Water buybacks and drought in the Murray-Darling Basin of Australia: confusing policy and catastrophe

Glyn Wittwer
Centre of Policy Studies, Monash University

Paper presented to the 14th Annual Conference on Global Economic Analysis, Venice, Italy, June 16-18, 2011

Abstract

TERM-H2O is a dynamic, multi-regional model of the Australian economy including water accounts, water trading possibilities and a bottom-up representation of Murray Darling Basin regions.

In modelling water buybacks with TERM-H2O, we assume that the voluntary process proceeds slowly over 12 years, with buyback volumes eventually totalling 3500 GL. This gives farmers time to utilize water saving technologies as they emerge. This is in contrast to the relatively rapid sales of over 900 GL that had already occurred by the end of 2010.

Drought modelling entails significant computational challenges due to the large inward supply shifts involved. But drought modelling is extremely important in the policy context. TERM-H2O results indicate that around 6,000 jobs were lost due to the 2006-07 to 2008-09 drought in the Murray Darling Basin. Even in the long run, years after a rainfall recovery, jobs remain 1,500 below forecast due to lost years of investment during prolonged drought. This contrasts with 500 jobs lost across the basin due to buybacks. Moreover, we are able to compare modelled results with actual outcomes.

TERM-H2O includes a fixed water requirement per hectare of irrigated land for a given crop. If water availability falls, either farmers must choose another crop requiring less water or move some irrigable land to dry-land production. TERM-H2O includes regions and activities in which there is substantial mobility between irrigated and dry-land production, and other regions in which there is no such mobility. Such differences, embedded in base year data, explain differences across regions arising from buyback.

By including mobility of farm factors between dry-land and irrigated activities, TERM-H2O captures alternative uses for farm factors as water availability changes.

Some industry groups and politicians have asserted that buybacks will result in rural catastrophe. Not only does this underestimate the adaptability of farmers in response to a voluntary and fully compensated process. It also confuses the impacts of drought and buybacks, underlining the importance of modelling both.

This paper starts with an outline of the Act under which water buybacks in the Murray-Darling basin started in earnest. Before examining the modelled impacts of buybacks, there is a discussion of the response to buyback plans in Murray-Darling basin communities. This sets a context for modelling of buybacks and helps us see that drought modelling also has a part to play in policy discussion. From there, we will compare the modelled impacts of buyback and drought.

It is inevitable that some farmers and lobbyists will have mixed up the impacts of drought, which has brought considerable hardship to the basin, and buybacks which, although entailing full compensation, started during a period a drought. We model the impacts of drought as a separate exercise from the impacts of buybacks. Drought modelling indicates severe regional hardship in terms of jobs lost and lost years of farm investment. On the other hand, our buyback results indicate small and possibly beneficial impacts in the basin.

Buybacks: the 2007 Water Act

On 25 January 2007, the then Prime Minister John Howard announced a 10 point plan to address problems arising from water allocation in rural Australia. This was a further development in policy dealing with the environmental health of the Murray-Darling Basin. More than a decade earlier, the Council of Australian Governments (COAG) recognized the need for policy reform in the management of water in the basin (COAG 1994). Although COAG reforms had proceeded slowly, several desirable changes were made, including the disentanglement of land and water ownership. Eight of the 10 points in the 2007 plan are relevant to the Murray-Darling Basin:

> 1. a nationwide investment in Australia’s irrigation infrastructure to line and pipe major delivery channels;
> 2. a nationwide programme to improve on-farm irrigation technology and metering;
> 3. the sharing of water savings on a 50:50 basis between irrigators and the Australian Government leading to greater water security and increased environmental flows;
> 4. addressing once and for all water over-allocation in the Murray-Darling Basin;
> 5. a new set of governance arrangements for the Murray-Darling Basin;
> 6. a sustainable cap on surface and groundwater use in the Murray-Darling Basin;
> 7. major engineering works at key sites in the Murray-Darling Basin such as the Barmah Choke and Menindee Lakes;
> 8. expanding the role of the Bureau of Meteorology to provide the water data necessary for good decision making by governments and industry.
>
> Australian Government 2007, p. 1

The 2007 plan included provision of $3 billion for the Australian Government to spend on buybacks (point 4). The Murray-Darling Basin Authority (MDBA) formed in 2008 had the task of determining the volumes of water required to address point 6 of the plan, concerning sustainable diversion limits (SDLs). While provision for buybacks was always part of the plan, it was not clear how the Labor government, which came into office later in 2007, would implement the volumes set by the MDBA. Until late in 2010, public servants in the Australian Government and various state governments were referring to ‘claw-back’, which implied that there would be reductions in water volumes allocated to farmers without compensation. New Prime Minister Gillard announced in August 2010 that a Labor government would purchase all the water required by the MDBA to achieve sustainable flows in the Murray-Darling Basin (Kenny 2010). This announcement removed claw-back from the policy agenda.

The hostile reception in basin communities to buyback

Late in 2010, the Murray-Darling Basin Authority met with hostile audiences when it toured the basin attempting to explain the details of its basin plan. This is understandable, if we think that in the short term, there was substantial interaction between drought and community acceptance of buybacks. This is not because buybacks in any way worsened the plight of farmers during drought, but rather that initial buybacks were associated with a time of extreme stress. Indeed, drought may have accelerated the pace at which the buyback process proceeded. This is because the buyback process provides farmers with another financial option and is a substitute for borrowing from a bank.[1] Drought caused severe financial hardship. Buyback could not stop all cases of drought-induced financial insolvency but as an option for financing, it may have helped some farmers cope better with drought. [2]

In public meetings, the message that buybacks were voluntary and entailed full compensation to farmers was lost. Community responses appeared to be consistent with the expectation of uncompensated "claw-back", a process ruled out several months before the MDBA road-show. Perhaps the voluntary nature of buyback was muddied when Prime Minister Gillard announced that the government's aim was to complete the buyback process by 2014 (Kenny 2010). An early finishing date for the plan relative to the timeline envisaged in the 10 point Howard plan implied a hurried process, and one which would reduce the potential role for water-saving technological change over time to ease the adjustment process. But perhaps the greatest problem was that without careful communication, buybacks may carry the connotation that farmers have been responsible for environmental problems.[3] COAG reforms through the separation of land and water ownership should have altered government and community perspectives. By treating water according to its scarcity, which varies widely from year to year, farmers are part of the solution in basin management. Briscoe (2011) in a submission to a Senate inquiry into the Water Act 2007, was highly critical of attitudes implicit in the act. He stated that the act was directed at the environmental vote, playing on city dwellers with "little knowledge of the land and water environment of the world's driest continent, and a paternalistic and dim view of farmers and agriculture" (Briscoe 2011, p. 3). If the act evokes this sort of response from a prominent international academic on water issues, the ripples it sent through basin communities are unsurprising.

