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Institutional Path Dependence and Environmental Water Recovery in Australia's Murray-Darling Basin

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ABSTRACT: The concept of institutional path dependence offers useful ways of understanding the trajectories of water policy reforms and how past institutional arrangements, policy paradigms and development patterns constrain current and future choices and limit institutional adaptability. The value of this concept is demonstrated through an analysis of environmental water recovery in Australia's Murray-Darling Basin, where while significant water volumes have been reallocated to the environment, the costs have also been significant. While there are significant lessons from the Australian experience, attempts to emulate the approach involve substantive risks and may be prohibitively costly for less wealthy nations. Context-specific institutional analysis is emphasised as fundamental to water reform and critical for reform architecture and sequencing. A key finding is that while crisis can provide powerful catalysts for institutional innovation, institutional path dependence in the absence of active and disruptive policy entrepreneurs fosters a strong tendency to reinforce the status quo and limit innovation, potentially exposing social-ecological systems to greater shocks due to climate change and other sources of escalating uncertainty.

KEYWORDS: Water reform, environmental water, institutional path dependence, policy entrepreneurship, vested interests, polycentricity

INTRODUCTION

Pressures on the Earth's water resources have escalated to the extent that water use is identified as one of the nine planetary boundaries defining humanity's 'safe operating space' (Rockström et al., 2009), with projections that the water boundary will be approached by 2050 (Rockström, 2014). The World Economic Forum (2015) estimates that on current trends two-thirds of the world's population will experience water stress by 2025, and global water requirements will exceed sustainable supplies by 40% in 2030.

Excessive water extractions have degraded many riverine ecosystems, with climate change exacerbating this pressure due to more frequent and severe droughts in the mid-latitudes (IPCC, 2012). Irrigation is the major contributor to streamflow reductions in four of the world's major river basins (Grafton et al., 2012) including Australia's Murray-Darling Basin (MDB), where 96% of diverted water is used for irrigation (Connell, 2011). Streamflow regulation and irrigation use contributes to the poor or very poor ecological health of most of the 23 Basin's major rivers (Davies et al., 2010).

The MDB Plan is a recent legislative instrument that aims to optimise economic, social and ecological benefits of water management. It requires that water extractions from MDB rivers be reduced by about 25% (Commonwealth of Australia, 2012). The reforms in the MDB can be considered an international

'test case' because of the size of planned reductions, the basin-scale planning framework, and the extensive use of markets for water reallocation (Grafton et al., 2014). At the end of November 2015, environmental water recovery was estimated at 1954 gigalitres (GL), or just over 70% of the 2750 GL surface water recovery target (Commonwealth of Australia, 2015b).

Although claims that Australia's water reforms represent world's best practice are common, they deserve critical examination (Quiggin et al., 2012; Loch et al., 2013a). Australia has had over two decades of slow progress in implementing intergovernmental commitments to comprehensively reform water policy, including persistently failing to meet commitments made as early as 1994 to provide environmental flows based on best available science (COAG, 1994, 2004).

Connell (2011) chronicled successive 'failures' to deliver on promised MDB reforms, while several economists pointed to the massive costs and inefficiency of Australia's approach to environmental water recovery. Loch et al. (2013b) estimated that over $A20 billion has been spent on environmental water recovery in recent decades, with Young (2014) claiming that half could have been saved if more robust water allocation regimes had been established before tradable water rights were introduced. Tradable water rights were effectively 'gifted' to existing water rights holders, before rectifying excessive extraction levels throughout the MDB.

It is conceivable that reforms could have been achieved at much lower cost if the five 'Basin state' governments (Queensland, New South Wales, Victoria, South Australia and the Australian Capital Territory) with jurisdiction in the MDB had honoured their earlier commitments to reduce extractions and restore environmental flows (COAG, 1994, 2004). They held the legal and constitutionally derived powers to reduce, redefine or reallocate water rights in accordance with the public interest (however this may be defined), but these were not exercised sufficiently to meet environmental requirements, with many aquatic ecosystems remaining severely degraded due to lack of water (Kingsford, 2009).

An analysis of institutional path dependence can be used to explain why. Young (2014: 54) concedes that "no cheaper reform pathway may have been politically feasible" (see also Marshall et al., 2013). Australia's Productivity Commission (2010: xxxv, 140) observed that the high-cost path "can be seen as the price the Australian Government was prepared to pay to make progress on important reforms… [This path] was needed to convince the states to a truly basin-wide approach to water planning and to elicit the irrigation sector's support for increasing environmental water allocations". In short, reversals of earlier reluctance to implement environmental water reforms were achieved, and commitments to implement reform, were 'bought' from state governments that had twice previously agreed to essentially implement the same reforms. Why had these governments twice failed to deliver environmental water reforms and then reluctantly conceded?

Institutional analysts increasingly invoke institutional path dependence as a starting point for understanding the feasibility or affordability of reforms. North (1990) broadly defined path dependence as occurring where opportunities for institutional reform are constrained by existing institutional arrangements. Basically history shapes what is possible. Scholars applying this concept to the analysis of water reforms include McCann and Easter (2004), Marshall (2005, 2013), Crase and O'Keefe (2008), Heinmiller (2009), Libecap (2011), Cummins and Watson (2012), Garrick et al. (2013), Hall et al. (2014), Venot and Suhardiman (2014), Garrick (2015), and Cox (2016).

Building on this work, this paper employs the concept of institutional path dependence to understand the challenges of reforming water institutions. It focuses on environmental water recovery in the MDB. This research supports improved knowledge of how past institutional decisions affect the present and "can suggest both how they might come apart and how their permanence will shape water policy options and limit the politically possible" (Wilson, 2014: 2).

This paper is set out as follows. The next section presents a brief overview of the MDB. We then provide a selective summary of the literature on institutional path dependence, before interpreting MDB environmental water recovery efforts through the lens of this concept. Next we offer some

perspectives on why two decades of reforms achieved limited success in shifting water resources management from the dominant supply-oriented, engineering-dominated modes. We then document some reasons for progress in environmental water recovery despite institutional path dependence and, finally, offer concluding observations.

THE MURRAY-DARLING BASIN CONTEXT

The main rivers in the MDB flow from their headwaters in the Great Dividing Range, meandering across the extensive floodplains of the Murray and Darling basins before discharging to the Great Southern Ocean (Figure 1). With a climate dominated by recurring decadal droughts interspersed with flood phases (Gergis et al., 2012), the MDB is one of the world's most variable river basins in terms of stream-flows and precipitation (Grafton et al., 2014). Extensive networks of infrastructure regulate flows, with major storages on most rivers, hundreds of weirs, thousands of kilometres of channels, and barrages to prevent sea water entering the lower lakes at the Murray Mouth (Fawcett and Wood, 2014).

The MDB extends over one million square kilometres, with over 80% used for pastoralism and agriculture. Approximately 2% of the total agricultural area is irrigated, generating a significant proportion of the value of agriculture. The extensive floodplains have over 30,000 wetlands, including 16 listed under the Ramsar Convention of Wetlands of International Importance. Water extractions have degraded rivers, floodplains and wetlands (Grafton et al., 2012) contributing to the poor ecological health of most rivers (Davies et al., 2010).

