WATER MARKETS AS RISK MANAGEMENT AND ADJUSTMENT TOOLS WITHIN IRRIGATION COMMUNITIES – SOME AUSTRALIAN EXPERIENCES

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1 INTRODUCTION

The development of water resources and associated water management and policies has undergone significant changes over the last century and a half. Until the 1970s and 1980s the water industry was in an expansionary phase. Development was encouraged in pursuit of social and policy objectives: closer settlement, resettlement of soldiers, alleviation of unemployment and social hardship, increased food production to meet domestic needs and for exports. Policy makers were persistent in this effort often against sound advice from economists and in the face of economic failure of many of these projects, besides early evidence of significant environmental problems (Davidson, 1969; Powell, 1989). In this phase increased demand was met by increased supply.

Modern environmental policies, which emerged during the late 1960s, evolved into comprehensive environmental management strategies during the following three decades, and started to affect policies and laws (Bosselmann & Richardson, 1999). This process was driven by a strong change in public opinion with respect to environmental values, together with a better understanding of interrelated issues. The same three decades also saw a sharp increase in the marginal cost of supplying new water as the water industry entered the mature phase (Randall, 1981), as well as a decrease in the public willingness to fund such work due to the shift in public opinion.

The above economic, environmental and community concerns caused a shift in policy paradigm. Under the expansionary phase water management and policy was based on a centralised 'control and command approach' with little community involvement in the decision-making processes and associated with subsidised water prices and generous allocations, which encouraged excessive, inefficient and low-value water use. The 'command and control' approach has therefore often been associated with low level of community commitment to the long-term viability of irrigation systems, with the result that many systems suffered from lack of maintenance, low rate of fee collection, organised water theft and little regard for environmental issues (Easter, 1999).

As new water developments became curtailed the mature phase saw a shift in policy emphasis from meeting new demand with increased supply to introducing policy instruments that enabled new demand to be met by a reallocation of existing water resources between competing users; in this process, water changed from a social good to an economic good. During the 1990s economic instruments increasingly found their way into water management policies of international organisations such as the UN, the World Bank and the OECD as well as national governments. Water pricing policies based on full cost recovery prices combined with markets in water were seen as the main instruments in facilitating the reallocation process. Higher water prices should encourage irrigators to use water more efficiently on higher value products and force irrigators not able to make the necessary structural changes to exit the industry. Water markets should allow this process to take place and offer the exiting irrigators some compensation in the process, and leave the allocation process to market forces rather than government regulation. The success of these policies, and their potential social, economic and environmental implications in Australia, has been widely reported by the author (Bjornlund, 2002a,b; 2003a,b; Bjornlund and McKay, 2002, 2000).

Increased global competition for agricultural products, reduced access to water and increased water prices have placed irrigators under significant adjustment pressure to become larger and more efficient and to produce more valuable crops. This adjustment pressure places existing communities and social structures at

risk, as many smaller and inefficient irrigators, who cannot afford this adjustment, have to leave the industry and the community. Water markets are increasingly being relied upon to facilitate these processes. Two different markets have emerged: 1) the market in which the underlying long-term right to access the water is traded, often called formal markets; and 2) the market in which the short-term right to use the water is traded, often called informal markets. Formal markets have predominantly been active in developed countries due to the need for complex institutional structures, while informal markets have been widely used in a number of developing countries (Bjornlund and McKay, 2002, 2003; Easter et al. 1998).

This paper analyses the operations of Australian water markets and identifies how they have been used to manage reduced access to water, increased supply risk, and structural adjustment pressures. The first section outlines the Australian policy context, the second section describes the study region, the third section discusses the data used, and the fourth section discusses the findings.

2 THE AUSTRALIAN POLICY CONTEXT

2.1 The Council of Australian Governments (CoAG) – the change in policy paradigm

Following the international trend, the push to reform the Australian water industry started in 1992 with a major report by the Industry Commission (1992). The new water policy framework was set out in the Communiqué of the Council of Australian Governments (CoAG, 1994) as part of a major microeconomic reform agenda toward a National Competition Policy (NCP) together with similar reforms of the electricity, telecommunication, gas and rail services. The CoAG water reform framework was included in the NCP and associated intergovernmental agreements between the Federal and State Governments signed in 1995 and includes the following main elements:

1. *Pricing:* consumers should be charged according to consumption and prices set on a full cost recovery basis including environmental costs and providing a real rate of return on the written down replacement costs of the assets.