Despite the commitment of state governments to COAG reforms, there has been state meddling in buybacks. A campaign led by the Victorian Farmers Federation persuaded the

---

[1] Prolonged drought worsened the environmental crisis in the Coorong and lower lakes. Senator Xenophon agreed to support a stimulus package devised by the then Rudd government in exchange for a short-term commitment of $500 million for buybacks (Keane 2009).

[2] One of our motivations for using a dynamic CGE model to estimate the impacts of buyback is that baseline conditions influence policy impacts. No factor varies as much in scarcity as water, reflected in both irrigation water availability and dry-land productivity. Therefore, the interaction between drought and the buyback process may be important in analysis of the economic impacts of buyback.

[3] Government initiatives that established irrigation schemes did not involve market signals. Other objectives were at play, including soldier settlement schemes after both of the world wars. There is an almost universal tendency among irrigation schemes towards over-allocation in the absence of market signals.

then Victorian government to impose a cap on permanent trades of water outside catchment regions within the state. The impact of this interference with the business plans of farmers soon became obvious. There was a stampede to trade water with the commencement of each season so as to trade within the cap. This led to an oversubscribed lottery every year for those wishing to sell water in the Goulburn region, emphasising how little support the cap had in practice (Frontier Economics 2009). Despite this, the Victorian Farmers Federation (2008) misleadingly gave the impression that they had the support of all Victorian farmers for the cap. Irrigators wishing to downscale permanent plantings due to an oversupply of grapes or depressed prices for citrus crops have been frustrated by the Victorian cap. Buyback should have provided another sales option for these farmers.

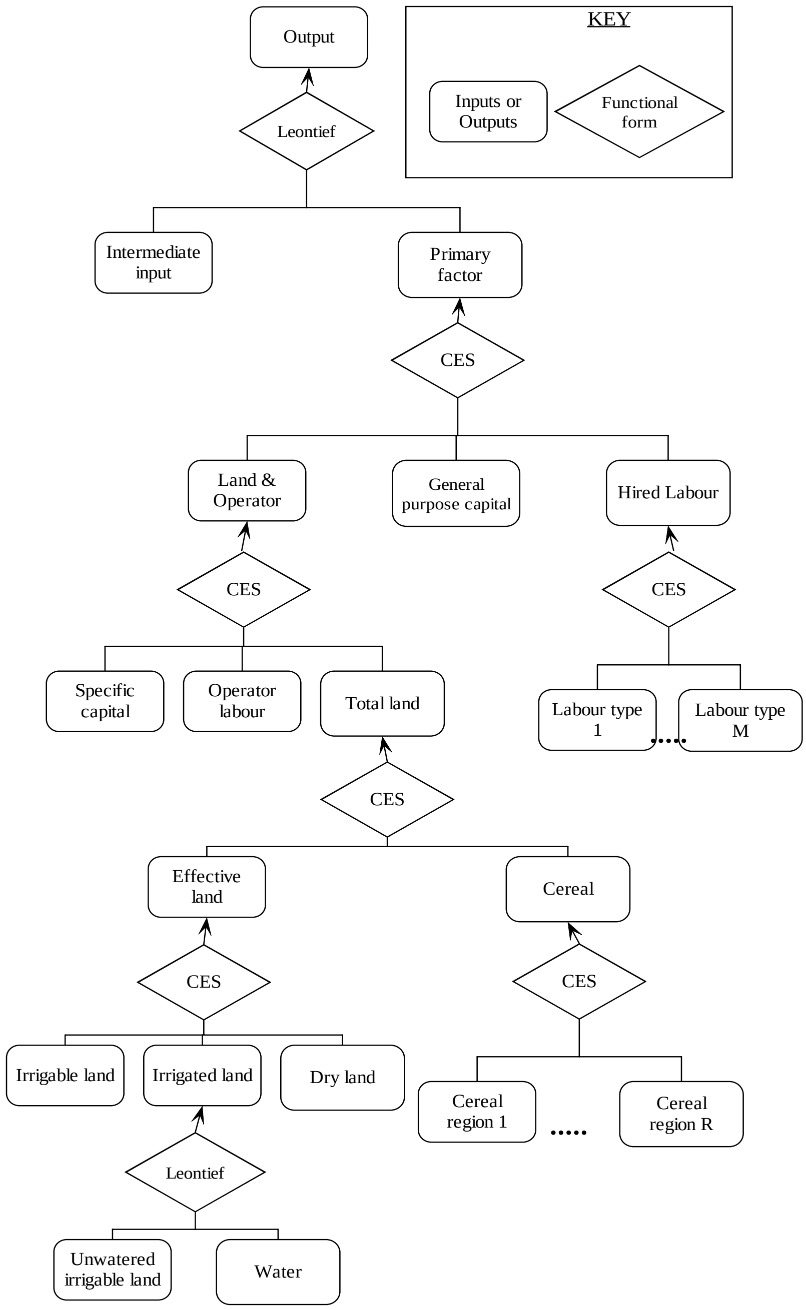
Before the heartening impacts of good spring rains across the basin were replaced by summer floods, Sunrice announced that it would be reopening the Deniliquin rice mill after it had been for closed for three years (Sunrice 2010). This is not consistent with the assertion of some lobbyists that buyback is like a permanent drought and hence worse than usual droughts. Buybacks continued through 2010: that a mill processing the most water-intensive crop in the basin re-opened implies that buyback impacts are minimal. Drought was responsible for job losses in the basin. Drought closed the Deniliquin rice mill and the end of drought led to its re-opening.

Features of the theory of TERM-H2O

The TERM model has revolutionised the representation of small regions in a CGE model (Horridge *et al*., 2005). The use of ABS census data has led to the inclusion of river catchment regions within the Murray-Darling basin as separate economies in a modified version of the model, TERM-H2O. Dixon *et al*. (2010) details the theory of TERM-H2O. Features of the theory are that farm factors are mobile between sectors. Labour, mobile capital and owner-operator inputs are mobile between dry-land and irrigated sectors. Irrigable land can be used either for irrigation or dry-land farming, whereas dry land cannot be used for irrigation activities. Each of these inputs follows CET possibilities. Water is mobile between irrigation sectors and, in the southern Murray-Darling basin, mobile between regions.

In practice, rice is an example of annual crop that is sensitive to water price rises. This is because rice uses a lot of water. As the water price rises, the cost share of water in rice production rises rapidly, so that water quickly moves to other uses. Annual crops are more sensitive to changes in the water price than other crops, not only a consequence of the cost share of water in production. In the case of irrigated cereals, there is a ready dry-land substitute. How do we model perennial crops? As shown in figure 1, some farm sectors include specific capital. Such capital includes vineyards, orchards and livestock herds that cannot switch between outputs. The inclusion of specific capital reduces the responsiveness of activities including such capital to changes in water scarcity. A typical pattern in TERM-H2O is that as water scarcity worsens, use of water rice and cereals production falls, livestock production moves from irrigated to dry-land technologies and water use in perennials falls relatively slowly. That is, water reduction in perennials occurs more through substitution from water towards other inputs (as shown by CES possibilities in figure 1) than through a decline in output.

