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Robust Reform: The Case for a New Water Entitlement System for Australia

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1. Introduction

The attention being given to water resources by the Council of Australian Governments (COAG) and the Murray-Darling Basin Commission (MDBC) suggests that much Australian water use is inefficient. Australia may be the driest inhabited continent in the world, but from an economic perspective, the nation's water resources are abundant. Thomas and his colleagues, in a thorough assessment of the role of water in the economy, could find little to suggest that water is a constraint upon opportunities for economic growth (Australian Academy of Technological Sciences and Engineering 1999). Mismanagement not shortage is the issue.

The focus of this article is on institutional arrangements for the efficient allocation and management of water. It offers a template for the development of a consistent water allocation system across Australia and a means to implement it. The search is for arrangements that are dynamically efficient, have low administrative costs, and are robust in an institutional sense.

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2. Biophysical, Economic and Institutional Challenges

2.1 Biophysical Status

Unlike water in many other parts of the world, Australian surface water supplies tend to be highly variable. Consequently, to endeavour to manage this extreme flow variability, Australia has invested large amounts in the development of dams and distribution systems. As a result, very few of our surface water and groundwater systems, in any way, resemble their natural state. As Watson (in this issue) observes, references to what existed prior to 1788 lack an understanding of the reality of the landscapes that now characterise Australia.

Australians incorrectly perceive rivers as narrow conduits. Many of our most serious problems in water management stem from a past failure to understand ground-surface water connectivity and the generally long time that groundwater systems take to respond to changes in land and water use. In fact, most Australian rivers are inextricably connected to a surrounding groundwater aquifer. These groundwater aquifers supply most of the base flow. As much as 50 per cent of the water flowing in the River Murray, for example, is thought to have spent part of its life as groundwater. Recent work by the National Land and Water Resources Audit (2001) has classified groundwater systems into local, intermediate and regional. When perturbed, local groundwater systems typically return to a new equilibrium within 20 years and intermediate systems

within 100 years, while regional aquifer systems can take over 500 years to express themselves fully in a river.

There is much debate about the current status of Australia's water resources. Biophysical assessment—almost devoid of economic analysis—reveals an adverse report card. Two key biophysical observations that are driving political debates include statements that:

- by 2020, unless significant action is taken, it is expected that River Murray salinity at Morgan over 50 per cent of the time will fail to meet World Health Organisation desirable drinking water standards (MDBC 1999); and

- between 20 and 40 per cent of irrigation water needs to be returned to the stem of the River Murray so that it can be restored to a healthy working river (Murray-Darling Basin Ministerial Council 2002).

Recent statements and actions by politicians suggest they perceive the community as willing to support the use of significant public funding to fix many of these biophysical problems. Many commentators seem aware that the business case for fixing systems like the River Murray is compelling (Young et al. 2002). Leave more water in the river, manage flow for both market and non-market benefit and remove flaws in allocation systems and gross domestic product will increase. As was the case with tariff reform, leaving more water in the River Murray and decreasing salinity impacts is a profitable investment. Many irrigation communities fear that personal welfare will decline as a result of environmental flow enhancement. Whether these fears become reality depends upon implementation detail.

2.2 Economic and Institutional

Australia has a plethora of water-licensing systems onto which mechanisms for managing externalities, rationing scarcity and trading have been bolted. If trading is to become the norm, then the case for introducing a nationally consistent system being made by Minister Anderson and others is compelling. Consistency reduces transaction costs and opens up economic opportunity. Differences among States are dramatic. Some New South Wales licences allow unused water to be carried forward to the next year, while Victoria and South Australia maintain 'use it or lose it' policies. New South Wales is now guaranteeing entitlement reliability. Victoria is the only State providing access to so-called 'sales' water.

Even the terminology used is inconsistent. Queensland and South Australia call access entitlements 'allocations', Victoria and New South Wales only use the word 'allocation' to define the quantity received in a specific year (Carmichael and Cummins 2001).

2.3 Hydrology

During the 1990s, recognition that water resources are limited led to:

- capping—the introduction of a limit on new licence allocations; and

- trading—the introduction of mechanisms to encourage economically inefficient water users to sell water entitlements and allocations to economically efficient water users.