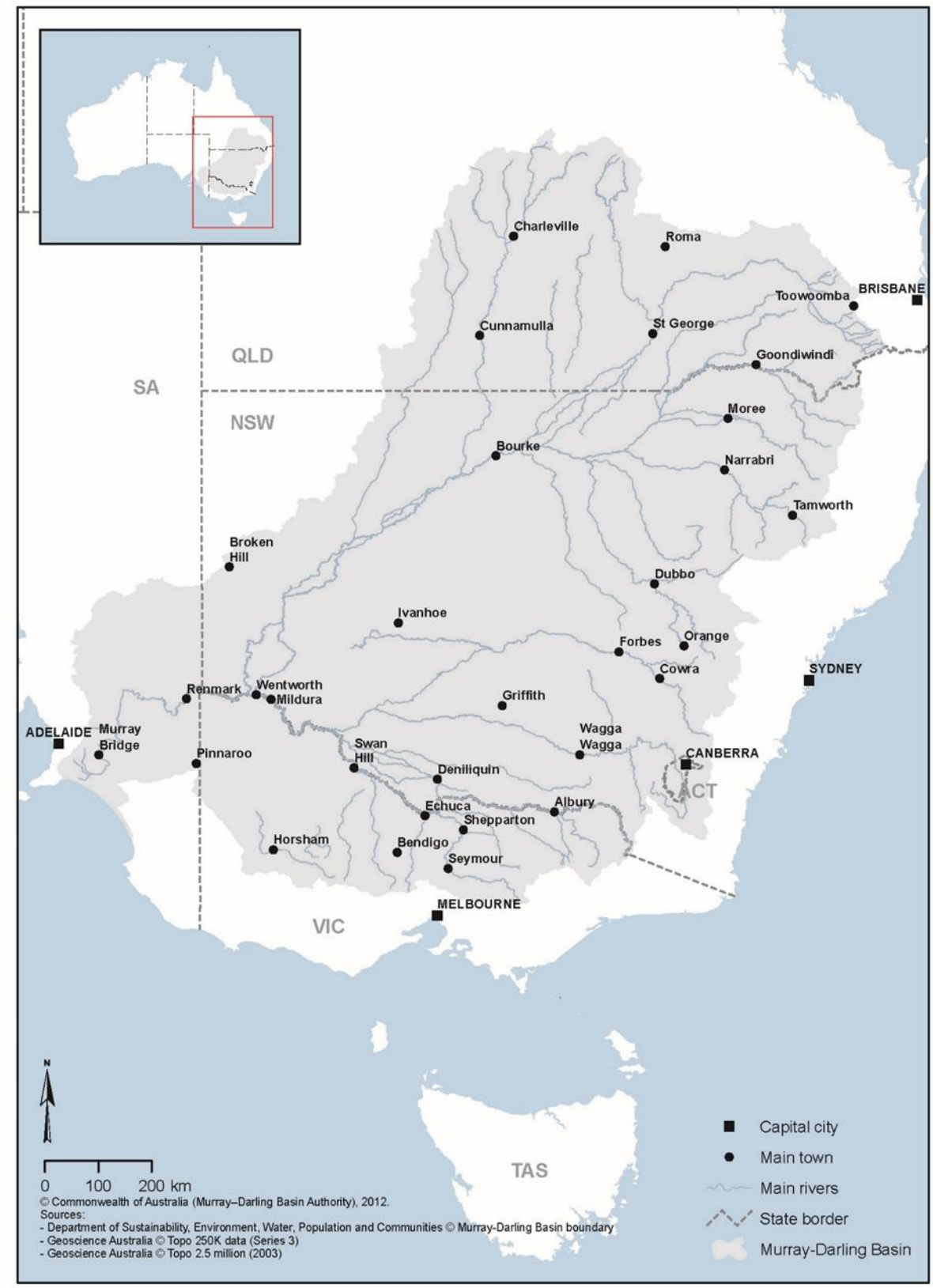
Water resource and irrigation development have been primarily the responsibility of state governments, each operating with a high degree of autonomy. While state-based systems evolved separately, cooperative arrangements for governing the basin's shared waters (mostly the River Murray system) also evolved over the past century.

Two defining features of the MDB are that most river systems are over-allocated (Marshall et al., 2013) and water resource security has been declining. A third is that degradation of many of the MDB's riverine environments is intense, with river ecosystem health in 17 of the basin's 23 valleys over 2004-07 classified as either poor or very poor (Davies et al., 2010).[1] Repeatedly over the last three decades, governments have developed cooperative policy initiatives aiming to introduce more sustainable and integrated water resources management that minimises further degradation and restore health to riverine ecosystems, but with only limited success (Connell, 2011).

In 2007, in the depths of the Millennium Drought (1995-2009), Australia's national (Commonwealth) government intervened, deciding to play an increasingly central role in responding to these challenges (Marshall et al., 2013). The intervention was based on claims that the crisis in Australia's most important river system provided evidence that co-operative governance arrangements were failing. The MDB Plan and major programmes of environmental water recovery resulted from this intervention.

[1] This finding was based on assessments across five themes: hydrology, physical form and processes, fish, macroinvertebrates, and vegetation.

Figure 1. The Murray-Darling Basin.



INSTITUTIONAL PATH DEPENDENCE

Path dependence has become a central concept for investigating historical influences on institutional change. This concept refers to self-reinforcing sequences in the establishment and long-term reproduction of a particular institutional pattern. It accounts for how choices made during a key turning point or 'critical juncture' can trigger a subsequent sequence of events, including further institutional choices, which follow a relatively stable pattern (Mahoney, 2000). During critical junctures, novel conditions "disrupt or overwhelm the specific mechanisms that previously reproduced the existing behaviour" (Sjöstedt, 2015: 2).

Institutional path dependence is dynamic, with each step taken along a particular development path increasing the benefits of this path over time compared with the alternatives that were originally available (Sjöstedt, 2015). Thelen (1999: 387) observed how "institutions continue to evolve in response to changing environmental conditions, but in ways that are constrained by past trajectories".

The concept of institutional path dependence has become influential within the new institutional economics (NIE), where North (1990) explained that the self-reinforcing feedbacks driving this phenomenon arise from both the internal and external dynamics of institutional change. The internal dynamics derive primarily from effects of institutional change within an organisation, because the "knowledge, skills, and learning that the members of an organisation will acquire will reflect the payoff – the incentives – imbedded in the institutional constraints" (ibid: 74). In turn, "the way in which knowledge develops influences the perceptions people have about the world around them and hence the way they rationalise, explain, and justify that world…" (ibid: 76). Institutional change thus influences the evolution of mental models including worldviews, rationalities and ideologies. The resulting mental models influence "the perceptions of the entrepreneurs in political and economic organisations that they could do better by altering the existing institutional framework at some margin" (ibid: 8).

External dynamics of institutional change arise from "the dependence of the resultant organisations on that institutional framework and the consequent network externalities that arise" (ibid: 7-8). These network externalities follow from organisations structuring themselves in line with the new incentives, and with the technological, biophysical and other conditions evolving under these incentives (Cox, 2016), and thus acquiring further incentives to preserve the new institutions. As Dixit (1996: 26) observed, "policy acts shape the future environment by creating constituencies that gain from the policy, who will then fiercely resist any changes that take away these gains".

External dynamics influence the 'structural' interests of organisations, whilst the internal dynamics influence their own perceptions of these interests. Together, the two sets of dynamics influence how boundedly-rational organisational actors come to perceive their vested interests in respect of an existing, proposed or new institutional arrangement. Although the NIE literature on path dependence focuses largely on self-reinforcing feedbacks, these are not the only sources of influence. Sunk (i.e. unrecoverable) costs of institutional changes are another, with evidence that humans continue to value such costs and are reluctant to leave a path in which they have been incurred (Kahneman and Tversky, 1979; Cox, 2016). Path dependence can also arise in the absence of self-reinforcing feedbacks due to sequencing issues (Arrow, 2000). Heinmiller (2009) argued that the sequence of institutional changes is important because early changes alter subsequent institutional policy choices, pre-empting some options and affecting the attractiveness of others. As an example, Young (2014) observed that establishing tradable rights and water markets in the MDB prior to fixing fundamental flaws in water allocation regimes greatly increased the costs of changing from irrigation-dominated paths to those better balancing irrigation and environmental needs.