Figure 1: Production function for a farm industry



Dealing with water in the database

The value of the marginal product of water may vary between users and regions. Whereas a typical base price for irrigators may be less than $100 per megalitre, urban users of water may pay in excess of $1,000 per megalitre. Since the price can vary widely, it is appropriate to include satellite accounts for water in the database in addition to the value of water. The value of water is based on ABS (2010) water accounts and available water prices for the base year. The ABS water accounts follow a national accounting basis at the state level. The linking of water accounts to national accounts is a relatively new concept. John Anthony Allen coined the term “virtual water” in 1993 and was awarded the Stockholm Water Prize in 2008 for his contribution to the field (Reuters 2008). The concept fits in with trade theory concerning production according to comparative advantage. That is, a water scarce nation or region should not aim for food self-sufficiency, but rather aim to supply sufficient water for basic human needs.[4] Nations with a comparative advantage in water abundance, including Australia given its higher per capita endowment of water, are likely to be net exporters of food, helping to meet the requirements of countries with relatively scarce water.

In devising estimates of the value of water in irrigation sectors, we do not change the overall gross operating surplus (GOS). Rather, we need to split GOS between irrigable land, dry land, operator labour, specific capital and mobile capital (figure 1). Dixon et al. (2010) explains this in greater detail. In addition to using ABS water accounts, we also assign a rainfall volume of water to each irrigation sector. This means that in a typical year, rainfall makes a contribution to irrigation requirements. If, for example, rainfall is 200mm below average during the growing season, that increases irrigation water requirements by 2 megalitres per hectare.

How mobile are farm factors?

Table 1 shows that in the droughts of 2002-03 and 2007-08, the water used in livestock pasture decreased and that used in cereal production increased relative to a more average year. This implies that livestock production in the basin moved in part from irrigated to dry-land technologies. This underlines the importance of a fixed water requirement per hectare of irrigated land for each irrigation output which allows such mobility.

[4] If water is still too scarce, water trading (as in the case of Singapore’s imports from Malaysia) has a role.

Comparing drought and buybacks using database weights

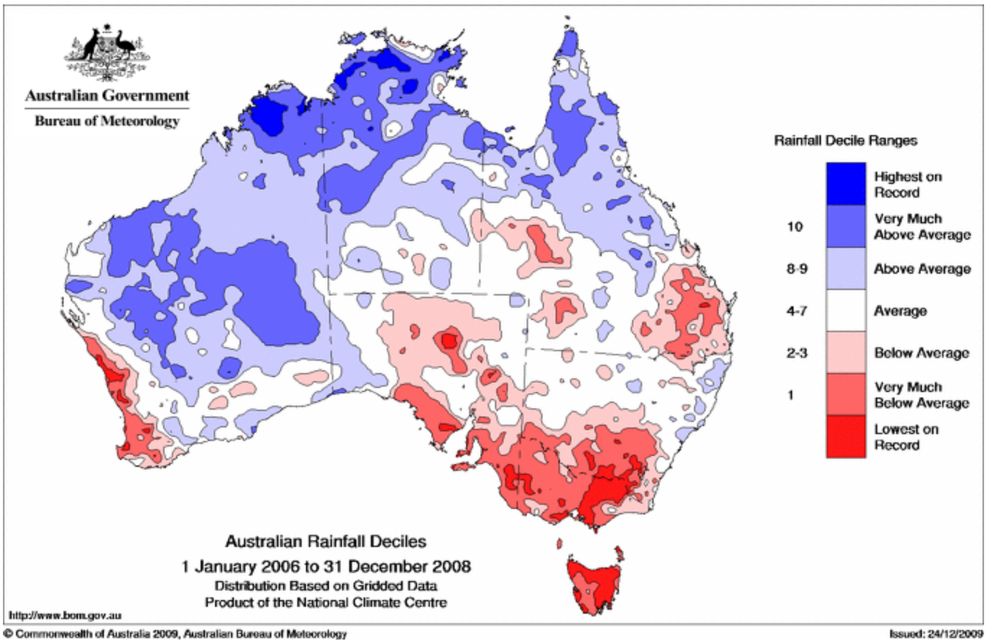
Table 1 Water use in the Murray-Darling basin by activity

	2001–02	2002–03	2005–06	2007–08
Livestock pasture/hay/silage	2,971	2,343	2,571	997
Rice	1,978	615	1,252	27
Cereals (excl. rice)	1,015	1,230	782	805
Cotton	2,581	1,428	1,574	283
Grapes & fruit	868	916	928	790
Vegetables	152	143	152	124
Other agriculture	504	475	460	116
Total Agriculture	**10,069**	**7,150**	**7,720**	**3,142**

Source: ABS (2009a), Table 4.20; ABS (2009b), Table 2.9.

Figure 2 shows that much of the southern Murray-Darling basin, and in particular, the main source of water, the Snowy Mountains, suffered the lowest rainfall on record in the three years to the end of 2008.

Figure 2: The three year drought in the southern Murray-Darling basin



We can calculate a naïve or first-guess estimate of the contribution of a farm subset *k* of all industries *j* to a percentage change in GDP in region r (gdp_r) as:

$$gdp_r = \Sigma_k(PRIM_{kr}.q_{kr})/\ \Sigma_j PRIM_{jr} \quad (1)$$

PRIM is the level of value-added output of each sector and q is the percentage change in output. As a starting point for our naïve calculation, we assume that for irrigation sectors i, $q_i = xwat_i$ where the latter is the percentage difference in water allocations from normal. Additionally, our naïve calculation of lost output in dry-land sectors j equals the technological deterioration due to drought ($aprim_j$) so that $q_j = aprim_j$. Our initial estimate of the impact of drought, in which a refers to all industries in region r is:

$$gdp_r = [\Sigma_i PRIM_{ir}.q_{ir} + \Sigma_j PRIM_{jr}.q_{jr}] / \Sigma_a PRIM_{ar} \quad (2)$$

Table 2 compares drought impacts and buyback impacts across the entire southern Murray-Darling basin, based only on estimated dry-land productivity impacts and changes in irrigation water availability and rainfall. The buyback scenario entails increasing purchases by the Australian Government from farmers from 796 gigalitres (as they were at the end of January 2010) to 3500 gigalitres (the most likely target at present). Entitlements across the basin amount to around 10,900 gigalitres (i.e. 25% = (3500-796)/10900)

Table 2: Comparing direct and modelled impacts for drought and buybacks

	Drought SMDB 2007-08 relative to forecast	Fully implemented buybacks relative to forecast
Dry-land productivity	-49%	0
Irrigation: rain	-56%	0
:water	-56%	-25%
Compensation	No	Full

Even without looking at database weights, table 2 shows us that the negative impacts of drought ought to be larger than buybacks. The last row reminds us that farmers will be compensated at market prices for buyback water, which should leave them no worse off. This ought to make regional losses even smaller than indicated in the rest of table 2, although we could debate the proportion of buyback revenues that are likely to stay in the basin. Some but not all farmers who sell water to the government will leave the basin. In turn, before trying to model the impacts, we expect the impacts of buybacks to be second order. Buybacks do not affect dry-land productivity, although they could increase dry-land production through a movement of farm factors from irrigation to dry-land farming. Buybacks do not affect rainfall, so the proportional impact on overall water availability will be smaller than the proportional impact on irrigation water.