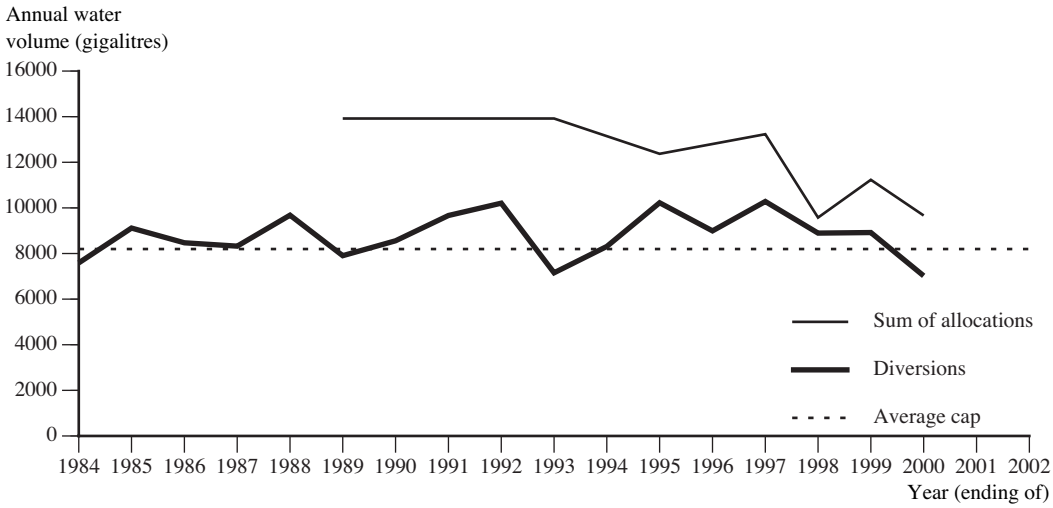
Capping has, at best, been partial. In most States, groundwater resources remain uncapped and, in the Murray-Darling Basin, further groundwater development suggests it will reduce the surface water availability by somewhere between 2 and 7 per cent. Water supplies are also being eroded by farm dam development, forestry and other forms of land-use change. None of the caps in place are designed to cope with climate change. Moreover, many trading arrangements are inconsistent with the hydrology of water use. In particular, few recognise that when water use is technically inefficient, most of the water eventually returns to the river for use by others and the environment. Under present arrangements, most irrigators are allowed to keep the 'savings' from increases in water-use efficiency and expand irrigation. Increases in water-use efficiency and most water recycling simply erode the cap. As indicated in Table 1, increased

Table 1 Simple Analysis of the Likely Effects of Policy Changes Resulting from Failure to Take Full Account of Hydraulic Process in the Southern Connected River Murray System

System flaw and assumed consequence	*Net effect on flow (gigalitres)*
Water-use efficiency savings are used to increase irrigation rather than river flow. (Assume average water-use efficiency increases by 10 per cent over the next 20 years.)[a]	–723
Sum of allocations is greater than the cap. (Assume that half the gap enters the market.)[b]	–373
Land-use changes like increased forestry reduce water yield. (Assume that the government subsidies and incentives for plantation forestry remain and that, as planned, the area under plantation is trebled by 2020.)[c]	–600
Salinity interception schemes remain outside the cap. (Assume new schemes stop an additional 20 gigalitres per annum from entering the River Murray.)[d]	–20
Groundwater and surface water access entitlements are not linked. (Assume cap eroded by 4 per cent.)[e]	–349
Total loss	–2065
Add back 1500 gigalitres sourced from irrigators to enhance environmental flows	+1500
Net change in mean flows in the River Murray	–565

Notes: (a) This assumes that a mean of 8734 gigalitres is used for consumptive purposes in the Murrumbidgee, River Murray Stem and Goulburn-Broken systems. 1500 gigalitres are withdrawn from irrigation but water-use efficiency for the remainder increases 10 per cent as irrigators invest in technology and infrastructure that reduce evaporation and transpiration and capture and use run-off. The extent of this investment will be substantially dependent on future market process and costs.
(b) At present, the sum of individual allocations is 20 per cent above the cap in New South Wales and 10 per cent above the cap in South Australia (see Figure 1). Assume removal of trading impediments plus increased scarcity brings 50 per cent of this presently unused 'cap gap' into use.
(c) It has been estimated that over the next 20 years increased forestry stimulated by financial incentives will reduce recharge across the entire Murray-Darling Basin by 1300 gigalitres. Conservatively, assume that this reduces mean flow by 600 gigalitres.
(d) At present, salinity interception schemes are not defined as consumptive water use even though the water pumped away and evaporated otherwise would have flowed into the River Murray.
(e) Results from MDBC studies are rumoured to have estimated that increasing groundwater development will erode the cap by somewhere between 4 and 7 per cent.

