The Australian Journal of
Agricultural and
Resource Economics

Journal of the Australian Agricultural and Resource Economics Society

The Australian Journal of Agricultural and Resource Economics, 56, pp. 42–60

Allocation trade in Australia: a qualitative understanding of irrigator motives and behaviour*

Adam Loch, Henning Bjornlund, Sarah Wheeler and Jeff Connor†

Governments in Australia are purchasing water entitlements to secure water for environmental benefit, but entitlements generate an allocation profile that does not correspond fully to environmental flow requirements. Therefore, how environmental managers will operate to deliver small and medium-sized inundation environmental flows remains uncertain. To assist environmental managers with the supply of inundation flows at variable times, it has been suggested that allocation trade be incorporated into efforts aimed at securing water. This paper provides some qualitative and quantitative perspective on what influences southern Murray–Darling Basin irrigators to trade allocation water at specific times across and within seasons using a market transaction framework. The results suggest that while irrigators now have access to greater risk-management options, environmental managers should consider the possible impact of institutional change before intervening in traditional market activity. The findings may help improve the design of intervention strategies to minimise possible market intervention impacts and strategic behaviour.

Key words: allocation water trade, Murray–Darling Basin, water management and policy, water markets.

1. Introduction

The River Murray in Australia has suffered long-term environmental damage because too much water has been extracted for irrigation. To secure environmental water, the federal government is using market intervention to purchase water entitlements (otherwise known as permanent water, or the right to a share of the resource in perpetuity) from

* The authors would like to express their thanks to the irrigators who participated and offered detailed insights into their trading behaviour. We also acknowledge the helpful comments of the journal's referees in improving this paper, and advice provided by Alec Zuo and Manish Agarwal. This research is part of a larger project funded by the Australian Research Council and six industry partners: Murray–Darling Basin Authority, Goulburn–Murray Water, NSW Office of Water, Department of Sustainability and Environment, CSIRO and University of Lethbridge, Canada.

† Adam Loch (email: adam.loch@unisa.edu.au), Henning Bjornlund and Sarah Wheeler are in Centre for Regulation and Market Analysis (CRMA), School of Commerce, University of South Australia, Adelaide, SA, Australia. Henning Bjornlund is in Department of Economics, University of Lethbridge, Lethbridge, AB, Canada. Adam Loch and Jeff Connor are in Ecosystem Sciences, CSIRO Sustainable Ecosystems, Glen Osmond, SA, Australia.

doi: 10.1111/j.1467-8489.2011.00575.x

irrigators in the Murray–Darling Basin (MDB). Under a program titled *Water for the Future,* \$3.1 billion was allocated towards recovering entitlements from willing sellers, and \$5.8 billion for infrastructure efficiency upgrades. By 2009–10, federal government purchases represented over 35% of total southern MDB entitlement purchasing (NWC 2011). Recent policy reform documents suggest recovery targets should increase to 3000–4000 GL (MDBA 2010), and profiled environmental flows periodically requiring ephemeral supplies of large volumes of water. Environmental flows can be achieved through conveyance water in rivers – that provide habitat, nutrient transfer and riparian benefits – and from periodic inundation events. While the irrigation allocation system endeavours to deliver a relatively constant supply and smooth natural flow variance through dam operations, in general the environment requires variable water supplies with periods of minor and major inundation, together with periods of drying. Thus, providing inundation at environmental sites will be challenging when event requirements do not correspond to the volume of allocation water supplied from entitlements alone. This may occur if insufficient entitlements are recovered, or when allocation levels attached to entitlements are inadequate to meet inundation requirements at optimal times. Crase *et al.* (2011) have also argued that the current focus on entitlement volume ignores the nuances involved with environmental water management and the non-linearity between volume and environmental outcomes.

Environmental water holders (EWHs) will manage entitlements for the environment (MDBA 2010) and might benefit from trading in seasonal allocation water (otherwise known as temporary water) and derivative water products (e.g. Leroux and Crase 2010; Wheeler *et al.* 2011). The Productivity Commission (2010) has also advocated the need for portfolio approaches coupling allocation trade with entitlement purchasing, and argued that derivative water products such as long-term leases, option contracts and water-use covenants could be highly beneficial. Additionally, EWHs may have opportunities to better match their water holdings to environmental demand with carry-over of seasonal allocations from one year to the next, as is currently possible for some irrigators. However, significant positive and negative externalities could result from institutional arrangements allowing EWHs to intervene in markets for allocations (hereafter referred to as *allocation trade/markets*) and to carry-over seasonal allocations. This is elaborated upon further in sections 1.2 and 2.

