improvement may focus on creating new rules, improving implementation of existing agreements, or enforcing compliance. Although structurally polycentric, this end of the spectrum is furthest from the flexibility, emergence, and collaborative learning required to enable adaptive governance (Carlisle and Gruby 2019).

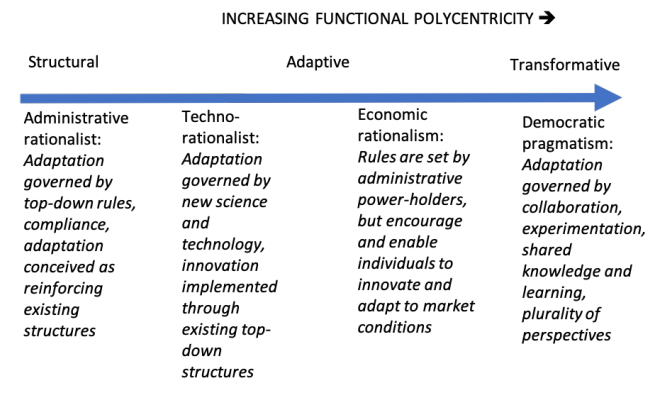
Democratic pragmatism, in contrast, emphasizes learning through interaction and experimentation, in which “the relevant knowledge cannot be centralized in the hands of any individual or any administrative state structure ... problem solving should be a flexible process involving many voices, and cooperation across a plurality of perspectives” (Dryzek 2013:100). Power and knowledge are shared, with conflicts and trade-offs negotiated on an (more-or-less) even playing field through consultation, deliberation, and dialogue. New ideas for change can emerge, and efforts toward improvement emphasize collective learning and action, but there may be relatively little insight into the resolution or treatment of fundamental trade-offs or allocation challenges. Dryzek (2013) emphasized that democratic pragmatism remains situated within the liberal capitalist system but demonstrates a problem-solving logic that corresponds to many features claimed for adaptive governance and therefore represents the other end of our spectrum. This end of the spectrum aligns with Carlisle and Gruby’s (2019) “functional” polycentricity because it is assumed that such problem-solving logics are more amenable to realizing the polycentric promise to adapt in the face of change.

Economic rationalism is evident in the deliberate creation of economic markets for provision of public goods (Dryzek 2013). It sits in between our two ends because these markets are constructed by administrative rules, but they allow actors within the polycentric system to coordinate and self-organize within the parameters set by the market and the administratively defined market rules. Knowledge can be a competitive advantage, so there are few incentives to share or collaborate in the generation of new knowledge, but the markets can generate information about buyers and sellers and the prices of transactions. In theory, conflicts and trade-offs are resolved through market mechanisms in which supply and demand typically allocate limited resources to the most efficient, highest-value use. However, in practice, allocation decisions tend to be biased toward those with the most economic power or political influence (Alexandra and Rickards 2021). People who are economically disadvantaged or lack political influence have little power in the economic rationalist problem-solving logic, and the markets are not intended to address this disparity (i.e., any efforts to redistribute assets or wealth are deemed to be external to the markets). Understanding the role and influence of economic rationalism, and of economic logics more generally, in shaping how power is distributed through a governance system is therefore an important consideration for adaptive water governance (Alexandra 2019).

Techno-rationalism was not included as a separate problem-solving logic in Dryzek’s (2013) discourses; however, it is prominent in water governance. Dryzek did describe Prometheanism as an overarching discourse in which ecological limits are denied and economic processes and technology will meet human needs without the need for environmental protection. These ideals accord with the techno-rationalism we describe, which presents technology to achieve both economic and ecological goals, i.e., achieve more with less. Techno-rationalist logics privilege new or emerging technologies in problem solving with knowledge located within the techno-scientific elites to be distributed via administrative or economic means. Such logics are prominent in early adaptive governance scholarship, which implicitly privileges scientific expertise. However, over time the field has come to place greater emphasis on Indigenous and local knowledge (Wyborn et al. in press). More recently, it may be argued that coproduced modes of knowledge generation seek to connect techno-rationalism with democratic pragmatism, yet the dominant association remains with administrative rationalism (Lepenies et al. 2018).

The heuristic of the spectrum of polycentric governance is illustrated in Figure 1. Going from left to right indicates increasing functionality of polycentricity regarding the desirable features of adaptive governance including greater flexibility and agility, flatter hierarchies, greater openness to more diverse knowledges and voices, and increasing ability to innovate, learn, and transform. The logics of problem-solving form the indicators by which a particular strategy, policy, program, or in our case study, recommendation may be “placed” along this spectrum. This heuristic illustrates our argument that the ability of a polycentric governance system to deliver adaptive governance is influenced by the range of underlying logics and the power of relationships that are embedded within them. Following the normativity of adaptive water governance, we propose that indicators further to the right of the spectrum are more desirable because they are associated with greater transformative capacity.

Fig. 1. Spectrum of polycentricity.



Case study background

Water resources in the MDB are over-allocated (Commonwealth 2007). On average irrigation uses 46% of surface water availability (CSIRO 2008) but more in drier periods. The MDB covers 5 jurisdictions, is home to 2.66 million people, the territory of over 40 First Nations and generates \$AU30 billion from tourism and agriculture. The MDB contains 16 Ramsar-listed sites, over 30,000 wetlands, and 77,000 km of rivers, many in poor ecological condition (Davies et al. 2012). River flows have been further reduced by extended drought (van Dijk et al. 2013, BoM 2020), climate change (Cai and Cowan 2008), floodplain harvesting (Steinfeld and Kingsford 2011), and illegal and unregulated diversions (Wheeler et al. 2020). Annual inflows have declined in the last 20 years by 49% compared with the long-term average (MDBA 2020). This drying trend is projected to increase markedly under climate change, heightening longstanding contestation over water resources (Alexandra 2021).

Historically, water resources were managed independently by basin states for consumptive uses with minimal consideration for environmental requirements (Connell 2007). Major changes in national policy objectives prompted by drought and over-allocation drove water reforms starting in the 1990s and culminating in the Intergovernmental Agreement on the National Water Initiative (NWI) in 2004 (Marshall and Alexandra 2016). The NWI is the most comprehensive attempt at water reform and remains the primary policy framework guiding state and federal governments. Its policies combine neo-liberal market reforms with the principles of ecologically sustainable development (ESD). The NWI aimed to address over-allocation, to reform water rights to enable trading, and to stabilize national standards for water management (CoAG 2004).