Naïve estimates and modelled impacts at the regional level

Table 3 compares naïve estimates of drought impacts, based on database weights, with modelled impacts. In Table 2, row (1) shows dry-land productivity and row (2) an index of water availability relative to a normal year. Rows (3) to (5) provide estimates of the contributions of dry-land plus irrigation farming to GDP in each region. Rows (6) to (8) contain our first-guess contributions of irrigation and dry-land sectors to changes in real GDP in the regions of SMDB. The modelled contributions to changes in regional GDP by broad sector and irrigation water are shown in rows (9) to (14). Row (15) shows the volume of net water sold by region.

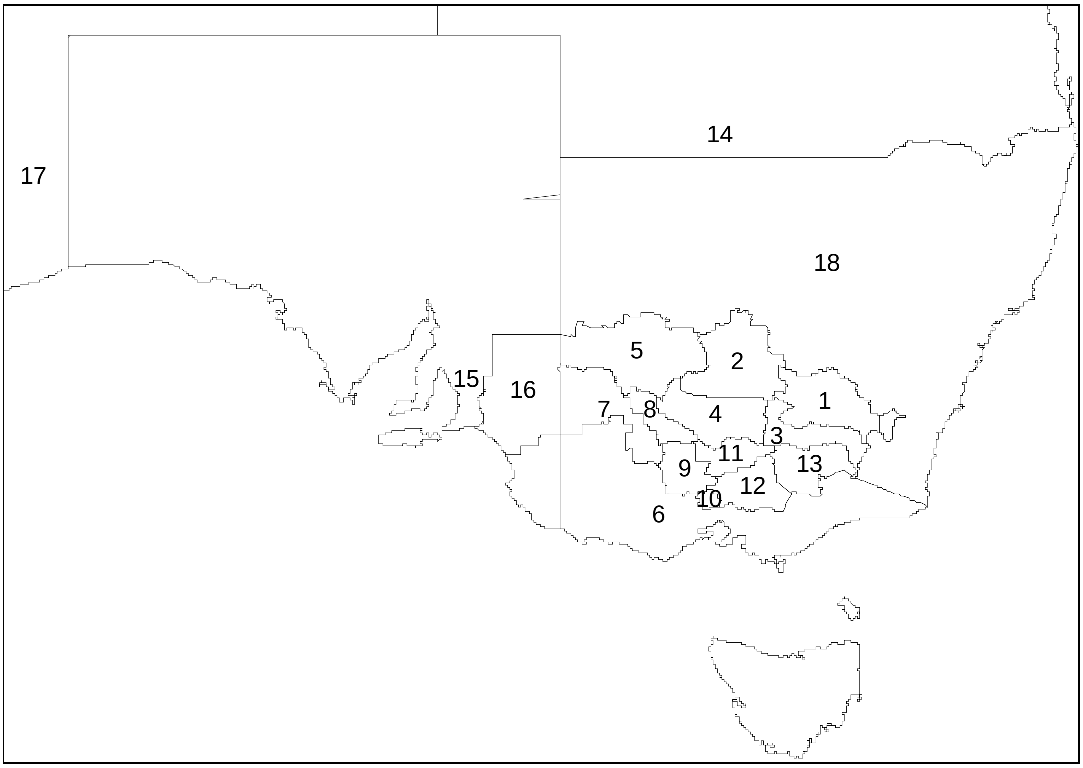
Comparing rows (6) and (9), we see that dry-land first-guess losses predict modelled broad sectoral losses quite closely in some but not all regions. Variations arise from some resource movements. In Lower Murrumbidgee, farm factors move from irrigated towards dry-land production as irrigation water is exported to other regions.

Table 3: Impacts of drought by region, 2007-08 relative to no-drought baseline (%)

	WagCntMrmNSW	LMrmbNSW	AlbUpMrryNSW	CentMrryNSW	MrryDrlngNSW	MldWMaleeVic	EMalleeVic	NthLoddonVic	SthLoddonVic	ShepNGoulVic	SSWGlbrnVic	OvnsMurryVic	MurrayLndsSA	All SthMDB
Water allocations and productivity levels (100 = average)														
(1) Dry-land productivity [a]	42	42	42	42	42	36	36	69	69	69	69	69	36	51
(2) Water[b]	51	51	14	14	40	42	42	46	40	46	46	45	60	44
Contributions to GDP in 2005–06 base (%)														
(3) Dry-land	8.3	8.4	6.4	2.3	8.0	13.6	14.4	3.9	1.4	6.9	7.4	3.8	8.0	6.8
(4) Irrigation	1.9	15.3	1.2	19.6	12.1	8.0	14.5	1.5	0.7	9.2	3.2	2.8	14.1	6.1
(5) Total	10.2	23.7	7.6	21.9	20.1	21.6	28.9	5.4	2.1	16.1	10.6	6.6	22.1	12.9
Naïve estimates of contributions to GDP (%)														
(6) Dry-land	-4.8	-4.9	-3.7	-1.3	-4.6	-8.7	-9.2	-1.2	-0.4	-2.1	-2.3	-1.2	-5.1	-3.3
(7) Irrigation	-0.9	-7.5	-1.0	-16.9	-7.3	-4.6	-8.4	-0.8	-0.4	-5.0	-1.7	-1.5	-5.6	-3.4
(8) Total	-5.7	-12.4	-4.7	-18.2	-11.9	-13.3	-17.6	-2.0	-0.9	-7.1	-4.0	-2.7	-10.8	-6.7
Modelled contributions by broad sector														
(9) Dry-land	-4.4	-2.6	-3.1	0.1	-3.0	-9.0	-9.2	-0.7	-0.3	-0.9	-1.4	-0.8	-5.6	-2.7
(10) Irrigation	-1.0	-10.2	-0.3	-13.2	-2.0	-1.1	-0.5	-0.5	-0.1	-2.1	-1.0	-0.8	-0.5	-1.9
(11) Food	-0.3	-0.6	-0.1	-0.2	0.0	-0.1	-0.2	-0.4	-0.1	-0.7	-0.1	-0.2	-0.6	-0.3
(12) Rest	-1.1	-0.5	-0.7	-1.6	-0.6	-1.7	-1.3	-0.2	-0.3	-0.6	-0.4	-0.9	-0.9	-0.8
(13) Net Water	0.4	3.8	-0.2	-4.9	-1.5	-0.7	-1.6	0.1	0.0	0.6	0.3	-0.2	-0.7	0.0
(14) GDP	-6.4	-10.0	-4.4	-19.7	-7.1	-12.7	-12.8	-1.6	-0.7	-3.6	-2.6	-2.8	-8.3	-5.7
(15) Net water sold (GL)	83	456	-38	-194	-33	-29	-86	5	-4	-104	2	-20	-39	0

a Authors' estimates based on rainfall deficiencies.
b Data provided by Murray-Darling Basin Authority.

