Submitted by R. Quentin Grafton and Qiang Jiang
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Economics of Water Recovery in the Murray-Darling Basin

This submission responds to the Productivity Commission's *Market Mechanisms for Recovering Water in the Murray-Darling Basin* by assessing: (1) effects of the current drought; (2) effects of water buybacks; and (3) economics of water buybacks versus investments in on-farm irrigation efficiency. The findings within this submission are obtained from existing peer-reviewed published literature. Additional modelling by the submission authors on the economics of water recovery will be provided to the Productivity Commission by separate cover.

The Murray-Darling Basin (MDB) is suffering its worst ever recorded drought that is having a devastating impact on communities, agriculture and the environment. The current water crisis has led to important water reforms over the past decade including: the 2004 *National Water Initiative*, the *Water Act 2007* and the 2008 *Water for the Future* policy. Full integration of these worthy initiatives, with particular attention to (1) society and communities, (2) the economics of water reform and (3) the long-term sustainability of the environment offers the promise of a viable future for those who live, work and enjoy the environmental benefits of the Basin.

The current drought and its effects on reduced seasonal allocations of water has created an understandable angst by farmers and their communities about any further reductions in water diversions planned under the *Water for the Future* package. Existing research, however, suggests that both past and planned water recovery will only have a minimal impact on the overall value-added of agriculture in the Basin. Although the effects of planned water buybacks are small Basin-wide, compared to the impacts of the current drought and future climate change, the impact will be much larger in some regions than in others.

Effects of the current drought

Since 2001 the Basin has suffered a sustained drought despite the fact that some catchments in the north of the Basin have received above normal rainfall in 2008/09. For the period 2002-2007 average annual inflows in the Murray River totalled 3,986 GL — the lowest recorded for a five year period. This is much less than in any other recorded drought. For instance, inflows averaged 5,501 GL over the period 1940-45 and 5,707 GL over the period 1897-1902 during the Federation Drought (see Figure1).

The impact of record low inflows is illustrated by flows at the barrages at the mouth of the River Murray over the past 40 years. There have been no recorded flows at the Murray Mouth since November 2006 and positive flows have been recorded in only 19 of the past 90 months (see Figure 2). At the end of July 2009 active water storages were about 25% of their long-term average for July and there is possibility of an El Nino event later in the year that would normally be expected to reduce inflows in most parts of the Basin. The current drought has also led to much reduced diversions of water (see Figure 3) that has contributed to increased debts. The impact on the environment, however, has been exacerbated because environmental flows have been reduced by proportionally more than water diversions during the current drought throughout much of the Basin (Connell and Grafton 2008), as illustrated in Figure 4 for the Murrumbidgee River.

Horridge et al. (2005) developed a 'bottom-up' Computable General Equilibrium (CGE) model (TERM) of Australia and used it to analyse the economic impacts of 2002-2003 drought on Australian Gross Domestic Product (GDP). They found that the drought directly reduced GDP by 1%, and a further 0.6% indirectly via negative multiplier effects (Horridge et al. 2005, p. 300). The relatively small impact on an economy-wide basis is because agriculture contributes only 3.6% of Australian GDP. By contrast, the drought had a large and negative impact on agricultural output that fell by about 30% nationally. Some regions, however, suffered even larger losses with a fall in agricultural production in New South Wales of about 45% due to the drought.

Effects of water buybacks

The effects of water buybacks can be estimated using models of the hydrology and economics of agriculture of the Basin. Models differ in terms of the specification, parameter values, method of solution and their spatial dimensions.

Peterson et al. (2004) used the TERM-WATER model to analyse the impacts of water trading in the southern MDB. A key finding of their work is that water trading substantially reduces the impact of reductions in irrigation water availability. They found that using 1996/97 water availability, a 30% water buyback would reduce gross regional product (GRP) in the southern MDB by about 2%, and Australian GDP by 0.024%.

