

Towards a more nuanced discussion of the net-benefits of sharing water in the Murray-Darling Basin

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Abstract. Despite the focus by stakeholders, the States and the Murray-Darling Basin Authority on exploring the economic costs and benefits of the proposed Murray-Darling Basin Plan, there are a number of issues relevant to an economic evaluation of the Plan that are easily overlooked. While a proposed Murray-Darling Basin plan has been released, water sharing agreements will continue to evolve and much detail remains to be worked out as part of implementation at the state level. Given this, we seek to synthesise current research on the costs and benefits of the Murray-Darling Basin plan. In doing so we discuss eight issues relevant to understanding the net-benefits of water reforms that, though recognised in the literature and policy debates, have become somewhat peripheral despite their potential importance. The first two issues are related to the potential social costs associated with reduced viability of communities and ongoing viability issues for farms. The next three issues are focused on benefits from the proposed Plan. This includes the estimation of benefits for downstream beneficiaries, the opportunity provided to farmers from selling water and the benefits associated with reductions in system risk due to non-incremental changes in ecosystems. The remaining three issues relate to approaches for maximising the benefits associated with the water reform process. This includes the evaluation of a wider range of options, consideration of how to better use water markets to assist farmers to manage risk, and evaluating not only how much water is needed but how it can be more effectively managed.

Key words: irrigation, environmental benefits, water buy-backs.

Introduction

In October 2010, the Murray-Darling Basin Authority (MDBA) released a Guide to the proposed Basin Plan and held a series of information sessions with communities and the States in the Murray-Darling Basin (MBDA 2010). Major newspapers reported that the Guide to the proposed Plan was met by immediate opposition from communities within the Murray-Darling Basin (Wahlquist 2011). People in communities were concerned about the potential loss of jobs and impacts on local communities. Subsequently, many of the concerns of affected communities have been captured in an extended set of reports released in January 2011 (EBC et al. 2011). On November 28, 2011, a proposed Basin Plan was released for consultation. A window of opportunity exists for a more nuanced public discussion about the benefits and costs of resetting the balance among water users. State water resource plans are to be developed and accredited by 2014 in New South Wales, Queensland and South Australia and by 2019 in Victoria. Considerable detail remains to be worked out at the State level through the development of Water Plans, the implementation of these plans as well as the next ten-year plan. Thus the proposed plan will not be the final word on how water will be shared among water users in the Murray-Darling Basin.

The debate about the costs and benefits of the proposed Murray-Darling Basin Plan has been framed by the requirements of the *Water Act 2007* [sec. 20d]. The *Water Act 2007* sets out the requirement to limit extraction quantities of surface and ground water resources to environmentally sustainable extraction levels. Further, according to the wording of the Act, water resources are to be managed in a way that optimises economic, social and environmental outcomes. In addition, the Plan is to be evaluated using best available science and economics. For the majority of economists, this implies that cost-benefit analysis will be used. However, cost-benefit analysis is only a decision support tool. There are choices about how to define the alternatives to be evaluated and the assumptions to be used; all of which influence costs and benefits to be considered and how are they estimated.

In this paper we therefore seek to review and synthesise what is already known about the economic costs and benefits and then discuss eight other issues germane to considering the full range of costs and benefits associated with addressing over-allocation.

Estimation of the costs of the proposed Murray-Darling Basin Plan

To estimate the costs of the proposed Murray-Darling Basin Plan, various computable general equilibrium (CGE) models have been used to derive estimates of losses in production, producer surplus and employment that could follow from reduced water for irrigated agriculture under the scenarios provided in the Guide to the Basin Plan. This includes models developed by researchers at the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), the Australian National University (ANU), the Centre of Policy Studies (CoPS) at Monash University and the Risk and Sustainability Management Group at the University of Queensland. Water management is typically modelled by combining hydrologic models of water availability and flow with long-term economic models of the regional economy.