In the path dependence literature more broadly, the term 'lock in' signifies that opportunities for reform are constrained, but not that institutional arrangements are beyond reform. Stability of an institutional path over time arises from what have been called mechanisms of institutional reproduction. The strength of such mechanisms can vary between the institutional options available for

selection during a critical juncture, and can affect the stability of the path triggered by the option actually selected. Mahoney (2000: 515) found from research in historical sociology that:

> Institutions that rapidly and decisively trigger mechanisms of reproduction are especially capable of seizing opportunities provided by contingent events [i.e. events triggering critical junctures] and thus setting into motion self-reinforcing sequences that are path dependent. Efficacious mechanisms of reproduction enable an institution to quickly take advantage of contingent events that work in its favour, solidifying a position of dominance before alternative options can recover. By contrast, with institutions that more gradually trigger mechanisms of reproduction, a contingent event may initially favour the institution, but the institution will not prevail in the long run because the mechanisms are not activated quickly enough or powerfully enough to capitalise on the early advantage.

Mahoney (2000) distinguished four modes of explanation for mechanisms of institutional reproduction (i.e. utilitarian, functional, power and legitimation modes), while Thelen (1999: 399) argued that diagnosing the mechanisms that sustain particular institutional patterns holds the key to "understanding moments in which fundamental political change is possible". The latter observed that diagnosis of this kind means "we need to know who is invested in particular institutional arrangements, exactly how that investment is sustained over time, and perhaps how those who are not invested in the institutions are kept out" (ibid: 391). She found also that moments conducive to institutional reform can arise "when collision of two previously unconnected policy streams … turn[s] a particular area of policy in a direction that policy makers did not originally intend", or when gaps and lags between different (e.g. national and provincial) levels of governmental policy action create openings that enable non-government actors to influence institutional development in ways that government actors have not anticipated and are unable to control (ibid: 396).

Rodrik (2014: 206) identified that 'formative moments' (i.e. critical junctures) can also be triggered when those in powerful positions implement new ideas, noting that: "Reform often happens not when vested interests are defeated, but when different strategies are used to pursue those interests, or when interests themselves are redefined". This perspective recognises that stakeholders' vested interests around institutional change are artefacts of mental models about their identity, how the world works and what options are available to them. Innovation in these mental models "can unlock what otherwise might seem like the iron grip of vested interests" (ibid: 194). Innovation of this kind can be purposive, but may also arise from serendipity, unplanned experimentation, or through transferring ideas that worked elsewhere. It can also arise from crises, when prevailing dominant interests lose legitimacy and/or become more open to alternative institutional approaches. Moments conducive to institutional reform can be achieved too by non-dominant interests preparing for, creating and/or taking advantage of 'windows of opportunity' which open when crises occur (Olsson et al., 2006; Marshall et al., 2010). To capitalise on such crises it is crucial that "entrepreneurs notice and exploit those loose spots in the structure of ideas, institutions and incentives" (Leighton and López, 2013: 134).

Institutional path dependence is of particular concern to scholars interested in the resilience of social-ecological systems because it may constrain such systems from achieving the institutional adaptations required for their robustness in the face of unforeseen events (e.g. arising from climate change). Concerns have been raised that institutional path dependence may threaten the robustness of the MDB's social-ecological systems (e.g. Walker et al., 2009), with Loch et al. (2016: 3) observing that "under increasing uncertainty surrounding future Australian (and global) climate contexts, it becomes important [in MDB water policy choices] to create flexible pathways that avoid lock-in actions or irreversible investment". Fostering social-ecological robustness thus requires an anticipatory approach to governance capable of envisioning the lock-in implications of institutional options when choosing between them (Boyd et al., 2015).

In summary, institutional path dependence does not mean that potential paths are predetermined by historical circumstances, but rather that a range of dynamics and factors shape prospective

institutional innovations. In the next section we provide an interpretation of institutional path dependence in the MDB policy reform process around environmental water recovery. Our focus is on how institutional path dependence in this context has added to the costs of achieving effective recovery of environmental water by maintaining recovery efforts on a predominantly supply-driven, infrastructure-oriented path, and how this may increase the future costs of adapting in response to surprises, including those anticipated to arise from climate change. The impacts of institutional path dependence in the policy reform process beyond those on the costs of environmental water recovery (e.g. on economic sustainability of irrigation regions) are beyond the scope of our analysis. The MDB has experienced a succession of attempts to reform water policy since the 1990s, and the implications of institutional path dependence for the outcomes of each of these are considered in the following section. This consideration is informed by the theoretical discussion of institutional path dependence presented earlier, and explores in particular the emergence of critical junctures offering opportunities to disrupt the inherited supply-driven pattern of policy development, and how mechanisms of institutional reproduction constrained how these opportunities were seized to increase cost effectiveness in recovering environmental water. We start by considering the historical origins of the supply-driven path of institutional development in respect of MDB water policy.

ENVIRONMENTAL WATER RECOVERY IN THE MURRAY-DARLING BASIN: AN ACCOUNT OF INSTITUTIONAL PATH DEPENDENCE

Origins of infrastructure-dominated pathways for water resources management

Reallocation of large volumes of water from irrigation to the environment is emblematic of a new era in water resources policy. It represents an historic departure from the institutional path followed in the MDB for over a century, and in other parts of the world for several thousand years. This long-dominant path has been supply-oriented, focused on designing and constructing infrastructure for water storage and supply (Brandes et al., 2009) through understanding and controlling the physical and social aspects of water (Linton and Budds, 2014).

Pursuit of this path intensified in the late 19th century and early 20th century with the international 'craze' for irrigation development that resulted in the establishment of substantial 'hydraulic bureaucracies' whose mission was described as "a celebration of technology and domination over nature" (Molle et al., 2009: 336).

After privately financed irrigation schemes had struggled with drought and finances, Australian governments became heavily involved in developing irrigation. In 1907, the head of Victoria's Rivers and Water Supply Commission argued for greater government support of irrigation development and increased application of engineering expertise. 'Nation building' focused on 'taming rivers', with large dams constructed to supply vast irrigation schemes built under the clarion call of 'drought proofing', continued through most of the 20th century (Pigram, 1986), and spawned politically powerful constituencies and institutions that continue to dominate water policy (Cummins and Watson, 2012). The turn in the early 20th century towards public support by Australian governments for a supply-driven, engineering-dominated pattern of irrigation development can thus be understood as a critical juncture leading to a particular path of institutional development which continues to constrain water policy reform efforts seeking cost-effective recovery of water to sustain the ecological health of the MDB's riverine systems.

Irrigation expansion and the Cap

The rationalities and institutions of water management adopted in Australia after British occupation in 1788 were transferred from the colonial power where water is pervasive in the landscape (Cathcart, 2009). However, the British system of riparian rights was eventually found to be poorly suited to

Australia's more variable climate. The Victorian politician (and subsequently national Prime Minister) Alfred Deakin championed centralised government control of water leading to the Victoria Irrigation Act 1886. Legislation mirroring this was introduced in most Australian states in the lead-up to the nation's federation in 1901 (Garrick, 2015). These laws vested all water in the state and formalised the issuing and administration of water licenses (Hussey and Dovers, 2006). This legal and administrative system enabled state governments to allocate and reallocate water and modify the volumes, terms and conditions as they deemed appropriate, and thus represented a conscious attempt to stave off emergence of lock-in around the pattern of water rights created during that formative period (Garrick, 2015). Statutory water rights, issued as water use licenses, were typically attached to land titles (Grafton and Horne 2014; Wheeler 2014). These rights, together with public investments in irrigation infrastructure, were used to encourage rural economic development (Grafton et al., 2014) which "combined with autonomous colonial/state foundations, gave rise to powerful state-based water bureaucracies" (Crase et al., 2009: 441).

The state governments retained the water and natural resources management powers in the Australian Constitution agreed to at federation, but control of the Murray River was one of the most divisive issues in the debates leading up to federation. Conflict between the southern MDB states persisted beyond federation. After a severe drought, they finally accepted the 1914 River Murray Waters Agreement where the Commonwealth offered to fund the construction of dams and weirs that supported navigation and provided the storage capacity needed to meet emerging irrigation demands (Heinmiller, 2009).

