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Presumptions of linearity and faith in the power of centralised decision-making: two challenges to the efficient management of environmental water in Australia

Lin Crase, Suzanne O'Keefe and Brian Dollery†

Water policy in the Murray-Darling Basin continues to be dominated by the trade-offs between agricultural and environmental interests. This has recently been played out with the acrimonious debate that circumscribed the release of the Guide to the Murray-Darling Basin Plan. In this paper, we argue that too much emphasis has been placed on the volume of held water as an indicator of environmental benefit. We also contend that there is an attendant presumption of linearity in the relationship between volumes of held water and environmental benefit which could lead to perverse outcomes. A second problem is that there is too much enthusiasm for contemplating the solutions to water management problems as residing primarily at the federal level of government. These factors stand to ultimately limit the efficient delivery of environmental objectives.

Key words: environmental policy, irrigation, water policy.

1. Introduction

The previous three decades have seen expanded interest in the environmental consequences of water withdrawal and use in Australia, particularly in the Murray-Darling Basin where governments have sought to reduce extractions, especially by irrigated agriculture. Central to this policy approach is the real and perceived 'over-use' of water and its impacts on the environmental health of water-dependant ecosystems (see, for example, Hillman 2008).

Currently, water for meeting environmental demands comprises two main forms, although these are not strictly separable in all cases. On the one hand, government agencies have access to rules-based water, sometimes called 'planned water', for example, minimum flow requirements in a stream. On the other hand, there exists a pool of water rights known as 'held water' (NWC 2010). In simple terms, this comprises volumetric water rights that have been secured from other entities by an environmental manager.

† Prof. Lin Crase (email: l.crase@latrobe.edu.au) is a Director of the Centre for Water Policy and Management, La Trobe University, Albury-Wodonga Campus, Wodonga, Victoria, Australia. Dr Suzanne O'Keefe is at Regional School of Business, La Trobe University, Wodonga, Victoria, Australia. Prof. Brian Dollery is at the University of New England, Armidale, New South Wales, Australia.

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Perhaps the most controversial component of environmentally focussed water reform is the proposed Murray-Darling Basin Plan. The Plan emanates from the Water Act 2007 and is required to set volumetric sustainable diversion limits (SDLs) that are expected to deliver the ecological benefits sought by policy makers.

Much controversy was witnessed in 2010 with the release of 'proposed' SDLs. Discussion focussed on the likely trade-offs that would attend reduced water access for irrigators (see, for example, Crase *et al.* 2011). At the core of this debate was concern that an increase in 'held water', albeit purchased from willing irrigators, would undermine the economic and social fabric of irrigation communities. Subsequently, most political effort has turned to adjusting the proposed SDLs by ostensibly reducing the volume of water required to meet the environmental policy objectives.

Notwithstanding the acrimonious debate about the trade-offs between ecological and extractive benefits, other dimensions to this discussion warrant closer scrutiny. First, the relationship between held volumetric water entitlements and the achievement of environmental policy objectives requires greater attention. More specifically, environmental policy has conventionally been interpreted and measured in terms of the volume of water devoted to achieve ecological outcomes. The extent to which this is a useful conceptualisation of the problem is a moot point. Second, and in a related vein, the volume of water held by a central environmental agency is, at best, an indicator of the potential to achieve environmental ends; volume tells little about the efficacy with which that resource might be managed to meet environmental ends. In this regard, more needs to be understood of the benefits and costs of centralised control of environmental water reserves.

This brief paper explores both of these issues. We argue that generally there has been:

- Too much emphasis on the volume of held water as an indicator of environmental benefit and an attendant presumption of linearity in the relationship between volumes of held water and environmental benefit and
- Too much enthusiasm for contemplating solutions to water management problems as residing primarily at the federal level of government.

We further argue that these two approaches are often mutually reinforcing and collectively run the risk of limiting the effectiveness of environmental water management.

The paper comprises four additional parts. In section two, we provide an overview of the current policy setting in the Murray-Darling Basin and reflect on the policy landscape that has led us to this point. Section three is used to examine the penchant for describing policy achievement in volumetric terms. We argue that this is both illustrative of and reinforces presumptions of linearity in ecological response functions. In section four, we review the current emphasis on centralised control and management. Here, we consider the gains that might attend a more decentralised approach, especially in the context of non-linear and complex ecological systems. Section five comprises brief concluding remarks.