Dixon et al. (2009) used the TERM-H2O model to analyse the economic impacts of a water buyback (1,500 GL) in the southern MDB. They calculated that the impact of such a buyback on the southern MDB economy is small, and predict it would reduce real GRP by less than 1%. This is a fraction of the negative impact that would arise from even a moderate drought and the associated reductions in seasonal water allocations. The reason why water buybacks have a much smaller impact than equivalent declines in diversions due to drought is because farmers are: (1) directly compensated for the loss of water and (2) the reduced diversions with a buyback are accounted for in the planning and planting decisions of farmers.

Based on the historical inflows of the Murray River for 1980 to 1999, Mainuddin et al. (2007) developed a model to assess the effects on irrigated agriculture from increased environmental water allocations (250, 350, ..., 1,500 GL/year). These environmental allocations of water in GL are not the same as GL of water entitlements because water entitlements have different levels of reliability where the amount of water allocated to an entitlement in a given irrigation season depends on the water entitlement's level of reliability (such as 'High Security' or 'General Security' entitlements that determine the preferential access to the consumptive pool), the overall Cap for the basin, diversion limits by catchment, expected inflows and water storage levels. Mainuddin et al. found that economic activity after the water buy back is virtually unchanged and note "Notwithstanding the large impact on irrigated areas and crops, the overall economic profit remains almost unchanged from the base case, at $1,863 million. This is partly due to reduced water allocations to activities such as pasture beef and sheep that generate little profit, and indeed in some years generate losses." (Mainuddin et al. 2007, p. 130).

A summary of the key results by crops in the TERM-H2O and Mainuddin et al. models is provided in Table 1 and their regional impacts by model and catchment is provided in Table 2. Their predicted results from a 1,500 GL buyback of water include:

(1) To minimise the opportunity cost of water purchases for the environment, most of the water should be acquired from the Murray-Riverina and also the Murrumbidgee catchments. These two regions alone provide 75% of the water acquired for the environment. Although the Ovens catchment and the Upper Murray provide much less quantities of water in absolute terms, their proportional decline in water use is the largest in the basin, or approximately 75% of their catchment water use;
(2) Water buybacks would have the greatest change in production in terms of irrigated cereal and also rice crops. However, the biggest reduction in water use occurs in terms of irrigated pasture used in livestock farming; and
(3) The loss in GRP in the regions from a water buyback will likely be the greatest in the Murray (Upper Murray and Riverina) and Murrumbidgee catchments although the estimated decline in the Basin as a whole is small, or about 2%.

Qureshi et al. (2007) also examine the economic effects of water buybacks in the southern MDB. Their key finding is that a proportional (equal share) buyback of water for the environment is *not* as cost effective as a targeted buyback from catchments where water has lower value in use. This supports a similar finding by Mainuddin et al. (2007). Qureshi et al. (2007) find that net revenues are $2 million/year higher with a targeted buyback and unrestricted interregional (across catchment) water trading than with a pro rata water buyback and unrestricted interregional trade. Net revenues would be $117 million/year higher with a targeted buyback and unrestricted interregional trade compared to a pro rata water recovery and no interregional water trade. Thus, targeting water buybacks to particular locations where the value added in agriculture is relatively low and, especially, the freeing up of water trade reduce the costs associated with water buybacks.

More detailed modelling of the effects of various water buybacks that accounts for different inflows is currently being undertaken by the submission authors and will be provided by separate cover to the Productivity Commission.

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Water buybacks versus investments in on-farm water-use efficiency

The *Water for the Future* package allocates fixed amounts of funding to water buybacks ($3.1 billion) and investments in on and off-farm water use efficiency ($5.8 billion). To ensure cost effectiveness, the two approaches should return an equivalent quantity of water for the same price or $/ML.

A comparison of the cost effectiveness of water buybacks and water efficiency investments associated with the Living Murray Initiative is provided in Table 3. Based on the market price of water entitlements and the cost of acquiring water via efficiency investments, the Social and Economics Reference Panel for the Murray-Darling Basin Commission concluded in April 2008, in a period of low water availability, that water buybacks are a cost effective method of acquiring water.