The Water Act (2007) provides the legislative framework for more adaptive governance of the MDB, one of its functions being to adjust to climate change (Alexandra 2021). The act established the Murray-Darling Basin Authority (MDBA), an independent federal agency that oversees water resources management, largely through the statutory Basin Plan (Commonwealth of Australia 2012) and the accreditation of state water resource plans. The plan reinforces the principles of the NWI by providing consistent rules for trade and transfer of entitlements and defining a maximum volume that can be taken for consumptive use. The

plan establishes a volumetric target of 2750 GL for water to be returned from irrigation to the environment. The Water Act specifies under “general basis on which Basin Plan to be developed” (Commonwealth of Australia 2007:S21) that climate adjustments and the water recovery target must be determined according to “best available science,” the principles of ESD and the NWI, and have regard to social, cultural, Indigenous, and other public benefit issues. The act’s objectives give effect to Australia’s commitments to international treaties, including the Convention on Biological Diversity and the Ramsar Convention, and in doing so, promote water resource management that optimizes environmental, social, and economic outcomes. This legislative foundation of the act recognizes the different powers under Australia’s constitution, in which water resource management and planning remain the remit of the states, although the federal government has the authority to set sustainable diversion limits for basin catchments and the basin as a whole. The Water Act (2007) and the NWI demonstrate the structural features of polycentricity with responsibility and power shared across different levels of government and specific inclusion of non-governmental interests. However, although the states ceded some powers to the federal through this process, it effectively institutionalized conflict over water allocation between state (focused historically on consumptive use) and federal (responsible for environmental protection to meet treaty obligations) governments.

Although these reforms sought to address environmental impacts of over-allocation, they have failed to address historic injustices to First Nations peoples, who are afforded limited access or rights to water under current frameworks (Marshall 2017, Jackson et al. 2021). The Water Act requires Indigenous communities to be engaged in decisions about the management of basin water resources, and in 2018 the Water Act was amended to include an Aboriginal representative on the board of the MDBA. Despite a recent recognition of the cultural values of water, partnerships with First Nations representative bodies and various government agencies, and ongoing calls for participation in decision making, First Nations rights, recognition, and roles in water management continue to be marginalized (Jackson et al. 2021).

The Water Act establishes a legal framework for more adaptive governance; however, the reforms have been heavily politicized. Under this pressure, the government’s zeal for reform waned, and the volume of water recovered for the environment was substantially reduced to limit social and economic impacts (Grafton 2019). Progress on implementation remains disputed, with many questioning whether Australia’s international obligations are being upheld (Carmody 2010, Pittock et al. 2010, Kirsch et al. 2021, Bender et al. 2022), and whether desired environmental outcomes are possible (Colloff and Pittock 2022). The unevenly distributed social and economic impacts of reforms have created distinct winners and losers and substantial mistrust of the process and of governments (Sefton 2020). The plan’s treatment of climate change (Alexandra 2017, 2020) and First Nations (Jackson et al. 2021) has been heavily criticized, alongside several substantive critiques of the governance system and mechanisms of reform (Alston et al. 2016, Alexandra 2019, 2020, Grafton 2019). This all suggests a need to at least adapt and potentially transform water governance in the MDB if the objectives of the Water Act are to be realized.

Adaptive governance mechanisms, inquiries, and reviews provide opportunities to adjust policy and institutional settings through a systematic process of reflection and learning. However, examination of their role within adaptive governance scholarship has been minimal. As Grafton (2019) argued, water reform requires regular and independent review to support transparency and accountability, while Alexandra (2019) suggested that the proliferation of reviews and inquiries conducted since the Water Act was passed indicates a loss of confidence, legitimacy, and authority. Both argue that inquiries are critical to ensure reforms remain targeted toward stated objectives. Recent inquiries have covered water markets, socioeconomic impacts, environmental water management, water availability for Indigenous peoples, and management compliance. Inquiries typically include public engagement mechanisms and are a means of holding governments to account. These efforts have fallen outside the legislated 10-year reviews of the Water Act and the plan, suggesting a need and appetite for adjustments within those timeframes. Inquiry reports provide insights into reform progress and their recommendations may illuminate options for change, while illustrating whether governments or the public have an appetite for transforming existing arrangements. Thus, reports can indicate whether reform processes have become captured by powerful interests who promote and reproduce the status quo through accepted policy logics (Grafton and Williams 2020, Colloff et al. 2021).

The Water Act and the Basin Plan are scheduled for review in the coming years (2024 and 2026 respectively), presenting a significant opportunity for change. Our analysis took the recommendations of existing reports as key sources of data on adaptive governance reforms and interpreted through a conceptual framework of the polycentric spectrum and problem-solving logics described.

METHODS

Analysis involved sampling and qualitative thematic coding of recommendations of inquiries, reviews, and major reports on water reform and water governance in the MDB dating from 2004-2021. The timeframe reflects the most recent phase of water reform since the agreement to the NWI. In addition to a web-based search, the Australian Parliamentary Library and Senate Committees and Inquiries databases were searched using the following terms: Murray-Darling Basin AND review OR report OR inquiry AND socioeconomic OR environmental water OR climate change OR ecosystem OR plan recommendations OR water trading OR governance OR senate inquiry OR authority reports OR (Indigenous OR Aboriginal OR First Nations). The initial search, conducted in January 2021, yielded 50 documents with an additional 7 documents found in a secondary search in August 2021. Documents were scanned to exclude reports conducted within a single jurisdiction (e.g., NSW Independent Commission Against Corruption) or on niche topic areas (e.g., hydrological modeling). These exclusion criteria narrowed the scope to documents pertinent to water reform and/or governance of the whole basin. The initial 57 documents were filtered to include only those containing explicit recommendations. The initial data set includes 34 documents listed in Appendix 1.

The 558 recommendations from these 34 reports were first coded through an inductive coding process, whereby codes were generated based on the key themes in a recommendation. This

generated 66 unique thematic codes (see Appendix 2). This initial coding surfaced the common logics underpinning water reform (administrative, techno-rationalist, market rationalism, democratic pragmatism) that were subject to more detailed analysis through deductive coding. Although we strived to code a recommendation to a dominant, single logic, 25 recommendations clearly spoke to 2 logics (i.e., improve the administration of technical systems) and as such, were double coded and counted under both logics in the figures reported. From here, we selected data from a smaller set of codes reflecting key water reform topics (see Appendix 2) including water markets, the water recovery target, environmental water, community impacts, climate change, and First Nations. Codes relating to scientific knowledge, knowledge priorities, and infrastructure were also included to capture data relating to the techno-rationalist logic identified in the initial coding. After duplicates were removed, the second round of coding included 413 recommendations from 32 reports with the earliest document in the final data set from 2006 and the last from 2021.

