



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

CSIRO submission

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Table of contents

| | |
|---|----|
| Background..... | 3 |
| Qualification | 3 |
| Part one: Problems | 3 |
| Inconsistent language | 3 |
| Entitlement specification..... | 4 |
| The bundled nature of existing licensing systems..... | 4 |
| Trading and environmental externalities | 5 |
| Trading and the distribution of wealth | 5 |
| Trading and Carry forward/borrowing rules..... | 5 |
| Groundwater carry forward and borrowing rules | 6 |
| Exchange rates | 6 |
| Transaction costs | 6 |
| Temporary versus permanent trading reform..... | 7 |
| Salinity policy..... | 7 |
| Market based instruments and salinity policy..... | 9 |
| Part two: Opportunities | 9 |
| With regard to entitlements..... | 9 |
| With regard to allocations | 9 |
| With regard to the management of externalities..... | 10 |
| Closing comment | 10 |
| References cited in this submission..... | 10 |



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

Background

CSIRO has extensive experience in

- the effectiveness and opportunities provided by water trading policies;
- the role of water accounting and whole of basin budgets [quality and quantity] as a knowledge underpinning to trade arrangements; and
- the hydraulic, river health and water quality implications of facilitating trade.

We understand that Productivity Commission officers will be meeting with a number of CSIRO scientists. We encourage the Commission to do this and source material directly from them.

Given the tight timeframe for submissions, we propose to keep this submission brief and focus on key points and important issues that affect the efficiency of water trading arrangements and any externalities that trading aggravates.

Please feel free to contact us for further information.

This submission is divided into two parts.

- The first part deals with problems which we are aware of.
- The second part focuses on opportunities to overcome these problems.

Qualification

We are aware that the terms of reference for the Productivity Commission study can be interpreted as ones that exclude consideration of equity issues from both procedural equity and distributional equity perspectives. CSIRO research particularly by Geoff Syme and Blair Nancarrow has identified considerable community concerns about the consequences of trade and with the fairness of the consequences of changing opportunities to trade water. For information see Syme and Nancarrow (2000), Nancarrow and Syme (2001) and, also, Syme et al. (1999).

Part one: Problems

Inconsistent language

Across Australia, the words 'allocation' and 'entitlement' have different meanings. In particular, the Productivity Commission needs to be aware that the word allocation is used in some states to define an entitlement and in other states to define both entitlements and allocations.

Consistent with the National Water Initiative, in this submission an 'entitlement' refers to the nature of a right to periodically receive permission to access water. Most entitlements in one way or another give the holder access to a share of a pool of water.

In this submission the periodic opportunity provided by the entitlement is called an "allocation." Allocations are most commonly defined in volumetric terms but can also be defined in hectares that can be irrigated and/or the rate at which water may be extracted and/or the type of crop or pasture to be irrigated over a specified area.

Consistency and comparability by converting all allocations to volumetric terms is an essential precursor for trading and will ensure trading can be undertaken within a water budgeting (quality and quantity) framework that incorporates sustainability requirements.

In this submission the term 'allocation' is used to define the volume of water that a person has permission to access or sell within a period of time. Once accessed (extracted) or sold, this once off access right is extinguished.

Up to a limit, some unused allocations can be carried forward from one period to the next.

In many cases, approvals to use water are bundled up with an entitlement and issued as a licence. Increasingly, however, states are moving to unbundle any approval to apply water to land and the conditions that apply to this approval from the entitlement.

For a summary of conflicts in terminology see Carmichael and Cummins (2001). Likewise, across Australia's irrigation industries multiple terms are used to define key elements of profitability and productivity. See Cooperative Research Centre for Irrigation Futures 2005 for further detail.



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

For a discussion of the merits of separation see Young and McColl (2002) and (Young and McColl (2005a).

Entitlement specification

Some barriers to trade have been put in place to deal with imperfections in the way entitlements have been defined and, also, to prevent changes in irrigation practice from having adverse impacts on the environment. Trade-related imperfections that affect the environmental interests and are associated with the way water entitlements have been defined include failures to:

- Recognise the extent of connectivity between unconfined aquifers (groundwater) and surface water supplies; For example, a cap on surface water extraction may lead to users accessing the linked unconfined aquifer and thereby further drawing down the total water resources available;
- Budget and account for the links between catchment land use, water storage and surface water availability. For example, development of farm dams on a catchment or change in land use to higher water using crops such as forestry will impact on the total water resource available.
- Account for changes in water use efficiency and the level of return flows associated with a licence if this is part of water budget calculations. For example, if a return flow obligation in terms of the volume to be returned either via surface drains or via seepage and leakage into aquifers and from these aquifers back to the river system is not specified then with increasing efficiency and improved agricultural practices on farm all water available will be used and remain on farm. This increases *in situ* productivity, a worthwhile outcome in itself but will impact on the systems overall water budget.