2. A synopsis of 30 years of reform

Water policy development in the Murray-Darling Basin has occurred in a number of discrete phases. Musgrave (2008) identifies three separate eras. The first phase spanned the late 19th and early 20th centuries and was characterised by 'substitution of control by the state for riparianism, the institution of the right to use water under license, the authorisation of loans by the state to failed irrigation entities, and the establishment of bureaucracies through which the state could exert control over the resource' (Musgrave 2008, p. 34). This period laid the foundation for encouraging the extractive use of water, while other uses of the resource (e.g. amenity and environmental services) remained largely neglected.

The second phase is described by Musgrave (2008, p. 35) as 'the march of irrigation'. Covering the first six decades of the twentieth century, this era was witness to 'the spread of irrigation […] in a burst of nation building, which had the virtually unquestioning support of the whole community'. Water diversion for consumptive use grew rapidly in this phase accompanied by the development of irrigation industries like rice, cotton and horticulture. Musgrave (2008, p. 40) observed that:

> At the end of the century, the Basin had been bequeathed a substantial irrigation industry, a large inventory of storages, and a widespread, but in places a somewhat decayed, infrastructure. It also inherited an alarming level of land and water degradation, the nature of which was only dimly perceived prior to 1990.

Towards the end of this phase, greater emphasis on fiscal prudence resulted in water agencies being less concerned with water 'development' and more disposed to recovering the costs of water services from water users. This policy shift was accompanied in the 1980s and 1990s by raised awareness and interest in the environmental ills of the Basin. Thus, 'environmental issues, and concerns over the sustainable use of water in the Basin, joined criticism of the efficiency of irrigation, and of the equity of new, subsidised development' (Musgrave 2008, p. 41).

By the time the second round of national water reforms was sanctioned by the Council of Australian Governments (CoAG) in 2004, the nexus between volumetric extractions and environmental degradation had become well established in policy makers' minds. Earlier, in 1995, the Murray-Darling Basin Ministerial Council (MDBC) had created this link by placing a volumetric cap on extractions and partly rationalising this approach on environmental grounds. The MDBC 'interim cap' on water extractions in 1995 then moved to a permanent footing in 1997. The aim was to limit extractive use to the level that attended 1993–94 levels of irrigation development. In effect, it represented an effort to place a volumetric 'line in the sand' without reference to specific environmental outcomes. The motivations for the cap were ostensibly twofold: (i) the growth in extractions was deemed to be undermining the reliability of water rights for existing right holders, especially during periods of drought; (ii) excessive volumetric extractions were linked to the increased environmental stress being witnessed in parts of the riverine system (MDBC 2004). Put differently, the cap reasserted the direct link between expanding volumetric extractions and deleterious environmental outcomes.

The National Water Initiative (NWI) took this link to the next stage by insisting that the environmental and public good requirements for water resources be held separately from the consumptive pool of the resource (see, CoAG 2004). Importantly, by this time, consumptive water use had been articulated in volumetric terms, as a result of earlier CoAG market reforms in 1993–4.

Under the NWI, the environmental claims on the resource were to have been strengthened. An important component of this reform was dealing with what were termed 'over-allocated' and 'over-used' systems. The aim was to return these systems to some form of sustainable level of extraction (NWC 2009) by reducing the level of volumetric take. In large measure, the 'over-allocated' systems were located within the Murray-Darling Basin where previous policy episodes (described above) had overtly encouraged extractive use.

An important policy episode was the Living Murray program (TLM) that specifically targeted the over-allocation of the River Murray (see, MDBA 2008a). Almost all environmental analysis attending TLM was undertaken on the basis of the volume of water required to deliver a particular ecological outcome.

Initially, most of the public funding for dealing with 'over-allocation' was earmarked for infrastructure investments to purportedly deliver water 'savings', so that they could then be diverted for environmental gain. This policy approach did not go without criticism, in part because of the spurious nature of the volumetric water savings (see, for example Gyles 2003; Perry 2009) and in part because the policy approach represented, to all intents and purposes, the reintroduction of thinly disguised public subsidy to irrigation interests (see, Crase 2009). A relatively small portion of the public investment to address 'over-allocation' was directed towards buying volumetric water rights.