Research by Qureshi et al. (2009) in the Murrumbidgee supports the conclusion that market-based water recovery is cost effective. In their modelling they account for return flows from irrigation that subsequently becomes available for downstream and aquifer users while also augmenting environmental flows. An improvement in on-farm efficiency that reduces return flows will have an offsetting and negative impact on environmental flows. As a result, in locations where there are lower levels of irrigation efficiency and return flows are larger, the cost effectiveness of water buybacks is enhanced relative to infrastructure subsidies. Qureshi et al. (2009) argue that a key reason for cost effectiveness of water buybacks is that, in contrast to infrastructure subsidies, they provide farmers with flexibility as to how to use less water. Farmers that voluntarily choose to sell their water in a buyback and remain farming can employ deficit irrigation, change their land use and/or tillage practices or invest in improvements in irrigation efficiency. In the subsidy approach, water is acquired only through efficiency improvements whether it is the least costly method or not. Water efficiency improvements may also have a 'rebound' effect in terms of reduced return flows.

Market-based water recovery is also more flexible in a temporal sense in that it allows farmers and their communities to reinvest, and to autonomously adapt to lower water diversions in ways they best suit them. By contrast, infrastructure subsidies 'lock in' current irrigations systems and water use that reduces flexibility to adapt to climate change and climate variability. They also economically disadvantage irrigators and irrigation districts that, at their own expense, have already installed efficient irrigation systems.

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Summary

The key findings of this assessment are:

(1) Reductions in agricultural income in the past decade since 2001 are directly attributable to the current drought and not market-based water recovery;
(2) Predicted negative economic effects on irrigated agriculture from climate change are much greater than planned (~1,500 GL) water recovery;
(3) Planned (~1,500 GL) water recovery in the *Water for the Future* package is predicted to have only a minimal impact on overall economic activity (less than 1% decline) in the Basin, but will have a relatively larger economic impact in particular catchments and locations;
(4) The on-farm losses from reduced water diversions from the voluntary sale of water entitlements are fully compensated by the proceeds of such sales. The net effect on the regional community of sales is dependent on how the proceeds are reinvested (on or off-farm and whether in the region or not);
(5) Market-based water recovery is marginally more cost effective when purchases are targeted to locations with lower value-added irrigated agriculture, primarily in the upper and south-eastern catchments of the Basin;
(6) Market-based water recovery for the environment is a much more cost-effective method of acquiring water for the environment than providing subsidies for on-farm water efficiency; and
(7) Restrictions on water trading increase the costs of adapting to market-based water recovery.

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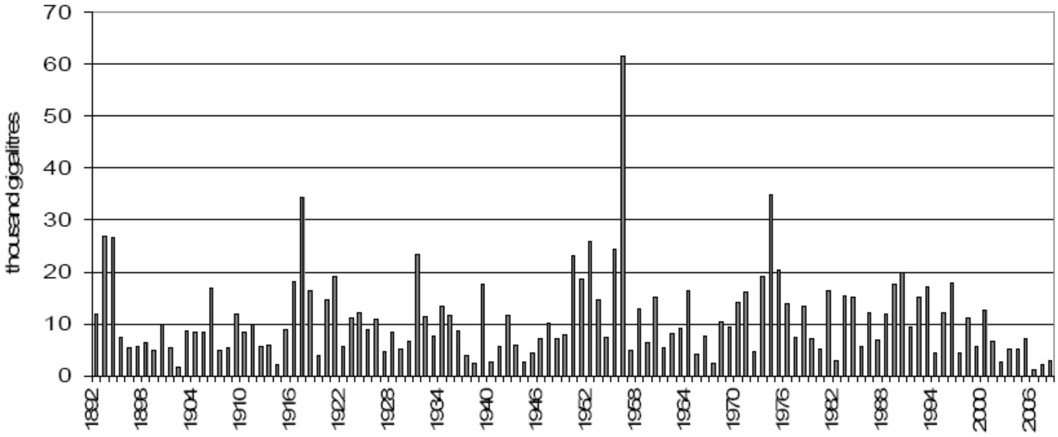
Figure 1 Murray system inflows (including Darling), 1892 to 2008



