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The role of the Unbundling water rights in Australia's Southern Connected Murray Darling Basin

Mike Young, University of Adelaide

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Executive Summary

Australia has defined its water entitlement and allocation arrangements in a manner that has made it possible to establish one of the world's most sophisticated water marketing systems. This system is best developed in the Southern Connected Murray Darling System which sits within Australia's Murray Darling Basin.

Initially, irrigators were issued licences to irrigate a maximum area of land. These licences were converted into licences to take up to a defined maximum volume of water each year. As irrigation expanded, two types of rationing systems where introduced. At the entitlement level, two types of licence were introduced

- High security licences – which nearly always received their full allocation; and
- General security licences – which only received a full allocation in wet years.

When it is not possible to give users their full allocation, water is allocated to all licence holders on a proportional basis. Eventually, it was realised that no more licences should be issued and a cap was placed on water use. At the same time that this limit – known as the cap – was introduced a suite of water reforms were put in place to enable water trading. The initial objective of trading was to make water use more efficient and enable it to move to its highest and best use at any point in time.

Initially trading was administratively complex and slow. Gradually, however, experience increased and the benefits of trading became more and more apparent. There have been dramatic increases in water use efficiency and considerable innovation.

One of the key innovations that made it possible to trade large volumes of water efficiently is the introduction of what is now known as "unbundling". Unbundling involves the conversion of one property right into a bundle of separate instruments each designed to pursue a different objective and, often, operate at different scales.

Rationale for choosing the case study

While it would be possible to present the "Australian" water entitlement, allocation, use control, distribution management and trading system as a case study, for the purposes of this EPI project it is judged more useful to focus on one of the key features of this system. The feature chosen is the "unbundling" of the licensing system. Unbundling is chosen because it demonstrates one of the necessary conditions for the development of market-based approaches to the management of natural resources that can be expected to remain efficient through time and deal equitably and fairly with large numbers of water users.

Definition of EPI and purpose

The underpinning goal of water trading was to increase economic growth by allowing water to be moved to places where it could make the greatest contribution to economic development. The initial argument was that water should be put to its "highest and best use."

In retrospect, however, Australia has learned that water trading enables efficient and rapid adjustment to extreme water scarcity. The "unbundling" innovation identified in this case study has been critical to the development of this capacity to adjust quickly to water scarcity problems.

Australia began with a water allocation system that issued a single property right (a licence) to a water use. Each licence consisted of a "bundle" of entitlements to use water, conditions about how it may be used, etc. Unbundling involves the separation of this bundle of rights into a number of separate parts.

Prior to the introduction of unbundling, the amount of water used by irrigators was administered using a licensing system that made it difficult to move water allocations for one location. Transaction costs were high. The approach taken was to temporarily transfer the licence from one water user to another, then take the water off the licence and then, after the water had been taken from the licence, the licence was transferred back to the original owner. The process was slow and administratively complex. To this day, this type of transfer is known as a temporary trade because the trade used to involve the temporary transfer of a licence from one person to another.

To simplify this process, a decision was taken in 1994 to allow people to hold water licences without owning any land. In order to facilitate this and increase investment security formal water entitlement registers were established and procedures put in place to enable landholders to obtain permission to irrigate an area of land without knowing where the water would come from. As reforms progressed further, it was decided to define water licences as shares and issue them in perpetuity.

Separate bank-like water accounts were then set up and structured so that water was allocated to each shareholders account in proportion to the number of shares they held. In parallel with these arrangements, any landholder who wished to use some water in an account needed to have a use approval that authorised the government to deduct water from an account as it was used. Whilst complex, the result was the emergence of extremely efficient water trading arrangements.

In parallel with these reforms, efforts were made to improve system-wide planning processes so that irrigators could make investments with greater confidence.

Legislative setting and economic background

In Australia, the degree of protection from competition in the production of agricultural products is low.

Significantly, in 1994 Australia established a National Competition Policy that sought to use markets as the prime mechanism to make water use and many other services provided by government more efficient. This commitment, nearly 20 years, has forced many changes. Productivity is now much greater.

With regard to the legislative setting used to enable water management

- Each component of the unbundled set of arrangements is defined in legislation and in a suite of plans approved by parliament.

- A key feature of the resultant suite of institutional arrangements is a process that uses the approved plans to manage third party impacts.
    - If a third party is aggrieved by a water trade and the trade is in accordance with the rules set out in the plan, the only course of action available for a third part to prevent the trade from occurring is to arrange for the rules in the plan to be changed. There is no opportunity for a third party to prevent a transaction that is consistent with rules set out in the plan.
    - An independent regulator is used to minimise opportunities for regions to find ways to impede trades from occurring. A complex set of rules, for example, are used to define the maximum fee that a person may be charged for trading water from one district and into another.
- As each stage in the development of the current unbundled system of property rights was introduced, a pragmatic decision was taken to begin by defining formally defining each dimension of the emerging system in a manner that mimics the status quo. (This is known as grandfathering.)

Results and impacts of the proposed EPI

The resultant improvement in individual wealth has been an increase in the value of the property right in the vicinity of 15% per annum for well over a decade. This rate of return has been much greater than could be achieved by investing in the Australian share market. There has been a dramatic increase in the technical efficiency of water use and in the development of new technology.

In retrospect, grandfathering has proved critical in gaining acceptance of the new market based system of allocating and managing water use. At each stage in the reform process, the process began by redefining rights in a manner that did not change the status quo.

The introduction of water trading has dramatically reduced the economic impacts of drought. The Southern Connected River Murray System experienced a long dry between 2002/3 and 2008/9. Water diversions during this period declined by around 80% but the gross value of irrigated agricultural production dropped by around 40%.

This, however, only presents the upside of the case. The water accounting and allocations systems used in the Murray Darling Basin lacked hydrological integrity. Water allocations were not reduced as water use efficiency increased and as return flows decreased environmental problems began to emerge. The result was a move from a fully to an over-allocated system that governments are finding it hard to solve.

In addition to a reduction in return flows, surface water trading increased groundwater use and reduced the amount of groundwater that returned to the river. This over-allocation problem worsened as the value of water increased. Seeking to capture this value, landholders also began to divert overland flows that previously reached the river into their storages. In parallel with this governments began to construct salinity interception schemes necessitated by the general increase in irrigation water use that was occurring.

Today, in an attempt to over come the over-allocation problem the Australian government is using the water market they established to buy back water entitlements for the environment. To date, all entitlement sales to the government have been voluntary. Over the next decade, it is expected that existing entitlements will need to be reduced by 35% to 50% - such is the extent of the suite of unaccounted for innovations that have occured.
With the benefit of hindsight it can be seen that as the water market has driven up the value of water, the billion dollar cost of fixing this over-allocation problem is much greater than it would have been if robust water accounting arrangements had been put in place before the water market EPI was put in place.

Conclusions and lessons learnt (200 words approx.)
For water use to be efficient, remain efficient through time, be seen to be equitable and to deliver local and system-wide environmental objectives, there must be as many EPI's as there are objectives. As a bare minimum, there must be an instrument that ensures that water use is efficient on a daily basis and another to ensure that long-term investment decisions are taken in an efficient manner.
In short, this case study finds that the use of economic policy instruments will be more effective if existing property right arrangements and existing instruments are unbundled.

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1. Characterisation of the case study area

The best source of an overview of the case study area is the Government's recent guide to the proposed Basin Plan (MDBA 2011). Rather than reinventing the wheel, this section extracts (plagiarises) paragraphs from this guide without any attempt to rewrite the text.

Environmental characterisation

Across the Basin from the south and east to the north and west, average annual rainfall decreases, and evaporation and climate variability generally increase. Overall, the climate of the Basin varies greatly from year to year, which means that flows in the rivers of the Basin are highly variable and unpredictable. The Basin has a long history of floods and droughts (Puckridge et al. 1998; Young et al. 2001; Arthington & Pusey 2003).

Water run-off in the Basin is very low compared with other major river systems around the world; river systems in the Basin also experience much higher flow variability than those of any other continent. Inflows from rainfall to the rivers of the Basin have ranged from around 117,907 GL in 1956 to around 6,740 GL in 2006 (MDBA unpublished modelled data). The average annual flow of the River Murray is only about 16% of that of the Nile, 3% of the Mississippi and just 0.25% of the Amazon (McMahon et al. 1992).