2. *Water entitlements:* Water entitlements should be separated from the property right in land and associated with clear specifications of ownership, transferability, reliability, and where appropriate, quality.

3. *Trading in water entitlements:* Water trade should be encouraged to ensure that water is used to maximise its contribution to national income and welfare within social, physical and ecological constraints of catchments.

4. *Institutional reforms:* Integrated Catchment Management should be the concept underlying natural resource management. Water authorities should be devolved into three separate entities taking care of the functions of water resource management, standard setting and regulatory enforcement, and service provision with clear and non-conflicting objectives with improved and more transparent accountability. Irrigators should be given greater influence over the management of irrigation areas by transferring the operational responsibilities to local bodies.

5. *Consultation and public education:* The community should be involved in natural resource management issues and education programs should be implemented to improve the ability of the community to participate in the decision-making processes.

6. *The environment:* Specific entitlements should be given to the environment, acknowledging it as a legitimate user of water.

The states are committed to implementing the reforms, following the timeline set down in the agreements and the National Competition Council is monitoring the process - reporting on progress and lack of compliance. If the State governments fail to implement the reforms the Federal Government can impose financial penalties by withholding financial assistance grants. Even though the NCP has largely to do with financial efficiency rather than sustainability, it has quite significant environmental policy requirements and

reinforces the legitimate role of governments in pursuing policy objectives, which could not be delivered by market forces alone (Fisher, 2000). Whether these requirements are adequate to achieve the desired outcomes is still debated (Lyster, 2002).

2.2 The Murray–Darling Basin Commission

The Murray–Darling Basin is Australia's largest and most important river system covering most of the inland part of southeastern Australia, and constitutes some 14% of the country's total area (figure 1). It supports 75% of Australia's irrigation, and provides just over 41% of the country's total gross value of agricultural production (MDBMC, 2001), with a significant flow-on effect, supporting more than 1.5 million jobs, most of them in the major cities outside the Basin (MDBMC, 2002). The Basin also supports significant tourism, with 15 million visitors a year in its national parks and forests; in addition it has important cultural, social and environmental values, and thus has significant importance for all facets of Australian life (MDBMC, 2001).

Figure 1 The Murray–Darling Basin **(source: the Graphics Group, CSIRO Land and Water).**

The Basin came under increased stress during the 70s, 80s and 90s, with large blue-green algae blooms in the early 1990s bringing the issue to the fore of the mind of many Australians. An audit of water use in the Basin was therefore initiated in 1995 (MDBMC, 1995). It concluded that the level of extraction for consumptive use was far in excess of what was ecologically sustainable and continued to increase. All jurisdictions have issued large volumes of water entitlements, which had never been used or only partly used. As water markets take hold, this water is likely to be activated, further escalating the increase in use. The Audit predicted significant environmental and economic impacts, if the predicted development continued. It was therefore decided to Cap the volume of water extracted for consumptive use to the volume that would have been used at the 1993/94 level of development (MDBC, 1996).

It is generally accepted that the present Cap will have to be revised, and that the volume of water for consumptive use will have to be further reduced (DNRE, 2001) – the question is by how much. The Murray–Darling Basin Ministerial Council has just started a community process 'The Living Murray' (MDBMC, 2002), to determine how much more water should be set aside for environmental purposes, to secure continued prosperity within the Basin, and how such reduction should be paid for and implemented. The document sets out three reference points: 350 GL per year, 750 GL per year and 1,500 GL per year.

Under the Cap agreement all other rivers within the Basin are going through similar processes developing water-sharing plans defining how much water is needed for in-stream flows and environmental events and how much water is available for consumptive use. Many of these plans result in significant reductions in irrigators' entitlements. State and Federal governments are presently trying to develop a uniform approach to the claims of irrigators for compensation or structural adjustment assistance (Water CEOs Group, 2002).