Figure 1 Diversions from the Southern Connected River Murray System, the Sum of all Allocations and the Average Cap



Source: Young et al. (2002).

water-use efficiency is not the answer to the maiden's prayer.

Historically, licences were issued on the understanding that the water allocated would be used in most but not all years. As a result, administrators typically allocated licences so that the sum of all access entitlements was between 10 and 20 per cent over the cap and, in some groundwater systems, by as much as four times sustainable yield. Across the River Murray system total surface water allocations typically exceed the cap by nearly 20 per cent (see Figure 1). But the issue is not just one of over-allocation, there is also an equity issue. In many cases, development of water resources has been either partial or did not occur at all. In a non-trading environment this did not matter. Introduction of trading, however, has activated this so-called dozer and sleeper water. Many people fail to realise that, in the past, this 'unused' water was left in public storage dams and then made available to others. The introduction of trading means that some of those who had obtained water at its supply cost now have to pay market prices to access the same water. They are not enjoying this new expensive experience.

Another serious flaw in most volumetric systems is a failure to account for the impact of increased forestry and other land-use changes that reduce water yield. Current estimates of the likely impact of the government-endorsed and subsidised vision of trebling plantation forestry across Australia by 2020 is expected to reduce flows in the Murray-Darling Basin by around 1300 gigalitres (Hairsine 2003, pers. comm.).

Without the benefit of access to sophisticated groundwater models, Table 1 attempts to provide a sense of the magnitude of the flaws in entitlement and allocation systems in the River Murray system. Water in this system is seriously over-allocated and through what is now being called the 'Living Murray' process many people are expecting governments to decide to reduce the average amount of water used for irrigation by around 18 per cent or 1500 gigalitres. Our overall conclusion is that there appears to be a 2000 gigalitre gap which is not being adequately considered in the current policy debate. Markets are excellent servants. Give markets an opportunity to reveal a loophole and they will. If governments proceed to reduce irrigation entitlements by 1500 gigalitres and take no other action, the result in 20 or so years time and after all the system flaws have revealed themselves will be *less not more* environmental flow. More sophisticated modelling is likely to result in significant revision of these estimates but, after extensive consultation with groundwater experts and inspection of economic and biophysical models, we are confident that the estimate in Table 1 is of the right order of magnitude.

One other largely unaddressed issue is the National Competition Policy recommendation that water prices should include the cost of externalities. As recommended to the High Level Steering Group on Water (Siebert, Young and Young 2000), for externalities to be costed it is necessary first for governments to define a minimum duty of care against which obligations to others can be measured. Across Australia this is not occurring. In the Murray-Darling Basin, for example, salinity trading occurs only at the State level with the consequence that irrigators see the cost of salinity management as a fixed and, mainly, public cost. The opportunity for individual irrigators to internalise significant costs of salinity management is not yet available. As a result, salinity continues to get worse. In the same way as it makes sense to cap water and allow individuals to trade allocations, so it makes economic sense to cap salinity impacts and allow individuals to trade them.

2.4 Policy Challenges

Essentially, the policy challenges now faced by Australian water resource and environmental managers collapse to:

- the search for a robust set of institutional arrangements, defined in the broadest sense possible, to enable the efficient allocation and management of water resources and both *consumptive and non-consumptive* water use through time; and

- the search for an efficient and equitable transition pathway to such a set of institutional arrangements.

3. Robust Institutional Arrangements for Water Allocation and Management

3.1 Robustness

Institutional robustness requires a focus on new allocation mechanisms. Robust systems have an architecture that can be expected to produce efficient and politically acceptable outcomes in an ever-changing world (Jen 2003). Robust systems persist, are adaptable, and can stand the test of time.