The Murray Darling Basin contains approximately 40% of all Australian farms, and produces wool, cotton, wheat, sheep, cattle, dairy products, rice, oilseeds, wine, fruit and vegetables for domestic and overseas markets (ABS 2009). Agriculture also provides the raw materials for most of the manufacturing activity within the Basin and for many processing companies outside the Basin. Today, farming, forestry and pastoral industries cover nearly 80% of the land in the Basin and, with inland fisheries, generate more than 40% of the gross value of Australian agricultural production. The Basin also generates 3% of Australia's electricity and 33% of its hydro-electricity (ABS 2008).

Rainfall runoff

Average annual rainfall in the Basin is 530,618 gigalitres (1,000 times the volume of Sydney Harbour). Of this, 94% evaporates or transpires through plants, and 2% drains into the ground, leaving only 4% as runoff.

There is considerable variation in rainfall runoff from one part of the Basin to another, and this variation bears little relationship to catchment size. The catchments draining the Great Dividing Range on the south–east and southern margins of the Basin contribute most to total runoff. For example, the Murrumbidgee and Goulburn, Broken and Loddon river catchments account for 35% of the Basin's total runoff, yet they cover only 12% of its area. On its own, the Upper Murray catchment accounts for 17.3% of runoff, from only 1.4% of the Basin.

Environment
Many of the Basin's natural resources are of high environmental value. Its wetlands are extensive and perform essential hydrological, biological and chemical functions, which support and maintain the productivity and health of the river systems. A number of the Basin wetlands are recognised under the Convention on Wetlands of International Importance (otherwise known as the 'Ramsar Convention').

People
Home to more than two million people, the Basin supports many regional service centres and agricultural communities, as well as Canberra, the nation's capital. Outside the Basin, a further 1.3 million people depend on its water resources, including Adelaide with the largest population base reliant on Basin water resources.

About 30 Aboriginal nations live in the Basin and practice a rich cultural heritage based on the Murray–Darling river systems.

Agriculture
The Basin is Australia's most important agricultural area, producing over one–third of Australia's food supply.

The Basin generates 39% of the national income derived from agricultural production. It produces 53% of Australian cereals grown for grain (including 100% of rice), 95% of oranges, and 54% of apples. The Basin supports 28% of the nation's cattle herd, 45% of sheep, and 62% of pigs.

In Australia, irrigated land is 0.6% of total agricultural land. In the Basin, irrigated land is 2% of agricultural land. The Basin includes 65% of Australia's irrigated agricultural land.

Storing and distributing water
In the last 100 years, life in the Murray–Darling Basin has been transformed by the construction of major water storages on the rivers. The total volume of publicly managed water storage capacity in the Basin is just under 35,000 gigalitres. The Murray–Darling Basin Authority is responsible for managing about one–third of that volume – with major storages at the Dartmouth Dam, Hume Dam, Lake Victoria, Torrumbarry Weir, the Menindee Lakes and other river regulatory structures.

These storages have made it possible to store water during wet periods and release it as needed during summer or in droughts.

Water use
In an average year, a significant proportion, around 40% of water is diverted from the River for a variety of consumptive purposes. Consumptive water use in the Murray Darling Basin and also in its Southern connected system is primarily for irrigated agriculture (See figure 1).

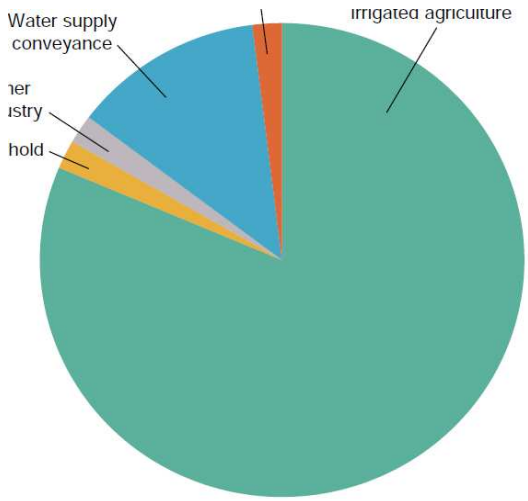

Figure 1a Consumptive water use by sector in the Murray–Darling Basin

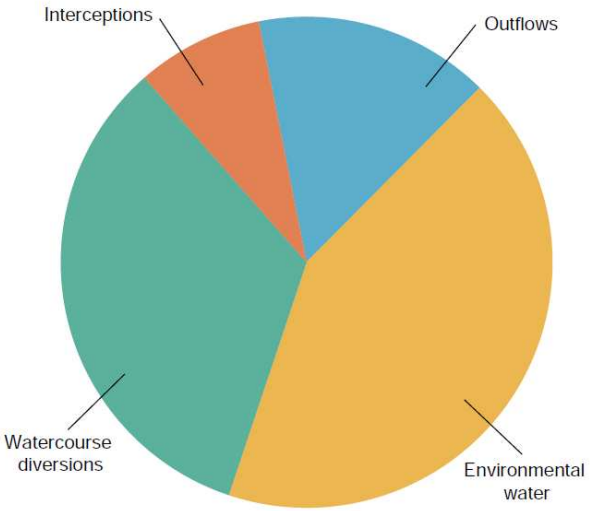

Figure 1b Current shares between diversions, interceptions and outflows, and from the Murray Mouth and the environment

Figure 1 Water use in the Murray Darling Basin
Source: MDBA 2011

Property rights

Table 1 shows the distribution of water entitlements in the Southern Connected River Murray System. In most regions, a variously named water sharing, allocation and management plan is used to define the rules for determining how much water is available for allocation to consumptive use purposes. Allocations are then made to one or more defined "pools" of water and this water then distributed to entitlement shareholders in each pool.

In many regions, there a number of priority pools have been established. Water is first allocated up to a volumetric limit to high security pools and then to general and low security pools. Announcements as to the amount of water that will be allocated to each pool are made on the first working day after the first and fifteenth day of each month.

Entitlement shares are typically defined in megalitres (ML) and once an entitlement shareholder has been allocated their maximum volumetric entitlement, no more water is allocated to them.

Entitlements and allocations are tradeable. Once made allocation become the property of the entitlement holder they are allocated to. Within the limits of the storage system allocations can be either left in storage, used or sold to someone else. Within a variety of constraints, allocations can be carried forward from one year to the next.

Table 1. Surface water entitlements in the Southern Connected River Murray Systemas at 30 June 2010 (basic rights and unregulated flows are estimates)

State and MDB Plan region	High security[1] (ML)	General and low security[2] (ML)	Other regulated flows[3] (ML)	Surface water basic right[4] (ML)	Unregulated flows[5] (ML)	Total[6] (ML)
Murrumbidgee (ACT)	0	0	71,000	0	4,386	75,386
Lower Darling (NSW)	7,633	78,100	11,518	3,727	250,000	350,978
Murray (NSW)	191,603	1,667,723	380,715	2,319	287,783	2,530,143
Murrumbidgee (NSW)	377,435	1,888,070	435,493	6,578	261,374	2,968,950
Murray (SA)	302,659	0	573,523	0	0	876,182
Campaspe (Vic)	42,366	24,104	52,005	0	8,697	127,172
Goulburn–Broken (Vic)	1,090,792	645,101	44,426	0	84,482	1,864,801
Loddon (Vic)	22,832	10,728	3,890	0	31,402	68,852
Murray (Vic)	1,303,686	611,281	51,784	0	48,905	2,015,656
Ovens (Vic)	26,165	0	7,832	0	40,056	74,053
Total	**3,365,171**	**4,925,107**	**1,632,186**	**12,624**	**1,017,085**	**10,952,173**

Notes:

1. High security includes New South Wales and South Australia high security, and Victorian high reliability.
2. General and low security includes New South Wales general security and Victorian low reliability.
3. Other regulated flows includes: ACTEW diversions from reservoirs in the Australian Capital Territory; all priority types of supplemented flow licences in Queensland; South Australian River Murray licences (exclude entitlements for urban, environment and individual holder for stock and domestic purposes); New South Wales stock and domestic, local water utility and conveyance licences on regulated rivers; and Victorian urban bulk entitlements and other licences on regulated rivers. This does not include access to supplementary flows or unsupplemented flow licences in regulated systems.
4. Surface water basic rights are those that enable individuals to take water for stock and domestic purposes where licences are not normally formally issued for these rights. Information was only available for some New South Wales rivers for surface water basic rights. Basic rights do exist in other States, but volumes were not available.
5. Unregulated flows are all flows in unregulated systems and any additional access to supplementary flows (New South Wales) or unsupplemented flows in regulated systems (Queensland).
6. Entitlements with different reliabilities have been added to form the values in the 'Total' column.