Deductive coding identified: (1) the underlying logic of each recommendation (administrative, techno-rationalist, market rationalism, democratic pragmatism), (2) how the recommendation addressed trade-offs (trade-offs explicit, trade-offs implicit, trade-offs optimized, not applicable), and (3) which actors were identified as the party(ies) responsible for implementation. These recommendations covered 50 different areas with those most commonly occurring (>10) listed in Appendix 2. The final analysis interrogated recommendations on climate change and First Nations to consider the logics present, the actors responsible, and the repertoires of participation envisaged. A systematic assessment of how recommendations changed overtime was beyond the scope of this analysis, however, we noticed some patterns in more recent reports.

In our analysis, we first assessed whether the recommendations “enabled the water governance system to adapt as it seeks to address persistent conflicts associated with trade-offs in water allocations.” This is regarded as a minimal adaptation challenge because it was a well-established issue, which had historical and structural foundations, and in many respects, represents the core issue the existing governance arrangements were set up to deal with.

Second, we examined the extent to which recommendations “fostered institutional change that would explicitly integrate climate change into decision making across the governance system.” The threat of climate change had previously been recognized but was not a core concern when the current governance system was created. Therefore, we propose that considering climate change demands greater adaptation or transformation of existing water governance arrangements.

Third, we considered whether the recommendations “identify, acknowledge, and support the transformative changes required to achieve water justice.” This is regarded as requiring more transformative approaches because it is founded on more complex ideas such as decolonization, sovereignty, and justice, and requires fundamental changes to entitlements, values, and power structures underpinning water governance in the MDB.

The recommendations provide a sizable data set that yielded rich insights into adaptive water governance in the MDB. However, they are a narrow window into the detail within each document.

To make the data manageable, our analysis was necessarily constrained to what was represented in the recommendations, and beyond that, within the scope of the terms of reference of the inquiries, reports, or reviews. Noting this limitation, the data set provided ample scope to consider the role of reviews and inquiries as mechanisms to enable adaptive water governance.

RESULTS

After introducing the dominant logics found, we present our analysis in three sections, and focus on our proposition that increasing adaptive water governance in the MDB requires the existing governance system to adapt and to transform. These three areas represent increasing complexity in terms of the adaptation and transformative capabilities required.

Logics of problem solving in the Murray-Darling Basin

Administrative rationalism and techno-rationalism were the most dominant logics underpinning the recommendations and then in much smaller proportions, economic rationalism and democratic pragmatism. We briefly characterized each logic, the dominant themes, and actors mobilized within these recommendations. Table 1 includes illustrative recommendations from each logic.

Recommendations underpinned by administrative rationalism (231) predominately focused on strengthening, reinforcing, and clarifying existing governance arrangements, for example, developing registers of rules and regulations, developing water plans, and improving transparency in monitoring and auditing. Unsurprisingly, the primary actors were various levels of government and government agencies, and the recommendations were imbued with a top-down logic of government driving action. Reflecting the general concern that basin governance (roles, responsibilities, requirements) was convoluted, several recommendations focused on clarifying and communicating governance arrangements to the public. Recommendations underpinned by this logic predominantly focused on environmental watering (32), water planning (24), compliance (21), monitoring, evaluation, reporting, auditing (19), and the water recovery target (16).

The techno-rationalist logic (117 recommendations) contained two related yet distinct foci: science and technology. Recommendations focused on science dominated this logic (80) calling for improved research, monitoring, and data compilation and sharing, conveying an assumption that accurate information will lead to better decision making. Although largely focused on biophysical sciences and technology, few recommendations called for socioeconomic information (6) and knowledge of cultural flows and First Nations water needs (3). Science focused recommendations often stressed “clearly communicating” research to the public. Recommendations focused on technology (32) suggested that improvements in infrastructure or monitoring technology would enable outcomes to be optimized across consumptive and environmental uses. Of the 33 topics covered by techno-rationalist recommendations, the largest subset focused on monitoring, evaluation, auditing and reporting (12), the water recovery target (11), and climate change (11). Again, a top-down expert-driven logic dominated, with government actors overwhelmingly identified as the responsible parties (117), yet when that broad category was disaggregated into the various arms of government, the category of “no actor specified” was the largest, with 27 recommendations.

Table 1. Examples of the problem-solving logic underpinning recommendations.