Source: Productivity Commission (2009a, p. XXI)

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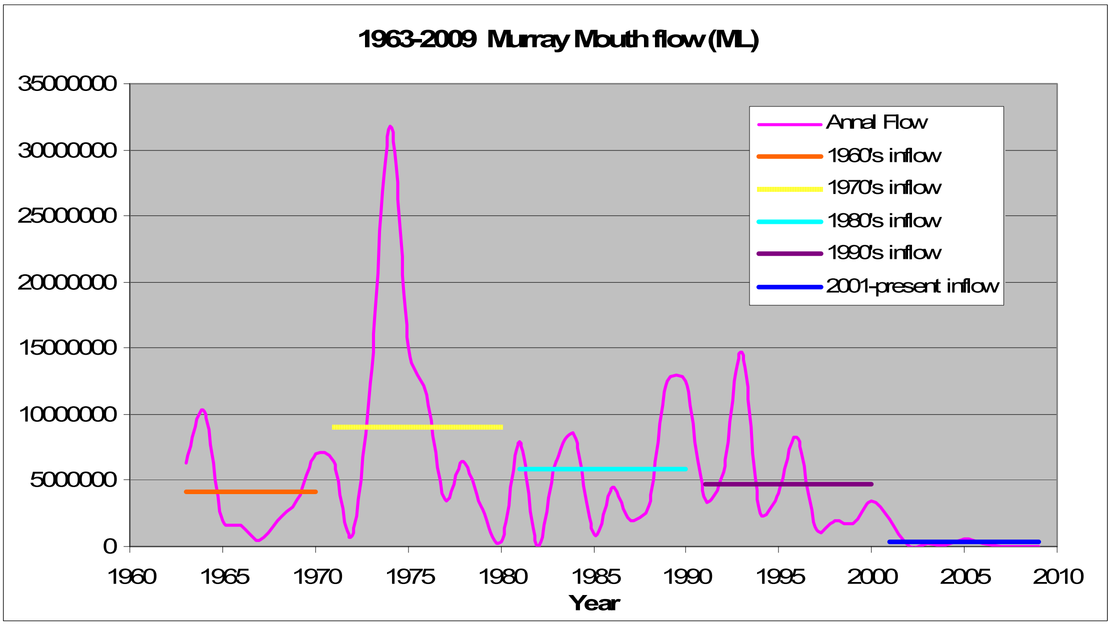
Figure 2: Flows at the Murray Mouth 1963-2009



Data Source: Murray-Darling Basin Authority

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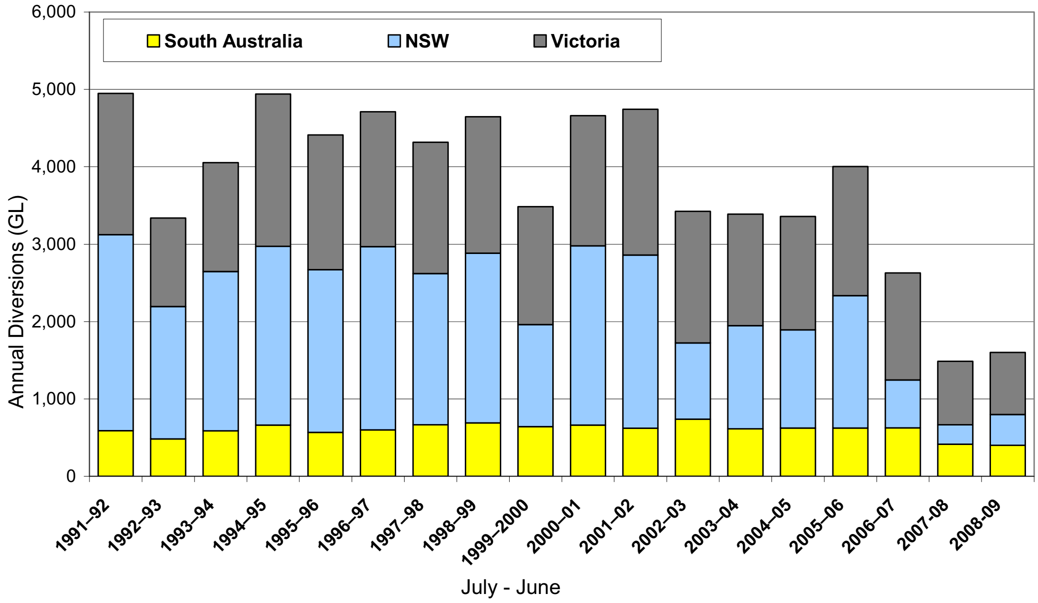
Figure 3: Murray Water Diversions 1991-2009