Source: http://www.bom.gov.au/water/nwa/2010/mdb/context/waterRights

Figure 2 shows the location of the Murray Darling Basin in Australia and its prime water resource management regions. Water trading arrangements are most developed in what is known as the Southern Connected River Murray System. This southern system contains a suite of large dams at the top of the system coupled with a series of locks and weirs that makes a high degree of flow regulation possible.

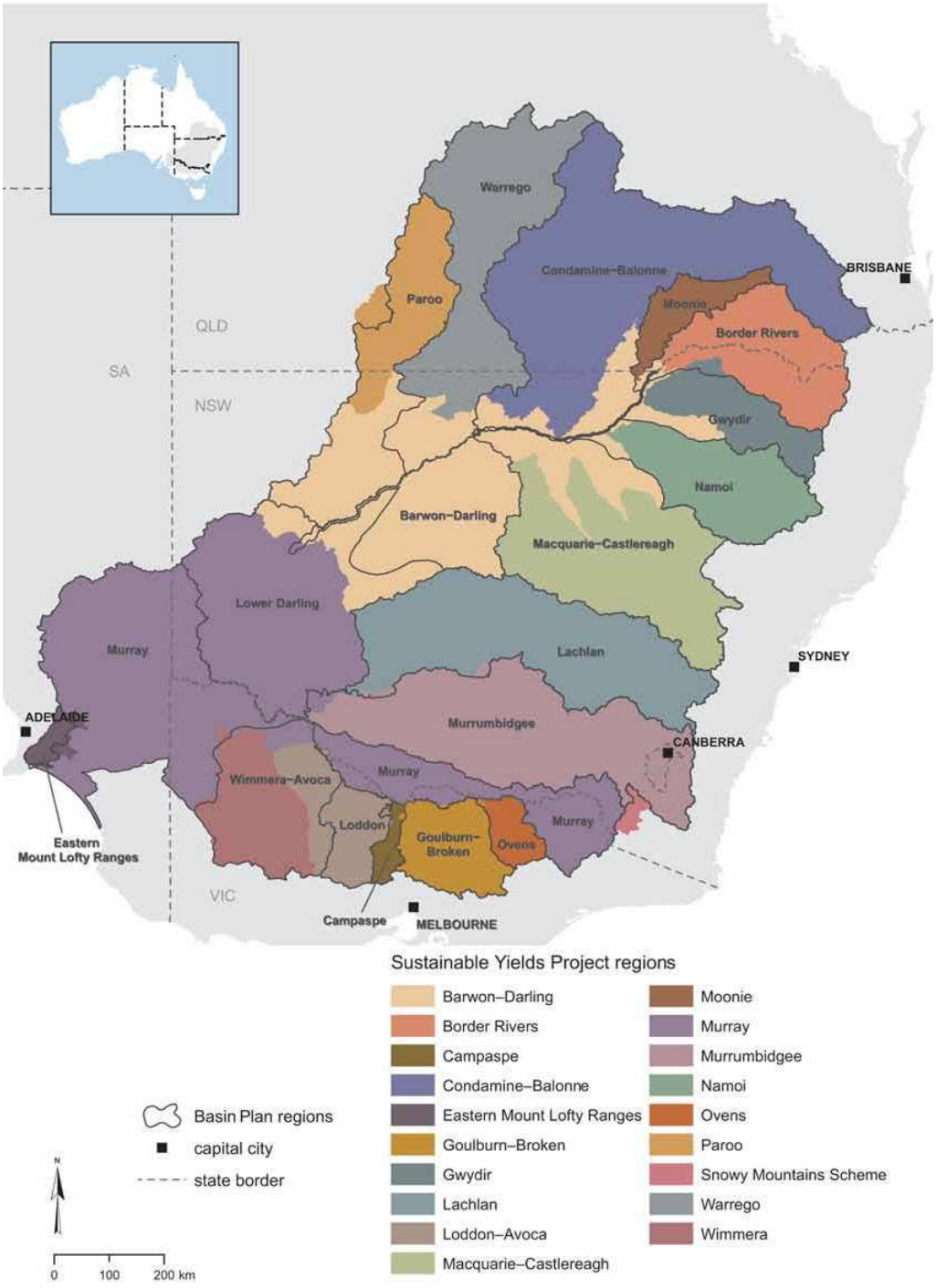

Figure 2 The Murray Darling Basin. The Southern Connected portion of this Basin, where water markets are most developed, includes the Murray, Lower Darling, Murray Murrumbidgee, Ovens, Goulburn Broken, Campaspe and Loddon Catchments.

Source: MDBA Guide to the proposed Basin Plan (2011).

2. EPI Background

The Australian approach to the development of an unbundled water entitlement and allocation system has evolved over many years. Many mistakes have been made and many lessons learned. In a paper prepared for the OECD, Young (2010) identifies seventeen lessons of particular importance to the development of systems like this.

In retrospect, a number of the key features of the Australian approach were developed without any expectation that an EPI would ultimately be established. The following key features were particularly important

1. An historical decision to define all licences within a region in a similar way with the result that when any reduction in the amount of water available for use was made such a reduction was made by reducing each licensed amount by a percentage. Within any defined pool, all licence holders are treated equally and, unlike the USA, no licence holder is more senior than any other licence holder. This also made it possible ultimately to define water entitlements as shares. In jargon terms, this means that the development of relatively deep markets has been possible because entitlements were fungible.

2. A decision in 1994 to commit Australia, through a National Competition Policy, to the development of more competitive approaches to the development of the economy by bringing market disciplines to the delivery of many services provided by state governments and "fine" states who did not implement the required policy reforms within an agreed timeframe. In water this required, amongst other things,

    a) The separation of water licences from land titles so that it would be possible for people to hold a water licence even if they did not own any land.
    b) The corporatisation of all water supply arrangements so that those responsible for water allocation and policy decisions would not be responsible for delivery of water. In practice, this meant that each state had to transfer ownership of its water supply and delivery infrastructure to a company and appoint a board to make all decisions associated with the operation of this infrastructure.
    c) A requirement that each water supply business recover at least the full marginal costs of operating that business and move progressively towards full cost recovery.
    d) That it become possible to trade water from one location to another. In the same system and that it be possible any one to own a water entitlement – even if the y don't own land.

3. A decision in the 1994/95 to place a limit of the total amount of water that could be diverted from all surface water resources in the Murray Darling Basin. This limit is known as the "cap."

4. Federal and State agreement to implement a National Water Initiative in 2004 that added a lot of detail to the 1994 competition arrangements and, in particular, required

    i) clear and nationally-compatible characteristics for secure *water access entitlements*;
    ii) transparent, statutory-based water planning;
    iii) statutory provision for *environmental and other public benefit outcomes*, and improved environmental management practices;
    iv) complete the return of all currently over-allocated or over-used systems to *environmentally-sustainable levels of extraction*;
    iv) progressive removal of barriers to trade in water and meeting other requirements to facilitate the broadening and deepening of the water market, with an open trading market to be in place;
    v) clarity around the assignment of risk arising from future changes in the availability of water for the *consumptive pool*;
    vi) water accounting which is able to meet the information needs of different water systems in respect to planning, monitoring, trading, environmental management and on-farm management;
    vii) policy settings which facilitate water use efficiency and innovation in urban and rural areas;
    ix) addressing future adjustment issues that may impact on water users and communities; and
    x) recognition of the connectivity between surface and groundwater resources and connected systems managed as a single resource.