Logic of problem solving	Recommendation	Report title
Administrative (total 231 recommendations)	It is recommended that the Council of Australian Governments (CoAG) reiterates its commitment to the 2019-06-30 deadline for water resource plan accreditation because of concerns arising from this review. It is further recommended that NSW and Victoria accelerate their work on preparing Basin Plan-compliant water resource plans.	Murray-Darling Basin Authority (2017)
	The committee recommends that the government coordinate with the basin state governments to undertake a comprehensive assessment of carryover rules and regulations and investigate the potential for amendment to the rules.	Senate Select Committee on the Murray-Darling Basin Plan (2016)
	The committee recommends that the Commonwealth Government commission a study to identify all regulations and agreements in place that inhibit the efficient management of water in the Murray-Darling Basin and, where appropriate, work with the states to remove these regulations.	House of Representatives, Standing Committee on Regional Australia (2011)
Techno-rationalist, science (total 37 recommendations)	The committee recommends that all state and territory jurisdictions review the levels of water diversion from the floodplains and only grant licences to extract overland water after an independent scientific review of current levels of extraction has been completed.	Senate Rural Regional Affairs and Transport Committee (2006)
	That for multiple-scale watering actions, the Commonwealth Environmental Water Office ensures the full range of expected ecological outcomes are determined and communicated to the appropriate long-term intervention monitoring project teams.	Hart and Butcher (2018)
	It is recommended that by 2018-06-30 states publish an improvement program for hydrologic models to account for water intake including their plans for transitioning to eWater Source and ongoing improvement of model performance. If a decision is made not to transition to eWater Source, the reasons for this should be published.	Murray-Darling Basin Authority (2017)
Techno-rationalist, technology (total 117 recommendations)	The committee recommends that a higher priority be placed on the replumbing of rural Australia through the urgent implementation of both on-farm and off-farm infrastructure projects.	Senate Rural Regional Affairs and Transport Committee (2009)
	The authority recommends there be a preference for water recovery based on irrigation infrastructure improvements rather than through water entitlement purchasing.	Murray-Darling Basin Authority (2016)
	The committee recommends that the Australian Government continue to fund and support an infrastructure program aimed at optimizing water efficiency in the Murray-Darling Basin.	House of Representatives Standing Committee on the Environment and Energy (2018)
Economic rationalism (total 60 recommendations)	The Commonwealth with the states and territories should give priority to developing a more efficient and transparent water market, including setting best practice standards or regulations for water brokers or intermediaries.	Senate Environment Communications References Committee (2010)
	Where state and territory governments provide access to water for Indigenous communities for economic development they should: (1) source water within existing water entitlement frameworks, such as by purchasing water on the market or as part of transparent processes for releasing unallocated water; (2) ensure adequate supporting arrangements (such as training and business development) are in place to enable Indigenous communities to maximize the value of the resource; (3) involve Indigenous communities in program design; (4) specify and implement future governance arrangements; and (5) regularly monitor and publicly report on these provisions (such as the volume of entitlements sourced, water used, and supporting arrangements) and their outcomes. Australian state and territory governments should revise relevant provisions in the National Water Initiative to align with recommendations 3.3 (1) to 3.3 (5).	Productivity Commission (2017)
	Improving trade processes and market transparency: there is a need to improve the transparency and accessibility of information necessary to participate in the market including timely and accurate trade data. This includes providing higher-quality information to market participants and provide it more quickly and a broader need to streamline trade processes, such as the processes authorities impose to approve transactions.	Australian Competition and Consumer Commission (2020)
Democratic pragmatism (total 40 recommendations)	Basin governments and the Murray-Darling Basin Authority must commit to working with basin communities on water management to boost meaningful and coordinated two-way engagement.	Murray-Darling Basin Authority (2020)
	A regional development package that puts communities at the center of reform by assisting communities most affected by water recovery to restructure their economies to adapt to a future with less water is required. Assigning for example, 10% of the remaining \$AU5.1 billion would release up to \$AU500 million for regional development initiatives. Linking public funding directly to the Basin Plan, by the Commonwealth working directly with community leaders, local government, regional development boards, and natural resource management agencies to recover the water in a manner that optimizes regional development opportunities for those communities.	Cosier et al. (2017)
	Governments need to work with communities in the basin with acute social and economic issues to develop action and outcome plans that will address these issues over the next three years. Such plans should build on any existing plans and be driven by local communities that are provided with additional skills and expertise to help them develop long term (say, 2-3 decades) and short term (up to 10 years) tailored plans.	Sefton (2020)

Economic rationalism was the next dominant logic, and comprised 60 recommendations concerning various aspects of the water market, trade practices, market transparency, and economic development. Many acknowledged problems with the water market, focusing on rules and structures that could prevent perverse social, economic, or ecological outcomes. Notably, more recent reports (ACCC 2020, PC 2021) explicitly call for substantive change to avoid “more of the same”. Expectedly, the water market was the dominant topic (38), but perhaps notably, the First Nations (5) was the next most dominant. These recommendations focused on access to water for economic development within the “existing entitlement framework.” Again, central government actors dominated alongside environmental water holders (largely government actors) and catchment management authorities (quasi-government entities), NGOs, water entitlement holders, and Indigenous groups.

Democratic pragmatism underpinned 40 recommendations, predominantly from more recent reports. These recommendations focused on improving consultation, engagement, and communication with stakeholders, including local and regional communities and First Nations as a means to address concerns around the social, cultural, and economic impacts of water reform. These recommendations deployed various repertoires of engagement, such as “consult,” “engage,” “partner,” and “work with,” illustrating degrees of empowerment or power sharing through these processes. A few recommendations suggested that communities should drive reform, thus shifting power to communities and emphasizing their role in keeping governments accountable. Government actors as a group dominated (38), however, there were notably more mention of First Nations/Indigenous groups (7) and communities (5) as a proportion of the total recommendations within this logic. These recommendations focused on a more limited set of topics, predominantly First Nations (11) and environmental water (8).

Addressing trade-offs between irrigation and the environment

Three approaches to trade-offs were identified: trade-offs implicit (138), trade-offs optimized (42), and trade-offs explicit (22).

Implicit trade-offs

Implicit trade-off (138) recommendations focused on areas of water reform or governance involving a trade-off between different water users, but the detail was not stated. A logic of administrative rationalism dominated (72), related to desirable improvements in water management or governance, often calling for further investigations and reforms. A few recommendations suggested that environmental needs should be prioritized without mention of the effect on irrigation communities. Although recommendations cannot be expected to cover every aspect associated with their implementation, it was notable that implicit trade-offs dominated the data set. The underlying assumption in many of these recommendations was that trade-offs did not need to be made, and most skirted around the issue, for example:

... the Australian Government should target any further assistance to [irrigation] communities where substantial adverse impacts arising from water recovery [for the environment] to date or any future recovery program have been identified (Productivity Commission 2018).

This recommendation was among 12 that considered community and socioeconomic impacts of water recovery, with some 6

directly addressing the need to support communities most impacted by reforms. Recommendations focused on structural adjustments and proposed either targeted assistance for substantially impacted areas or support for communities or irrigators to identify alternative economies or crops requiring less consumptive water.

Trade-offs optimized

These recommendations (42) suggested that optimal outcomes could be realized and trade-offs avoided through technological improvements, irrigation efficiencies, or providing cultural benefits from environmental water. The dominant logic was administrative rationalism (22), then techno-rationalism (14) with several recommendations seeking to optimize benefits across social, economic, and environmental domains and pursue multiple objectives, such as linking First Nations cultural flows to environmental watering or substituting efficiency measures for water buy-backs:

Australian, State and Territory Governments should ensure that their policy frameworks provide for the efficient and effective use of environmental water to maximize environmental outcomes and, where possible, provide additional community outcomes relating to water quality, Indigenous values, recreation and economic benefits (Productivity Commission 2017).

Others suggested that socioeconomic factors be considered in acquiring environmental water and steps be taken to minimize social and economic impacts.

Trade-offs made explicit

Forty recommendations grapple with trade-offs between different water users via words like “compromise” or “rebalancing.” In 2010, the Productivity Commission recommended that the MDBA should set the water recovery target “in a way that balances environmental, social, and economic trade-offs” and that if this is “inconsistent” with the Water Act, it should be amended. More recently, the Productivity Commission (2021) explicitly called for:

... principles to frame the process for assessing and reflecting the relative values placed by communities on environmental, social, and economic outcomes to inform the trade-offs that have to be made in water planning.