There are several other entitlement imperfections whose effects are not part of existing trading systems but, if the system was extended, would become part of the trading system. These include

- A failure to accommodate for climate variability and change, with most of our water allocation regimes developed from now outdated climate

baselines and also not fully accommodating the short term variability in water available;

- A Murray Darling Basin Commission (MDBC) policy that defines salinity interception works as the non-consumptive use of water even though these works involve pumping of groundwater from within several hundred metres of a river system, (usually from an unconfined aquifer that is linked to the river) and its transfer to a place where it can be evaporated.
- Systems based assessments also identify the affects of fire on the quantity of water available for consumptive use as additional matters that should be included in a fully specified entitlement.

CSIRO *Water for a Healthy Country* has compiled a full assessment of threats to water supply for the MDBC. This report is yet to be released by MDBC and the Productivity Commission is referred to the MDBC should it wish to pursue these issues further. Refer also to Young and McColl (2003a,b).

The bundled nature of existing licensing systems

Across Australia, many types of licensing system are in use in a manner which reflects the nature of the development and institutional arrangements in place at the time. In the River Murray system, Shi (2005) has identified over 400 types of entitlements that are being used to define opportunities to access and use water. Many of the differences relate to subtleties associated with the development of local land use conditions and supply systems. Whenever a different set of use conditions needs to be defined, whenever a barrier to trade needs to be or was constructed a new form of entitlement was created. The history of this plethora of entitlements is similar to the plethora of leasehold land and permissive occupancy entitlements and reflects the continuing attempts of Australia's resource administrators to grapple with each particular suite of circumstances rather than work from a well specified policy base.

Unbundling of water licences – separation into their component parts – can be used to radically reduce the number of entitlements needed in the system. Young and McColl (2002) recommended separation into at least three basic building blocks



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

- An entitlement
- An allocation
- A use approval

Given the presence of transaction costs associated with trade and that the volume of water available for use varies from year to year, there is a strong case for two types of entitlement

- A highly reliable entitlement that in all but the most adverse of conditions delivers the same quantity of water from year to year; and
- An entitlement whose allocations vary from year to year within a risk management and predictability framework based on detailed water budgets and climate predictions.

Despite the preference of previous governments to establish many more levels in the allocation preference hierarchy, there is almost no efficiency case for having more than two types of entitlement provided that any legal entity is able to hold any mix of the two entitlement types *and* the size of the highly reliable entitlement pool is not too big. With a dual entitlement pool structure, any legal entity can manage supply risk by holding an appropriate combination of the two entitlements (Young and McColl 2004, a,b). While a case can be made for a three level preference allocation system with an even higher level of preference being allocated to urban and industrial water uses, if trade is unfettered, the restriction of access to water by purpose only creates inefficiencies in the marketplace.

Trading and environmental externalities

The original reason for introducing trade among regions and across state borders was to encourage competition and thereby efficiency in the use of water. Without doubt, this has increased the productivity and profitability of irrigation in Australia. [Water for a Healthy Country, 2005].

It also has the potential to create significant positive and negative externalities. This implies that a greater understanding of the opportunities that trading can provide is essential and where necessary encouragement for those that provide positive benefits. For example, water traded away from highly saline areas has substantial benefit. Irrigators in the Kerang Pyramid Hill Boort region claim that trading has enabled them to reduce the

extent of salinity they produce by around 20 EC (electrical conductivity) at Morgan (Young et al 2005). This should be compared with a gain of only 6 EC achievable using infrastructure funding offered under the National Action Plan for Salinity and Water quality.

On the other hand, if there is failure in water budgeting to deal with increasing groundwater use and return flow losses this means that environmental flows are less than they otherwise would be. One of the main reasons for this is that most allocation rules in management plans for regulated River systems are written by reference to the quantity of water in large storage dams. Change in land use conditions *below* the dam are rarely accounted for.

Another issue that requires careful consideration is the impact of changes in the location of water use on river floodplain health. Salinity is a particular issue and small changes in groundwater levels under a floodplain can have important consequences for floodplain health. As yet, few arrangements take these considerations into account.