5. A series of attempts to resolve over-allocation and water accounting problems in the Murray Darling Basin first by a decision to secure 500 GL of water for the environment under a Living Murray Initiative and second by the transfer of Basin wide water planning responsibilities to an independent Murray Darling Basin Authority and the commitment of A$3.1 billion for the purchase of water entitlements from irrigators and the transfer of these entitlements to a Commonwealth Environmental Water Holder coupled with the commitment of A$5.8 billion for investment in so-called water savings projects to improve water use efficiency in a manner that enables half of the savings made to be transferred to the Commonwealth Environmental Water Holder.

As summarised above, the extent of water reform in the Murray Darling Basin has been extensive. Rather than describe all of the reforms shallowly, in the remainder of

this document attention is given to one aspect of the reform program that has been critical in the development of water trading arrangements. The aspect chosen is the reform process known as unbundling.

Unbundling involves the conversion of a single water licence into a number of separate property rights. The term unbundling comes from the notion that a licence contains a bundle of property rights. Unbundling involves the separation of this bundle of rights into their component parts. Figure 3 illustrates the way that Australia's water entitlement system has been unbundled. The framework for the first step emerged from National Competition Policy. It was assumed that if water rights were made tradable and prices set to recover full costs the efficiency of water use would improve.

The second step involved the further unbundling and definition of each component of the system in a manner designed to give investment security to irrigators.

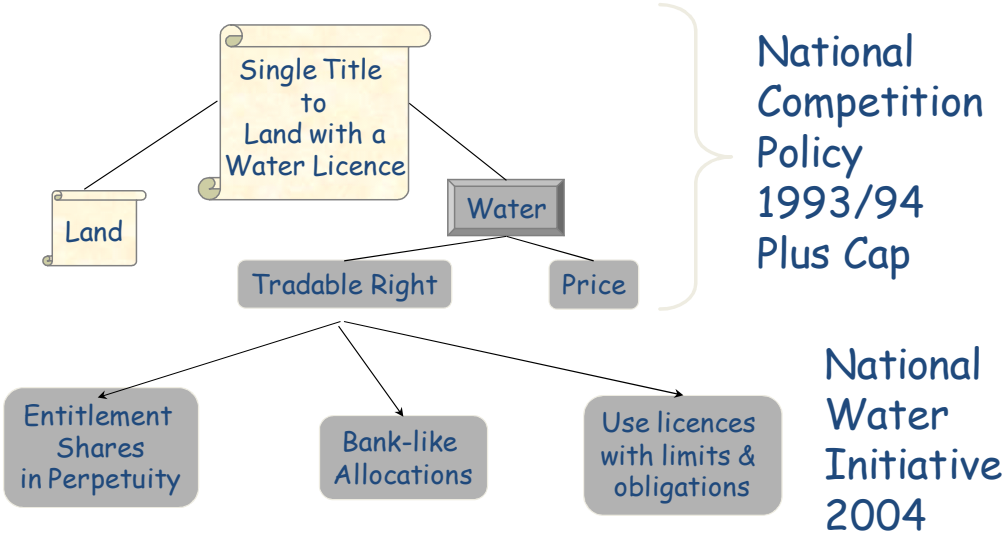

Figure 3 An overview of the way that water licence arrangements in the Murray Darling Basin have been unbundled.

Prior to the introduction of unbundling, the amount of water used by irrigators was administered using licences that made it difficult to move water allocations for one location. The approach taken was to temporarily transfer the licence from one water user to another, then take the water off the licence and then, after this had been done, the licence was traded back again. The process was slow and administratively complex.

The formal proposition that it made sense to unbundle water licences was first made by Young and McColl (2002) and followed from Young's involvement in drafting amendments made to administrative arrangements in New South Wales in 2000. In particular, the legislation required licences to be defined as shares of water allocated in proportion to the number of shares held.

As shares had no water use conditions attached to them, they could be defined as rights in perpetuity in a manner that gave water users investment security. Under this new arrangement, the only way an aspiring water use could gain access to water was to convince an existing water user to sell water or sell a water access entitlement to them.

In the process of unbundling it became necessary to establish formal registers that define each licence holder's share of any water allocated to a region. Separate bank-like water accounts were then set up to record the amount of water allocated to each share holder and track use and sales of that water. Conditions that regulate the use of water at any location are defined using a separate policy instrument with the result that entitlement and allocation trades can be executed without having to consider the nature of any externalities resulting from a decision to move water from one location to another.

Separate works approvals and delivery entitlements were also issued.

The result is an administrative framework where there are as many policy instruments as there are policy objectives. Much more efficient management becomes possible.

Whilst complex, the result was the emergence of extremely efficient water trading arrangements. Today water allocations trade over the internet and water trading has become a business that involves many brokers.

Surprisingly, there was little consultation around the detail of the unbundling reforms and the legislation that surrounded it. In each case, the reforms were presented as a win-win opportunity for licence holders. From the outside, the reforms looked like an attempt to simplify administrative procedures and define licensing arrangements with rigour.

3. Assessment Criteria

2.1 Environmental outcomes

These apparent benefits of the unbundled approach to water allocation used in the Southern Connected River Murray System hide an important oversight. Unbundling drove structural adjustment, investment and innovation but unless the system wide water allocation system is designed to adjust for these changes, the system must be expected to trade into trouble.

In Australia's Murray Darling Basin, this is exactly what happened. A massive over-allocation problem has emerged because system managers and the agreements they had negotiated did not anticipate the extent of change that the EPI would induce.

In retrospect it can be seen that it is critical to establish robust water accounting arrangements and allocation arrangements that are consistent with hydrological realities. When these arrangements are not in place the introduction of an EPI can make the nation as a whole, many communitites and many individual irrigators worse off.

The unbundling of water entitlements in Australia made the low cost and rapid trading of water allocations possible. Today, most water allocation trades are executed in less than two days. Trade is possible across state jurisdictions and during the irrigation season occurs on a daily basis.

The sequence of reforms is important to understand (see Box 1). In the Murray Darling Basin, these reforms began, in the late 1980s, with a series of negotiations that introduced a cap on diversions in 1994. This "cap", as it was called, was acknowledged as an interim cap and was expected to prevent an increase in water use. If the cap had been introduced without the introduction of trading the volume of water used in the basin would have remained the same.

In 1994, however, as part of a National Competition Policy, state governments were required to allow water entitlements to be held separately from land titles and traded. The result was a dramatic increase in the volume of trading (see Figure 4).

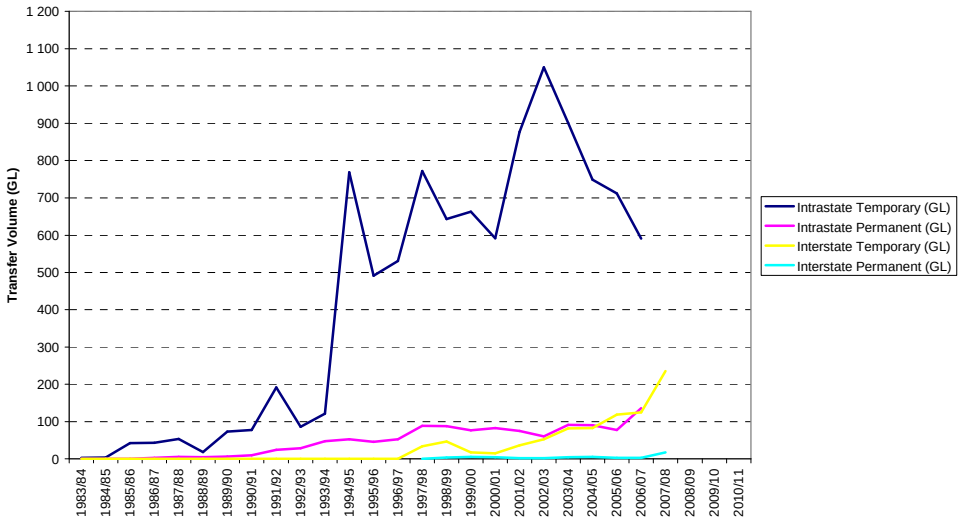

Figure 4 *Development of Murray Darling Basin water market. (Allocation trades are known as temporary trades. Entitlement trades are known as permanent trades.)*

Source: Young (2010).