Modelling by ABARE-BRS (2010) estimated that reductions in surface water diversions of between 3000 and 4000 GL/year by irrigated agriculture result in: (i) a fall in the gross value of irrigated agriculture of 13-17 per cent; (ii) a lowering of irrigated agricultural profits of between 6-9 per cent; and (iii) a decline in Basin employment of between 0.09-0.12 per cent. Similar magnitude economic impacts were reported by Mallawaarachchi et al. (2010) from the University of Queensland who suggested that the gross value of irrigated agriculture would fall by 16 per cent.

Goesch et al. (2011) (from ABARES) subsequently modelled the effects of a 3500 GL reallocation of water from irrigation to the environment. They estimated that the gross value of irrigated agricultural production would decline by 15% without any mitigating policies, and 10% if mitigating policies were used (e.g., buy-backs and investment in irrigation infrastructure). In terms of overall agricultural production, this would fall by 5% without use of mitigating policies, and 4% if they were applied. In the long run they estimated that Basin employment would decrease by about 900 jobs in the absence of mitigating policies, and remain virtually unchanged if mitigating policies are used. However, short-run employment effects could be more significant. In order to provide a polar extreme estimate of the potential impacts in the short run, Goesch et al. (2011) estimated that short-run employment effects in the absence of any mitigating policies and assuming that all water was sourced at one point in time (neither of which are proposed), water buy-back could lead to 5000 job losses.

Grafton and Jiang (2011) from the ANU, estimated that the resulting reduction in annual net Basin returns, was 9.5 per cent for a reduction in irrigation of 30 per cent and 16.3 per cent for a 40 per cent reduction in use of water for irrigation. Their model showed that foregone profits resulting from additional environmental flows may be modest with a free water market. However, particular regions may be more vulnerable than the average (e.g., the Murrumbidgee).

Dixon et al. (2011) at CoPS used their regional general equilibrium model "The Enormous Regional Model (TERM – H_20)" to analyse the effects of government water buy-backs and find that under their assumptions, economic activity in the southern Murray-Darling Basin would increase. Wittwer (2011) further analysed the question of the relative impact of water buy-backs and drought in the MDB. He found that the short and long-term employment impact is many-fold greater under drought conditions as compared to water buy-backs. For example, he forecast 6000 job losses across the Basin because of drought, but only 500 jobs lost when buy-backs are modelled (or 800 jobs lost if water use was restricted but no compensation was paid through water buy backs).

Overall, the results of these analyses suggest that a reallocation of between 3000 to 4000 GL may reduce irrigated agricultural output by about 10-17% depending on the assumptions made and the model used. Overall agricultural output is estimated to decline by less than this for irrigated agriculture because it is estimated that resources would shift out of irrigated agriculture to dryland agriculture. Employment effects across the Basin are likely to be negligible in the long run given the reallocation of labour resources over time to dryland agriculture and to other sectors within and outside of the Basin as well as because of the methods that the government plans to use to obtain water (Dixon et al., 2011). However, in the short run, job losses, potentially significant, are likely to be experienced in various irrigation communities within the Basin (EBC et al. 2011).

The studies described in this section have all involved impact assessments. Jiang (2011) provides an overview of some of the modelling challenges associated with such assessments. In addition, when assessing costs they have focused on identifying likely decreases in agricultural output, profit and employment. One limitation of this is that none of these measures is directly relevant for cost-benefit analysis, which measures costs in terms of decreases in producer and consumer surplus. A second limitation is that analysis of this type may exclude some costs of concern to the wider community, such as impacts on the viability of communities or farms, which are two issues we discuss shortly.

Estimation of the benefits of the proposed Murray-Darling Basin Plan

On the benefits side, there have been many studies undertaken over the last 20 years to estimate the value of improvements in riverine and wetland health in the Murray-Darling Basin. The studies focus on the value of particular wetlands and rivers across the Basin creating snapshots of the value of recreation and tourism as well as the intrinsic value of the environment. These studies have used a diversity of methods such as hedonic pricing models, travel cost models, contingent valuation and choice modelling (summarised in Hatton MacDonald et al. 2011a). Many of the studies are quite local or regional in nature. Hatton MacDonald et al. (2011b) present national estimates of willingness to pay to improve the River Murray and the Coorong.