Trading and the distribution of wealth

One of the arguably adverse impacts of trading has been a significant redistribution of wealth in among water users in Southern NSW. In particular, before the advent of trading any water unused by the holders of high security water licences was made available to general security licence holders at the cost of delivery. As a result of the introduction of trading, allocations to general security holders have been reduced and these water users now have to source “unused” allocations from high security holders. In an attempt to partially offset this wealth impact NSW general security irrigators, but not high security irrigators, are now allowed to carry forward unused water from year to year.¹

Trading and Carry forward/borrowing rules

Water can be allocated either on a season by season basis or in a manner that allows carry forward to the next season and borrowing from future allocations. The most sophisticated form of carry forward arrangements are those that define capacity shares and allow carry-forward of any

¹ Volume limits apply



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

amount less evaporation and seepage losses. The intellectual contribution that underpins this idea is that by Dudley (1992) and is now being trialled in Queensland.

When entitlements are not defined as capacity shares, carry forward and borrowing rules have a significant influence on the prices paid for traded water and can come into conflict with management plans. One particular problem is the fact that some River Murray and Murrumbidgee River water can be carried forward in NSW but not in SA or Vic. A number of barriers to trade have been put in place to manage these arrangements but as fast as policies are changed astute water traders and entitlement holders are finding ways to get around them. Certainly whole of basin water budgeting and then translation into consistent policies and procedures for all states that share the waters of that basin are essential.

Conceptually, the most efficient systems are ones where either no carry forward is permitted or any allocation less an adjustment for storage loss may be carried forward. Which ever of these two approaches is taken, management plans must be adjusted accordingly as in order to achieve any environmental outcome, the allocation and system management rules used to define the size of each allocation pool need to be quite different.

Inter-linked trading systems that allow some types of carry forward but do not treat all water in a dam under the same rules, tend to have much higher transaction costs and higher administrative costs. In all cases, market incentives are such that people will continually search for ways that will effectively make it possible to carry forward any unused water. The main mechanism used to do this is to make sure that any water recorded in an accounting system as water that can not be carried forward is used before any water that can be carried forward is used.

Groundwater carry forward and borrowing rules

A number of groundwater systems in Australia define entitlements in terms of the area of land that may be irrigated. In effect, these systems allow 100% carry forward and borrowing in response to climatic conditions and crop needs. Groundwater systems with their long recharge systems are broadly amenable to this approach provided use is well within the system's sustainable yield. As part

of the move towards national consistency and in order to stimulate increases in water use efficiency many of these systems are now being converted to volumetric entitlements and/or unit share systems. Whenever this is done, considerable care must be given to the development of carry-forward and borrowing rules. For consideration of this issue and related issues associated with the introduction of unit shares in an area-based allocation system see (Young 2005).

Exchange rates

Whenever a trade occurs several exchange rates are involved and it is important to understand the difference between

- Conversion rate – the rate used to adjust for the reliability of one entitlement to another
- Locational exchange rates – the rate used to adjust for transmission losses associated with getting water from one location to another.

Allocation trades usually only involve a locational exchange rates as they relate only to a volume of water.

Entitlement trades can involve both conversion of the entitlement from one form to another and a locational exchange rate.

Reliability of water is increasingly an area of science interest as Australia moves to a drying and more variable climate. This is for both regulated and unregulated systems while recognising the opportunity for control is higher in regulated systems.

Transaction costs

For water trading to deliver many of the benefits sought by the COAG reform processes and the National Water Initiative, it is necessary for the transaction costs associated with a trade to be as low as possible. At present, the cost of an allocation trade can be as high as \$750.

Conceptually, it should be possible for an allocation trade to involve no more than the movement of a water allocation from one account to another. One of the great advantages of unbundling entitlements from allocations and use approvals is that this makes it possible for an allocation trade to be conducted for a cost of less than ten dollars and even, as Queensland's Sunwater is now offering,



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

within a region an allocation trade for no charge at all. Resembling an internet bank account, secure internet-based login systems are used to debit one account and accredit another account. In an ideal world it should be possible for all water accounts in the Murray Darling Basin to be given the equivalent of a BSB and Account number and to have them all linked together in the same way that the banking sector has been able to link all accounts together.