Throughout most of the 20th century state governments issued new water use licenses with the aim of increasing agricultural production. From the 1950s to the 1970s, the Commonwealth funded construction of infrastructure used to expand irrigation (Grafton et al., 2014). It also granted generous tax incentives to encourage farmers to invest in on-farm irrigation infrastructure.

Most licenses were issued during the relatively wet decades from the 1950s to the 1990s, so that serious problems of over-extraction only emerged when drier conditions returned (Wheeler, 2014).[2] Although it had become evident in the 1980s that the MDB's water economy was transitioning from an expansionary to a 'mature' phase, in which policy needed to refocus from increasing supply to demand management (Randall, 1981), a 'Cap' on further extractions from the MDB's surface water was only agreed to in 1995, reflecting the consensus by 'Basin governments' that water resources were over-committed[3] (Murray-Darling Basin Ministerial Council, 1995).

The 1994 COAG water reform framework

In 1994, the Council of Australian Governments (COAG) (1994) agreed to an ambitious programme of water policy reforms. This was part of the wider national economic reform agenda – the National Competition Policy announced a year earlier – that aimed to modernise the Australian economy, including through introducing greater competition and the 'user pays principle' (Hussey and Dovers, 2006). Government-owned enterprises and state-sponsored sectors, like energy and water, were a key target of these economic reforms. Coming in the wake of the Rio Convention on Sustainable Development, the water reform agenda aimed to balance pro-market reforms, designed to replace the incumbent supply-driven approach to water policy with a demand-driven approach, with broader sustainability goals.

[2] For instance, in 1991 a toxic bloom of blue-green algae occurred over a distance of 1000 kilometres of the Darling River and led the New South Wales Government to declare a state of emergency (Bowling and Baker, 1996).

[3] The 'Cap' announced in 1995 was an interim measure, but in 1997 it was made permanent for the MDB states of New South Wales, Victoria and South Australia (Crase et al., 2009).

The COAG reforms were based largely on the recommendations of the Industry Commission (1992), the Australian Government's preeminent economic research organisation. Based on its wide-ranging inquiry into water it recommended the introduction of a comprehensive regime of tradable water entitlements, coupled with introduction of full cost recovery through corporatisation of irrigation authorities. The Commission argued that higher charges would result in reduced water use with attendant environmental benefits, stating that the "reforms needed in the rural water economy go well beyond higher water charges. But it is the higher charges which could have the most immediate effect upon both irrigators and rural communities – higher charges may bring a significant reduction in water usage in some areas. In turn, this may mean a contraction in irrigation and consequent dislocation for local communities, although the restructuring could allow an expansion of some crops in particular areas. And the environmental benefits could be widespread" (ibid: 208).

In the water reform agreement, governments committed also to an ambitious programme "to arrest widespread natural resource degradation" (COAG, 1994: 3); providing environmental flows to all rivers based on the best available science; and to introduce "comprehensive systems of water allocations or entitlements backed by separation of water property rights from land title", with the environment recognised as "a legitimate user of water" (COAG, 1994: 4). These commitments can be understood as arising from a critical juncture created by a collision of previously unconnected policy streams (namely water policy, competition policy and environmental sustainability policy) in the novel context of a maturing water economy.

Irrigation water charges in the early 1990s did not recover the cost of building, repairing or operating irrigation infrastructure (Industry Commission, 1992), and it was estimated that these charges would need to be increased substantially to achieve full cost recovery (ACF, 1992). Irrigators feared that strict application of 'user-pay principles' and an abrupt withdrawal of historic subsidies would make many irrigation enterprises uneconomic. Recognising that closure of marginal irrigation enterprises may threaten the viability of whole irrigation districts due to fewer farmers sharing the cost of operating and maintaining infrastructure, a more orderly industry restructuring was called for (ibid).

The Commonwealth offered staged financial incentives to the states to implement the agreed reforms, but these 'tranche' payments were conditional on progress within a prescribed period. Each state embedded the requirements of the COAG framework in new legislation. NSW, for instance, legislated the Water Management Act (2000) which defined environmental protection as a legitimate and high priority use of water. This Act mandated development of watershed (sub-basin) water-sharing plans through consultative planning processes in which selected stakeholders would be represented. Allocations to irrigators, other water users and the environment were to be defined in these plans. Irrigators resisted legislated reallocation of water rights to the environment but the state government was motivated to secure its tranche payments (Heinmiller, 2014).

State governments committed themselves in the COAG water reform agreement to introduce trading arrangements for water allocations and water entitlements[4] by 1998. This timeline was overly optimistic (Quiggin, 2008). This lack of progress can be understood from the perspective of the theory presented earlier as resulting from the mechanisms of reproduction for the new institutions lacking the speed and power required to capitalise on the early advantages they enjoyed courtesy of favourable policy and environmental events. In short, those with vested interests in maintaining the supply-driven path of policy development were able to regroup significantly in response to the threat to their

[4] A water access entitlement is an ongoing entitlement to a share of water from a specified consumptive pool as defined in the relevant water plan. A water allocation is the specific volume of water allocated to water access entitlements in a given season, defined according to rules established in the relevant water plan. Water allocations are announced on a seasonal basis, depending on how much available water exists in the water resource from which the allocation is drawn (Commonwealth of Australia, 2015c).

dominance posed by the confluence of forces driving intergovernmental agreement to the water reform framework, sufficiently at least to delay or reorient implementation of those elements perceived as inconsistent with their interests.

Reasons proposed for slow progress included farmers' reluctance to separate water rights from land due to fears that this would lead to water being traded out of irrigation districts (Horne, 2013) or out of irrigation entirely (McCann and Garrick, 2014). Such fears recognised (a) the priority given in the COAG agreement to facilitating "a system of tradable entitlements to allow water to flow to higher value use subject to social, physical and environmental constraints" (COAG, 1994: 2), (b) returns from water vary significantly across crop types and irrigation regions, and (c) irrigation is generally not a 'high value water user' when compared in conventional economic terms with other sectors. The latter fact raised irrigator fears that governments intended to facilitate trade of water from irrigation to higher-value users like miners, manufacturers and urban water consumers (Kiem, 2013). In an uncanny symmetry, these fears reflected Alfred Deakin's underlying motivation for centralising control of water: to enable the state to reallocate scarce water to higher-value uses, like mining. Irrigators were presumably also concerned at the prospect of water rights being reallocated to environmental flows.

Designing and implementing the 1994 COAG water reforms

The debate about the need for more water for the environment intensified throughout the 1990s with Australia's national environmental advocacy organisation, the Australian Conservation Foundation (ACF), launching a campaign to save the Darling River in 1995 (Alexandra and Fisher, 1995). Meanwhile, irrigators and their representatives lobbied to minimise allocations to the environment and to ensure the best possible deals from reforms, including those separating water rights from land. Holders of statutory water rights were not entitled to any compensation if volumes attached to licenses were reduced by state governments (Fisher, 2006; Young, 2014). The success of the mechanisms of institutional reproduction exploited by irrigators in prosecuting their 'property rights agenda' during the process of separating these rights from land was demonstrated by them gaining new tradable water rights equivalent to notional volumes on the licenses, rather than at accustomed extraction levels which were often much lower. Consequently, landholders with water licenses they had never exercised or not exercised for years ('sleepers' and 'dozers', respectively) succeeded in being permitted to fully activate their licenses under the new regime despite persistent warnings to governments that this would exacerbate the poor condition of the rivers (see, e.g. ACF, 1992; Alexandra and Fisher, 1995).

While COAG (1994) notionally adopted the Industry Commission policy recommendations, full cost recovery has not been rigorously applied. State governments generally wrote off the debts of irrigation corporations and statutory water authorities, and the Commonwealth Government continues to fund infrastructure renewal and upgrades under the banner of water-saving projects for environmental water recovery (Crase et al., 2009).