Notwithstanding that the economic merits of the two approaches for dealing with 'over-allocation' (i.e. buyback versus subsidised infrastructure) varied markedly, they shared one thing in common – the key performance metric was the volume of water that would be delivered to an environmental authority/water manager as a consequence of a given intervention.

3. Water volumes and presumptions of linearity

The most recent episode of reforms relates to the Basin Plan and the intention to establish SDLs as required by the Water Act 2007 (see, for instance, MDBA 2008b). Central to the Act is the notion that separate State control of water resources has proved detrimental to the environmental health of the Basin as a whole, and thus, a higher level of authority is required. The new SDLs differ from the existing cap in several ways – for example, SDLs are to be based on scientific assessment of the volume of water required to stave off further environmental degradation and improve ecological health; they are binding on States; and incorporate both ground and surface water. The Act requires that the Murray-Darling Basin Authority (MDBA) establishes SDLs that reflect an Environmentally Sustainable Level of Take (ESLT). This is the volume of water that can be taken from a water source which, if exceeded, would compromise key environmental assets of the water resource, or key ecosystem functions of the water resource, or the productive base of the water resource or key environmental outcomes for the water resource. According to the Act, environmental assets include water-dependent ecosystems, and ecosystem services, and sites with ecological significance.

In October 2010, the MDBA took the extraordinary step of releasing a guide to the proposed Basin Plan (the Guide). The rationale offered was that the consultation mechanisms required under the legislation fell short of that which was preferred by the Board of the MDBA. The Guide also outlined the processes that had been adopted in the formulation of SDLs.

Three main steps were purportedly followed in the establishment of basin-wide SDLs. First, the Authority assessed the complex network of ecological systems across the basin (covering about 1 million square kilometres) and determined that there were four key ecosystem functions and 2442 key environmental assets. A decision was also made that adherence to meeting the requirements of these functions and assets, while addressing the goals of the *Water Quality and Salinity Management Plan*, would adequately deal with the needs of the productive base and secure the environmental outcomes required in the Act.[1] Second, the Authority identified 106 hydrologic indicator sites from across the Basin to represent the interconnectedness of ecological functions and ecological sites. Of the environmental assets, 18 corresponded with hydrological indicator sites. Notwithstanding that this represents a very small subset of the 2422 key assets in the Basin, it was deemed that this approach was adequate, especially given the data and time constraints attending the exercise. Third, detailed analysis of the hydrologic indicator sites showed that between 22,100 and 26,700 GL would be required per year, on average, to meet the environmental objectives of the Act. Given existing arrangements and the current level of extractive entitlements, it was

[1] Details of the process for formulating the Water Quality and Salinity Management Plan are available at MDBA (2010b).

deduced that an additional volume of between 3000 and 7600 GL/year was required (MDBA 2010a). Although it was not made particularly clear at the time, these amounts included water that was already held as a result of various infrastructure and buyback programs. For instance, the Productivity Commission (2010 p. XXIX) had already estimated that held water entitlements would approach 2500 GL/year simply on the basis of existing water recovery programs, implying that the new SDLs would amount to an additional 500–5100 GL, assuming the trajectory of water recovery from other programs did not change.

One of the peculiarities of the Water Act was that the Authority was then required to review SDLs in the context of social and economic impacts. The Authority found that the upper limit (7600 GL/year) would impose unacceptable costs, and thus, it resolved that SDLs of between 3000 and 4000 GL should be the range of volumetric reductions under consideration.

The political fallout from the release of the Guide resulted in the Minister appointing a new Chair to the Authority. The Minister also released legal advice that was contrary to that purportedly used by the Authority in the establishment of the original SDLs (see, Burke 2010). While making an effort to explain that this was not to be taken as criticism of the Authority, the implication would appear to be that lower SDLs were being sought from the Minister (see, for example Crase 2011).