With regard to entitlement trading there are several administrative barriers to entitlement trading. These include:

- The design of registers in a manner that requires the subdivision of an entitlement holding every time a trade occurs rather than the simple sale of several individually number units.
- The requirement in some states for stamp duty to be paid on entitlement trades
- The requirement to exit fees to be paid before an entitlement can be transferred out of a region.
- The large number of entitlements types involved and the huge amount of detail that must be attended to when ever a trade is conducted
- Failure in some but not all states to guarantee the integrity of their registers.

Temporary versus permanent trading reform

One of the most striking dimensions of water reform in Australia has been the large number of changes that have been made in the last decade and the huge number of reforms that are still being proposed. Australia is definitely on a path of continuous improvement and with attention to adaptive management the benefits to the nation are likely to be substantial.

The nation started water reform in 1993 and the National Water Initiative sets out an initiative that arguably will extend the reform process well past 2014, with preferably a revision of the National Water Initiative based on learnings in its implementation before that time. In such an environment, sequencing issues deserve careful consideration. There is a strong case for speeding improvements in allocation (temporary) trading

arrangements and working carefully to resolve entitlement definition arrangements so that these need only be touched once (See Young and McColl 2003a,b). Conceptually, if low-cost allocation accounts are established in all states, temporary trading barriers replaced with rationally derived location exchange rates and trading costs set on par with those for money trading in the banking sector then most of the economic gains can be realised without the need to engage in the politically risky and conceptually challenging and expensive issues associated with the redefinition of entitlements.

To this end we draw the Productivity Commission's attention to the fact that if allocation trading is unrestricted and attainable at very low cost, then any person wishing to permanently secure access to an entitlement need only arrange to acquire the entitlement at its current location, leave it on its current register and then arrange to automatically trade any allocations received to another location.²

Salinity policy

While State Governments have access to a set of institutional arrangements that enable them to offset the impacts of increased irrigation, individual irrigators have no opportunity to invest in the system. As a result of these arrangements, investment in practices that reduced salinity impacts in the river are less than they otherwise would be.

Salinity trading arrangements in the Hunter River system allow for the periodic dumping of salt during periods of high flow when the impact of this salt will be minimal. In the Murray-Darling Basin system, salinity management arrangements seek to retain salt within the system and transfer it to evaporation basins. There is no incentive or institutional arrangement that encourages the removal of salt to the sea.

In Victoria a salinity levy is placed on people who wish to trade water and this levy varies by salinity impact area. "High" and "low" salinity impact areas are used (see Table 1).

A zoning approach similar to Victoria's is being developed in South Australia. "Low" salinity impact

² In effect, this is tagged trading without the need for government intervention.



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

areas are really “deferred” impact areas. The impact still occurs but is delayed by many years. The Productivity Commission may like to explore the consequences of this approach for future management of the River Murray.

In the Murray-Darling Basin, salinity targets are set by reference to the maximum amount of concentration at different points in the system. The main and most prominent target is that set for Morgan -- at this point a target of 800 EC 95% of

the time is set. Economic theory would suggest that it would be appropriate to vary this target to account for changes in the impact of salinity on irrigation and, also, on urban and industrial water users. While we have not done any detailed analysis, we suspect that it would be more efficient to organise river management and trading arrangements so as to ensure that salinity concentrations are low during periods of high use and high during periods of low use.

Table 1 Summary of salinity levy payable for permanent trades (Perm) and temporary trades (Temp) in Victoria from Nyah to the Border for Low Impact Zones (LIZ). No trade is allowed within or into a High Salinity Impact Zone (As at 2004)

| Trade from | Trade to | | | | | | | | | |
|---------------------|----------|----------|----------|----------|----------|----------|----------|----------|-------------|-------------|
| | LIZ 1 | | LIZ 2 | | LIZ 3 | | LIZ 4 | | HIZ | |
| | Temp | Perm | Temp | Perm | Temp | Perm | Temp | Perm | Temp | Perm |
| Outside area | \$2.60 | \$26.00 | \$6.50 | \$65.00 | \$13.00 | \$130.00 | \$26.00 | \$260.00 | No trade in | No trade in |
| LIZ 1 | \$0.00 | \$0.00 | \$3.90 | \$39.00 | \$10.40 | \$104.00 | \$32.40 | \$234.00 | No trade in | No trade in |
| LIZ 2 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$6.50 | \$65.00 | \$19.50 | \$195.00 | No trade in | No trade in |
| LIZ 3 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$13.00 | \$130.00 | No trade in | No trade in |
| LIZ 4 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | No trade in | No trade in |
| HIZ | No trade | No trade | No trade | No trade | No trade | No trade | No trade | No trade | No trade in | No trade in |