ACF (1992) argued in its submission to the Industry Commission (1992) inquiry that initiating water-trading regimes before introducing full cost recovery would establish a market for a subsidised resource, and that over-extraction should be remedied by specific adjustment mechanisms to increase the environment's share of available water. With irrigation water provided largely at public expense, ACF (1992) argued that tradable water entitlements should only be introduced with formal agreements about how volumes would be adjusted. These proposals were not adopted in subsequent policy reforms.

Given the dominant influence of the National Competition Policy on the 1994 water reform framework, property rights and market reforms were given greater emphasis in implementation efforts than reforms to restore ecosystems through environmental flows. Water users did not possess well-defined, tradable property rights comparable to land title when the reform framework was introduced (Quiggin, 2008). State governments committed to separate water entitlements from land titles to

facilitate the establishment of functioning water markets. Existing water use rights that could, in the process of defining entitlements, have been reduced or redefined by governments without compensation were converted to tradable rights and 'gifted' to entitlement holders, with few new conditions and without significant reductions in the volume of entitlements. License holders gained a 'financial' asset and the market for water rights stimulated increased water use, further stressing over-allocated rivers.

Markets in water rights were thus activated before sufficient rights for the environment had been defined, despite those responsible for administering water policies knowing that the river systems were severely over-allocated (Young, 2014). As sleeper and dozer licenses became activated, the total volume of water available for extraction was spread more thinly and allocations became less reliable. Water rights were progressively traded to higher-value irrigation uses, considerably increasing the value of these rights when public administrators later turned to engaging in market purchases ('buy-backs') for environmental water recovery (Wheeler et al., 2013).

Moreover, tradable rights to water from rivers were established prior to regulating alternative irrigation water sources, such as groundwater or surface drainage. The Cap in combination with tradable rights created incentives for irrigators to shift to alternative water sources. One consequence was that irrigators invested substantially in increasing groundwater use and on-farm retention of water that might otherwise have benefited riverine ecosystems (Grafton et al., 2014). The sequencing of reforms, over two decades, each only addressing part of the interconnected water systems, thus increased total water use despite formal recognition of over-allocation and the need to reduce use.

Young (2014: 54) expressed surprise at the failure to more fully think through the implications of introducing trading regimes "without simultaneously fixing flaws in the water allocation regime". Reflecting on the perverse outcomes of activating water markets prematurely, Crase et al. (2009: 444) observed that "the water market that had been so heavily promoted by economists as the vehicle for encouraging water reform played a significant part in exacerbating the over-allocation problem. These events set the scene for the re-emergence of engineering as the most politically acceptable means of addressing this issue".

We find that irrigators came out of each subsequent stage of the reform process better placed than the environment. One can only speculate on the degree to which irrigation lobbyists and hydraulic bureaucracies[5] influenced specific policy decisions. However, it is evident more broadly that mechanisms of institutional reproduction supportive of the long-standing supply-driven approach to water policy development remained ascendant in practice over those associated with the demand-driven approach agreed to in the 1994 COAG reform package. Recognition of the strong alignment of water bureaucracies with irrigation industries (e.g. Molle et al., 2009; Garrick, 2015) is not new, with ACF (1992) warning at the outset of reform efforts that the authorities responsible for administering water policy had been 'captured' by irrigation interests. Understanding historic alignments of interests is important for imposing greater rigour on those attempting to introduce reforms.

The Living Murray initiative

Eight years after the 1994 COAG agreement, insufficient progress in delivering environmental flows motivated the Murray-Darling Basin Ministerial Council to release a discussion paper on 'the Living Murray' (TLM) which aimed to "start community discussion about whether or not water should be recovered from water users for the environment" (Murray-Darling Basin Ministerial Council, 2002: 29).

[5] During this period these bureaucracies primarily involved state government agencies responsible for water administration and policy, and for construction and maintenance of public irrigation-related infrastructure, together with the consulting firms increasingly relied upon by these agencies as their staff numbers declined in response to the neoliberal push for 'smaller government'.

The central question posed was how the costs of environmental water recovery should be apportioned between governments and irrigators. Division over resolving this question became a major obstacle to progress on restoring environmental flows, with state governments concerned that a 'government-pays' approach involving either (a) purchase of water rights from willing irrigators, or (b) compensating irrigators for compulsory acquisitions of a share of their water, would set powerful precedents about 'property rights' relevant to both water and other natural resource reforms (BDA Group, 2003). The irrigation sector staunchly opposed an 'irrigator-pays' approach involving non-compensated compulsory acquisition of a share of water rights, and raised concerns that large-scale reductions in irrigators' water rights through either of the government-pays approaches may threaten the economic viability of some irrigation-dependent rural communities (ibid).

The resulting impasse was overcome in 2003 when COAG announced that a new National Water Initiative (NWI) would be developed and that the Murray-Darling Basin Ministerial Council had agreed to a 'government-pays' approach using $A500 million allocated by the Commonwealth towards the 'first step' of addressing water over-allocation problems of the MDB (Crase et al., 2005). At the time of these debates, the Millennium Drought was making the degradation of the MDB's riverine environments more starkly apparent. Increasing public concern resulted in environmental agencies being given greater roles and legitimacy in water policy making processes, and added urgency to the delivery of environmental watering commitments made by agencies historically responsible for water resources (Horne 2013; Docker and Robinson, 2014).

With $A500 million of Commonwealth funding 'on the table', options for returning water to the environment were explored given the current policy settings. The two main approaches proposed were (i) 'water-saving' infrastructure projects and (ii) market purchases of water rights ('buy-backs'). Economists argued that buy-backs from willing sellers would be more cost-effective than either water-saving infrastructure or compulsory acquisition of a fixed share of water rights (BDA Group 2003; Watson 2003). Despite the clearly articulated rationale for buy-backs, state governments favoured water-saving projects, reflecting the continuing influence of irrigation interests, including recently formed irrigation corporations, on water policy deliberations (Bell and Quiggin, 2008).

The choice of this path can be understood in terms of (a) water-saving infrastructure projects maintaining irrigation enterprises and districts at existing production levels,[6] (b) water-saving projects often funding the renewal or upgrade of ageing infrastructure, despite most irrigation infrastructure operators (IIOs) having previously accepted responsibility for funding maintenance and upgrades of the infrastructure under management[7] (Crase et al.,2009; Cummins and Watson, 2012), and (c) well-funded programmes of infrastructure projects securing greater funds and continuing employment within state water agencies, the IIOs and the engineering consultants with established expertise in irrigation systems (see Molle et al., 2009 for parallels in international experience). Together these three reasons provide a strong example of the self-reinforcing dynamics of institutional path dependence as discussed earlier.

The timeliness, technical feasibility and cost effectiveness of proposed water-saving projects rapidly became a critical issue. Identification, detailed planning and development of such projects typically involve long lead-times and large transaction costs, with sizable uncertainties regarding the actual

[6] These projects were funded to increase the efficiency with which water was delivered or used, thus enabling existing irrigated enterprise levels to be operated with less water. The reductions in water use were defined as 'savings'. A share of these savings was designated as environmental water.

[7] Extensive privatisation or corporatisation of IIOs occurred within the MDB during the 1990s. Governments typically provided generous 'golden handshakes' to the IIOs in this process to enable them to rehabilitate run-down infrastructure. This funding was generally on the condition that IIOs would thereafter accept financial responsibility for maintaining or upgrading their infrastructure.

water savings achievable. After committing funds to infrastructure projects with 'easy water savings', the costs per megalitre recovered through such projects increased. As a result, governments recognised the need for greater reliance on buy-backs (Horne, 2013; Docker and Robinson, 2014). Concerns that water savings from infrastructure projects were likely to be over-estimated further strengthened the case for buy-backs (Loch et al., 2016). Crase et al. (2009: 446) explained that over-estimation can result from water purportedly 'saved' in one place was usually providing benefits elsewhere – e.g. via groundwater flows – and therefore "engineering works do not 'save water' per se – they merely have the effect of redistributing water in space and time" (see also Batchelor et al., 2014).