Box 1

An overview of the sequence of water reforms in the Murray Darling Basin

1994	Introduction of an interim cap on diversions
1994	National Competition Policy requires states to introduce policies that require full cost pricing, the introduction of water trading in rural areas and arrangements that allow water entitlements to be held by legal entities that do not hold an interest in land
1996	Within-state trading allowed
1998	A two year pilot interstate water trading trial commenced between NSW, Vic and SA but limited to areas close to the South Australian border
2000	Review of interstate water trading results in a decision to expand trading to cover most surface water use in the connected Southern Connected River Murray System
2002	Various proposals for the reduction of water use in the Basin by reducing allocations by as much as 1,500 GL which eventually resulted in a decision to take a first step towards solving the "problem" by returning 500GL to the environment over the next five years
2004	National Water Initiative introduced
2007/8	Commonwealth Government passes a Water Act that attempts to transfer responsibility for development of a water use plan for the Murray Darling Basin and the resolution of over allocation problems in this system to the Commonwealth. Subsequent negotiations between the Commonwealth and State Governments eventually resulted in a decision to establish an independent, expertise based Murray Darling Basin Authority coupled with arrangements that gave State Ministers and officials a larger say in the development of the Basin Plan
2010	A guide to the Basin Plan released
2011	A proposed Basin Plan released

Trading stimulated widespread investment in technologies designed to improve water use efficiency. These investments, however, significantly reduced return flows and, also, in the use of ground water that previously flowed unused into the river (Young and McColl 2003; Young 2010). There was also a significant increase in the capture of overland flows that previously flowed to the river. In short, the introduction of water trading worsened the extent of the Basin's over-allocation problem that was identified when the cap was introduced. In retrospect, the cap should have been a cap on *nett use* rather than a cap on diversions which allowed those who improved irrigation efficiency to expand water use (Young 2010).

In five years immediately after the introduction of water trading, use of water increased by 29%. The area irrigated increased by 22% (Bryan and Marvanek 2004) and nearly all of this new area involved the establishment of new vineyards and orchards. None of the water allocation plans, however, made any allowance for this increase in water use. Allocations continued as if no increase in water use had occurred. As a result, late in 2002 the River Murray stopped flowing and in November 2003 dredges had to be put into the mouth of the River to keep it open.

Officials were aware of these problems but were unable to find a politically acceptable way to manage the adverse effects of these processes on the health of the

river. By 2002, it had been estimated that, at least, 1,500 GL of cap equivalent would be needed to restore health to the Basin and estimates of the economic and social impacts of securing this and other amounts of water for the environment where being made (See for example Young *et al*. 2002). Whilst the increasing environmental costs of not fixing the Basin's over-allocation problems were appreciated, governments found difficulty in agreeing about what to do. Ultimately, it was decided that a Living Murray program would be implemented as a first step towards solving the over allocation problem. Under this program, it was decided that 500 GL of water would be secured for the environment over the four years between 2004 and 2009. This amount was, however, insufficient to cover the losses being caused by the expansion of irrigation and investment in new technology (Young and McColl 2003).

Nett progress in the resolution of the over-allocation problem was negative and, in 2007, the Commonwealth Government decided to step in and introduced a new Commonwealth Water Act coupled with a commitment to purchase A$3.1 billion of water entitlements and invest a further A$5.8 billion in improving the efficiency of irrigation on the condition that half to the savings were returned to the river. Progress still proved difficult and in 2010 the Murray Darling Basin Authority in a guide to the development of a new plan for the basin estimated that entitlements in the entire Basin had to be reduced by over 3,000 GL (MDBA 2010). Whilst the benefits of trading were apparent it was becoming increasingly clear that the costs of not fixing the Basin's over allocation problems before introducing water trading were rising. A problem that could have been fixed in 1994 – at little cost to taxpayers – had evolved into a problem that would cost over A$8.9 billion of tax revenue to fix. As there are only 15,120 irrigators in the Murray Darling Basin (ABS 2011), this is equivalent to over A$588,000 per irrigator.

Figure 5 shows the extent of progress that the Federal Government has made in the purchas of water entitlements for the environment. At the time of writing, approximatley 1,000 GL of entitlement has been purchased from irrigators and this is having a significant impact on water entitlement prices.

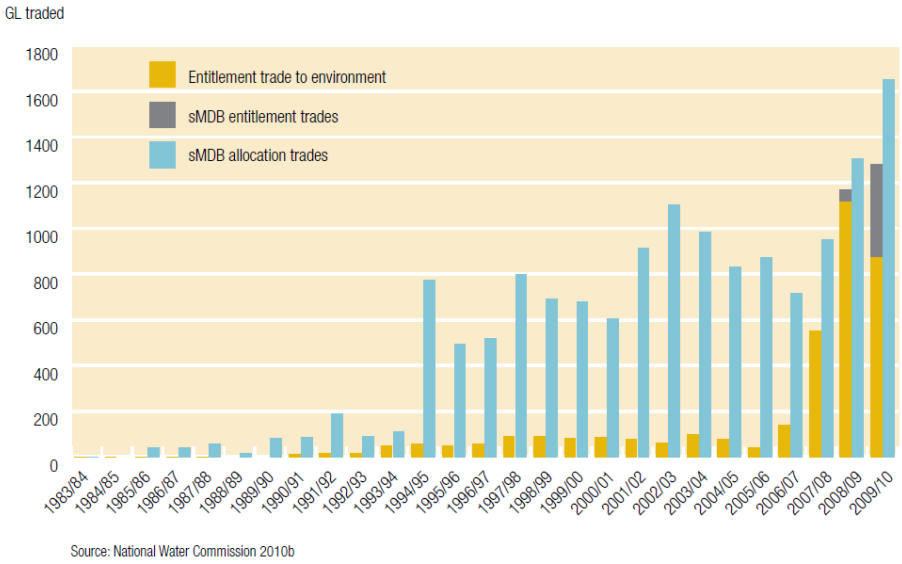

Figure 5 Volume of water entitlements purchased for the environment as a proportion of all water entitlements in the Southern Connected River Murray System

Source: Fargher and Olszak 2011

2.2 Economic Assessment Criteria

Economic Efficiency

As shown in Figure 4 the decision, taken in 1995, to enable water entitlements to be held by people who did not own an irrigation property was critical in reducing the transaction costs associated with water trading. Once implemented, investors could decide when and how to buy water and many innovations followed. The old command and control approach where permission to change where water was used was difficult to obtain was abandoned.

To the surprise of many, but as expected by the architects of this reform program, the result was a large degree of innovation and new investment in water use. Water use efficiency has increased dramatically. As shown in Figure 5, the return on investment in water entitlements has averaged well over 12% per annum. During the long dry period in the MDB from 2002/3 until 2008/09 all assessments of Basin productivity have shown that trading was critically in minimising the economic impact of this period on the irrigation community (NWC 2010).

Recently the National Water Commission has estimated that the introduction of water trading has increased Australia's Gross Domestic Product in the 2008/09 irrigation year by A$220 million.

Adoption rates for water trading are high. In the three years to 2010/11, ABARES estimates that 43% of irrigation farms in the Southern Connected River Murray System traded water. "The majority of irrigators indicated that they found the

process of trading temporary water allocations to be easy (89%), reliable (84%) and affordable (72%) (Fargher and Olszak 2011).