The concept of a search for a robust set of institutional arrangements is not common in microeconomic analysis. From an economic perspective, one of the greatest contributions to thinking about robustness comes from the inaugural economist-Nobel Prize laureate—Jan Tinbergen—in the form of the Tinbergen Principle (Tinbergen 1950). This principle states that to attain a given number of independent policy targets through time there must be, at least, an equal number of policy instruments. Thus, if arrangements for managing water allocation and use are to be robust, the components of existing systems must be separable from one another. In unseparated systems, whenever any problem emerges, the entire system comes under review, negotiations are complex, and an opportunity is provided to reopen old agendas. The clue to the robust resolution of many of Australia's water resource problems lies more with separation than in integration.

3.2 Balancing Market and Non-Market Uses

In the past, it has been common for legislators to grant absolute priority to the environment, transport and recreation, and only licence water access to the remainder. Thus, licences were allocated for a term and ministers were always allowed to reduce allocations without compensation. Performance criteria associated with this prior assignment, however, are vague. The first-best solution would be to define a set of minimum baseline conditions and then establish a mechanism that allows some trade-off among objectives as supply and demand conditions change by season and through time. In the long run, dynamically efficient water use requires either a very flexible rule-based cap or a structure that allows administrators to 'trade' an environmental allocation. In over-allocated systems and as licences are secured to improve the state of the river, one dynamic option is to place part of all existing access entitlements in an independent environmental trust and then allow its manager to trade counter-cyclically, selling allocations in a drought and buying them back in wetter years.

3.3 Water Access Entitlements, Allocations and Use Conditions

In 1994, COAG recommended separation of water licences from land title, allowing water access entitlements and allocations to be deployed to uses generating greater economic returns (COAG 1994). Faced with the requirement to deliver water trading or lose access to Commonwealth money, most States chose simply to bolt water-trading arrangements onto existing licence systems, with little attention to equity, investment security, water quality and river health implications. The result has been the emergence of a host of new problems that are, amongst other things, the focus of a report to COAG from the chief executive officers of Australian water management agencies (Natural Resource Management Ministerial Council 2003).

Unfortunately, COAG introduced the words 'property rights' into the performance requirements imposed on States in 1994. In retrospect, the use of this 'economic jargon' has been interpreted by some parties as implying creation of compensatable property rights. Similarly, 'clear specification of entitlements in terms of ownership, volume, reliability, transferability and, if appropriate, quality' (COAG 1994) has been misinterpreted as an instruction for States to guarantee volume and to ensure that changes necessary to effectively regulate negative externalities, accommodate changes in social values and maintain river health will be compensatable. In retrospect, it would have been more efficient to fully specify interests and transparently assign risks among the parties involved.

Building upon this concept of fully specifying risk, and upon the Tinbergen Principle,

the features of a robust set of water-licensing arrangements separated from land title have been identified (Young and McColl 2002). Key features of the proposed system include:

(i) formal unit shares issued in perpetuity and defined as an unequivocally guaranteed, mortgageable claim to a proportional share of any periodic water allocations;