The reaction to the Guide also resulted in a parliamentary enquiry chaired by an independent member, Tony Windsor. The enquiry, undertaken by the House of Representatives Standing Committee on Regional Australia, recommended a review of the scientific methods used to establish SDLs (e.g. recommendations 2, 3) and a cessation of water buy-backs to be accompanied by increased public expenditure on irrigation infrastructure (e.g. recommendations 7, 8, 9). These recommendations seem to stem from concerns about the 'scale of reductions' in water availability that appeared in the Guide (Standing Committee on Regional Australia, 2010, p. ix).

In simple terms, the political and bureaucratic processes appear to be premised on two bold assumptions:

1. that the volume of water is the primary driver of environmental outcomes, and
2. that there is a direct and linear relationship across the range of volumes under consideration.

Reducing the volume of water that makes up SDLs is expected to produce some linear decline in the capacity to meet environmental objectives and a commensurate reduction in the undesirable economic and social impacts.[2]

[2] A similar over-simplification seems to apply to economic and social phenomena. This dimension of the policy weakness is beyond the scope of this paper, but nonetheless worthy of further research.

Perhaps most worrisome about this approach is that so little seems to have been learned from previous policy experiments designed along similar lines.

Illustrative of the limitation of this approach is TLM that ultimately set a target of 500 GL/year to be returned to the River Murray on the basis that this would represent the 'first step' to environmental restoration.

The 'first step' was announced in 2002,[3] but only after considerable effort had gone into establishing a scientific basis for decision-making. Interestingly, the Expert Reference Panel assembled for this work did not consider the impacts of 500 GL as a volumetric target. Rather, the Panel was expressly required to contemplate the likely environmental outcomes under six different scenarios. These comprised a 'do nothing' case; a scenario where the operational activities of water managers are adjusted in favour of environmental outcomes (e.g. reduced inversion of flows versus the unregulated environment); improved operational activities accompanied by the recovery of 350 GL for 'environmental flows' sourced solely from the River Murray; improved operational activities accompanied by 900 GL of flow sourced Basin-wide; improved operational activity and 1950 GL of flow from the Basin generally; and improved operation plus 4000 GL of flow sourced from the Basin.[4] The findings of the Panel were that the first three scenarios would have a low probability of delivering a healthy working river system and even 900 GL was rated with a low to moderate probability of beneficial system-wide change. Perhaps ironically, only 4000 GL was estimated to produce a high probability of achieving environmental gain (Jones *et al*. 2002).

In a somewhat disheartening trip 'back to the future', the then Prime Minister John Howard announced that a volume of 500 GL would suffice to test the benefits of returning water for environmental ends. There are three key lessons from this episode. First, the final decision was clearly at odds with the advice of the expert panel. In effect, it could be argued that such a modest level of reallocation was pointless, because productive use would be foregone but the non-linear response of ecological processes would ensure no discernable environmental gain. This is not to say that politics has no role in overruling scientific advice. Rather, the point is that bad politics results in only losers.

Second, the Expert Reference Panel went to considerable lengths to highlight that the environmental health of the Murray depended on more than just assigning volumes of water for environmental flows. The Panel expressly noted that progress would require enhanced river management which included 'improved habitat condition, improved catchment and floodplain management, and better water quality' (Jones *et al*. 2002, p. 4). And yet the progress of TLM became almost solely measured in terms of the volumes of held water resulting from the project.

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[3] The 'first step' was scheduled to conclude in 2009–10.

[4] By the time TLM had moved to the community consultation phase, these reference points were further modified. More specifically, 350, 750 and 1500 GL were used as reference points for consultation purposes (see, Crase *et al*. 2005).

Adding to this dilemma was the fact that the first decade of the century saw the Basin enter its driest phase in living memory. This drought meant that volumes of held water entitlements were of even less use as a metric of environmental intervention. Like all entitlements, TLM water was subject to the variability of harvested water. Thus, even though the electorate may have believed that 500 GL was available to address environmental degradation, there were two factors that significantly reduced water availability. First, this initial phase of TLM was to conclude in 2009–10, which meant the volumetric target of 500 GL/year was not scheduled for delivery until that point. For instance, in 2007–08, after TLM had been in operation for 5 years, total held water under the program amounted to 133 GL. Moreover, even at the end of the 'first step', TLM had fallen short by about 30 GL, with the Independent Audit Group (IAG) reporting that 472 GL had been recovered by June 30, 2010 (MDBA 2011). Second, and probably more importantly, the very low allocations had meant that even the available water entitlements yielded very little water for deployment at environmental sites. The ongoing drought meant that the allocation that attended the 133 GL of held entitlement in 2007–08 amounted to a mere 16.96 GL of water (MDBC 2009).