2.3 The new generation of water legislation and policies

In compliance with the CoAG water reform framework and the MDB Cap State water policies have undergone significant changes, with new legislation introduced in South Australia in 1997 and in NSW and Queensland in 2000. These Acts all separate land and water rights, introduce markets in water rights, recognise the environment as a legitimate water user, and provide a framework of water management planning with some community involvement. Both the NSW and Queensland Acts give increased certainty to water rights for the duration of the water management plans by stating that right holders are entitled to compensation if reduction is made to their rights for the duration of the new plans. However, no compensation is payable if existing rights are reduced as a result of developing the water management plans or revising them upon expiry.

Most water authorities have also revised their seasonal allocation policies. Traditionally the authorities announced the allocation as a percentage of water right at the beginning of the season based on water availability in the storages and historical inflows during the season. This policy provided certainty for irrigators who could plan their cropping for the season based on these allocations. Today, most authorities announce the allocation at the beginning of the season, based only on what is available in the storages, and then revise it on a monthly basis during the season, as additional water enters the storages. This change has placed a larger part of the risk management on irrigators, who now have to plan their cropping for the season without full knowledge of how much water is available. To assist irrigators in managing this risk, authorities provide probabilities each month of the likelihood of the allocation reaching different levels.

2.4 The impact of this new paradigm on irrigators

The above discussions clearly show that the last decade has generated significant policy uncertainty about the future of irrigation within the MDB and that irrigators are under pressure from a number of policies to be more efficient in managing their water resources. There is clear evidence that the combined impact of these policies has caused irrigators and their communities to be frustrated, angry and confused (Bjornlund, 2002a,b). It is also evident that irrigators need to be far more astute in managing their water resources and need new and better instruments to manage the increased risk. Both formal and informal water markets are potentially significant tools in this process.

3 THE STUDY AREA – THE GOULBURN-MURRAY IRRIGATION DISTRICT (GMID)

The GMID is Australia's largest irrigation district and is located in Northern Victoria along the Murray River upstream of Nyah (figure 1). The area is dominated by the dairy industry, which is the predominant high value use, but with large areas in cereal and annual pastures for mixed grazing, which are the low value uses. All irrigators have a water right, which is delivered in full 96 out of 100 years. In addition, irrigators have access to 'sales' water. The level of 'sales' is announced as a percentage of water right and has historically exceeded 100%. Dairy farmers have therefore developed their properties based on 'sales' of 60%, giving access to 160% of water right. However, in recent years 'sales' have declined due to: 1) general resource constraints; 2) water trading activating unused water; and 3) the impact of the MDB Cap. As can be seen from table 1 the level of resource constraint is significantly higher within the Goulburn System. This paper deals with data related to the western part of the GMID; the northern part of this area is supplied by the Murray System while the southern part is supplied by the Goulburn System.

Table 1: Relationship between seasonal allocations and extent of trade

	Goulburn System		Murray System	
Season	Allocation (%)[1]	% of trade[2]	Allocation %	% of trade
1995/96	150	7	200	3
1996/97	200	4	200	3
1997/98	120	9	130	13
1998/99	100	13	200	5
1999/00	100	14	200	8
2000/01	100	16	200	2
2001/02	100	18	200	5

Source: Goulburn–Murray Water's Records

[1] Maximum seasonal allocation; [2] total water trad for season as percentage of total water use.

Informal markets were introduced in 1987, while formal markets were introduced in 1991. The informal market transferred about 25,000 ML per year during the first seven years, but since 1997/98 has stayed above 200,000 ML. During 2001/02 trading accounted for 11.1% of water use, but was as much as 18.2% within the Goulburn System (table 1). Trade on the formal market was also subdued during the first years, and then surged in 1997/98, and has since been at a level between 17,000 ML and 24,000 ML or just around 1% of total entitlements, or less than one tenth of trade on the informal market. A new Water Exchange, introduced in 1998/99, has facilitated the high volume of trade on the informal market (Bjornlund, 2003b). The surge in trading was caused by a number of factors: 1) six years of drought with very low 'sales'; 2) the impact of the Cap; 3) the relaxation of trading rules in 1994/95 (Bjornlund 2002c); 4) irrigators becoming increasingly familiar with water trading (Bjornlund, 2003a); and 5) the initial success of water markets activating large volumes of unused water, augmenting the impact of the drought.