Source: Lower Murray Urban and Rural Water, <http://www.srwa.org.au/index2.htm>



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

Market based instruments and salinity policy

The Productivity Commission's terms of reference specifically mention market-based instruments. While there is a lot of optimism about the immense potential of these instruments we caution that the prime global experience with them is that the gains achieved are typically a fraction of their potential. The main reason for this appears to be that insufficient attention was given to design detail and insufficient detail given to the development of the necessary accounting systems, enforcement systems and registers. Knowing how a water system functions, where the opportunities for intervention are and then setting objectives and investment priorities accordingly are essential if market based systems are to deliver outcomes.

While we have not done an audit, our impression is that there are many more examples of failure than success.

Part two: Opportunities

In this part of our submission we list in short form a number of policy reforms that the Productivity Commission may wish to explore in more detail. Opportunities that CSIRO considers worthy of analysis, and has been doing some exploratory analysis of, include:

With regard to entitlements

1. Explicitly developing strategies that recognise equity, the role of water in regional social and economic development, and from this base setting overall regional and national objectives that provide a context for -
2. Unbundling of entitlements, allocations and use approvals in all states and for all water resources, surface, groundwater and reuse water;
3. Removal of purpose specification from all entitlements including urban entitlements and the specification of any entitlement only in terms of its expected reliability while recognising that "water fit for purpose" is a quite separate issue
4. Specification of all entitlements as unit shares so that it is clear that entitlement holders are responsible for reductions in allocations as a

result of adverse climate change and for increased risk with climate variability

5. Defining entitlements in a manner that facilitates delivery of outcomes for the system across issues such as return flow, groundwater connectivity and salinity interception.
6. Reducing the number of entitlements in any system to two – a highly reliable entitlement and a varying entitlement
7. Defining any unconfined aquifer that is strongly connected to a surface water allocation as part of that system and setting sustainable yield accordingly. This is likely to imply a 1:1 exchange rate set between surface water and groundwater that is close to a river;
8. Establishing entitlement registers whose integrity is guaranteed
9. Developing a process that allows robust entitlement reform to be completed in one not many steps and avoids the many mistakes that have been made in the past

With regard to allocations

1. Encouraging systems based approaches that specify water supply budgets quantity and quality for basins/catchments and set objectives for the systems performance in delivery of sustainable yield – again in terms of both quantity and quality and then in this context -
2. Moving speedily to unbundle allocations from entitlements and use approvals and establishing electronic accounting systems that are fully integrated and facilitate allocation trading at very low cost.
3. Setting up mechanisms that allow independent adjustment of location exchange rates and conversion rates as conditions change.
4. Resolving the question as to whether or not and in which circumstances it should be possible to carry forward allocations and borrow allocations.



Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

With regard to the management of externalities

1. Within the context provided by a clearer articulation of the sustainable yield, assimilative capacity and thresholds for river, estuary, wetland and floodplain health -
2. Facilitating the unbundling of use approvals from entitlements and allocations and their management via catchment plans
3. Developing guidelines and protocols that enable the introduction of incentive arrangements that encourage individuals to reduce salinity or enrichment impacts (salinity offset, salinity impact banking and full salinity credit trading and likewise for nutrients are all possibilities)
4. Developing valuation systems and through this allocation systems that enable the rules for salinity and enrichment trading to be developed with confidence.
5. Designing allocation systems that encourage the rational transfer of salt to the sea and the management of the river that accounts for salinity and nutrient impacts on floodplain systems as well as impacts on consumptive water users.

Closing comment

As noted at the start of this submission the time frame allowed for submission to this Productivity Commission project is very tight and, as a result, this submission has had to be prepared with insufficient time to engage all CSIRO people with expertise in the water area. As a result, we urge the Productivity Commission to consult widely and carefully and stress that CSIRO would like to assist the Commission in any way that is appropriate.

Finally, we draw the Productivity Commission's attention to the fact that many water reform practitioners and many water users are highly critical of the processes used to design and implement reforms (Young et al. 2005). When the issues involved dramatically affect and shift wealth from one group within a region to another in the same region, failure to attend to procedural fairness issues and, in particular, understand the detail associated with existing arrangements can lead to unintended outcomes.

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Rural Water Use and the Environment: The Role of Market Mechanisms

Productivity Commission Research Project

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