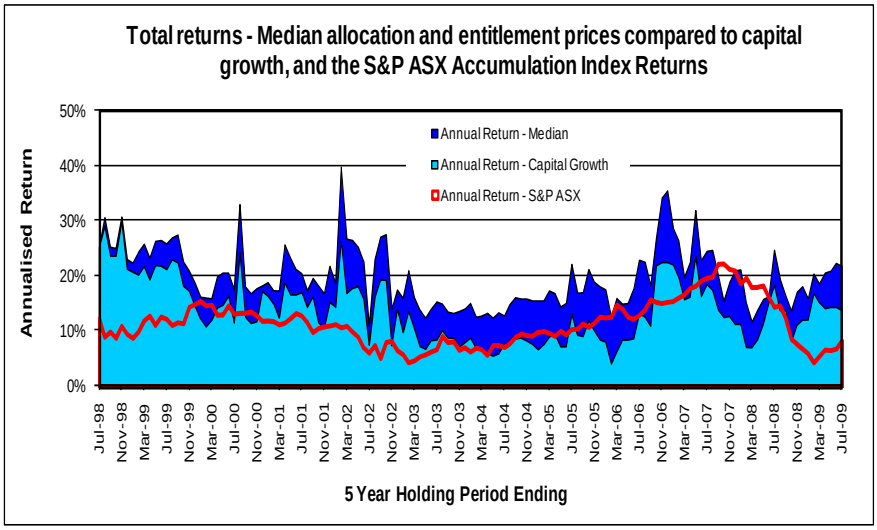

Figure 6 Annual returns from selling allocations (dark blue) and capital growth (light blue) in the value of a water entitlement compared with an index of the value of shares in the Australian Stock Exchange (S&P ASX), Goulburn Murray System, Murray-Darling Basin.

Source: Bjornlund and Rossini (2007).

While most of the assessments of the economic benefits of the development of water markets are positive from an individual landholder viewpoint, until recently many analysts failed to examine the effects of this EPI on the inter-temporal efficiency of water use. Before trading was introduced, most irrigators did not use all the water allocated to them and that which they did not use was left in dams for reallocation in subsequent.

When water trading was introduced, however, the new policy signal given to irrigators was that if you could not profitably use any water allocated to you, you should sell it someone who could. Irrigators responded accordingly and water that would have previously been left unused in the systems main dams was sold to someone who could use it. As a result, too much water was used and dam storages were run down too quickly. So much so that Brennan (2007) estimates that the apparent annual benefits of water trading were less than the cost of the increased drought-like impact of trading on the amount of water available for use in subsequent years. As soon as officials appreciated the importance of allowing the carry forward of water from one season to another allocation policies where changed but this was not before significant costs were incurred (Young 2010).

In retrospect, the golden rule, now realised by all Australian governments, is that if water trading is introduced, it must be possible for irrigators to decide that the optimal strategy is to carry forward water from one year to the next – especially when water supplies are low.

Cost effectiveness

As far as I am aware there has never been a formal assessment of the administrative costs of unbundling the water licence systems maintained in each Australian State. The first step in this process involved building water entitlement registers and running the processes necessary to register them. Prior to this step, licences were attached to land titles and often lacked clarity as to who really "owned" the water licence. Whilst the department may have issued the licence to a farmer, the land title on which the irrigation occurred may be held jointly in the names of three people. To make matters even more complicated, one of the people on the title may have deceased or be in the process of going through a divorce. On a case by case basis, each licence had to be examined and, once all issues resolved, placed on a register.

The interests of banks also had to be considered. Prior to the separation of water entitlements from land titles, the value of land included the value of all the water licences associated with it and banks used these titles as security. As water entitlements were separated from land titles, registers had to be built in a manner that enabled third parties to formally register an interest in a water entitlement. Once this had been done, each register had to be validated in terms of ownership and banks given the chance to renegotiate an appropriate level of security. In each state, this process took several years.

At the same time, bank-like water allocation accounts had to be established and arrangement put in place to ensure that these accounts had integrity. Today, every entitlement is linked to a water account and the holders of these accounts can transfer water from their account to another account. In the most sophisticated systems, these transfers can be executed over the internet in a manner that is similar to the processes used to transfer money from one account to another (Young and McColl 2002).

In all cases, the government picked up the costs of establishing registers, building water accounting systems etc at the State level. Within some irrigation areas, however, in a parallel set of reforms ownership of the water distribution systems where transferred at no charge from the government to water supply companies owned entitlement holders. Whilst this enabled irrigators to take control of "their" water supply system, it meant that they, not government would be responsible for the full marginal costs of water supply. The result, once again, was a dramatic increase in the efficiency of water delivery. In the case of the Murrumbidgee Irrigation System, for example, the transfer of responsibility for management of this supply system to irrigators in 1999 resulted in a real reduction in management costs

for each of the next six years. The NSW government, however, found it necessary to almost continuously increase bulk water charges over this period (see Figure 6).

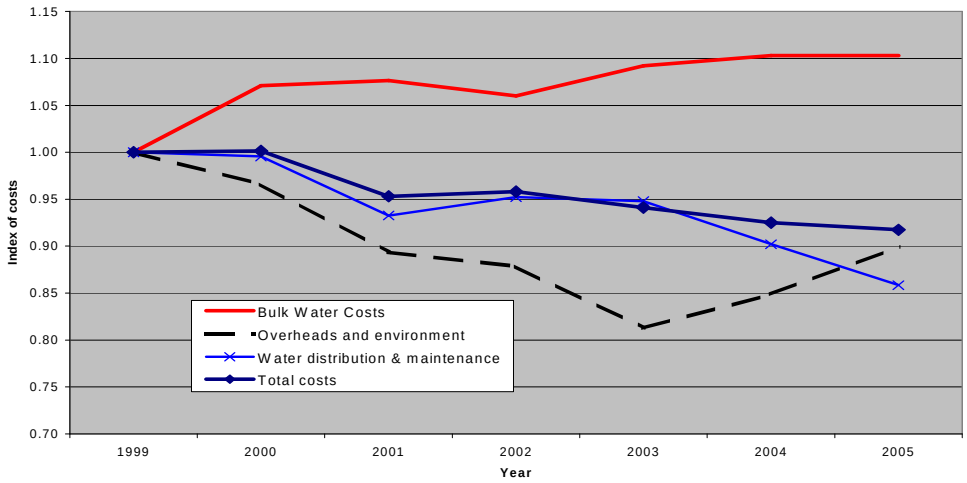

Figure 6 Example of the efficiency obtained by transferring ownership and responsibility for operating the Murrumbidgee Irrigation system to irrigators

Source: Young *et al*. 2006

Throughout the Murray Darling Basin, water now trades on a daily basis and a complex array of water supply and information systems have been developed by government and by industry. A water broking industry has been established. Figure 7 provides an overview of the relationship between water trading and the volume of water available for use. As theory predicts, in times when allocations are low, trading is high and vice versa

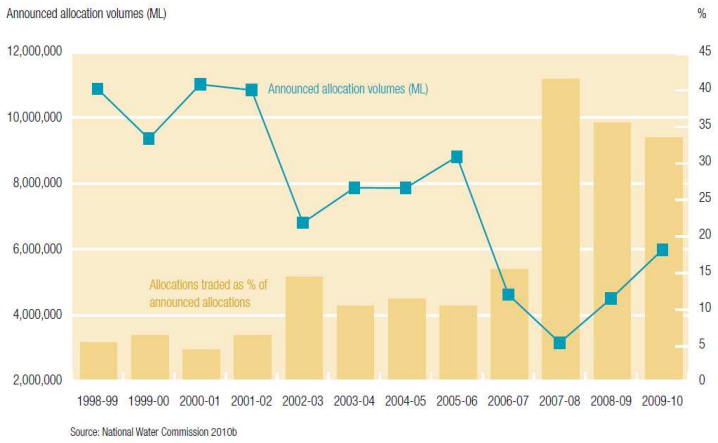

Figure 7 Relationship between announced water allocations and the volume of water traded

Source: Fargher and Olszak (2011).

The extent to which water trading has also improved water use can be seen from Figure 8. As a result of the long dry in the first decade of this century, the amount of water diverted for irrigation in the Murray Darling Basin declined from nearly 12,000 GL to 2,000 GL but the Gross Value of Irrigated Production only declined from A$7.5 billion to A$4.5 billion. That is, an 80% drop in water availability only caused a 40% decline in the gross value of production.