Source: Murray-Darling Basin Authority

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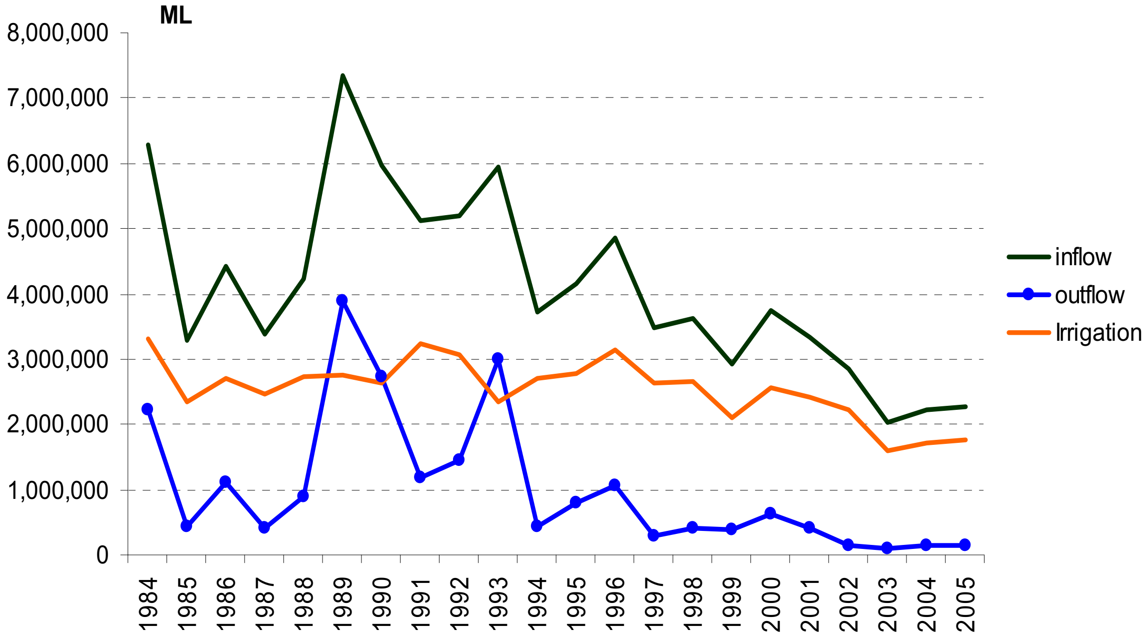
Figure 4: Annual Inflow, Outflow and Irrigation Use on the Murrumbidgee River, Australia 1984-2005



Source: Grafton (2009, p. xvi)

Table 1: The effects of targeted water buyback in various crops of the Southern Murray Darling Basin (SMDB)