As a summary of the benefits of the proposed Basin Plan, Morrison and Hatton MacDonald (2010) developed an inventory of existing studies valuing improved river health. They produced estimates for each catchment in the Basin of the value associated with increased recreational activities, as well as values associated with improving vegetation, native fish populations, frequency of waterbird breeding, and waterbird species found in important wetland areas. Morrison and Hatton MacDonald (2010) did not seek to produce aggregate benefit estimates, but rather per unit value estimates that could be combined with ecological response functions to identify the values associated with specific Sustainable Diversion Limits (SDLs).[11] A summary of the value estimates produced from this study are presented.

The body of existing work, undertaken for a variety of purposes, was however limited in its ability to evaluate the benefits of the proposed Basin Plan. None of the original studies covered the proposed scope contemplated in the Guide to the MDB Plan of 3000 to 4000 GL (CIE 2011). Of particular concern was the challenge associated with adding up the non-use values across each of the individual catchments (Morrison and Hatton MacDonald 2010), as well as paucity of research on recreation values and other indirect use/ecosystem service values.

The task of understanding benefits is complicated by the fact that ecological response models for the entire basin are not currently available, many of the improvements in ecology will be realised in the medium to long term, and are dependent on how the States implement their Water Resource Sharing Plans as well as on other natural resource management policies. Additionally, there are many ways volumes of water reallocated to the environment can be delivered with resultant ecological responses. Interdisciplinary work which forges stronger links between the hydrology, ecological responses, and socioeconomic benefits will be fundamental in the next stage, once the Plan is operational. An important challenge will be to optimise the multiple objectives of the Basin Plan – social, economic, and ecological – and any tradeoffs (e.g., between upstream and downstream ecological assets) that this implies.

As part of this process, there are potentially several other benefits of relevance to evaluating the Murray-Darling Basin Plan that have received relatively limited attention. These include understanding the increase in downstream production values from a reallocation, the benefits to irrigators from the sale of water with low reliabilities, and the values associated with reduced system risk, and are discussed in the next section.

Other potential costs, other potential benefits and other potential options for maximising net-benefits

Due to the nature of impact assessment and the way that environmental valuation is typically undertaken, there is a tendency to focus on certain costs and benefits when undertaking cost-benefit analysis. It is possible that certain cost and benefit items, that while noted in the literature, become somewhat peripheral and possibly excluded. Further, it is possible that certain opportunities for maximising net-benefits associated with water reforms may also become peripheral, because they are not part of the purview of the Water Act. Nonetheless, they may be relevant to the wider societal goal of maximising social welfare through the water reform process. Hence, in this section we discuss eight issues that we believe are of relevance to maximising the net-benefits associated with the water reform process. These issues have for the most part previously been identified in the literature, yet have become somewhat peripheral in the public debate.

Other potential costs

Issue 1: What is affecting the viability of communities?

Of particular concern to communities negatively affected by the proposed Murray-Darling Basin Plan has been the potential

[11] SDLs are the maximum long-term annual average quantities of water that can be taken on a sustainable basis from the Basin's total water resources and from each area. If exceeded, the extraction could compromise: key environmental assets/functions/outcomes of the water resource; and the productive base of the water resource (MDBA 2010).

effect on population levels and cultural identity. Communities have also been concerned about the closure of farm related and non-farm related businesses, changes in demographics and effects on mental health (EBC et al., 2011). This is of relevance to cost-benefit analysis as previous studies have demonstrated that there may be non-use values associated with preventing decline of rural communities (e.g., Bennett et al. 2004).

Without disputing the legitimacy of these concerns, agriculture is an inherently uncertain enterprise. Farmers have always faced uncertainty over weather from drought to flooding as well as long-term structural agricultural change. Long-term pressures that have transformed farming include the liberalisation of trade conditions in Australia, and the decline in terms of trade over time, which has resulted in an increasing pressure on farmers to make their enterprises more productive (McColl and Young 2006; Barr 2009). Commodity prices can fluctuate markedly within relatively short spans of time and changes in currency exchange rates and consumer preferences can quickly displace what were previously secure farm markets. As farmers are generally price-takers, they do not have the opportunity to influence demand. Hence to maintain an equal return on their investment they need to increase their output, and have done so over time by increasing farm size (Barr 2009).