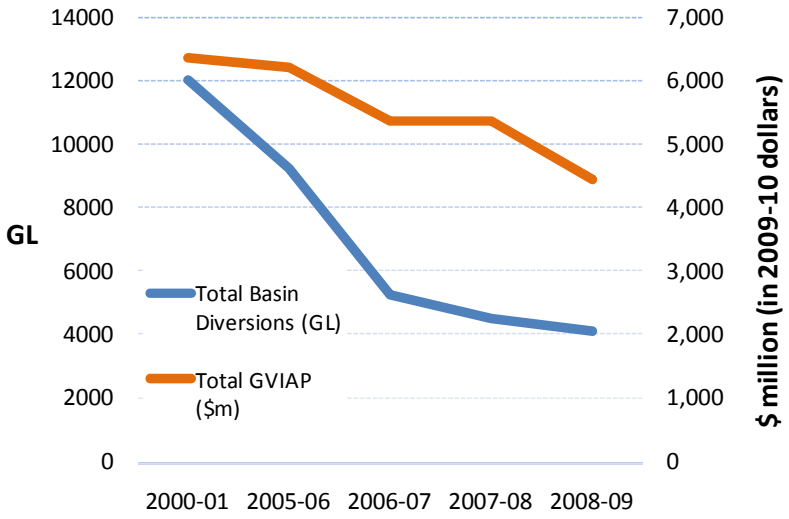

Figure 8 Change in the Total Value of Irrigated Agricultural Production and the amount of water used in the Murray Darling Basin, 2000-01 to 2008-09

Source: Gooday pers. com. (2011), presentation to ACCC Conference Brisbane.

2.3 Distributional Effects and Social Equity

Until recently, all the distributional effects of the introduction and development of water trading were largely seen to be positive in a near Pareto sense that few people were made worse off and many were made better off as the value of water entitlements increased and people voluntarily choose to sell water because they could make more money from selling this water than using it. Many also chose to sell water to finance investment in new more efficient irrigation technology.

Towns and local communities also appeared to benefit from these changes even though local shop keepers complained that the trade of water out of their region was not in their best interests. Case study and focus group work, however, has found it very difficult to find concrete examples of situations where this was the case (Young *et al.* 2006)

As the extent of the Murray Darling Basin's over-allocation problems have become more apparent, however, a new suite of distributional effects have become apparent. As already mentioned in an attempt to resolve the over-allocation problem, the Australian Government has been buying water entitlements for the

environment from irrigators willing to sell some or all of their water to them. From the perspective of a person selling a water entitlement the transaction, given the circumstances faced by that person, is normally worthwhile – otherwise they would not have agreed to the sale. From the perspective of other irrigators in a district, however, the transfer of water out of a district can mean that the unit costs of supplying water to remaining irrigators can increase.

Local businesses often take a similar view as with less water in the district opportunities to sell goods and services are less. While this argument is often put, however, empirical evidence of this occurring is proving difficult to find as the a considerable proportion of the money received by irrigators when they sell a water entitlement to the Government is re-invested locally. Dixon et al. (2011), for example, report that a 23% reduction in water entitlements in the Southern Connected System is likely to produce a slight positive increase in regional income because irrigators are paid for the water entitlements they sell and the money they receive is reinvested. Nevertheless, governments are finding that perceptions of the negative impacts that actions like this are predicted to have a very real. Political opposition to current buyback policies is considerable – to say the least.

2.4 Institutions

Context

A range of different institutional arrangements underpin Australia's approach to water reform. A recent political imperative was the emergence of an eight-year long dry period in the last decade right throughout Australia. Water – at least water shortage – rose to the top of the political agenda. Every mainland capital city, except Darwin, was placed on major water restrictions. Irrigation allocations to many irrigation entitlement holders was zero. In such an environment, the public is looking for and expects water policies to change. In the middle of this dry period, the Australian government was able to produce a National Water Initiative that set the context for many of the reforms that followed. It also made it possible for Australia's Federal Government to propose to "take over" management of the Murray Darling Basin and establish a new Murray Darling Basin Authority.

Unbundling

Unbundling commenced in 2000 in the State of New South Wales and is now required under the National Water Initiative. It has now been implemented in all States in the Murray Darling Basin.

A quite complex suite of administrative arrangements had to be put in place to enable the unbundling of the water licensing system originally used to allocate water in Australia. In most cases, a new water act was drafted and then approved by Parliament. Under the new regime, water entitlements are a special form of a property right. The term "property right", however, is rarely used by Australian administrators as they have found it easier to talk about the nature of each person's

entitlement and avoid getting tangled up in debates about the nature of people's rights. The right issued is officially described as a "Water access entitlement."

Access entitlements take the form of a share and are usually issued in perpetuity. Once the system is set up the only way to secure an entitlement to a share of water in a system is to purchase a share from an existing share holder.

Ownership of entitlements is vested in individuals and arrangement put in place to enable water to be traded from one irrigation district to another.

Water supply companies are allowed to charge people who permanently transfer water entitlements from one irrigation district to another an exit fee.

To prevent unfair behaviour the maximum fee that may be charged is regulated by a national market regulator (the Australian Competition and Consumer Commission).

Allocation trades are implemented by debiting one person's water account and crediting another person's water account.

Entitlement trades are implemented by amending names on a water entitlement register. Entitlements can be mortgaged.

Brokers are used to bring buyers and sellers together and settle each trade.

Administrative arrangements have also been unbundled. Under a new National Water Act (2007), a Murray Darling Basin Authority has been established and this Authority given responsibility for developing a new Basin Plan which amongst other things will define the maximum amount of water that can be diverted from each water resource in the Basin. State Governments are then responsible for developing and implementing a water sharing plan for each region. Use approvals are managed locally.

2.5 Transaction Costs

A large amount of attention has been given the development of arrangements that reduce transaction costs associated with trading. In particular, a series of rules have been developed in an attempt to prevent irrigation districts for discouraging trade out of their district and also to prevent States from preventing the transfer of water out of their state. Tables 2 and 3 below summarise the water allocation and trade service standards that government now try to comply with.

State and territory		
	Intrastate trade approval	**Interstate trade approval**
New South Wales, Victoria Queensland, Australian Capital Territory	90% of allocation trades within 5 business days*	90% of allocation trades within 10 business days*
South Australia	90% of allocation trades within 10 business days	90% of allocation trades within 20 business days
*All interstate trades except for trades with South Australia, which would be consistent with standards set out above for South Australia		

Water entitlement trade service standards (implemented from 1 July 2009)

State and territory		
	Intra and interstate trade approval	**Intra and interstate trade registration**
Trade approval/rejection time	Total amount of time taken by the relevant water authorities to approve or reject a trade application received from the buyer or seller. The time excludes the duration when the application is back with the buyer or seller due to incorrect/incomplete information and include the approval/rejection times for all water authorities involved in processing the trade.	
Trade registration time	Total amount of time taken by the relevant water authorities to register a water entitlement trade in the water register after receiving the relevant transfer documents/registration application from the buyer or seller. The time excludes the duration when the application is back with the buyer or seller due to incorrect/incomplete information and include the times for all water authorities involved in adjusting the water accounts and registering the trade.	

Figure 9 provides a useful overview of the factors that need to be considered when reducing transaction costs. A new consideration are limits on the charging of what are called exit fees. These are the fees that a water supply company can charge when a water

Enabling mechanisms	Prerequisites						
	Legal certainty	Transparent market rules	Effective governance	Timely and accurate information	Low transaction costs	Adequate enforcement	Confidence in intermediaries
Rights definition and titling							
Clearly defined water entitlements	■						
Unbundled water rights (access, use and delivery components)	■				■		
Statutory water plans	■						
Statutory public water registers	■			■	■		
Clear risk assignment framework	■						
Market and trading rules							
Market rules to meet specific objectives—environmental, operational, etc.	■	■					
Charge rules—termination fees, transaction fees for trades	■	■					
Defined processes for rule changes	■	■					
Governance							
Separation of regulatory, policy, commercial and operational functions	■		■				
Appeals process for regulatory decisions	■		■				
Transparent process for water allocation determinations	■		■				
Market information							
Publication of real time storage and inflow data				■	■		
Accurate and timely reporting of trade volume and price data				■	■		
Coordinated release of water allocation determinations				■	■		
Compliance and enforcement							
Statutory water accounting	■					■	
Water metering	■					■	
Cost-effective verification and audit systems	■					■	
Appropriate penalties for non-compliance	■					■	
Market administration & trade processing							
Electronic lodgement of applications					■		
Transparent approvals processes					■		
Market intermediaries							
Competitive market for intermediary services					■		■
Exchanges and trading platforms					■		■
Defined conduct and competency standards							■

Figure 9 Prerequisites and enabling mechanisms for efficient and effective water markets
Source: NWC 2011

2.6 Policy Implementability

The choice of the EPI in this case derives from an initial decision to develop water markets as part of National Competition Policy. At the time, the Australian Government decided that it was critically important the Australia became more competitive. Water was included as part of this agenda. If this commitment had not been made then it is likely that much less progress would have been made. Significantly, any state that failed to comply with the Australian government's competition policy agenda was fined many millions of dollars. Implementation of water reform, in political practice, was mandatory.