The environmental impacts of TLM were to have been assessed by reference to ecological responses at icon sites, selected at the time of the development of the program. Each site was to be managed via a site management plan with the environmental impacts of volumetric management used to assess the merits of intervention. Perhaps not surprisingly, in the final year of TLM, the IAG reported that 'despite clear indications of continued ecological decline at Icon Sites, the volumes of water required to achieve wide-spread improvement of their ecological health remained beyond the capacity of TLM to address in 2009–10 without the completed works and/or significantly improved allocation levels' (MDBA 2011, p. 91).

While the prolonged drought may be seen as the reason TLM was unable to deliver discernable benefits, there are also strong grounds for arguing that TLM was always destined to fail. The initial decision that reducing the water required for the environment will still produce a lesser but still positive ecological response was seriously flawed. This underlying assumption of linearity was compounded by downplaying other important factors that impact on environmental water management. Sadly, the same processes appear to be at play in the formulation of the current Basin Plan.

4. Centralised decision-making

An important contribution of TLM was that the institutional apparatus for managing environmental water across jurisdictions needed to be developed. The involvement of the federal government in financing TLM meant that processes that facilitated more centralised decision-making emerged. The details of these arrangements are described in the study by Crase *et al.* (2011) but the role of the Environmental Water Group (EWG) is worth noting.

The EWG comprises senior bureaucrats from each of the Basin States, and at the start of each watering year, this group collectively assigns water to meet the requirements of icon sites. Given the paucity of water to allocate during the recent drought, the task of the EWG has reduced to applying a triage approach.

The IAG reported positively on these centralised arrangements for deploying water, at least in times of extreme scarcity. More specifically, the EWG was seen as delivering on 'a dynamic adaptive approach to priority setting, water delivery and general management response'. In sum, the IAG noted of the EWG that '[t]hrough most of the first phase of TLM, the level of cooperation and rapid adaptive response to real-time monitoring (hydrological and ecological) have been noteworthy and appear to have contributed significantly to maximising the ecological benefits at Icon Sites from the limited environmental water available' (MDBA 2011, p. 95).

However, it is important to understand that this centralised approach focussed on managing only six icon sites with a modest amount of water and this level of achievement may not easily translate to more complex scenarios. As noted earlier, the Basin Plan has already identified over 2000 key assets along with four ecosystem functions. When greater volumes of water need to be assigned across different jurisdictions, there is no guarantee that the *esprit de corps* that has hitherto facilitated responsive management in TLM will emerge.

In order to indicate the types of challenge that attended expanded centralised decision-making, we refer to Figure 1, a recent series of flows in the River Murray downstream of Yarrawonga.