With the Millennium Drought persisting, political pressure from the irrigation sector for greater access to available water mounted. Five of the NSW Government's seven water sharing plans (WSPs) for regulated rivers were suspended due to the drought, some for multiple years, without any publicly available information about the suspension timelines or the conditions under which they would be lifted (National Water Commission, 2013; Natural Resources Commission, 2013). Concerns about how water sharing plans were being implemented added further impetus to arguments for buy-backs.

Perceptions existed that water allocated for environmental flows under the WSPs was being used deliberately to underwrite allocations to irrigators. It seems indeed that the environment was treated in practice as a residual claimant on available water during the Millennium Drought, given that environmental flows in the MDB declined by approximately four times as much as diversions for irrigation (Grafton et al., 2014). This experience demonstrated the benefits of buying back entitlements for the environment, since such entitlements retain the same rights and allocation characteristics as irrigators' entitlements; the environment thereby, at least in theory, receives a constant proportion of available water.

A prominent example of environmental agencies focusing on buy-backs was the NSW Government's RiverBank programme. With $A105 million from the NSW Government and $A71.8 million from the Commonwealth, the aim was to 'buy back' water for the state's most stressed and valued rivers and wetlands over the five years from 2006 to 2007. RiverBank funds were not intended for restoring flows in the Murray or lower Darling rivers because various other intergovernmental initiatives, including TLM, were implementing buy-backs in these systems (NSW Office of Environment and Heritage, 2012). Nevertheless, RiverBank staff and procedures were used to recover water entitlements for TLM once the lack of water recovery progress through water-saving projects became obvious (ibid).

The Commonwealth steps in

Slow progress in implementing the 1994 water reform framework resulted in the national and state governments agreeing to reinvigorate the water reform agenda through the National Water Initiative (NWI) (COAG, 2004). The NWI was national in scope but strongly shaped by the need to manage political conflicts over water in the MDB (Marshall et al., 2013). As a complex multi-layered policy, it had fundamental tensions in terms of conflicting values, rationalities and imperatives (Hussey et al., 2006), but nonetheless the states recommitted to return all over-allocated water systems to environmentally sustainable levels of extraction and to introduce 'barrier-free' water markets (COAG, 2004).

The Commonwealth expected successful implementation of the NWI reforms due to the states and territories formally agreeing to a detailed implementation programme, but progress in remedying over-allocation in the MDB remained painfully slow and difficult. In 2007, in the depths of the Millennium Drought, the Commonwealth attempted to wrestle control of water policy in the MDB from the state governments. This unprecedented intervention was justified by claims that Australia's most important river system was in crisis, and that existing cooperative intergovernmental arrangements were failing (Garrick, 2015). The then Prime Minister John Howard announced a quantum scaling-up of environmental water recovery for the Basin, announcing the National Plan for Water Security (NPWS)

(Howard, 2007). With a national election looming, he observed that "in a protracted drought, and with the prospect of long-term climate change, we need radical and permanent change... [T]here must be a clear recognition by all – especially by state and territory governments – that the old way of managing the Murray-Darling Basin has reached its use-by date". Here we observe the emergence of a further critical juncture in the path of MDB water policy development, brought about in this case by a confluence of political, environmental and natural resource crises (i.e. irrigation water shortage).

The Commonwealth commitment of $A10 billion to the NPWS was conditional on the MDB states referring parts of their constitutional powers over water resources management. The funding was to be split between two programmes: Restoring the Balance with a $A3.1 billion budget to purchase water entitlements from willing sellers (i.e. for buy-backs); and the Sustainable Rural Water Use and Infrastructure programme with a $A5.8 billion budget to invest in water-saving infrastructure projects (Marshall et al., 2013). Although this funding split prioritised water-saving infrastructure, it would seem the degree of bias was tempered significantly by the urgent need for timely recovery of environmental water and the lessons gained from TLM regarding the timeliness advantages of buy-backs.

The (Commonwealth) Water Act 2007 (Commonwealth, 2009) established the MDB Authority (MDBA) as a Commonwealth Government agency with responsibility for developing and implementing a Basin Plan. The Commonwealth intended that the Basin Plan would result in an integrated and comprehensive approach to managing the MDB's water resources (Garrick, 2015). Setting enforceable limits on the volumes of water to be extracted from each sub-Basin was politically contentious and irrigators strongly criticised the lack of public consultation (Boully and Maywald, 2011), but the Plan was finally legislated in 2012.

Bi-partisan support for the MDB reforms was demonstrated after the Howard government was defeated at the 2007 election and the incoming Labor government announced the Water for the Future programme in 2008 (COAG 2009). This rebadged the NPWS, adding over $A3 billion to its budget. The new government expected all water recovery projects to meet criteria that demonstrated 'value for money' (Productivity Commission 2010).

The Productivity Commission (2010; see also Grafton, 2010; Qureshi et al., 2011; Crase et al., 2013) found buy-backs were markedly more cost effective, or better value for money, than water-saving infrastructure projects and recommended that remaining funds be reallocated to buy-backs. Ignoring this advice, the Australian Government (Commonwealth of Australia, 2015a) legislated a 1500 GL cap on buy-backs "to address community and industry stakeholder concerns over the potential adverse social and economic impacts on irrigation-dependent communities" (Commonwealth of Australia, 2015b: 15).

These decisions demonstrate that reforms need to be politically acceptable if they are to be sustained. In the case described above, the mechanisms of institutional reproduction favouring supply-driven water policy (here entailing investment in water-saving infrastructure) ultimately came to dominate despite the demand-driven approach having seemed to achieve ascendancy with Commonwealth and state government agreements to the 1994 COAG water reform framework and the 2004 National Water Initiative. This outcome echoes a general observation on institutional path dependence by Thelen (1999: 385): "Losers [from policy reforms] do not necessarily disappear … For those disadvantaged by prevailing institutions, adapting may mean biding their time until conditions shift, or it may mean working within the existing framework in pursuit of goals different from – even subversive to – those of the institution's designers". The MDB constituency advocating investment in water-saving infrastructure was in the end stronger, more persistent and more influential than the more diffuse constituency supporting the buy-back approach.

REFLECTIONS ON THE PATH TAKEN

The foregoing account of environmental water recovery in the MDB demonstrates that institutional path dependence in water reform can be understood through multiple perspectives. Three are outlined below.

Collective action by vested interests

Those parties with interests in maintaining the supply-oriented path of water resources development in the MDB – predominantly irrigators; irrigation-based industries (including engineers and contractors); irrigation-dependent communities; local, state and federal politicians representing such communities; irrigation lobby groups; and hydraulic bureaucracies (including irrigation infrastructure operators) – are fewer in number and more geographically concentrated than those seeking reallocation of water to the environment. Moreover, these parties on average have much stronger stake in reform outcomes than the broader public with environmental interests. Hence, the challenges faced by irrigation interests in mobilising and acting collectively are significantly lower than those faced by environmental interests (Daniell et al., 2014).

Where environmental interests manage to surmount these challenges and achieve commitments to policy and institutional reforms, they still need to sustain levels of scrutiny and collective action to protect reforms from attempts to dilute or co-opt them in the implementation process (Horn 1995). Throughout two decades of MDB water reforms, powerful vested interests have diverted the implementation focus from the original vision of strengthening economic efficiency and environmental sustainability (Crase et al., 2009) by undermining and modifying fundamental reform principles and key decisions (Connell, 2011).