One of the driving factors underpinning this policy reform was a significant and early increase in the value of water entitlements. Although many problems emerged, and had to be dealt with, all understood that abandonment of this new policy would result in a significant decline in the personal and newly found wealth that the increase in the value of water entitlements generated. Soon after the reform was implemented, it became clear that Australia would probably always have water markets – at least in the Southern Connected River Murray system. Any government that stopped water trading would be accused (rightly) of causing a massive decline in the wealth of a significant group of people.

Throughout this reform process, stakeholder groups have played an important part and have become well organised. At least three stakeholder groups stand out

- Those representing the irrigators
- Those representing the environment
- Those representing the research (science) community

As the reforms have been rolled out, individual community concerns have been high and considerable structural adjustment has occurred. At the local level, many irrigators have taken the opportunity to exit from the industry and entire irrigation systems have been reconfigured. Fear of change has been a dominant concern of many but in most cases it has been difficult to find examples of systems that actually have made people worse off (Young et al. 2006).

Overall, the approach taken has been highly flexible and involved a continuous search for new and better policies. In this regard, the National Water Commission has played a significant role in the pursuit of better arrangements. Their approach as custodians of the water reform agenda has been to commission study after study and run processes that have made it easy for states to learn from one another and for the research community to contribute. Annual reviews of progress have been particularly important and influential.

The issue that has eluded all, however, has been the lack of speedy progress in the resolution of system-wide over-allocation problems. Changing the rules that govern

all is proving politically difficult as so many considerations and interests have to be considered simultaneously. Interestingly, the most significant progress that has been made has involved the use of markets to buy water for the environment.

Markets work with individual behaviour and incentive, they do not solve system wide problems.

Administrative barriers to trade still remain and are used with various degrees of success to prevent competition. The National Water Commission is responsible for periodically reviewing progress in the development of water markets.

The most recent assessment is at http://www.nwc.gov.au/water-reform/assessing-progress/biennial-assessments/the-national-water-initiative-securing-australias-water-future-2011-assessment. This review observes that

> Water markets are now an important mechanism enabling water in many rural areas to move to more productive and efficient uses. The markets have produced positive economic gains at the community, regional and national levels. Water trading has become a vital tool for many irrigators in responding to variable water availability and other market factors.

- Water trading is more streamlined after the removal of many artificial barriers to trade, the facilitation of interstate trade and the implementation of better service standards and transaction systems.
- Surface water in the Murray–Darling Basin is traded in an increasingly mature market, which could still benefit from further reforms to improve market dynamics. Outside the basin, and for groundwater systems, improvements can be made to the regulatory infrastructure required for trading to develop and grow.
- Pricing and institutional reforms have been beneficial. Consumption-based and cost-reflective pricing has encouraged more efficient water use, although during the recent drought the pricing signal was less significant in urban systems than water restrictions and other demand management strategies.
- The recovery of full efficient costs means that many water businesses are now better placed to fund necessary new investment. Independent economic regulation and consumer protection frameworks are improving transparency and accountability while protecting disadvantaged customers.

2.7 Uncertainty

Uncertainty about the direction of system wide reforms and the resolution of over-allocation problems remains one of the most significant issues in the entire water reform process. As a general rule it would seem that the larger the water supply system, the harder it is to achieve reform.

From an EPI perspective, all stakeholders now appreciate that that unbundled water marketing arrangements are here to stay. The debate has shifted from the

question of whether or not to have them to one that focuses on finding the best way to fix the suite of challenges that remain in the most equitable manner possible.

Consistent with the Tinbergen Principle, it is clear that unbundling has made the resolution of problems easier as they can be dealt with one by one (see Young and McColl 2002). Unbundling reduces uncertainty and allows stakeholders to engage on issues of concern to them without the need to engage in all processes.

4. Conclusions

The main conclusion and arguably most significan observation that can be made from the development of water trading in Australia is that it takes time. The development to this EPI has taken over 20 years and, at least, another 10 years of reform is expected as progress is made in the resolution of over-allocation issues and improving water markets.

A second conclusion is that unbundling has made it easier to resolve issues one by one. It also makes it much easier for individuals to adjust and innovate. New business and new technology must be expected to emerge with each reform that is made.

3.1 Lessons learned

Over all the assessment from an individual water use perspective is that the introduction of this EPI has succeeded. From a national perspective, most experts also describe it as a success. When one looks carefully, however, it is clear that Australia got the reform sequence wrong. As a Nation, Australia would have been better off if it had solved the water accounting and over-allocation problems before it introduced water trading.

In a recent report to the OECD (Young 2010) draws attention to the following lessons

Lesson 1: *Unless carefully managed, the legacy of prior licensing decisions can result in markets causing over-allocation problems to emerge in a manner that erodes the health of rivers, aquifer and the water dependent ecosystems associated with them.*

Lesson 2: *Transaction and administrative costs are lower when entitlements are defined using a unit share structure and not as an entitlement to a volume of water.*

Lesson 3: *Market efficiency is improved by using separate structures to define entitlements, manage allocations and control the use of water.*

Lesson 4: *Early attention to the development of accurate licence registers is critical and a necessary precondition to the development of low-cost entitlement trading systems.*

Lesson 5: *Unless water market and allocation procedures allow unused water to be carried forward from year to year, trading may increase the severity of droughts.*

Lesson 6: *Early installation of meters and conversion from area based licences to a volumetric management system is a necessary precursor to the development of low cost allocation trading systems.*

Lesson 7: *It is difficult for communities to plan for an adverse climate shift and develop water sharing plans that deal adequately with a climatic shift to a drier regime. More robust planning and water entitlement systems are needed.*

Lesson 8: *The allocation regime for the provision of water necessary to maintain minimum flows, provide for conveyance and cover evaporative losses need to be more secure than that used to allocate water for environmental and other purposes.*

Lesson 9: *Unless all forms of water use are accounted for entitlement reliability will be eroded by expansion of un-metered uses like plantation forestry and farm dam development, increases in irrigation efficiency, etc and place the integrity of the allocation system at risk.*

Lesson 10: *Unless connected ground and surface water systems are managed as a single integrated resource, groundwater development will reduce the amount of water available that can be allocated to surface water users.*

Lesson 11: *Water use and investment will be more efficient if all users are exposed to at least the full lower bound cost and preferably the upper bound cost of supplying water to them. One way of achieving this outcome is to transferring ownership of the supply system to these users.*

Lesson 12: *Manage environmental externalities using separate instruments so that the costs of avoiding them are reflected in the costs of production and use in a manner that encourages water users to avoid creating them.*

Lesson 13: *Removal of administrate impediments to inter-regional trade and inter-state trade is difficult but necessary for the development of efficient water markets.*

Lesson 14: *Markets will be more efficient and the volume of trade greater if entitlements are allocated to individual users rather than to irrigator controlled water supply companies and cooperatives.*

Lesson 15: *Equity and fairness principles require careful attention to and discipline in the way that allocation decisions and policy changes are announced.*

Lesson 16: *Water markets are more effective when information about the prices being paid and offered is made available to all participants in a timely manner.*

Lesson 17: *Develop broking industry and avoid government involvement in the provision of water brokering services.*

3.2 Enabling / Disabling Factors

At the highest level, these lessons are readily transferable to other countries. In many cases, however, the first step is likely to require significant property right reform. Australia was lucky, it started accidently with an approach to the development of its water entitlement and allocation system that made it relatively easy to introduce a

market. The starting point was a property-right system that was fungible or at least through unbundling made in to a fungible asset. If Australia had started with a seniority allocation system, such as that used in much of the United States of America, this would not have been possible.

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