Here, the recommendation did not assume a priori values hierarchy, rather that information be presented for those making decisions, an approach that was reflected in three other recommendations within this category. Intentions of recommendations that explicitly dealt with trade-offs were: to optimize social and economic outcomes (4); to prioritize environment above socioeconomic impacts (2); and to minimize socioeconomic impacts (3). These recommendations send mixed signals about how trade-offs should be addressed, potentially fueling contestation around the hierarchy of values in water reform.

Addressing climate change

Twenty-five recommendations explicitly dealt with climate change. It is notable that 15 of these were from reports focused on water reform across Australia indicating the relatively marginal attention within the MDB despite longstanding research focused on climate risks in the basin (Alexandra 2021). Climate change

recommendations were dominated by techno-rationalist (12) and administrative rationalist logic (14), and government actors were dominant. A 2012 report by the now abolished National Water Commission on “water policy and climate change in Australia” provided seven recommendations on a range of topics including risk management, contingency planning, objective setting, and transparent decision making. However, there was a notable shift in the focus of recommendations after this review and within reviews specifically focused on the basin, toward a relatively simplistic focus, predominantly (11) on developing more knowledge to identify climate risks to water resources, communities and ecosystems, and to support climate adaptation. Eight recommendations encouraged planning for future climate change or to take climate change into consideration in existing mechanisms such as the plan or the water recovery target despite this being an explicit requirement of the Water Act (Alexandra 2021). Climate change recommendations were silent on mitigation to reduce climate risks or provide opportunities to diversify rural economies. Instead, they focused on the adaptation of various entities: communities, governance, planning processes, industries, and infrastructure to a changing climate, for example:

Improving scientific understanding of the potential future stresses caused by extreme weather events... and long-term changes in climate including water availability, supported by a climate change adaptation program for environmental assets, industries and public infrastructure (Cosier et al. 2017).

The Productivity Commission reports on National Water Reform (2017, 2021) contain the most detailed recommendations on climate adaptation. Moving beyond simplistic directives to generate more knowledge or to consider climate change, these reports identified the need for water planning to consider priorities, actions, and rules for drought conditions, alongside a need to develop processes to “rebalance” consumptive and environmental objectives in the context of climate change. The 2021 report, however, suggested that action should be delayed until there is “sufficient evidence that benefits will outweigh the likely costs.” This is concerning given inherent uncertainties in climate projections and the tendency to mobilize climate uncertainty as a political narrative to delay action (Alexandra 2021). Further, the report reflects an economic rationalist logic that the benefits and costs of adaptation can be calculated in advance under conditions of high uncertainty, thus ignoring the fundamental tenets of the NWI related to ecologically sustainable development and the precautionary principle. The scope and magnitude of anticipated change in the MDB suggests that processes to develop “pathways to transition to the new balance” will be politically fraught and require many years of negotiations to agree on and implement. Only one recommendation explicitly mentioned trade-offs in adaptation priorities:

Basin water users, managers, First Nations and community groups need to plan for the future climate. As well as Basin-wide assessment, local climate opportunities and risks should be given attention along with implications, trade-offs and adaptation priorities (MDBA 2020).

The Productivity Commission reports (2017, 2021) framed this as “rebalancing” environmental and consumptive objectives. The

logic of democratic pragmatism is noticeably absent within these recommendations, suggesting an assumption that climate change can be handled through existing governance structures, which have to date fundamentally failed to address climate change. Overall, most recommendations do not go beyond basic directives to take climate change into account and overwhelmingly assume that the first step requires building scientific understanding of climate risks and impacts. Given that two decades of scientific research quantifying these risks and impacts have failed to deliver adaptive policy responses, it is unclear how additional research would change these policy settings (Alexandra 2021).

Addressing First Nations voice and water justice

Thirty-two recommendations explicitly dealt with First Nations and their position relative to water reform. Within these recommendations, democratic pragmatism (13) dominated, followed by administrative rationalism (11), and economic rationalism (4) with only two displaying a techno-rationalist logic. These recommendations focused on a range of topics but predominantly cultural and economic outcomes (10) for First Nations through various mechanisms, for example, integration into existing water markets or aligning cultural objectives with environmental watering. First Nations were the most dominant group of actors (12) with the remaining recommendations evenly distributed across various levels of government and government agencies.

These recommendations invoked diverse repertoires of participation with representation (7) and engagement (6) most dominant and others calling for “input,” “consultation,” “coordination,” and “employment.” Calls for engagement focused on participation in: identifying relevant data, planning for environmental water, or identifying cultural flow priorities. Among the seven recommendations calling for greater representation within water reform/governance, there were explicit calls for various forms of representative structures such as “a committee on Aboriginal water interest,” advisory committees, and representative committees to elevate Indigenous concerns within existing governance structures. Indigenous rights to water were only mentioned twice, by Walker (2019), who suggested that:

Basin States should review and amend their water resource planning and management legislation to expressly recognize and authorize the taking and use of water in exercise of Native Title rights and interests, whatever they may be determined to be and without additional limitations.

However, there may be explicit conflict between the exercise of these Native Title rights (e.g., to fish) and the exercise of statutory water rights, which deplete flows in ways that may reduce fish populations. The Productivity Commission (2021) focused its recommendations on “sourcing water within existing entitlement frameworks” and rights were only discussed in areas in which water markets were undeveloped and therefore not within the MDB.

Notably, trade-offs were either not applicable or implied in these recommendations, yet greater entitlements for First Nations necessarily involved reducing current allocations for consumptive or environmental water. Instead, recommendations focused on access to water, for example, “practical pathways for the use of

water for cultural and economic outcomes” (MDBA 2020, our emphasis). Framing reform in this way completely negates calls for recognition of water rights and water justice for First Nations in the basin (MLDRIN 2007). Other recommendations perpetuate the assumption that trade-offs can be optimized through environmental watering priorities meeting cultural flow objectives. This attitude is exemplified by Keelty (2019) who recommended:

Consider further mechanisms by which Aboriginal representatives can have input into the watering priorities of the Commonwealth Environmental Water Holder in order to meet their cultural flow aspirations.