As a consequence the trend has been in the Murray-Darling Basin (and across Australia and the world) towards fewer farms of bigger size. The number of farms in Australian agriculture has declined by 1.3% per annum over the past few decades (Barr 2009). In real terms, this has led to a reduction of almost 32,000 family farms; a drop of 22% between 1986 and 2001 (Australian Bureau of Statistics 2003). These changes also imply a greater degree of diversity within the sector. There are more large enterprises. For example, between 1994 and 2004, the number of farm enterprises worth between \$1m and \$2m almost doubled. The number of low value farms (up to \$22,500) reduced by approximately a third (Barr 2009). Barr (2009) found there were higher than average exit rates in peri-urban areas and in irrigation districts, particularly where dairying was a major industry. In peri-urban areas, demand for land is driving land prices up, providing farmers an incentive to sell.

One view is that fewer family farms leads to general de-population in rural areas, making it harder for rural communities to maintain an adequate employment base and to provide the range of goods and services desired by residents (Barclay et al. 2007). Less buoyant rural economies provide fewer off-farm employment opportunities and this can have detrimental consequences for family farms, where frequently the farm income is just one source of household income (Barr 2009).

One potential reason for de-population is that younger people have more attractive educational opportunities and greater off-farm work opportunities (Barr 2009). In Australia, as in many other parts of the world, the agricultural workforce is ageing and fewer young farmers are entering the industry. The median age of Australia's farmers has been climbing since 1976. In the 2001 Australian Census, 15% of farmers in farm families were aged 65 years and over, whereas those under 35 years accounted for 12% of farmers (ABS 2003). Wheeler et al. (2011) found the mean age of irrigation farmers in Australia's largest irrigation area, the Goulburn Murray Irrigation District in Victoria, has risen over the past decade, from 49 years of age in the late 1990s to 56 years in 2010-11.

Declines in population may also be due in part to a myriad set of factors from commodity price changes, declining health and education services, uncertainty related to climate change and water allocations through to succession planning (Wheeler et al. 2011). In their study of influences of changing farm succession over time, Wheeler et al. (2011) found that naming a successor was positively associated with the current and future management of farms, as farms who had not named an heir were more likely to go into a period of stagnation (selling land, not adopting efficient irrigation infrastructure, not increasing irrigation area). Farms that named a successor were more likely to be positively adapting to changing circumstances than farms with no successor. Also, when analysing succession across districts, they found that it was more influenced by characteristics of irrigation districts than actual farm types.

Overall these results suggest declining rural population trends are likely to continue regardless of the implementation of the proposed Murray-Darling Basin Plan, and hence any estimation of the non-use values associated with decline in the communities associated with the Basin Plan should recognise this trend. Long-term structural changes in agricultural areas, ageing of the farming population due to younger people having more attractive options elsewhere, and uncertainty related to climate change will all occur, even if the Plan were not implemented. However, it is likely that uncertainty with respect to water allocations remains a contributing factor to depopulation. Future research must consider in more detail this question, In particular, we need to understand how changes in government water and agricultural policies play a part in regional farm exit choices over time, taking into consideration other key influences on such as differences in water allocations, climate conditions and regional water market conditions. One key question that should be studied is how much current government policies and programmes have influenced the ongoing adjustment process that would have occurred anyway without the buybacks.

Issue 2: Does selling water provide farmers with an opportunity to retire comfortably or does it have consequences for the next generation?