TERM-H2O model with 1500 GL buyback			TERM WATER model with 1500 GL buyback		Mainuddin et al. model with 1500 GL buyback	
Crop	Production change (%)	Water use change (%)	Crop	GRP change (%)	Crop	Buy back volume (GL)
Cereal Irrigated	-33.2	-49.1	Diary	-4	Rice	0
Rice	-21.8	-29.1	Perennial horticulture	-0.7	Grape	0
DairyCatIrig	-1.9	-4.1	Rice	-20	Pasture-Beef	495
OthLivstoIrg	-9.7	-16			Pasture-Dairy	750
CottonIrig	-2.2	-5.2			Pasture-Sheep	225
Grapes	-1.1	-4			Oilseeds	0
Vegetables	0.3	0.6			Deciduous Fruits	0
FruitIrig	0.3	0.8			Citrus Fruits	0
OthAgriIrig	-18.3	-23.4			Legumes	15
SMDB Total	-7.2	-25.8			Cereals	0
					Potatoes	0
					Vegetables	0

Notes:
1. 1,500 GL is 33% of 2004-05 water use in the SMDB. Dixon et al. (2009, pp. 18 -20) predict that 1,500 GL will be 25.8 % of water used in the southern Murray-Darling Basin in 2017.

Sources: Adapted from (Peterson et al. 2004, p. X), Dixon et al. (2009, pp. 18 -20) and Mainuddin et al. (2007, p.129).

Table 2: The effects of targeted water buyback in various regions of the SMDB

TERM WATER model[1]				Mainuddin et al. model[2]	
Buyback scenario	10% buyback	20% buyback	30% buyback	1500 GL buy back	
Region	GRP change (%)	GRP change (%)	GRP change (%)	Region	Buy back volume (GL) and change in water use %
Murrumbidgee	–0.87	–1.92	–3.23	Upper Murray	15GL and -75%
Murray	–1.21	–2.65	–4.42	Kiewa	0
Mallee	–0.41	–0.98	–1.78	Ovens	15GL and -45%
Goulburn	–0.39	–0.94	–1.72	Broken	0
Loddon	–0.13	–0.31	–0.58	Goulburn	0
Ovens	–0.06	–0.13	–0.24	Campaspe	0
Murray land	–0.30	–0.70	–1.27	Loddon	210Gl and -14%
Total	–0.52	–1.17	–2.02	Avoca	30GL and -20%
				Murray-Riverina	705GL and -37%
				Murrumbidgee	420GL and -20%
				Mallee	30GL and -9%
				Wimmera-Avon	0
				Lower Murray	90GL and -38%

Notes:

1. 10%, 20% and 30% buyback is defined as 10%, 20% and 30% reduction in the 1996-1997 mean irrigation water use of the southern Murray-Darling Basin, see Peterson et al. (2004, p. 31).

2. Mainuddin et al. model uses historical mean inflow of the Murray river between 1980 and 1999 (8,317 GL), see Mainuddin et al. (2007, p.129). Change in water use by catchment calculated using last column of Table 2 (% acquired of total across basin) converted into GL and as a percentage of the base case scenario.

3. GRP = Gross Regional product.

Sources: Adapted from Peterson et al. (2004) and Mainuddin et al. (2007).

Table 3: Estimated Water Cost Savings ($/ML) from Infrastructure Investments

Infrastructure project	**Current estimate of the approximate $ per ML of Long Term Cap Equivalent**	**Reliability of water recovered**
Great Darling Anabranch Pipeline	$1,000/ML	High
Coleambally Main Canal – Seepage and Leakage Savings Project	Up to $2,700/ML	High
Shepparton Irrigation Area Modernisation Project	$2,860/ML	High
NSW Wetlands Water Recovery – Stage 1	$2,500/ML	High
Water Recovery from SA River Murray Wetlands – Stage 2: the feasibility of generating water savings and environmental benefits	$4,000/ML	High
Metering accuracy, water use efficiency study and evaluation of infrastructure options for water recovery for the West Corurgan Private Irrigation District in Southern NSW	$5,000/ML	High
Investigation of the potential to recover water by the construction of a 30GL en-route storage ‘The Drop’ on the Mulwala Canal in the Murray Irrigation Ltd area of operation	>$5,000/ML	High
Ricegrowers’ Association	>$2,500/ML	Mix

Source: Social and Economics Reference Panel for the Murray-Darling basin Commission (2008, p. 8).