Desire for environmental watering to address structural inequalities within water governance in the MDB is common with 10 recommendations in some way seeking such “co-benefits” through Indigenous input, consultation, or engagement in decisions about environmental water. Although these co-benefits may be possible and should be pursued, they reflect an overall finding that these recommendations fail to address the underlying legal and institutional structures that have silenced First Nations’ voices within formal water reform processes (Hartwig et al. 2020, Jackson et al. 2021, Moggridge and Thompson 2021). Unless these foundational issues are addressed, First Nations justice, rights, culture, and economic development will likely continue to be marginalized within the MDB (Jackson et al. 2021).

DISCUSSION

Our analysis of 558 recommendations from 34 reviews and inquiries in the Murray-Darling Basin found that administrative and techno-rationalism are the dominant problem-solving logics underpinning water reform. Despite the expectations that reviews and inquiries enable adaptive governance, we found that they reinforced the limitations of the status quo. As such, movement toward the more flexible and adaptive end of the polycentric spectrum has been limited by entrenched logics that limit the capacity for the overall system to adapt and transform.

Avoiding difficult questions

The recommendations illustrate a preoccupation with resolving conflicts between environmental and consumptive needs while simultaneously seeking to avoid the explicit trade-offs therein. This reflects a central narrative that water reform can optimize outcomes through the logics identified, although remaining largely silent on ways to engage with the underlying conflict. Agonistic models of politics, informed by the reality of political contestation and distinctive political-cultural identities, offers one way forward (Mouffe 2013). Rather than seeking consensus through deliberation and compromise (the approach of administrative rationalism and democratic pragmatism), an agonistic approach would address contestation by respecting the rights of opposing actors to advocate for their positions. This is consistent with an adaptive governance perspective that is explicit about power and resists naïve assumptions that conflicting interests can always be resolved (Van Assche et al. 2017). Approaches aimed at seeking consensus often assume that when differing opinions are voiced and heard, a rational collective viewpoint can be reached through exchange and reason (Arendt 1969). Without agreement on what consensus is and how it can be defined and differentiated based on consensus of values,

beliefs, and stated preferences, participants in deliberations over highly contested and polarized values often talk past each other (Dryzek and Niemeyer 2010). To date, much discussion of agonistic pluralism remains in the realms of political and planning theory, however, there are examples of participatory processes underpinned by these ideas (Bojórquez-Tapia et al. 2017). We suggest that these debates could usefully inform adaptive water governance theory and practice, leading to experimentation with participatory processes seeking to address trade-offs through deliberation that accepts conflict as central to governing resources and seeks to make differences visible rather than hiding behind promises of win-win, optimization, and compromise.

The polycentric spectrum presented highlights that the emergence of more adaptive polycentric arrangements is not simply a matter of building capacity to learn or respond but in this case also requires a fundamental shift in the underpinning logics and power dynamics that hold the less adaptive polycentricity in place. The persistent reliance on administrative, techno-rationalist, or market-driven logics embodies a politics of compromise by downplaying trade-offs made when distributing a finite, overallocated resource. A few recent reports acknowledge the trade-offs particularly regarding climate change, but most failed to address this issue. Instead, they entrenched a compromise that left many parties unsatisfied with the reform process. Calls for more scientific understanding, technological innovations, and monitoring of social, economic, and ecological impacts of water reform could further enhance the power of technocratic elites, potentially delaying much-needed change.

The techno-rationalist logic is potentially countered by democratic pragmatism. However, the aspirations to shift power to communities embodied in these recommendations are not possible without legislative reforms that address the power of the states over water planning and allocation, thus holding the system at the less adaptive end of the spectrum. It is, therefore unlikely that calls for greater community ownership would shift the power structures embodied within the polycentric system toward the more transformative end of our polycentric spectrum unless some of the administrative rules-based arrangements are pared back first.

The narrative of compromise and “win-win” symbolizes entrenched power structures and illustrates that reviews and inquiries are failing to challenge the power of centralized actors (federal and state governments). That shifts in power are not evident even in the relatively minor adaptation challenge of trade-offs does not bode well for the more substantive challenges. Reforms to address climate change and water justice requires capacities to reorient current decision-making hierarchies. Achieving water justice requires legal rights to water for First Nations (Hartwig et al. 2020), yet reforms based in the logics of economic rationalism have led to defining water entitlements as exclusive and tradable property rights (CoAG 2004). Most recommendations accept marketized allocation regimes based on the securitization and trading of extractive entitlements. The water market has changed agricultural practices and the distribution of crop types within the basin, yet this has maintained or even enhanced the power of large corporate entities. This suggests that a polycentric system underpinned by economic rationalism may be adaptive in response to market forces but is

unlikely to contain within it the normative aspirations at the transformative end of our polycentric spectrum and within broader adaptive governance discourses to empower marginalized voices.

The redistribution of power?

It is unsurprising that governments are the primary focus of these inquiries, yet this dominance reflects their retention of formal power. This is perhaps why we do not see evidence of adaptation or transformation from inquiries focused on maintaining the status quo. As Carlisle and Gruby (2019) suggested, the dominance of powerful actors in a polycentric governance system can stifle creative problem solving and eliminate institutional diversity. We found limited shifts toward transformative ends of the polycentric spectrum and little evidence of recommendations calling for arrangements that would empower actors to experiment, coordinate, and learn. Although federal and state governments maintain both power by design and pragmatic power (Morrison et al. 2017), they continue to use their authority to set rules and distribute resources in ways that reinforce the status quo and undermine the power of more marginalized actors.

Existing governance frameworks need to transform to address climate change and First Nations water justice, or perhaps, as Pahl-Wostl (2020) suggested, these challenges may provide a “trigger” for transformative change. This is perhaps emerging with the logic of democratic pragmatism present within recommendations about First Nations. However, recommendations that support the current policy settings risk tokenistic engagement. First Nations will not be empowered without other actors relinquishing some of their economic and political power (Hartwig et al. 2020). Transformative change initiatives are repeatedly blocked by logics and institutional pathways that reproduce power relations through incremental reforms within the existing frameworks (Marshall et al. 2013, Marshall and Alexandra 2016). Again, the dominant logics from the less adaptive side of the polycentric spectrum are constraining movement toward more of a transformative polycentric system.