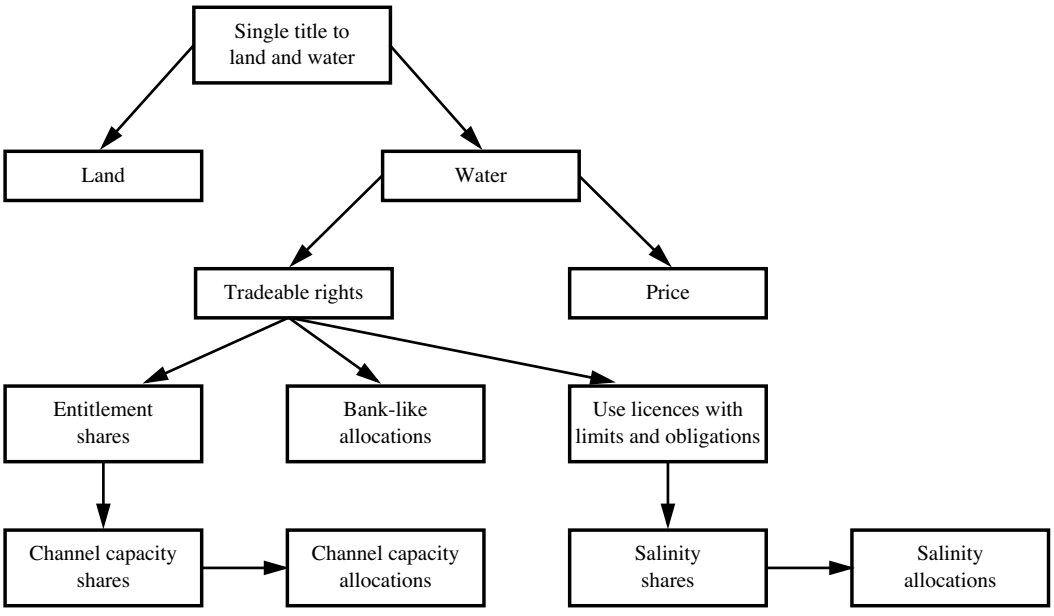
(ii) separate management of all allocations using low-cost bank-like accounting and trading protocols that define the quantity that may be traded or used in 'net' not 'gross' terms;

(iii) independent authorisation of irrigation via use licences that reserve pollution rights to the Crown and define all duties associated with water use at a site in a manner that remains consistent with conditions expressed in statutory catchment management plans (see Figure 2); and

(iv) provision for definition of the amount of water allocated for environmental purposes partly as a prior right and, where appropriate, partly as a tradeable allocation enabling an environmental manager or trustee to decide when and if a water allocation may be sold to a water user, left in the system for the benefit of recreational users, used for the production of ecosystem benefits or to maintain estuaries.

The system also requires that access entitlements be allocated to a single entity. In some parts of Australia, water access entitlements have been distributed both to water supply companies and trusts in the form of a bulk licence and to irrigators as an individual licence. Robust systems recognise that only one interest can be primary. All other interests must be defined via an encumbrance on the water access entitlement or use licence. From an efficiency perspective, it does not matter whether the primary interest is held by a water supply company periodically selling water to irrigators, or by individual irrigators. Either way, each party can be expected to contract with the other party to gain access to the services they require. If irrigators are the primary holders, bulk access

Figure 2 Framework for the Transformation of Existing Water Licences into a Robust Access Entitlement, Allocation and Use Management System Separated from Land Title



Source: Young and McColl (2002).

entitlements are unnecessary for all but supply system losses. Other design details include options to enable trade between surface and groundwater and, also, the development of markets for channel capacity and salinity. Where annual and perennial land-use systems coincide, there is an option for high security and general security shares to be issued.

4. Transitional Arrangements

4.1 Sequencing

Australian water politicians are currently showing a preference for the removal of impediments to permanent water access entitlement trading and securing an additional 1500 gigalitres for environmental flows in the River Murray. Similar targets can soon be expected to emerge for the Darling system and several stressed coastal rivers. The presence of market impediments and the comparative absence of externality cost obligations, however, means that the value of water access entitlements, allocations and use licences are less than they would otherwise be. In over-allocated systems, like the River Murray, the result is a sequencing opportunity and a sequencing trap. Remove market impediments before a robust entitlement and allocation system is put in place and the cost of reform increases. However, if water is secured for the environment at the same time as market impediments and entitlement flaws are removed, then the market gains from this process can be used to reduce the case for transitional assistance payments.

Failure to pursue these reform sequencing opportunities and, in particular, to implement the politically easy options without addressing the underlying flaws is likely to result in the emergence of problems that will hinder opportunities to make further progress. As a general rule, it will be less costly for governments to acquire additional water to enhance the environment before impediments to permanent water trading are removed and before a new flawless water access entitlement system is put in place.

Given the presence of significant unrealised rents encapsulated in impediments to water trade, conceptually the simplest option would be to compulsorily acquire all water licences at current value, put in place the necessary reforms and then sell a new suite of water access entitlements to highest bidders. For the remainder of this article, we assume that the 'acquire, fix and roll-out a new flawless system' approach is not politically feasible. If it were, then the need for transitional assistance payments may be minimal.