Figure 3: Map of SMDB regions in TERM-H2O



Regions: 1 Wagga-Central Murrumbidgee, 2 Lower Murrumbidgee, 3 Albury-Upper Murray, 4 Central Murray, 5 Murray Darling, 7 Far West, 6 Rest of VIC, 7 Mildura-West Mallee, 8 East Mallee, 9 Bendigo-Nth Loddon, 10 Sth Loddon, 11 Shepparton-Nth Goulburn, 12 Sth/SthWest Goulburn, 13 Ovens-Murray14 QLD, 15 Rest of SA, 16 Murray Lands SA, 17 Rest of Australia, 18 Rest of NSW.

Comparing modelled outcomes and actual outcomes for drought

Table 4 compares modelled outcomes for farm products in the SMDB with available data on percentage changes in 2007-08 relative to 2005-06. Columns (1) to (3) show the modelled deviations from forecast due to drought (versus a hypothetical no-drought baseline for 2007-08) and columns (4) to (6) estimated actual changes between 2007-08 and 2005-06. Hence, the comparisons are not between like and like, but are the best we can do.

Table 4: Comparing modelled SMDB outcomes to observed changes

	Output[a]	Price	Water used[b]	Output[c]	Price	Water used[b]
	Modelled outcome deviation from 2007-08 base (%)			Observed 2007-08 relative to 2005-06 (%)		
	(1)	(2)	(3)	(4)	(5)	Water (6)
Cereal	-55.3	43.6	-78.8	1.1	92.1	-55.9
Rice	-84.9	86.2	-90.7	-98.2	46.3	-97.8
DairyCattle	-13.6	29.5	-40.9	1.9	52.0	-64.9
OthLivestock	-23.1	41.4	-44.6	na	na	-76.8
Grapes	-17.9	18.0	-49.0	2.2	44.6	-14.4
Fruit	-7.7	13.5	-23.1	5.4	17.6	-17.8
Vegetables	3.5	6.8	-1.4	-2.0	3.1	-15.5
OthAgri	17.3	7.9	12.6	na	na	-50.0

a Value-added basis.
b Water used in irrigation production.
c Value of output, not value-added.
Source: ABS catalogue no. 7125.0 ; Anderson et al. (2009), ABARE.

Cereal production did not shrink as much in the observed period as we modelled. This reflects soaring cereal prices in the observed period: the actual price hike was twice the modelled drought-induced price hike. World prices of cereals in 2006-07 were driven up by increased use of bio-fuels and other international developments beyond price hikes arising from drought within Australia. The output outcomes for dairy cattle, grape and fruit turned out better than we modelled, again with observed prices rising more than the modelled deviation. Yet dairy cattle's use of water dropped more than we modelled: this reflects a larger-than-modelled movement from irrigated to dry-land production. Since dairy output prices were high in 2007-08, dairy producers were willing to move to dry-land and pay for cereal feed (grains and hay). Although the observed value of dairy cattle output rose by 1.9 percent (Table 3, column (4)), the value-added almost certainly dropped significantly, reflecting high feed costs and bringing the observed result closer to the modelled result. Overall, there was a greater movement of water out of rice production than we modelled.

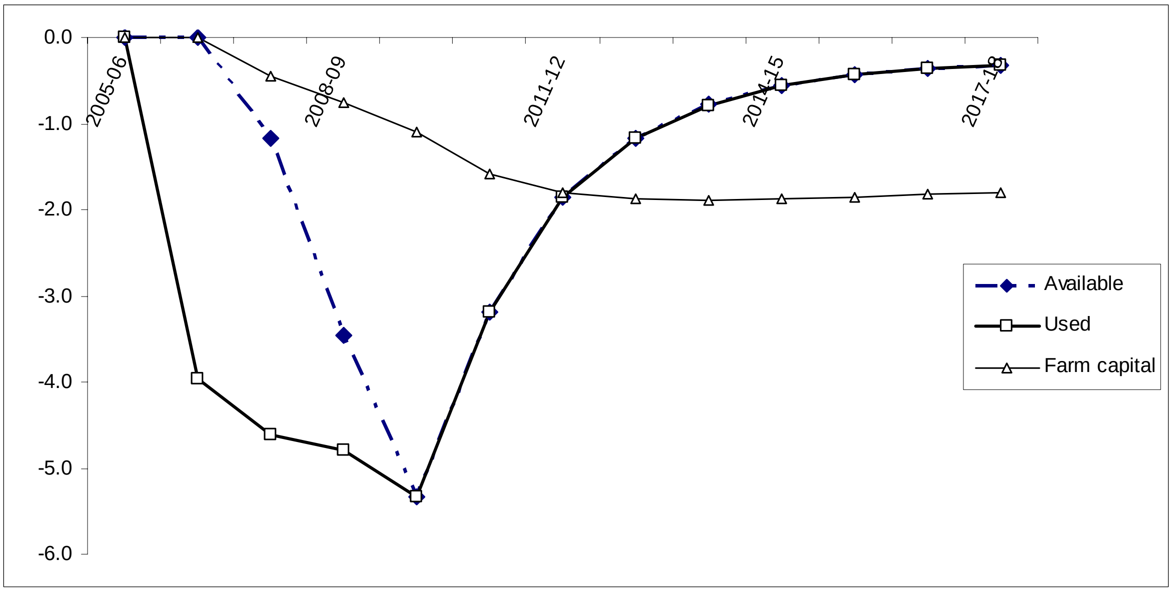
Other than rice, only vegetables and the relatively small other agriculture sector did worse than modelled. Vegetables output did marginally worse than forecast due to the output price hikes of competing, more export-oriented products. The other agriculture sector includes nursery products: Australia's mainland capitals with the exception of Darwin all faced water restrictions in this period which drove down demand for this sector from household gardeners.

Next, we examine water prices. We would expect water prices to have increased between 2005-06 and 2007-08 by a larger amount than modelled, due to the observed surge in commodity prices for some major irrigation products. This is so: the modelled increase was $285 per megalitre relative to forecast in 2007-08, compared with an observed increase in the Goulburn region relative to 2005-06 of around $500 per megalitre. A weakening of commodity prices in 2008-09 resulted in the price of water falling to $275 per megalitre above 2005-06 levels, closer to the modelled outcome (Watermove weekly data, downloaded from www.watermove.com.au).