Decentralized adaptive approaches require strategic, long-term consultation, as well as opportunities to articulate conflicting interests, and enable local solutions to emerge (Zurita et al. 2018). Some reforms, such as water resource plans (WRPs), aim to devolve decision making to catchment-scale (there are 33 WRP areas in the MDB) and must explicitly include Indigenous uses and values (MDBA 2021a). However, responsibility remains with the state governments to develop the plans and with the MDBA to accredit them and monitor compliance. Thus, hierarchical and centralized power structures are retained and as such institutionalize fundamental tensions between the state and federal governments. For example, the NSW government failed to submit any WRPs for accreditation by the agreed deadline in 2020 and has formed a bilateral agreement to circumvent their non-compliance (MDBA 2021b). This example highlights that even incremental efforts toward a democratic pragmatist model and inclusion of First Nations’ voices operate within constraints of the overarching administrative rationalist model.

Returning to calls for more empirical research on how manifestations of polycentricity are related to environmental and social outcomes (Carlisle and Gruby 2019) and power dynamics in polycentric networks (Morrison et al. 2017), our analysis finds

that competing logics of problem solving and related power dynamics can differentiate between structural and transformative polycentricity. The diversity of government actors with different legislation and policies operating with various individuals, corporations, and communities indicate a system that is structurally polycentric. However, the logic driving water reform in government agencies remains top-down and hierarchical. Governance problems arise because these institutions are not adaptive. Although power by design still resides with the federal and state actors within the polycentric network (Morrison et al. 2017), the current structural polycentricity may exacerbate the reform challenge because the multitude of federal, state, and non-governmental actors and their conflicting interests and mandates add institutional complexity to efforts to respond to change. The tension between different logics is apparent yet similar to what Lemos et al. (2004) found with water governance reforms in Brazil; the drive toward democratic pragmatism is stymied by the ways in which the system enables entrenched elites to maintain control over the reform process (power by design). In essence, polycentric organizational structures are not sufficient to achieve the transformative goals of adaptive governance if they are not accompanied by commitment to more democratic problem-solving logics that enable new power relations.

CONCLUSION

Polycentric arrangements are held to be normatively desirable within adaptive water governance scholarship because of their perceived adaptive capacity, which is said to enable transformative change (Pahl-Wostl 2020). However, increasingly scholars are questioning the polycentric ideal calling for more critical inquiry into whether the aspiration meets the reality, and to better understand power dynamics and social-ecological outcomes within polycentric systems (Morrison et al. 2017, Carlisle and Gruby 2019). We have argued for an approach that considers the underlying logics of problem solving that drive how governance plays out in a polycentric system. Using the concept of a “spectrum of polycentric governance,” we have argued that some forms of polycentricity are likely to be more adaptive and transformative than others. We applied Dryzek’s discourses of problem-solving to disaggregate forms of polycentricity and applied this to a case study of Australia’s Murray-Darling Basin to consider how competing logics play out in an ongoing process of water reform. Our analysis suggests three broad conclusions that have implications for water reform in the MDB and more broadly for adaptive water governance theory and practice.

First, we find that entrenched logics of administrative and technological rationalism both produce and are re-produced by the power of federal and state governments who set, administer, and monitor the rules governing the system. We find that the transformative changes required to address First Nations’ water justice and climate change are unlikely to emerge from formal reviews that accept the underlying premise of the current policy and institutional frameworks. Rather, reviews essentially seek to make the status quo work a little better through incrementalism and technological efficiencies that perpetuate the mythology that “win wins” are possible. As such, we suggest that typical reviews and inquiries, which represent opportunities for learning and change, are unlikely to drive shifts toward more adaptive governance in the context of these dominant logics. If they do not trigger changes that maintain the overarching objectives of reform, this

suggests their role is political and performative. Although they may assess and make public progress on water reform, our finding that they largely reiterate similar messages and logics over time is indicative of their inadequacy as mechanisms to enable adaptive course correction or reform. It would therefore behoove government actors who perpetuate the cycle of reviews and inquiries to seek other mechanisms to assess the status of reform, to experiment with ways of sharing decision-making power that is more inclusive and capable of confronting the trade-offs and conflicts inherent to water reform. Moreover, if addressing climate change and water justice requires transformative changes to governance, the incrementalism to-date begs the question of whether those with the power to undertake upcoming reviews of the Water Act and the Basin Plan have the appetite and ability to push for greater changes when significant reform windows open.

Second, our case study shows that entrenched conflict and power asymmetries can result in a governance system that is largely “stuck” at the structural end of the polycentric spectrum. These findings directly question the assumption that polycentric systems will enable adaptation toward a system that is normatively desirable. The system may have adapted over time in response to market logics and vested interests, however, these changes have stalled progress toward the overarching objectives of the reform to rebalance environmental and consumptive uses of water. This raises the question for further research to consider whether it is simply the “adaptive” nature of adaptive water governance that is desirable or if some other normative proposition, perhaps water justice is needed as a central organizing concept within this field of scholarship and practice.

Finally, the analysis of the problem-solving logics underpinning the polycentric governance system yielded important insights into why elements of adaptive water governance within the MDB are confounded by the longstanding hierarchical, technocratic approaches to governance. The conceptual framework of a polycentric spectrum developed here could be used in other governance contexts to further test our assumptions about what enables the transformative aspects of polycentricity and the ways in which the entrenched power of the state or other powerful actors perpetuate the status quo. Our analysis shows that different governance logics led to inconsistent recommendations to reform the rules and policies of water governance. We find that in this case, our spectrum does not necessarily represent one that a governance system progresses through; from administrative to democratic but rather that these logics co-exist, creating tensions between different modes of governance that can stymie progress toward the kinds of transformative approaches to adaptive governance envisaged in the literature. Future research using ethnographic approaches or in-depth interviews could consider how these tensions play out in the lived experiences of those engaged with implementing various aspects of water governance. Such research could also consider whether the assumption that increasing functional polycentricity is more transformative in practice and that these systems are better able to address fundamental trade-offs and conflicting values.

If administrative and techno-rationalism are maladaptive to address uncertain futures and reviews and inquiries do not prompt transformative changes, then what is the prospect for adaptive

governance? The deficits identified in our analysis point toward alternative approaches whereby governance structures are situated in the interaction between the free ranging “public space” of ideas and options for reform and the “policy space” (or empowered space) for formalizing actions for change (Dryzek 2010:11). Such an approach requires effort to address power imbalances and lack of policy-making accountability that are perpetuated by separation between these spaces in the distributed decision-making characteristic of polycentric systems. In the case of the MDB, it is time to rethink the overall architecture of reform, the objectives and ways of achieving it, and how power and responsibility are distributed within the polycentric system. A shift toward more democratic approaches could be used to identify and support positive innovations through, for example, First Nations leadership or transformative approaches to climate adaptation. Grappling with the trade-offs inherent to water reform and the concomitant conflicts could clearly benefit from more adaptive approaches: experimental learning, self-organizing across a wide range of actors, voluntary social coordination, and deliberative processes. Such initiatives are in their infancy among basin communities and as our analysis showed, current politics and/or means to approach existing conflicts will need to change before such shifts are possible. This would require governance reforms that fundamentally grapple with how power is distributed among actors in a governance network and how conflicts between different uses will be navigated in a future with more demand and less water.