4 THE DATA

The discussions in section five will be supported by empirical evidence based on:

- telephone interviews with: 1) 100 buyers and 100 sellers of temporary water during 1998/99; and 2) 100 sellers and 100 buyers of permanent water during the 1994–96;
- the trading and water rights registers of Goulburn–Murray Water (G–MW); and,
- the activities on the Northern Victorian Water Exchange during the first five years of operation.

The telephone interviews were comprehensive and included questions about property characteristics, the irrigators' perception of a number of contemporary water policy issues, socio-economic characteristics as well as issues related to their activity in the water market.

5 FINDINGS

5.1 Adjusting access to water between seasons

As shown in table 1 seasonal allocations vary significantly but have generally declined from levels around 200% down to 100%. Considering that dairy farmers have based their plantings and herds at an average allocation of 160%, it is apparent that there is an ongoing need to reallocate water between users. This can be done in two ways: 1) the formal market facilitates the long-term reallocation of water toward dairy farmers; or 2) the informal market makes annual adjustments as needed. This section deals with the second part, while section 5.3 deals with the first part.

Table 2: Irrigator categories based on market behavior up to 30 June 2002

Trader category	% of farm businesses in category within the Western region[1]	Goulburn System[2]	Murray System[3]
Only participated in permanent sales	1.3	0.7	1.7
Only participated in permanent purchases	0.8	0.0	0.8
Both permanent buy and sell	0.1	0.2	0.1
Only participated in temporary selling	19.6	19.3	19.7
Only participated in temporary buying	15.3	14.5	15.5
Both temporary buy and sell	18.0	31.2	13.7
Both permanent and temporary trade	19.5	26.2	17.4
Never traded	25.5	8.0	31.2

[1] % of all farm businesses within the Western part of the GMID. [2] % of farm businesses within the southern part of the western region supplied by the Goulburn System. [3] % of all farm businesses within the northern part of the western region supplied by the Murray System.

When the seasonal allocation is low it could be anticipated that trade would be low since all irrigators are short of water and have problems making ends meet. However, as table 1 clearly shows, the lower the seasonal allocation, the larger the proportion of total water use is provided by the market. This indicates that considerable reallocations take place from season to season and that significant trade-offs must be present between users. This is confirmed by looking at table 2. This table groups farm businesses based on their behavior in both formal and informal markets. Irrigators fall into four main groups: 1) 35% who are only involved in one activity in the informal market, either buying or selling; 2) 18% who are both buying and selling in the informal market; 3) 19.5% who are active in both the formal and informal market (out of these 24.5% have both bought and sold water on the informal market); and 4) 25.5% who have never participated in any kind of trade. In total 23% of all farm businesses have used the informal market to buy in some years and sell in other years, while 35% are making the same kind of adjustment every year they trade: 19.6% are only selling while 15.3% are only buying water. Trading is far more active within the Goulbourn System, which has the highest level of water scarcity, with only 8% having never traded. The difference is particularly pronounced with respect to those who have used both the formal and informal market; and those who have used the informal market to both buy and sell water; this reflects the more serious need for risk management and adjustment.

Table 3: Why buy and sell on the informal market during the season of 1998/99

Reason for buying[1]	% of farm Businesses	Reason for selling[1]	% of farm businesses
Commodity prices very good	26	Commodity prices low this year	36
Low `sales´allocation	82	We always have excess water	37
Need the water permanently but cant afford to buy	62	If we sell more water permanently the value of our property will decline	64
Need the water permanently but buy annually for tax benefits	16		
A one-off opportunity to sell more of a certain crop	17		
Speculating in the buying and selling of water	10	Speculate in the buying and selling of water	22

[1] Buyers and sellers were asked to rate each reason for buying and selling on a 1 to 5 scale with 1 being not important and 5 being very important. Buyers and sellers included in the percentages in this table rated each reason 4 or 5 or quite to very important.

There is clear evidence that markets play an important role in allowing irrigators to adjust their annual access to water depending on the seasonal allocation and commodity prices. This behavior is also reflected in table 3: 1) 82% of the buyers said that an important reason for buying was that the seasonal allocation was low that year; 2) 26% said that commodity prices were good, and 3) 17%

said that there was a one-off opportunity to sell more of a certain product. Among the sellers 36% said that an important reason for selling was that commodity prices were low that year. The particular need of the dairy farmers is clearly illustrated by the fact that 50% of buyers had 100% of their irrigated land in pastures for dairy while 33% had between 50% and 100%.