Employment impacts of drought

The headline modelled impact is that 6,000 jobs were lost in the basin during the worst of the drought. That is not the end of the story. A long run story emerges from the years of lost investment during drought. Figure 4 shows the impact of drought on downstream processing and farm capital. TERM-H2O included a theory of excess capacity which resulted in some downstream capital being idle during drought, following Dixon and Rimmer (2010). The last impact of drought is that mobile farm capital remains 2% below forecast years after the end of the drought.

Figure 4: Downstream processing and mobile farm capital, SMDB
(% deviation from forecast)



The decline in farm capital relative to forecast years after recovery from drought results in a long-term decline in basin employment relative to forecast. In 2017-18, years after recovery, basin employment remains 1,500 jobs below forecast.

Buyback impacts – 3500 GL target

This section summarises key findings from previous modelling undertaken for the MDBA (Wittwer 2010). The following assumptions applied:

- Since the process is voluntary, with willing farmers selling part of their water entitlements to the Commonwealth, it proceeds slowly. That is, we assume that permanent water sales fit in with the forward planning of farmers.
- In each scenario, target volumes for environmental flows are not reached until 2022.
- Farmers are compensated at market prices for entitlements sold to the Commonwealth. This assumption applies to three scenarios but is dropped for a fourth scenario.

- Target volumes already include the 796 GL of entitlements sold to the Commonwealth by the end of January 2010 (but excluding buyback sales since then – which totalled 920 GL by the end of September 2010).

The relevance of a slow process is that technological gains that result in savings in water requirements in irrigation help alleviate losses in farm output over time. MDB communities have had to live with environmental challenges, including severe and prolonged drought over much of the past decade. Irrigators have made substantial water savings in the past through the use of new irrigation technologies. However, the adoption of new technologies takes time. In addition, without sudden reductions in local farm outputs that would result from large and concentrated water sales in a short space of time, the impacts on downstream processing sectors are smaller than otherwise.

As a first step, we use a simple calculation based on database weights to estimate the impact of removing 3500 GL of entitlements from production. Table 5 provides initial estimates of regional estimates, based on the direct impacts as for the basin-wide impact in table 2. Modelled GDP outcomes in most regions are slightly worse than this calculation (compared columns (3) and (2) in table 5). This is because the removal of water from irrigation production depresses farm land and capital rentals, which in turn reduces farm investment relative to forecast slightly. Consequently, farm capital in the basin falls relative to the baseline forecast. There is also a small reduction in employment in each region over time relative to forecast. Real GDP declines across the basin relative to forecast, but is little more than 0.2 percent below forecast by 2026.

Table 5: Comparing 2026 modelled outcomes relative to forecast with first estimate

	First	*Estimate*		*Modelled outcomes*	
	(1)	(2)	(3)	(4)	(5)
	water[a]	GDP %	GDP %	net water sold GL	B/C[b]
TmwthNSlpNSW	-13.3	-0.04	-0.06	0	0.15
NCentralNSW	-14.4	-0.33	-0.99	0	0.91
MacquarieNSW	-11.7	-0.04	-0.04	0	0.16
McqrieBarNSW	-10.9	-0.14	-0.31	0	0.55
UpDarlingNSW	-13.4	-0.13	-0.23	0	0.52
CntralWstNSW	-18.0	-0.03	-0.03	0	0.13
LachlanNSW	-6.4	-0.03	-0.01	0	0.23
WagCntMrmNSW	-25.9	-0.06	-0.10	18	0.24
LMrmbNSW	-28.2	-0.57	-0.19	-221	2.39
MurrayNSW	-14.5	-0.19	-0.28	185	0.92
MrryDrlngNSW	-21.7	-0.14	-0.15	-12	0.57
MalleeVic	-8.2	-0.06	-0.18	68	0.42
LoddonVic	-20.5	-0.02	-0.07	7	0.06
GoulburnVic	-17.8	-0.09	-0.28	-19	0.43
OvnsMurryVic	-11.8	-0.03	-0.15	9	0.14
DrlngDwnsQld	-20.7	-0.19	-0.77	0	0.60
SouthWQld	-21.0	-0.15	-0.58	0	0.61
MurraySA	-15.3	-0.10	-0.22	-35	0.44
All MDB	-17.3	-0.13	-0.25	0	0.41

Key:
a % of allocated water removed from production in addition to buybacks that have already taken place
b Compensation spending (5% of asset value) as a share of aggregate consumption

Figure 5 shows that the price of water rises due to buyback, providing a windfall to owners of water rights. But Figure 6 shows that the price of agricultural land across the basin falls. Hence, farmers whose water has a high asset value relative to the value of their land holdings will do better than farmers with a lower ratio of water to land assets. For example, vineyard and orchard growers may not do as well from sales to the Commonwealth as growers of annual crops. Growers of perennials may be keener to maintain the health of their vineyard or orchard than to sell their water. The composition of the distribution of water inputs and land inputs in total farm factor income may vary between regions. This results in regional and sectoral differences in outcomes.