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The data that support the findings of this study are openly available in figshare at <https://doi.org/10.6084/m9.figshare.14489721>.

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Appendix 1. Reviews and inquiries included in the analysis.

Author	Year	Title	Number of Recommendations	Type of report
Australian Competition and Consumer Commission	2020	Murray-Darling Basin water markets inquiry Interim report	14	Government commissioned inquiry
Byron, N.	2017	Review of the Commonwealth Environmental Water Holder's operations and business processes Commonwealth Environmental Water Holder On behalf of the Independent External Review Panel	9	Independent external review
Claydon, G.	2019	Review of the Murray-Darling Basin Joint Governance Arrangements Final Report	14	Independent external review
Cosier, P., Flannery, T., Harding, R. Hillman, T., Hughes, L., Lindenmayer, D., Karoly, D., Pittock, J., Possingham, H.	2017	Review of water reform in the Murray-Darling Basin, Wentworth Group of Concerned Scientists	5	Independent external review
Hart, B., Butcher, R.,	2018	Commonwealth Long-Term Intervention Monitoring Project: Stage 1 Mid-term Review and Evaluation	19	Evaluation
House of Representatives, Standing Committee on Regional Australia	2011	Of drought and flooding rains: Inquiry into the impact of the Guide to the Murray-Darling Basin Plan	21	Parliamentary inquiry
House of Representatives, Standing Committee on the Environment and Energy	2018	Report on the inquiry into the management and use of Commonwealth environmental water: Inquiry into the management and use of Commonwealth environmental water	9	Parliamentary inquiry

Jackson, S., Moggridge, B., Robinson, C.	2010	Summary of the scoping study: Effects of change in water availability on Indigenous people of the Murray-Darling Basin	3	Independent external review
Keelty, M.	2019	Northern Basin Commissioner first year report 2019	13	Ministerial appointed independent external review
Maloney, M., Boehringer, G., Maccarrick, G., Satija, M., Graham, M., Williams, R.,	2019	2019 Citizens' inquiry into the health of the Barka / Darling River and Menindee Lakes	50	Citizen's inquiry
Murray Darling Basin Authority	2014	General review of salinity management in the Murray-Darling Basin	5	Internal government review
Murray Darling Basin Authority	2016	The Northern Basin Review: Understanding the economic, social and environmental outcomes from water recovery in the northern basin	8	Internal government review
Murray Darling Basin Authority	2017	The Murray-Darling Basin Water Compliance Review: Containing reports by the Murray-Darling Basin Authority and the Independent Review Panel	12	Internal government review
Murray Darling Basin Authority	2020	The 2020 Basin Plan Evaluation	12	Internal government review
National Water Commission	2007	National Water Initiative: First biennial assessment of progress in implementation	4	Government commissioned inquiry
National Water Commission	2008	Update of progress in water reform	2	Government commissioned inquiry
National Water Commission	2009	National Water Initiative: Second biennial assessment of progress in implementation	56	Government commissioned inquiry

National Water Commission	2010	Alignment of water planning and catchment planning	9	Government commissioned inquiry
National Water Commission	2011	National Water Initiative: Third biennial assessment of progress in implementation	10	Government commissioned inquiry
National Water Commission	2012	Water policy and climate change in Australia	19	Government commissioned inquiry
National Water Commission	2014	National Water Initiative: Fourth biennial assessment of progress in implementation	8	Government commissioned inquiry
Productivity Commission	2010	Market mechanisms for recovering water in the Murray-Darling Basin: Productivity Commission research report	8	Government commissioned inquiry
Productivity Commission	2017	National Water Reform	24	Statutory review
Productivity Commission	2018	Murray-Darling Basin Plan: Five-year assessment	38	Internal government review
Productivity Commission	2021	National Water Reform 2020: Productivity Commission Draft Report	16	Statutory review
Sefton, R., Woods, R., Kassebaum, A., McKenzie, D., Peterson, D., Ramsay, M., Simpson, B.	2020	Panel report: Independent assessment of social and economic conditions in the Basin	20	Ministerial appointed independent external review
The Senate, Environment and Communication References Committee	2010	Sustainable management of the Commonwealth of water resources	4	Senate inquiry

The Senate, Rural and Regional Affairs and Transport References Committee	2006	Water policy initiatives Final report	16	Senate inquiry
The Senate, Rural and Regional Affairs and Transport References Committee	2008	Water management in the Coorong and Lower Lakes	12	Senate inquiry
The Senate, Rural and Regional Affairs and Transport References Committee	2009	Implications for long-term sustainable management of the Murray Darling	14	Senate inquiry
The Senate, Rural and Regional Affairs and Transport References Committee	2013	The Management of the Murray-Darling Basin	23	Senate inquiry
The Senate, Rural and Regional Affairs and Transport References Committee	2018	Integrity of the Water Market in the Murray-Darling Basin	6	Senate inquiry
The Senate, Select Committee on the Murray-Darling Basin Plan	2016	Refreshing the Plan	31	Senate inquiry
Walker, B.	2019	Murray-Darling Basin Royal Commission Report	44	Royal Commission
		Total Reviews and Inquiries	34	
		Total Recommendations	558	

Appendix 2. Thematic codes considered in deductive coding.

Thematic codes included in Deductive analysis	Climate change	Environmental works and measures	Social data
	Community education	ESLT and SDL	Socio-economic
	Community engagement	Extraction limits	Transparency
	Compliance	Indigenous cultural flows & practices	Trust
	Constraints relaxation	Indigenous economic development	Water information
	Digital technology	Indigenous knowledge	water literacy
	Economic analysis	Infrastructure	Water market
	Economic impact	Knowledge priorities	Water modelling
	Efficiency measures	Monitoring and reporting	Water planning
	Environmental Water	Scientific advice	
Most commonly occurring codes	Environmental water	Water Market	Water recovery
	Compliance	Monitoring	Climate change
	First Nations	Infrastructure	Water planning
	ESLT and SDL		