5.2 Adjusting seasonal access to water within seasons

The change in allocation policies toward low opening allocations followed by monthly adjustments could indicate that many farmers need to secure their crop early in the season and then sell the water again later if allocations increase. Analyses of the trading register indicate that 16% of farm businesses both bought and sold during 1998/99 with half of them selling as much as they bought, while a third sold half or more.

This behaviour is also evident when studying the price/allocation relationship on the water exchange. This is especially evident during the first and last year of the Exchange (figures 2 and 3). At the opening of the season 1998/99 the allocation was at a record low level of 40%. Horticultural growers panicked and bought water at high prices. As allocation levels increased and horticultural growers had enough to secure their permanent plantings the price level dropped to $90/ML, which according to some extension officers is the maximum dairy farmers should pay - above that price they would be better off buying feed. The following season also opened with less than 50% allocation and the third with just under 60%. However irrigators had learned that water would be available throughout the season and that prices fall late in the season. Irrigators therefore stopped panic buying early in the season. Armed with this experience some irrigators started to sell some water early in the season with the plan to buy it back later at lower prices. During 2001/02 these irrigators got seriously burned as prices, for a number of reasons (Bjornlund, 2003a), increased sharply at the end of that season (figure 3).

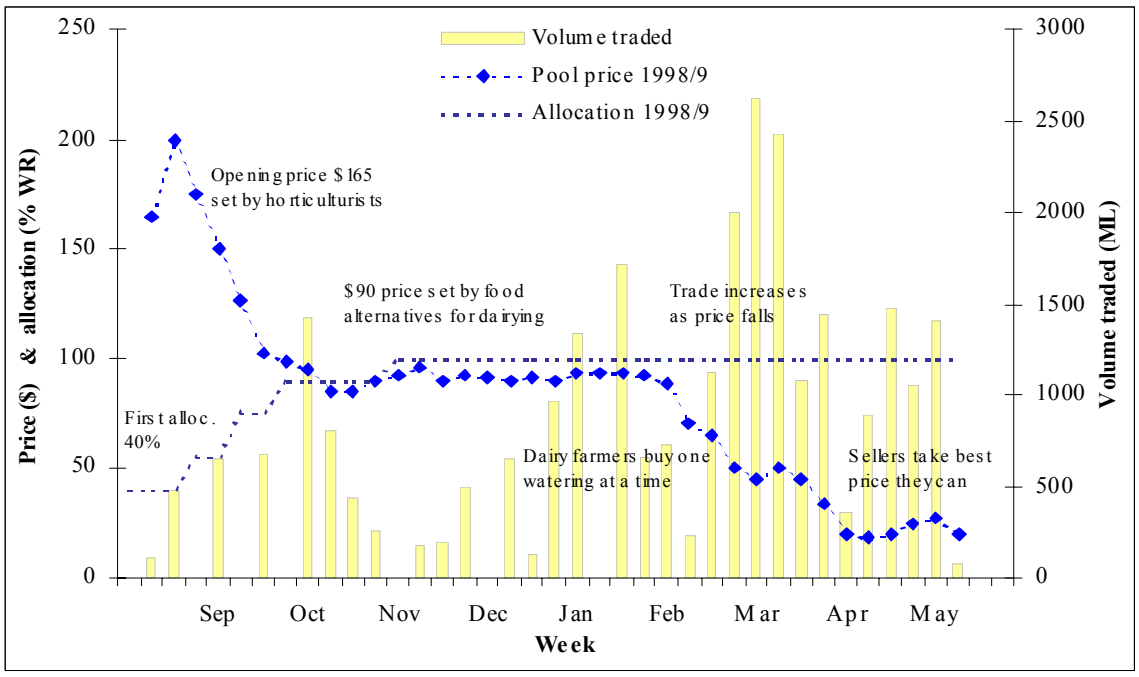

Figure 2: The first year on the Water Exchange (Source: DNRE, 2001)