Figure 5: Price of irrigation water in MDB

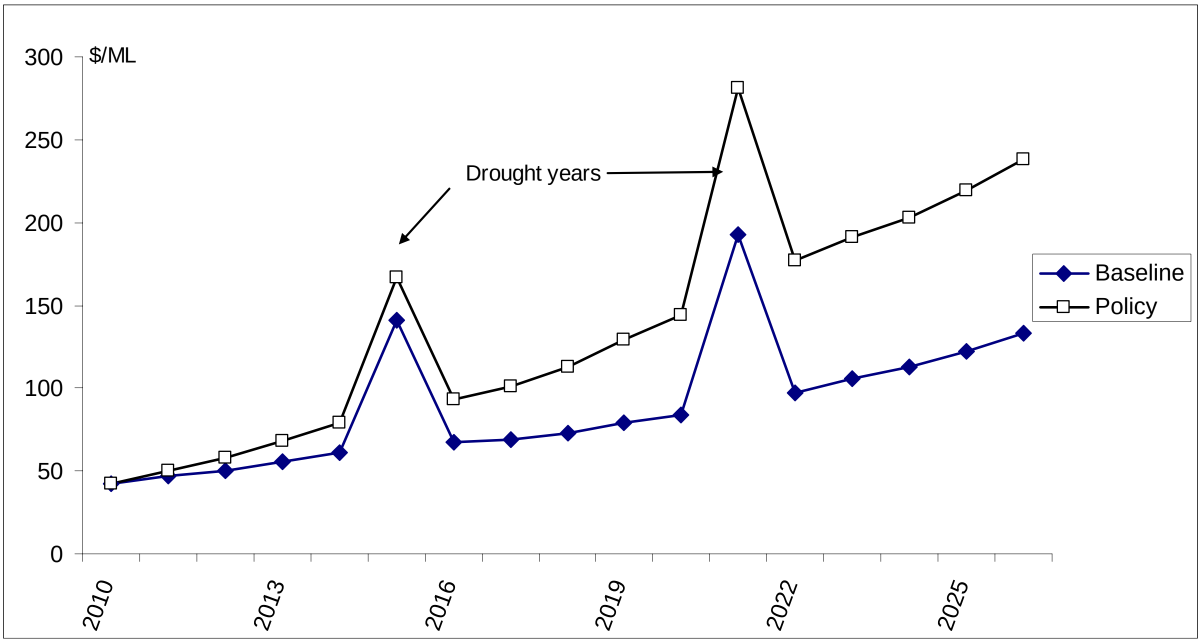
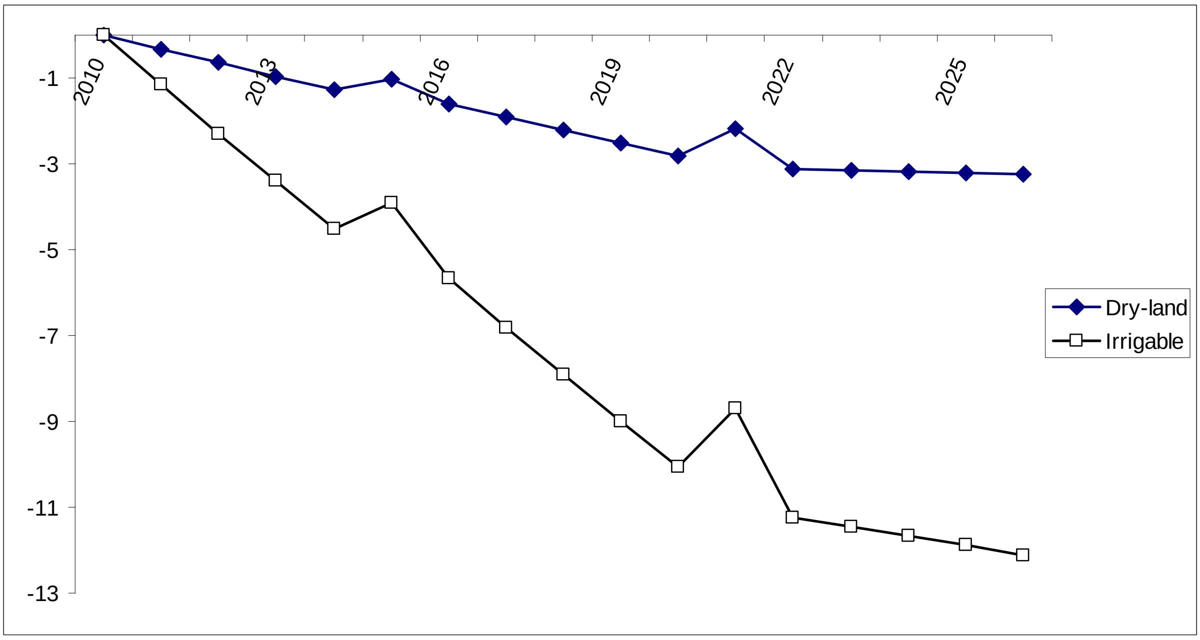


Figure 6: Price of agricultural land in MDB

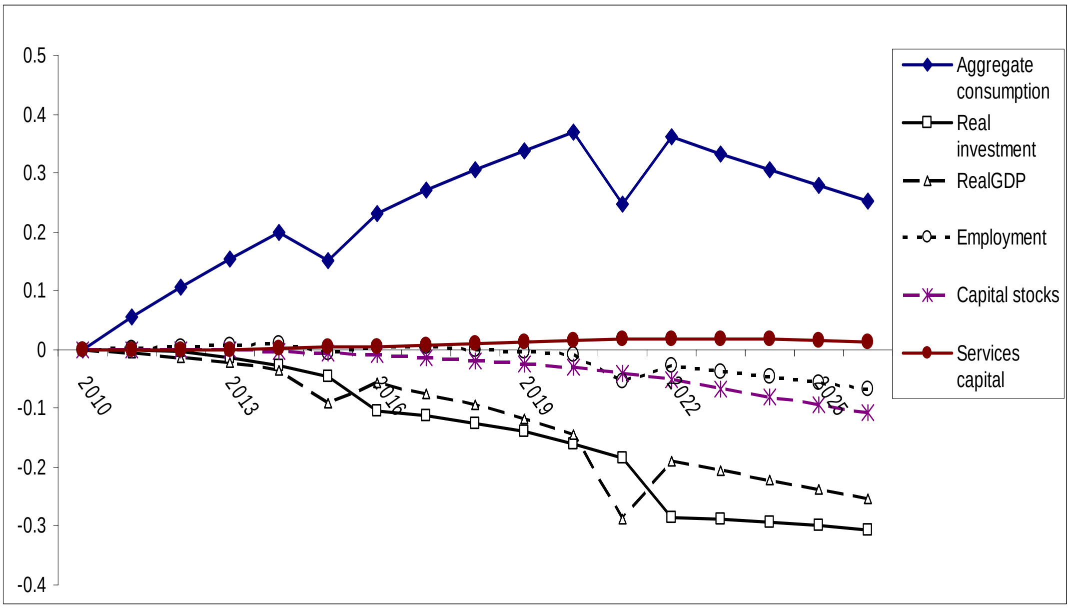
% change from forecast



Aggregate consumption in the 3500 GL scenario peaks at 0.3% above forecast across the MDB in 2022 (Figure 7). This reflects full compensation at market prices for water, and that farmers remain in the basin. Among regions, the Lower Murrumbidgee region has the largest increase in aggregate consumption relative to forecast, because it has relatively high water to land value ratio. The regions that gain least in terms of aggregate consumption are those in which irrigated agriculture is a relatively small share of the regional income base.