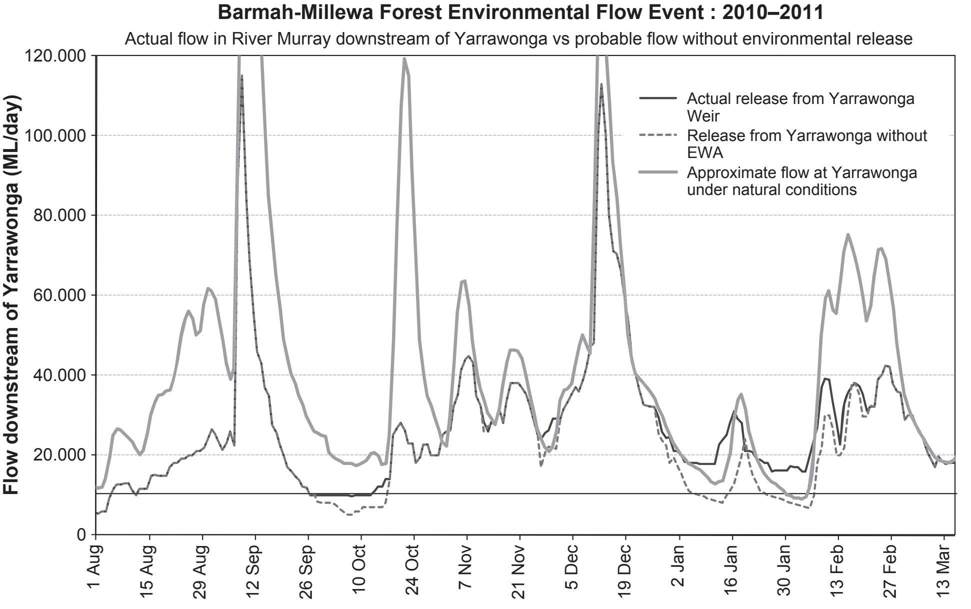

Figure 1 Source Murray-Darling Basin Authority 2011.

These flows are significant insomuch as one of the TLM icon sites, the Barmah-Millewa Forest, is located downstream. The forest is an important bird breeding sanctuary. It is also now recognised that bird species will only maintain nesting sites if water levels are maintained above the threshold that generates overbank flooding in the region. This occurs when flows in the River Murray exceed 10,000 ML/day downstream of Yarrawonga (indicated by the horizontal line in Figure 1). If the flood event that follows is interrupted, adults will generally abandon nests and the younger generation perishes (Briggs 1990).

Figure 1 illustrates the daily changes to flow in the River Murray between August 2010 and March 2011 downstream from Yarrawonga, where water is regulated by a dam. This was an extraordinarily wet period, especially in the context of the preceding drought. Modelled natural flows (i.e. such that there were no regulating structures on the Murray) show that water levels in the Barmah-Millewa Forest would have exceeded the threshold level of 10,000 ML/day for all of this period, apart from a few days in early February. However, the conventional management of the dam (indicated by the broken line) would result in water levels that fell below the threshold required to preserve nesting on three occasions. In simple terms, under conventional management of river regulation, nests would have been abandoned by adult birds in large numbers on three occasions.

The data illustrated in Figure 1 also show the actual management of flows that resulted from intervention and environmental releases. More specifically, these releases were used to maintain the bird breeding event, especially in late September–early October 2010. Great egrets (*Egretta alba*) and intermediate egrets (*Egretta intermedia*) were able to complete their breeding as a result (per com Terry Hillman 20 April 2011).

This case is instructive on several fronts. First, local management was required in order to facilitate this environmental outcome. Notwithstanding that this occurred within a centralised decision-making framework, it is not clear that a similar level of responsiveness could occur with a larger number of icon sites being simultaneously managed. Accordingly, when designing any centralised management apparatus for environmental water, it is important to maintain and encourage scope for local opportunism.

Second, this case again illustrates that conceptualisation of remedies only in volumetric terms seriously misrepresents the complexity of environmental water management. In this instance, held water could have been amortised across the period in question, resulting in interrupted bird breeding and sub-optimal ecological outcomes. Thus, focussing solely on the volume of water entitlement available to managers is at best a partial indicator of successful environmental intervention.

5. Concluding remarks

Controversy and disagreement seem likely to remain the norm in policy debates involving the reallocation of water between extractive users and environmental interests. By and large, such debates have reduced to arguments over the volume of water that should be assigned to one use or another. That policy debate has come to centre on volume as a proxy for benefit across a range of contexts should not be that surprising given the historical development of water rights in Australia.

Regrettably however, continued focus on volumetric measures as a policy ambition disguises important nuances, especially when it comes to environmental water management. As the focus of negotiations shifts to establishing lower, more politically acceptable SDLs for the Murray-Darling Basin, it will be important to recognise that the trade-offs are unlikely to be linear. Halving SDLs will not halve the environmental benefit and may well inflict monetary disadvantage on some irrigators for no recognisable gain on the environmental front. Understanding and incorporating non-linearity into political choices remains one of the main challenges of environmental water management in Australia.

An additional challenge is embodied in designing the institutional apparatus to make decisions about water held by environmental agencies. The TLM program is illustrative of how a centralised approach can be designed but it is not at all clear that similar arrangements will meet the demands of a larger more complex water management agenda. The example of the Barmah-Millewa Forest suggests that there are gains from facilitating local responsiveness at environmental sites. Notwithstanding the need for coordination, future governance arrangements should take care to foster local responsiveness.

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