As noted, the average age of irrigation farmers is increasing. Two of the reasons for this are the reluctance of older farmers to retire, and the inability of the farm to support two generations (Wheeler et al. 2011). The unbundling of land and water (i.e., the legal separation of land and water rights) reforms and the increased opportunities to sell water entitlements has meant that it has allowed some irrigators to sell their permanent water, provide for their retirement, and pass the farm onto the new generation (based on qualitative research underpinning Wheeler et al. 2012). The increased value of water licences, due at least in part to water buy-backs, has meant that the retirements of those farmers selling water for this purpose is more comfortable than it would otherwise have been. Whether this benefit is included in a cost-benefit analysis depends on whether the analysis is undertaken from the standpoint of the nation or the region. For the nation, the water-buy-backs are essentially the sale of property and would not be included in a cost-benefit analysis. On a regional level, there may be a net benefit after tax.

While buybacks have clear advantages for those seeking to retire, there are consequences for those receiving properties without water as inheritances. The younger generation faces a more difficult transition period with reduced or no ownership of water entitlements. They have to either manage the farm as a dryland property or buy in temporary water (the viability of which is determined by rainfall and storage). However, some properties that are a viable size with irrigation may not be a viable size as dryland properties (nor may be appropriate to be farmed as a dryland property). This implies that these properties may need to be sold and consolidated with other properties. It is possible that this may lead to a further decrease in rural employment and impacts on regional communities, and hence costs, though empirical analysis would be needed assess how farm viability is going to be affected by buy-backs, and an assessment made of where this is likely to be a concern.

Other potential benefits

Next, three other potential benefit items of relevance to economic evaluation of the Basin Plan are discussed.

Issue 3: Increasing uncertainty of general security licences because of climate change

Climate change implies a shifting of rainfall patterns in the Murray-Darling Basin, with less rainfall expected in the southern Murray-Darling Basin, the major source of basin flows (CSIRO 2008). This would be expected to lead to a reduction in water supply reliability, especially for lower reliability licences. Table 2 highlights the water allocations that have been received in various districts over the past decade. It shows the difference been high and lower reliability entitlements. During the height of the last drought, in Victoria and in New South Wales, lower reliability entitlements have received low allocations.

The future advent of climate change means that those holding lower security (and in some states – even high security) licences are likely to face higher risk in relation to their farm-level water plans. This risk will be greatest for permanent crop irrigators or those that need to make decisions before the water season starts or allocation levels are announced. Lower reliability may influence the desirability of holding general security licences, and potentially their value. As evidence of this point, Wheeler et al. (2012) found that those selling water to the government, or are likely to do so in the future, are more likely to be in regions that have experienced severe cuts in water allocations over the last five years. Therefore, the Commonwealth's program to buy back water, the *Restoring the Balance* program, has potentially provided a means for many to sell these riskier licences. Farm communities will therefore benefit from farmers being able to sell problematic assets, reduce debt or invest in other ways on or off their properties as a large proportion of those selling water indicate that they intend to do (Walpole et al. 2010, Wheeler et al. 2012). It is possible that this may lead to some farm families being able to remain on their properties, which may not have been possible if they had not been able to sell their water. This would therefore enhance rural communities, and create a positive non-use value. However, further empirical research on farm exit over time would be needed to identify the extent of this benefit.

Issue 4: Recognise downstream non-environmental beneficiaries

The debate about the benefits and costs of the proposed Murray-Darling Basin Plan has often been framed as involving costs to irrigators and benefits to the environment. The distribution of costs and benefits is more complex than this.

The proposed Water Sharing Basin Plan makes provision of water for critical human needs a key priority. The city of Adelaide and other country towns at the bottom of this river system depend in large part on water from the Murray-Darling Basin (see Figure 1). Increased environmental flows can have a number of benefits to downstream communities in terms of reduced treatment costs, reductions in risks associated with cryptosporidium and avoided salinity-related damage to infrastructure.

Increased flows to the southern part of the Murray-Darling Basin, in particular, to the Lower Lakes in South Australia, will also benefit irrigators in these areas. There was a substantial contraction in irrigation due to increased salinity levels in the Lower Lakes during the Millennium Drought (2001-2010). Salinity levels have been subsequently decreased with the increased rainfall/flooding through 2010-11. Flows which meet the environmental water requirements for some of the major downstream assets will also benefit some downstream irrigators.