At the start of 2002/03 the allocation was at less than 40% and the authority gave little hope that it would increase much. Horticultural growers expected the allocation to reach 60%–70% and bought water early to secure their permanent plantings based on that expectation. This resulted in record prices of up to A$500/ML. When these growers had satisfied their demand prices dropped again. It however became clear that the allocation was not going to reach 60%. Horticultural growers therefore needed additional water, resulting in prices again reaching A$500/ML (figure 3)

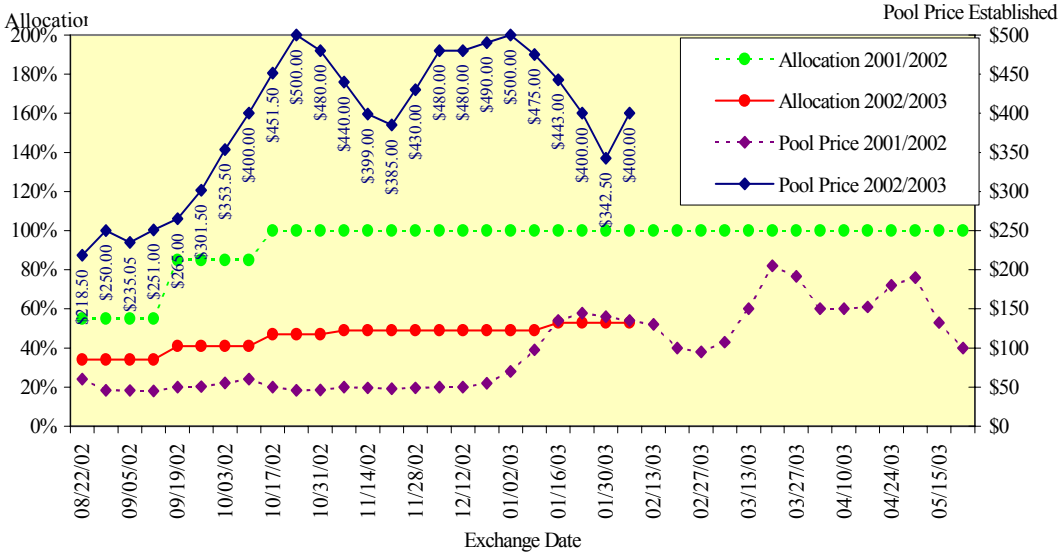

Figure 3: The Water Exchange 2001/02 and 2002/03 (Source: WaterMove)

5.3 Adjusting the level of long-term access to water and changing risk exposure

There are at least three obvious reasons why farm businesses might use the formal market to adjust their long-term access to water and thereby change their risk profile:

1. Irrigators have different abilities to manage fluctuations in seasonal access to water. Cereal and other broad acre producers can reasonably easily adjust their irrigated area from year to year and farmers with grazing for sheep and cattle also have a good ability to manage fluctuating supply, while dairy farmers, with significant investments in herd and dairy equipment and large areas in permanent pastures, find it much harder. Farmers with permanent plantings such as trees and vines find it very difficult to manage fluctuating supply because of the permanent nature of the plantings and the significant long-term losses associated with under watering. Since the least flexible farmers are also the highest value producers, it could be expected that these farmers would be willing to pay prices high enough to encourage the more flexible farmers to sell and trade off a capital gain for a higher dependence on annual purchases.

2. Some individuals are risk takers while other are risk adverse; it could be expected that those most willing to take risk would be willing to sell to the more risk adverse, and that the latter group would be willing to pay a high price for this insurance premium.

3. Some farmers are likely to be under significant financial pressure to sell water to pay off debt or to finance necessary farm improvements to become viable in the long term.

Table 2 shows that 21.7% have made some adjustment to their long-term access to water by buying or selling water in the formal market. Most of these, or 19.5% of all farm businesses, have been active both in the formal and informal market; this indicates that long-term changes to water access result in the need for ongoing short-term adjustments. Table 3 indicates that the need and potential for long-term adjustment is much higher than what has actually taken place: 62% of the buyers in the informal market acknowledge that they need the water most years but cannot afford the price, while 64% of the sellers in the informal market acknowledge that they have excess water every year but find that they are better of selling on an annual basis because they perceive that the value of their property will decline if they reduce their long-term access to water. (Bjornlund, 2001 and 2002d discusses the validity of this behaviour).