4.2 Restoring Environmental Flows

At least in the short term, for groundwater and river systems that are not over-allocated, existing systems can be retained and run conservatively.

In over-allocated and overused systems and if markets are allowed to operate, ultimately water access entitlements or reliability will need to be reduced.

Relatively cost-effective options of securing water access entitlements include:

(i) a pro rata reduction implemented administratively by reducing expected reliability and/or, in Victoria, by reducing the volume of water periodically offered for sale;

(ii) a pro rata reduction in the volume stated on each licence;

(iii) acquisition of water licences by using market-like processes including open-market, voluntary-tender and compulsory-tender mechanisms;

(iv) compulsory acquisition of either a proportion of each licence or closure of specific categories of water use and/or areas of irrigation; and

(v) contracts involving investment by government in infrastructure upgrades (supply system and/or on-farm) in return for the surrender of all or part of one or more licences.

Each option has its benefits, its costs, its equity and its political implications. Pro rata

reduction approaches can be expected to increase market activity and incur deadweight transaction costs as those who cannot afford to give up water buy it back. In systems where two or more types of licence exist, it is possible to reduce the reliability of just one type of licence. Whatever approach is taken, under pro rata reduction mechanisms, the most economically efficient water users can be expected to purchase water access entitlements or allocations from less efficient water users and from those simply investing and trading in entitlements and allocations.

Pro rata reduction by licence volume reduction is expensive as each licence has to be physically amended and registers in most States are not yet fully electronic. Legislation, however, could be put in place to enable licence conversion to be made whenever a licence is dealt with for another purpose and/or is replaced with a robust one. If pro rata reduction of each licence is combined with reissue of a robust access entitlement and use licence, total administrative costs will be less as double handling would not be necessary.

The lowest market acquisition approach known is the compulsory-tender approach used for sulphur trading in the United States. Under this mechanism, all licence holders are required to offer a proportion of their access entitlement for sale but can nominate any reserve price they choose. The result is the rapid emergence of a deep and mature market characterised by lower transaction costs than any other voluntary market process can deliver (Young et al. 2002). Sophisticated selection and incentive-for-cooperation approaches could be used in combination with this mechanism. In some areas, for example, the most efficient outcome may involve offering an additional payment when all use licences along a supply channel are surrendered. Prices need to vary by licence type and use. Where serious 'gross/net' flaws exist, total costs will be lower if a higher price per unit is paid for volumes secured from the least efficient water users so that volume-negative impacts on river flow are minimised.

A significant feature of compulsory acquisition systems is that they are exempt from capital gains tax. Compulsory acquisition powers, if granted, could prove a particularly attractive option along channels that, as a result of environmental flow enhancement and trading, are being abandoned.

Contracts involving the upgrade of supply or on-farm infrastructure in return for the surrender of water access entitlements are possible but, unless there are significant imperfections in the local water market, the outcomes sought could be more efficiently achieved by the purchase of water access entitlements. Private investors and water users could then make the necessary changes in competition with all other competing investments. A water supply company or trust, for example, may choose to sell part of its bulk licence and use the revenue to reduce evaporation losses by laying pipes.

From a governance perspective, it is important to consider how any water access entitlements secured for the environment are managed. As indicated earlier, our preference is for all water secured for the environment to be placed in an independent Murray-Darling-Basin-wide trust empowered to maximise environmental outcomes by trading water. The trust, for example, might sell some allocations in a drought and use the resultant proceeds to buy back a larger volume of water in subsequent years when water is cheaper.

How these options are mixed together is a matter that will occupy many government minds. After consideration of the options the Wentworth Group (2002) has suggested a mixed approach with irrigators having the access entitlements following conversion to a robust form reduced by 1 per cent per year for 10 years with the remainder of environmental flow water being purchased using a compulsory tender or other similar mechanism.

4.3 Water-Market and Access Entitlement Reform

In most parts of Australia, market and market-like arrangements for trading water access entitlements, periodic allocations and use licences are in their infancy. Markets for channel capacity and salinity are virtually non-existent. Separation of entitlement, allocation and use systems into their components opens

up opportunities to sequence implementation. In particular, separation gives an opportunity to speed development of the so-called 'temporary' market and, at least, freeze expansion of the market for access entitlements until hydrological flaws are removed. Whenever a permanent trade occurs, the market price paid reflects the value of the opportunity to exploit all existing flaws in perpetuity. Whenever a temporary trade occurs the market price paid only reflects the value of the opportunity to exploit the flaw in that year. The value of the flaw is not capitalised.