Historically, there have also been substantial communities of wetlands graziers in major wetland areas such as the Macquarie Marshes, Gwydir Wetlands, the Paroo and other wetland areas, (see Figure 1). These areas were known to provide high quality feed, and to be relatively drought resistant, with many farmers sending stock there during droughts. The development of irrigation areas during the 1970s and 1980s heralded a substantial decline in grazing and farmer populations in these areas.

Nonetheless, the value of grazing in these wetland areas is recognized in the literature, and might be expected to increase with any reallocation of water to environmental uses. For example, Arche Consulting (2010) recently found that flooding increasing gross profits of graziers by 59% and that there is an annual increase in profitability of $12.50 per hectare for floodplain country. Other earlier studies of wetlands grazing have also demonstrated the value of this beneficial flooding (Cunningham 1997). It is arguably appropriate that the magnitude of these benefits be identified in any economic analysis undertaken of the proposed Murray-Darling Basin Plan.

Issue 5: The value of reduced system risk

There has been a tendency when discussing the ecological benefits associated with the proposed Murray-Darling Basin Plan for economists in particular to treat the outcomes solely in marginal terms. This is the standard framework in economic analysis where a question typically posed by an economist to an ecologist is "How much will the population of X increase given water regime Y". There are several limitations with this approach. One limitation is that the predicted outcomes are generally stochastic and subject to uncertainty.

A second less obvious limitation is that the marginal improvement in ecological quality is not the only benefit from the proposed Plan. The reallocation will also reduce the risk of catastrophic ecological collapse (Quiggin 2008), such as substantial declines in the populations of significant species, or other non-incremental changes in ecological systems, which may not just have consequences for the environment, but for agriculture and humans as well. This is of particular concern given the ecological challenges posed by climate change. Many of the long-term changes to adjust the Basin Water Sharing Plan in response to climate change have been deferred to the next 10-year plan (Quiggin 2011). This provides an opportunity for research that forges stronger economic-ecological understanding and follow-on policies to manage for the risk of system collapse.

Other options for maximising net-benefits

Issue 6: An opportunity to evaluate other options

In cost-benefit analysis it is desirable to evaluate a range of options to identify those alternatives which have the highest net-benefit. In the evaluation of alternatives for the proposed Murray-Darling Plan attention has been focused primarily on alternatives involving reallocation of about 3000-4000 GL or less. The alternatives considered the use of water buy-backs and infrastructure investments to produce the necessary water savings.

There are several alternatives that could be considered in the next series of evaluations. This includes alternatives that involve much smaller reallocations of water (e.g., 1500 GL) and those that involve much larger reallocations of water (e.g., 4500 – 6000 GL). It is possible that some of the ecological outcomes that might be achieved through water reallocations are subject to key ecological thresholds that require larger reallocations. A cost-benefit analysis with a wider purview would allow this to be assessed (see also Frontier Economics 2011).

These are, however, not the only alternatives that might be considered in a more wide-ranging cost-benefit analysis. Because the fundamental goal of the Plan is to improve environmental quality, this raises the question of whether only focusing on purchasing permanent water is the best way to do this. Environmental improvements might be achieved by purchasing less water but investing more money in achieving other environmental outcomes such as buying up properties in ecologically sensitive areas (see Crossman et al. 2010, Byron 2011 and Pittock and Finlayson 2011). Others have raised the need for the Commonwealth Environmental Water Holder to engage in temporary trade: both the buying and selling of water allocations (Productivity Commission 2010).