Analysis of the buyers and sellers on the informal market during 1998/99 yield some insight into the nature of the buyers and sellers choosing not to use the permanent market (Bjornlund, 2002a). The buyers who

cannot afford to buy water in the formal market fall into two groups: one, which accounts for about 33% of all the buyers, consists of farmers who have given up developing their property to be viable in the long term, they only buy water to maintain production to be able to stay on the farm to retain the lifestyle benefits and to postpone exit adjustment to the time of generational change; and another, which accounts for about 55% of all buyers, consists of farmers in the process of developing their property to be viable in the long term and therefore invest all their funds in farm improvements. The sellers who have excess water each year are in two similar groups: one, which accounts for 60% of all sellers, consists of irrigators who have given up developing their property to be viable in the long term; they stay on the farm by selling all or most of their water every year, some dry land farming and a significant dependence on off-farm work; and another, which accounts for 27% of all sellers, consists of farmers in the process of developing their property, but contrary to the same group among the buyers, these farmers have the water for this development, which they sell on the informal market, in order to help finance the process, until they need it.

Analyses of buyers and sellers in the formal market up until the end of 1996 show clear evidence that already at that time resource constraint was the major factor driving especially dairy farmers to buy water. Among the buyers, 69% of all water was purchased by dairy farmers with only 29% going to expand production (Bjornlund and McKay, 2000); more than 75% of all buyers said that an important reason for buying water was to increase water application on existing crops and for drought security (Bjornlund and McKay, 2002). Among the sellers, sheep and cattle farmers sold 70% of the water with 17% of the water sold causing a reduction in cattle production and 10% in cereal production, however, most water sold (58%) did not cause any reduction in the sellers irrigated area (Bjornlund and McKay, 2000). When asked why they sold the water, about 69% said that they did not need it while 61% said that they needed the money, with only 20% wanting to reduce the irrigated area and 21% wanting to stop irrigation all together. These findings support the first of the above three reasons for adjusting the long-term access to water (Bjornlund and McKay, 2002).

To investigate reasons 2 and 3 for adjusting the long-term access to water, the 19.5% who are active in both the formal and informal market is of most interest. Cross tabulating these irrigators' activities in the formal and informal market provides some insight:

- 50% of those selling water on the formal market also bought water on the informal market; they shifted their risk position to rely more on annual purchases in exchange for cash. This reflects the fact that 61% of the sellers sold the water because they needed the money.

- 79.2% of those selling water on the formal market also sold water on the informal market, they sold some of the water that they traditionally have not used, and now sell their remaining excess on the informal market. In effect, they have not shifted their risk position but converted an unused asset to cash. This reflects the fact that 69% or the permanent sellers sold the water because they did not need it.

- 83.4% of those buying water on the formal market also bought water on the informal market; they have effectively bought drought insurance, but not been able to afford full cover. This reflects the fact that 60% of the temporary buyers bought annually because they could not afford to buy permanently.

- 55.3% of those buying water on the formal market also sold water on the informal market; they have effectively bought full drought insurance, and they are now selling water annually, when they do not need it, or they bought excess water to speculate in the buying and selling of water.

6 CONCLUSIONS

This paper has investigated irrigators' use of the formal and informal water markets to adjust their access to water both in the short-term between and within seasons and in the long-term to manage the increased risk associated with fluctuations in annual supply brought on by comprehensive changes to water policies.

The research has shown that both formal and informal markets have significantly assisted irrigators in managing the increased risk and helped them through a period with significant resource constraints, adjustment pressure and policy uncertainty.

7 ACKNOWLEDGEMENTS

The Australian Research Council funds this research together with ten industry partners: Dept. of Water Land and Biodiversity Conservation, Dept. of Primary Industries, SA–Water, Central Irrigation Trust and River Murray Catchment Water Management Board in SA, Goulburn–Murray Water, and Dept. of Natural Resources and Environment in Victoria, Murray Irrigation Limited, and Dept. of Land and Water Conservation in NSW, and the Australian National Committee on Irrigation and Drainage. The interviews were conducted under a research project funded by Land and Water Australia, which was held jointly with Professor Jennifer McKay.

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