These advantages of irrigation interests in acting collectively have been historically compounded by informal alliances between politicians, bureaucracies and irrigation-sector organisations that are referred to as 'iron triangles' because of their ability to persist in the face of external threats (e.g. Howitt and Lund, 1999; Heinmiller, 2014). Howitt and Lund (1999) and Heinmiller (2014) argued that the influence of iron triangles over water policy has declined with the rise of environmental interests. Indeed, a few years preceding the 1994 COAG agreement the then Premier (chief minister) of NSW observed in respect of natural resources management in his state that "in years gone by, miners, foresters and farmers were content to operate within fuzzy regulatory regimes because they were satisfied that they had 'captured' the regulators of the respective industries. But those days have gone. The resource departments have largely accepted that they have a wider brief than just promoting the industry sectors for which they are responsible" (Greiner, 1991, quoted in Wettin, 1991: 4). The subsequent MDB water reform experience reveals this prognosis to have been overly optimistic, and highlights the persistent influence and adaptability of iron triangles within the water policy domain. Irrigation interests in the MDB succeeded in gaining adoption of their full 'property rights' agenda, as well as a government-pays approach to environmental water recovery which included billions of dollars for upgrades of irrigation infrastructure. Cummins and Watson (2012: 26) found that "without doubt, the present approach to water policy is still influenced by political alliances and attitudes associated with the earlier dominance of irrigation in Australia". These political alliances were demonstrated by the 2015 transfer of Ministerial responsibility for the MDBA, and the Basin Plan, from the Commonwealth's environmental portfolio, to the agricultural portfolio over which irrigation interests have much greater influence (Horne, 2015).

Contrasting concentrations and diffusions of different interests tend to favour decisions based on the 'path of least resistance' in solving political problems. Crase et al. (2009: 444) observed that "spreading the costs of this policy [supporting water-saving projects] across many, ill-informed voters whilst appeasing the minority most likely to lose from an alternative policy ensures that low political costs attend such an approach". Cummins and Watson (2012: 18) lamented that "the gradual weaning

of irrigation from the teat of public subsidy looks to have collapsed with renewed government support for investment in off-farm and on-farm irrigation infrastructure, in the name of water saving".

Insightfully, in 1992, the Industry Commission warned that "the benefits from reform will be dispersed and appear as incremental gains to the community over many years, whereas the (…) individuals and communities affected have reason to resist change. This dispersion of benefits and concentration of costs characterise virtually all microeconomic reform initiatives" (Industry Commission, 1992: 208). The COAG 1994 and 2004 commitments to economically rational water policies based on user-pays and full cost recovery principles now seem hollow rhetoric in the face of the billions of taxpayers' dollars that have subsequently been allocated to cost-ineffective water-saving infrastructure.

Information asymmetry and institutional complexity

Irrigation interests are also advantaged in negotiations over environmental water recovery strategies by their longer and deeper involvement in the details of water policy and practice. This creates informational advantages over others who are relatively new to the water 'game'. These advantages can be significant given the messy and overlapping institutional arrangements for water management (see Wallis and Ison, 2011).

Institutional reforms typically result in new institutions running alongside older ones, leading to a proliferation of policies and rules. This opens up 'opportunistic spaces for adjustments' for the better-informed interests to exploit in pursuing their agendas (Venot et al., 2014). Institutional complexity combined with technical complexity can reduce scrutiny. For example, in modelling water savings from infrastructure projects, only limited numbers of specialists can construct or validate models, and critiques may be limited due to shared interests in maximising the overall flow of funding to these kinds of projects. Loch et al. (2014) refer to evidence that the costs of water-saving projects are frequently underestimated. Venot et al. (2011) referred to such underestimation as a 'subsidy capture' strategy. Ansar et al. (2014) found that budgets for three-quarters of the hydropower mega-dam projects they analysed were systematically biased below actual costs, with actual costs exceeding budgeted costs by an average of 96%.

Compared with governments, environmental interests and the general public, irrigation peak bodies are advantaged by acting as 'gatekeepers' to information about what irrigators prefer. For example, claims by irrigation peak bodies that their constituency wanted water recovery funds reallocated to water-saving projects from buy-backs were found by Loch et al. (2014) to not accurately reflect the majority view of a random sample of irrigators. This contrast with the claims of irrigation peak bodies suggests "the presence of rent-seeking in current arguments made by irrigation groups" (ibid: 403). This finding is consistent with Potts et al. (2016: 15) observing that an industry association can "be a site for rent-seeking by insiders who can exploit principal-agent problems that association members have in monitoring the industry employees and the board members themselves". It is possible to speculate along these lines that the status and political influence of irrigation peak bodies (e.g. National Irrigators Council, Irrigation Australia, NSW Irrigators Council) as well as security and remuneration of their directors and staff, benefit from the posturing involved in advocating increased public investment in infrastructure projects.

Culture, cognition and rationalities

Cathcart (2009) observed that culturally engrained perceptions of water scarcity imported to Australia with early British immigrants formed the foundations for Australia's attitudes to water in the new colony. These ways of thinking (i.e. mental models) about water, its uses and values became locked in within public policy discourse in this domain and thereby tended to constrain water policy reforms. Political rhetoric that appeals to such mental models – i.e. around drought-proofing, greening deserts

and nation building (Crase et al., 2009; Wheeler, 2014) – retains considerable efficacy in supporting publicly funded, engineering-based, irrigation-protecting 'water-saving solutions' (Batchelor et al., 2014).

The reasoning used to explain how water is 'saved' by replacing open channels with pipelines is also intuitively appealing, whereas critiques of this reasoning cannot be articulated simply. During droughts, while Australia's urban populations stoically suffer restrictions on their water use, 'saving water' on the scale possible with renewed irrigation infrastructure can be easily presented as socially responsible, regardless of the costs to taxpayers. Meanwhile, those attempting to counter these arguments face the disadvantage of relying on arguments that are more complex than those they are attempting to rebut. The greater familiarity of the public with traditional engineering approaches can also constrain choices and limit uses of more innovative policy instruments like water markets. As Machiavelli observed in *The Prince*, "the innovator makes enemies of all those who prospered under the old order and only lukewarm support is forthcoming from those who would prosper under the new. Their support is lukewarm … *because men are generally incredulous, never really trusting new things unless they have tested them by experience*" (emphasis added).

Economists have only had limited success in rebutting claims that buy-backs of the scale of Water for the Future would devastate irrigation-dependent economies. Against the intuitive plausibility of such claims, economists have found that buy-backs increase the value of irrigators' water rights (Dixon et al., 2011), and enhance the ability of irrigators to adapt to water resource scarcity, thus mitigating impacts of reduced water due to climate change or environmental transfers. Grafton et al. (2012) pointed to the experience of the Millennium Drought for evidence that the economic impacts of reduced irrigation water availability due to buy-backs would be substantially ameliorated by on-farm adaptation measures. They found that on-farm efficiency measures combined with use of markets to transfer water to higher-value enterprises enabled the gross value of irrigated agricultural production in the MDB to remain almost constant during the Millennium Drought, even though water extractions for irrigation declined by 70% from 2000-01 to 2007-08. With water as only one input to irrigation enterprises, there are often other opportunities for adaptation or adjustment in practices that improve crop yields whilst optimising water and energy use (Eyre et al., 2015).

Skills and professional capacity

Shortages of skills and experience are impediments to complex policy reforms. For example, the skills needed to introduce well-functioning water markets are broader than those that have historically been required to manage water (Grafton and Horne, 2014). Kiem (2013) found, for instance, that many irrigators lacked the risk management and other skills required to participate successfully in the water market.

Furthermore, the policy sequencing errors committed in activating water markets in the MDB, discussed above, can be understood as a consequence of the complexity and novelty of the undertaking, involving a large number of actors over several decades in both the formulation and implementation of revised policy settings. The various stages of reform occurred incrementally and typically lacked an overall architecture.

UNDERSTANDING PROGRESS IN ENVIRONMENTAL WATER RECOVERY

Although institutional path dependence has constrained cost-effectiveness in environmental water recovery in the MDB, some significant reforms have been achieved. A number of explanations for this progress are provided below.