A final alternative that is worthy of consideration is an alternative that changes the way that buy-backs are operationalised. Currently the water buy-backs are by tender and allow all landholders to offer their water for sale. While this approach provides equality of opportunity to all irrigators, some costs are faced by those who do not sell water if there is a hollowing out of the local economy and community. There may also be other impacts from reducing the number of landholders servicing the infrastructure in irrigation districts. An alternative is to consider purchasing water at a district farm level rather than an individual level. This would see buy-backs favoured in an area where a group of landholders want to sell water, rather than only a few individuals. This would mean that in areas of buy-back the benefits are more uniformly shared, and there is likely to be greater support for the buy-back in the local community. Prioritising of districts for buy-backs could also be based on what makes sense from an agricultural perspective. For example, one logical choice would be where there are areas of marginal farm viability or poor irrigation off-farm infrastructure and hence consolidation of properties is likely to be needed in the future regardless of the buy-backs. Indeed, the Federal Government has just committed to only strategic water entitlement purchasing in 2012; favouring a series of rolling tenders and greater emphasis on investment in infrastructure upgrades and water saving projects (Burke 2011).

Issue 7: The need to modify water markets to reduce risk

Given the inherent risk associated with farming, and the prospect of further adverse climate change in the Murray-Darling Basin, there is greater scope for farmers to continue to develop using the water market as a risk management strategy. The ability to carry-over water from one year to another is a valuable risk management strategy for many irrigators; however, the inconsistency of rules across states and various suspensions of carry-over provisions make risk planning increasingly difficult (Loch et al. 2012). Given other uncertainties facing farmers, expanding the carry-over provisions could help in reducing risk (Young 2011). With attention to institutional design and how to make water markets more efficient, the effectiveness of this risk management strategy for farmers could be enhanced. Research that focuses on institutional design of caps, embargos, support payments, and carry-over strategies could provide substantial benefits to irrigators over the long term, and hence we believe should be prioritised as an approach for increasing the benefits associated with water reforms.

Issue 8: Management of water as well as increased allocation

Through the implementation stages of the Basin Plan and development of State water plans there will be an opportunity to consider the management of water entitlements rather than just a focus on obtaining a certain amount of water as a way of maximising the benefits associated with the water reform process. Crase et al. (2011) argued that the current focus on entitlement volume ignores the complexity involved with environmental water management and the non-linearity between volume and environmental outcomes. As of October 2011, the Commonwealth Environmental Water Holder has purchased over 1,000 GL of water MDBA (2011). With its current water holdings, the Commonwealth Environmental Water Holder will need to manage entitlements on behalf of the environment and might benefit from trading in temporary water and derivative water products. The Productivity Commission (2010) has also advocated the need for portfolio approaches coupling allocation trade with entitlement purchasing, and argued that derivative water products such as long-term leases, option contracts and water use covenants could be highly beneficial.

Summary

By highlighting a series of eight issues that, while raised in the literature appear to have had limited attention, it is hoped that we identify opportunities for improving economic analyses associated with on-going water reform and implementation. On-going research by academics, the Murray-Darling Basin Authority and other government agencies will be helpful to optimise outcomes from water reform. The Murray-Darling Basin Plan is one step in a sequence of State and Commonwealth processes. Ultimately much will depend on the implementation through State-level water plans. Nonetheless, there remain opportunities to utilise further research to capitalise on potential benefits to society.

In evaluating the costs of the proposed Plan, attention has focused not just on the costs to agriculture but also the impact on Basin communities (EBC et al. 2011). This is potentially relevant from an economic perspective if there are non-use values associated with declines in regional communities. The issue is, however, more complicated than a simple loss of jobs or decline in regional economic activity. Decline in the viability of agricultural-dependent communities has been occurring for decades due to a number of factors unrelated to environmental management, such as drought, commodity prices, strength of currencies and international trade rules. While the proposed Basin Plan will have some impact on a number of communities, it is important to keep in mind that it is part of an ongoing rural structural adjustment process. Over the past decade, the reliability of different types of water licences has fallen considerably, increasing uncertainty for many irrigators, and buy-backs provide some irrigators with an opportunity to exit irrigation. It also provides others with a chance to sell part of their water that is proving to be less reliable, retire some debt or invest more strategically (Wheeler et al. 2012), which may benefit certain regional communities. However, while this will benefit certain farmers, especially those who are seeking to retire, the buy-back program may have implications for future farm viability, especially for irrigation farms that are too small to operate as dryland operations. Therefore, we suggest that further research is needed to understand the likely effects and costs for regional communities of water reforms.