Minor changes in the way access entitlements are defined can result in a major increase or decrease in value. Until the entitlement system flaws identified in this article are corrected, we recommend, at least, a freeze on any expansion of permanent trading.

Consider the impact of a 1000 megalitre trade from flood irrigation near Swan Hill in Victoria to drip irrigation outside the Murray-Darling Basin in the Barossa Valley in South Australia. At the Swan Hill location, use would have been fairly inefficient with water-use efficiency running at about 40 per cent. Around 400 megalitres would have been evapotranspired and 600 megalitres would have returned eventually to the river. When traded through to the Barossa, the full 1000 megalitres would be used and 600 megalitres lost to the River Murray. If a temporary trade is allowed this 600 megalitre flaw is exploitable for one year while a permanent trade locks in the impact of this and any other flaws forever. Risk is transferred from the individual to society. The first step in the reform process is to redefine traded allocations in 'net' not 'gross' terms and then allow unencumbered allocation (temporary) trading across the entire system using periodically revised exchange rates.

In parallel with the policy changes that only allow people to trade net allocations, policies that require forestry and other land-use changes that reduce water yield need to be introduced.

The next step in the sequence is to lower temporary-trade transaction costs and trading settlement times by separating use licences from water access entitlements as is happening in New South Wales. Once this is achieved, temporary trade can proceed unimpeded by environmental externalities as these are managed via use licence arrangements not allocation policy. Trading should be possible over the Internet and settled within days not weeks. Between-region and between-licence-system exchange rates would need to be revised periodically. Private leasing of water access entitlements for several years would be possible, but would not need government approval. The 'lease' would simply take the form of a private contract to transfer all allocations received to the lessee.

Next, decisions need to be made on the volume of water to be secured for environmental services, the methods to be used to source it and the most appropriate way to convert the access component of each licence into access entitlement shares. Dealing with access licences is administratively expensive as guaranteed registers need to be established and each mortgagee and each interested party contacted. In many cases, it will be advantageous as part of this process to reduce the number of types of entitlement listed. With few exceptions, there is little justification for more than two types of access licence: high security and general security. Once two levels of reliability are in place, water users can mix the two entitlements to achieve whatever degree of reliability they prefer. As access entitlement risks are most efficiently pooled at the scale that they occur, entitlement shares should be issued across connected water resources and not by state or administrative region.

The last step is to develop markets for salinity and other water quality impacts. At present, markets for salinity are very imperfect. Salinity impact permits need to be separated from use licences. Again, we recommend issuing salinity shares and allocations (see Figure 2).

5. Concluding Comments

The extent of the net financial impact of entitlement reduction and upgrade to a robust entitlement, allocation and use system will depend both on the volume secured for environmental purposes and the extent and nature of the existing imperfections. Clearly, the aggregate

package should seek to equate marginal social benefits with marginal social costs (see Freebairn in this issue) using valuation techniques that account for the consequences of market and non-market preferences.

If market and market-like mechanisms are used, then the financial resources necessary will need to be sourced. Determining how much financial burden should be borne by water licence holders and how much by the rest of the community is a distributional issue. Significant benefits from the suggested reforms will flow to irrigators in the form of valuable, fully specified and fully tradeable water access entitlements and allocations recorded in a register whose integrity is unequivocally guaranteed.

Choice of procedural process and style of communication with irrigators is critically important. As governments begin the process of securing water for the environment, irrigators will be less inclined to leave water in the river. At present, around 10 to 20 per cent of water is neither traded nor used! Failure to address the fundamentals of system design could result in outcomes worse than those already occurring. Back-of-the-envelope calculations suggest that the sum of the flow losses caused by existing hydrological flaws is greater than the volumes likely to be secured for the River Murray in the near future. Unless these flaws are fixed, expect less not more water in the river in 20 years time. It is time for a small group of three or four people to be commissioned to design and fully specify a robust system that could be implemented initially in one State and then rolled out across the nation.

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