Figure 7: Macroeconomic impacts, MDB

% change from forecast

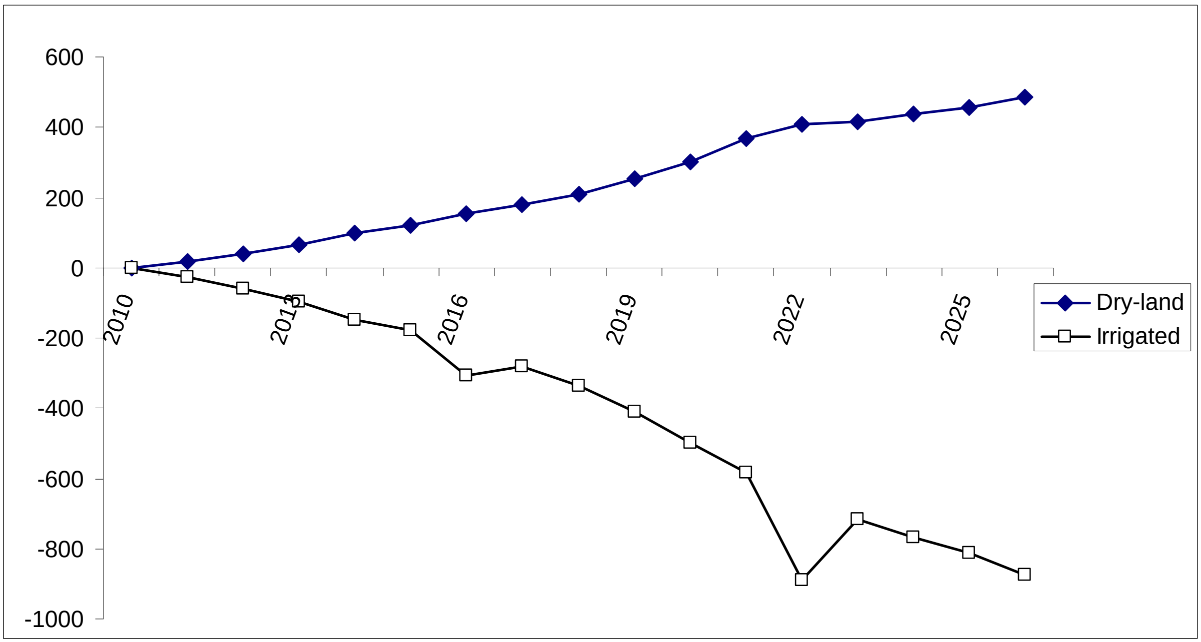


The slightly lower levels of farm investment and consequent lower levels of farm capital result in a small deterioration in regional outcomes over time (that is, after water sales to the Commonwealth have been completed in 2022). We assume that farmers spend only that percentage of buyback payments that maintains the real value of payments over time. Thereafter, real consumption moves gradually back towards forecast after the assumed payments end in 2022. At the same time, employment across the MDB drops slightly below forecast, reaching almost 0.1% below forecast by 2026. This amounts to around 500 jobs lost across the region relative to forecast. Basin-wide employment in services sectors, which depend on household spending and are relatively labour-intensive, remain slightly above forecast in 2026.

Reaching the SDL targets will impose some upward pressure on farm output prices. The largest impact will be on rice, which rises to 7% above forecast by 2026. In the same year, irrigation output in the basin falls more than $800 million below forecast, but this is partly offset by an increase in dry-land output of $400 million (Figure 8).

Figure 8: MDB farm output

$m change from forecast



From the Commonwealth’s perspective, the greater the volume of water purchased, the higher the cost, as the irrigation water entitlement price rises as more water is purchased and diverted to environmental uses. Since the Commonwealth’s purchases push up the price of water, the real cost to the Commonwealth will not be proportional to the volume of water purchased by the Commonwealth. Rather, the total cost will increase by a larger percentage than the increase in the target volume.

The impacts on downstream processing sectors are relatively modest. A movement of farm factors from irrigated to dry-land production partly alleviates reductions in farm output supplies to downstream processors.

Calculating the asset value of water and its impact on regional disposable income

Several steps are required in calculating how much SDL compensation payments impact on regional spending. First, we need to calculate the asset value of a water right. Second, we need to assign a certain proportion of compensation payments to disposable income in each region. TERM-H2O is unique among models used in analysing SDLs in that it accounts for the impact of compensation on each region’s household spending. Because there may be debate about the proportion of proceeds that stay within the region of sale, we can vary that proportion: in three scenarios we assume that all proceeds stay within the region of origin In a fourth scenario, we assume that there is no compensation at all for farmers for water taken out of production.

In practice, we might expect at least some of the proceeds of water sales to stay within the basin. In particular, some farmers in making investment plans may use water revenues as a substitute for bank finance. Therefore, it would not be surprising if banks anticipate a reduction in the value of loans they provide in the basin. Some farmers will cash in water rights rather than borrow to fund investments.

If only a fraction of compensation proceeds remain in the basin, the impacts will be less favorable than we have reported. Regions with relatively high proceeds as a share of regional income are more sensitive than others to the assumption concerning the proportion of proceeds that stay within the basin. Table 5 (column (4)) shows annual buyback spending as a share of aggregate regional consumption in each region in 2026. Across the basin, this fraction is 0.41% of aggregate consumption.

What happens to the asset value of water with a return to years of better rainfall? The method used to calculate asset values (Dixon et al., 2011) imposes a higher price on future years of expected drought. This is because demand for irrigation water is inelastic (that is, the value of water rises as the volume of allocations falls). The higher the expected frequency of droughts, the higher the present value of water. During the prolonged drought, expectations were that droughts would be relatively frequent in the future. With a return of rain (and once-in-generation floods), the expected frequency of droughts has fallen and with it, the asset value of permanent water. Anecdotal evidence is that the asset value of water per ML of average annual allocation has fallen from over $2000 to around $1500 with the end of the drought.

Further discussion

The current act (*Water Act 2007*) concerning water purchased for the environment does not allow for temporary trading as part of environmental water management. While there may be efficiency gains from amending the act, there is the danger that amendments may leave to substantial dismantling of the act. The current Federal opposition has made it clear that they wish to end the buyback process, following the pattern of mixing up the impacts of drought and buybacks. This is despite Malcolm Turnbull being the political architect of the existing buyback scheme under the former Howard government.

Discussion continues on how much water will be sufficient to restore and maintain the environmental health of the basin. Modelling outlined in this paper shows that the impacts on basin communities of water being removed from irrigation through buybacks will be small. However, the Australian Government’s budget constraint will place an upper limit on the volume of buybacks. This implies that environmental managers will never get the volume of water they believe is necessary for restoration of the basin. Therefore, they will have to make do. This means that to compensate for not having the required basin-wide volume, they must have flexibility. They can only get this if they are allowed to trade on the temporary market -- and communicate with environmental managers in other parts of the basin to determine which site is in the gravest need of water at a particular time. The current system of permanent buybacks has been drafted too much as final solution, and not as a pathway to managing ongoing environmental concerns within the basin.

References

ABS (2010) Water Account, Australia, 2008-09. http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4610.0Explanatory%20Notes12008-09?OpenDocument. Accessed 18 February 2011.

Anderson, K., Nelgen, S., Valenzuela, E. and Wittwer, G. (2010). Economic contributions and characteristics of grapes and wine in Australia's wine regions. Wine Economics Research Centre Working Paper No. 0110, University of Adelaide.

Dixon, P., Rimmer, M. and Wittwer, G. (2011), "Saving the Southern Murray-Darling Basin: the Economic Effects of a Buyback of Irrigation Water", *Economic Record*, 87(276): 153-168.

Frontier Economics (2009). Volumetric restrictions on water entitlement trade. A report prepared for the ACCC, August.

Reuters (2008) Scientist who invented "virtual water" wins prize. http://www.reuters.com /article/2008/03/19/us-water-idUSL1850227220080319. Accessed 18 February 2011.

Wittwer, G. (2010). The regional economic impacts of Sustainable Diversion Limits. Report prepared for the Murray-Darling Basin Authority, December.

Wittwer, G. and Griffith, M. (forthcoming), "Modelling drought and recovery in the southern Murray-Darling basin", *Australian Journal of Agricultural and Resource Economics*.