Crises

Huitema and Meijerink (2010: 2) observed from international experience that major transitions in water policy "tend to occur only after the existing paradigm … has been put to the test by disastrous events". The Millennium Drought served as such a crisis, and precipitated the refocusing of political priorities to water for the environment (e.g. Grafton et al., 2012; Wheeler et al., 2013; Horne, 2014; Wheeler, 2014). The drought triggered an ecological crisis in the Lower Lakes and Coorong in South Australia, focusing national attention on the MDB as a whole. Wheeler (2014: 62) found that "droughts or crises are critical to encourage cooperation and coordination of water reform, and to drive through institutional change in the form of transboundary agreements". Grafton et al. (2014) noted similarly that droughts provide opportunities to progress water reforms, but cautioned that they do not guarantee success. For instance, some market-oriented reforms achieved during the Millennium Drought were reversed once it ended (e.g. Crase et al., 2009; Horne, 2014).

Drought also opens up opportunities to resuscitate arguments for 'drought-proofing'. The billions of dollars provided to infrastructure projects and the resurgence of interest in building new dams (Commonwealth of Australia, 2014) are usefully understood from this perspective.

A major, albeit costly, step forward in environmental water recovery resulted from a political crisis faced by the Howard national government: namely an election it was predicted to lose. The $A10 billion NPWS announced prior to this election aimed to increase electoral support for the Howard government from environmentally conscious urban constituencies whilst also ensuring the ongoing flow of subsidies to conservative rural constituencies that had called for renewed public expenditure on 'drought proofing'.

Political agendas and policy entrepreneurs

Agreement to the 1994 COAG water reform framework was primarily driven by a commitment to implement the National Competition Policy that had been promoted by economic reformers or policy entrepreneurs operating beyond the water sector. By seeking to reduce the subsidies flowing to state-controlled sectors, the National Competition Policy offered to promote economic efficiency and growth, whilst providing strong arguments to counterbalance the 'nation building' and 'drought proofing' ideals. These reforms were supported by environmental groups, who with economic reformers established an unlikely discourse coalition (Hajer, 2005) outside the water sector which worked towards setting new policy directions that incorporated 'modern' economic and sustainability ideals.

The confluence of the Millennium Drought and the 2007 national election created fertile opportunities for driving through these water reforms, or at least variants of these reforms that had been strongly modified from those initially conceived as part of the neo-liberal influenced National Competition Policy (O'Neill and Argent 2005). After decades of stalling, substantial financial incentives from the Commonwealth finally motivated state water agencies to implement revised versions of what they had previously agreed to do. This pattern of behaviour illustrates the kinds of rent-seeking behaviours that are deeply embedded in the water governance regimes of most major irrigating nations (e.g. Molle et al., 2009; Venot et al., 2011).

Polycentricity

Opportunities for progressing environmental water recovery arose from what can be described as polycentric governance of the MDB's water resources. Polycentric governance refers to a governance arrangement comprising multiple decision-making units which have considerable autonomy from one another, with 'no one in charge' (Abel et al., 2016: 2; see also Marshall, 2010). 'Capture' of an entire governance arrangement is more challenging than with monocentric governance, where a single governing body, whose decisions are implemented through an integrated command structure, dominates decision-making.

The iron triangles in the MDB have historically influenced the state governments because water is their constitutional responsibility. To a large extent these governments administered water resources within their jurisdictions on a monocentric basis with water ministries and their agencies in command, albeit subject to constraints agreed to via the River Murray Commission or, later, the Murray-Darling Basin Ministerial Council. With environmental, sustainability and national competitiveness issues rising to political prominence in the 1990s, a shift to a more polycentric model of water resources governance occurred, with Commonwealth and state treasuries and environmental agencies gaining increased influence over water policy.

State environmental agencies played key roles, for instance, in attempting to hold state water resource agencies to account for their performance in implementing water-sharing plans during the Millennium Drought. The NSW government's environmental agency made a significant contribution by establishing RiverBank, a buy-back programme, at a time when that state's water resources agency remained firmly focused on water-saving infrastructure projects. This policy entrepreneurship and bureaucratic contestation made an important contribution to the NSW Government meeting its TLM water recovery targets, and the experience provided useful foundations upon which to build the larger Commonwealth-funded environmental water recovery programmes (Derek Rutherford, NSW Office of Environment and Heritage, pers. com., 2016).

Australia's federal governing system provides opportunities to harness the Commonwealth's fiscal dominance to overcome some of the states' reluctance to implement water reforms. Heinmiller (2014) reported on frustrated environmental groups lobbying the Commonwealth to intervene due to the lack of state government progress in implementing the COAG water reforms. The Commonwealth's greater involvement in MDB governance reduces the capacity of state-centred iron triangles to dominate decision-making. Commonwealth funding nevertheless provides strong incentives for these iron triangles to adapt their strategies in response to the new circumstances. Their effectiveness in doing so was demonstrated by the success of irrigation interests in gaining the Commonwealth's support for passing legislation in 2015 that placed a 1500 GL upper limit on recovering environmental water through buy-backs.

CONCLUSION

Marston et al. (2016: 8) recently observed from an international literature review that "despite a voluminous collection of water reallocation research, successful examples of water reallocation [including from consumptive to environmental uses] are relatively sparse". The progress made in reallocating water in the MDB from irrigation to environmental flows is therefore significant from an international perspective, and might be attributed in no small degree to Alfred Deakin's foresight in establishing water rights in Australia on a statutory basis to afford flexibility in reforming those rights. Nevertheless, this progress has come at a cost that only one of the world's wealthiest nations could afford. The costs included the continuing degradation of rivers over decades while reforms were stalled, and the 'privatisation' of public water resources through 'gifting' of tradable water rights to entitlement holders without attendant conditions to reduce use. Initiating water trading in advance of environmental water recovery catalysed increased total water extractions and further stressed rivers. Finally, there were the substantial costs to taxpayers of water buy-backs and infrastructure projects for the recovery of water. These public investments resulted in a major redistribution of wealth from the general public to the irrigation sector, with buy-backs enhancing the value of irrigators' water rights and infrastructure projects providing capital subsidies to existing water users.

Overcoming the embedded obstacles to water reforms has come at a large opportunity cost to Australians by way of other priority public expenditures that had to be foregone given governmental fiscal constraints. These opportunity costs have been increased considerably due to the success of irrigation interests in opposing demand-driven approaches with greater cost-effectiveness in

rebalancing environmental water and extractive uses of water. A further opportunity cost to be encountered by future policy makers arises from the renewed infrastructure deepening lock in of existing geographic patterns of irrigation, and of inherited supply-driven approaches to water policy, thereby undermining the robustness of the MDB's social-ecological systems to future shocks including those likely to arise from climate change. While these costs may prove to be acceptable compared with the environmental consequences of not addressing over-allocation, institutional path dependence helps to explain both the high costs and the slow and contested nature of Australia's water reforms.

This analysis of water reforms in the MDB towards environmental water recovery demonstrates that robust reforms depend on rigorous analysis of the historical and institutional context, and that reform architecture and sequencing are critical to well-designed reform processes. While there are significant lessons from the experience, attempts to model reforms on Australia's approach involve substantive risks and require considerable caution. No standard formula or prescriptions can be offered. Despite two national water reform agreements to break from the supply-driven path, institutional path dependence constrained water recovery options and limited opportunities to strengthen the robustness of the Basin's social-ecological systems.

Innovative policy ideas together with future crises will inevitably offer opportunities for further reforms. Loch et al. (2016: 10) observed, for instance, that "as irrigation infrastructure improvements in water delivery become marginally less efficient and more difficult to identify, and questions about the actual water quantum recovered from upgrades arise, it is expected that water market-based programmes will have to fill water-recovery gaps under increasing uncertainty and protracted adaptation to climate change impacts". Even so, reform success in the face of institutional path dependence will depend on disruptive policy entrepreneurs and longer-term policy development work (e.g. the role of COAG (1994) in setting up conceptual foundations for subsequent reforms) and the incremental testing of reform pathways that prove the feasibility of different approaches (e.g. the RiverBank approach). Capitalising on these opportunities will be crucial in building robustness of the Basin's social-ecological systems to the shocks of increasing depth and frequency that can be expected from climate change and other sources of escalating uncertainty.

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