In terms of benefits, there remains a need to understand critical thresholds across ecological assets across the Murray-Darling Basin, including conditions under which a collapse of ecosystems can be anticipated and how these thresholds can be avoided. Further research is required to evaluate the extent of these system risks and social preferences associated with different pathways.

Lastly we have suggested that effort go into evaluating a wider range of options. This will include alternatives involving smaller and larger allocations of water, as well as other alternatives such as managing entitlements for improving environmental quality in the Murray-Darling Basin. Further discussion is required on how much water is needed but also on the flow regimes that will enable best use of the reallocated water.

Acknowledgements

We would like to thank Jeff Connor and Rosalind Bark for providing useful comments on the draft paper and the very useful comments from two referees. Thanks to Martin Nolan for preparing the map of the Murray-Darling Basin.

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Appendix

Table 1: Proposed Value Estimates from Morrison and Hatton MacDonald (2010)

Regions	Native vegetation	Native fish	Colonial Waterbird breeding	Waterbirds and other species
UNITS	$'000 (present values)			
	1% increase in healthy native vegetation	1% increase in native fish populations	1 year increase in frequency of breeding	Unit increase in number of waterbirds and other species present
Barwon-Darling	$3,594	$667	$24,693	$3,578
Border Rivers	$2,437	$414		$1,086
Campaspe	$3,363	$2,990		$2,299
Condamine-Balonne	$2,926	$414	$15,337	$1,086
Mt-Lofty Ranges	$1,494	$1,329		$1,022
Goulburn-Broken	$5,019	$4,463		$3,431
Gwydir	$3,482	$667	$24,693	$1,749
Lachlan	$3,482	$667	$24,693	$1,749
Loddon-Avoca	$3,363	$2,990		$2,299
Macquarie-Castlereagh	$3,482	$667	$58,802	$1,749
Moonie	$1,961	$277		$728
Murray	$79,098	$73,794	$375,369	$12,203
Murrumbidgee	$3,594	$667	$24,693	$3,578
Namoi	$3,482	$667		$1,749
Ovens	$3,363	$2,990		$2,299
Paroo	$2,598	$414	$15,337	$1,086
Snowy Mountains Scheme				
Warrego	$2,598	$414		$1,086
Wimmera	$2,660	$509		$1,336

Source: These estimates are based on original research undertaken by a number of researchers over the past 23 years. Morrison and Hatton MacDonald (2010) provide this inventory of results in their paper.

Table 2: Water Reliability in the southern Murray-Darling Basin

	High reliability entitlements					Lower reliability entitlements			
Year	Vic Goulburn	Vic Murray	NSW Murray	NSW Murrumbidgee	SA Murray	Vic Goulburn (low)	Vic Murray (low)	NSW Murray (general)	NSW Murrumbidgee (general)
1998-99	100%	100%	100%	100%	100%	0%	100%	93%	85%
1999-00	100%	100%	100%	100%	100%	0%	90%	35%	78%
2000-01	100%	100%	100%	100%	100%	0%	100%	95%	90%
2001-02	100%	100%	100%	100%	100%	0%	100%	105%	72%
2002-03	57%	100%	100%	100%	100%	0%	29%	10%	38%
2003-04	100%	100%	100%	95%	95%	0%	0%	55%	41%
2004-05	100%	100%	97%	95%	95%	0%	0%	49%	40%
2005-06	100%	100%	97%	95%	100%	0%	0%	63%	54%
2006-07	29%	95%	69%	90%	60%	0%	0%	0%	10%
2007-08	57%	43%	50%	90%	32%	0%	0%	0%	13%
2008-09	33%	35%	95%	95%	18%	0%	0%	9%	21%
2009-10	71%	100%	97%	95%	62%	0%	0%	27%	27%
2010-11	100%	100%	100%	100%	67 %	0%	0%	100%	100%

Source: NWC (2011), p. 5.

Figure 1: Map of the Murray-Darling Basin with irrigation areas and Ramsar sites identified