This paper draws on qualitative interviews to understand: (i) irrigators' motives for participating in allocation markets, how these motives vary at different times during the season (intra-season) and how they vary from season to season (inter-season); (ii) how irrigators view interactions between allocation markets and institutional rules regulating trade and carry-over, and the resultant strategic behavioural opportunities; and (iii) their views on allocation market intervention. If EWHs include allocation trade in their

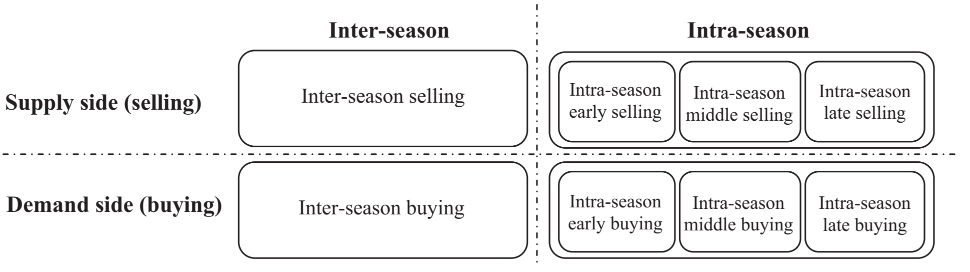

Figure 1 Market transaction framework – allocation trades.

environmental water-management programmes, insights from this paper may improve the design and timing of intervention to minimise institutional disruption risk and strategic behaviour by water users.

1.1. Water trade and carry-over background

Australia has undertaken significant reforms leading to tradeable water rights in the southern MDB, Australia's most active trading region (Grafton and Peterson 2007). Trading in water entitlements involves the permanent transfer of long-term rights to receive seasonal water allocations, providing capacity to extract water over a potentially perpetual period. Conversely, allocation trade transfers a specified volume of seasonal allocation and involves moving water from one user account to another during the course of a water year. Unused seasonal allocation may be carried over to the next water year as explained in more detail later.

Water years (seasons) operate from July 1 to June 30, and for the purpose of this paper, we have divided the water year into three periods: early (Jul–Oct), middle (Nov–Feb) and late (Mar–Jun). This provides the basis for a framework to describe factors that influence allocation trade decisions (Figure 1), and how these factors vary inter- and intra-seasonally.

Carry-over redistributes water between years, allowing individuals to manage their reserves at their own risk.[1] It encourages welfare efficiency because individuals can use water flexibly. Coupled with allocation trade, carry-over gives individuals greater control over their water. However, to work properly, individual carry-over should not adversely impact third parties, carry-over costs and risks should be explicit and carry-over rules should be simple and consistent (DSE 2010).

Carry-over has been available in New South Wales (NSW) and Queensland for some time, but only recently in South Australia (SA) and Victoria. In the NSW Murrumbidgee district, carry-over limits of 15% of seasonal allocations applied between 2001/02 and 2007/08, which relaxed to 30% in 2008/09.

[1] Alternatives to carry-over include capacity-sharing. For further details refer to Hughes and Goesch (2009).

This relaxation, in response to drought, was expected given that the benefits from improving inter-temporal water management increase with scarcity. By 2010/11, the sum of Murrumbidgee carry-over and seasonal allocations could not exceed 100% of entitlement, with surplus above this amount immediately forfeited.

In SA, temporary carry-over access was provided in 2007/08 under agreement with upstream states – it was not a permanent arrangement and subject to review each year. In 2008/09, irrigators accessed 50% of approved carry-over, while in 2009/10 access increased to 60%, and to 100% in 2010/11. While for the 2010/11 crop season SA irrigators had no access to carry-over storage rights in upstream state dams, in September 2011 the SA State Government renegotiated a long-term water storage agreement with the upstream states, incorporating access to carry-over (SA Department of Water 2011).

While carry-over assists irrigators to manage problems with central storage, they are an incomplete solution. Carry-over represents attenuated rights when storage access and losses are not explicitly defined, or where carry-over decisions cause externalities for others. Significant restrictions are often placed on carry-over rights to minimise externalities, which further weaken their effectiveness (Hughes and Goesch 2009). The 2010/11 system of carry-over in Victoria, however, represents an attempt to overcome these restrictions.

Victorian carry-over was introduced as an emergency drought measure in 2007 and then made permanent. To minimise third-party impacts and define storage access Victoria has introduced spillable water accounts (SWAs), allowing individuals to carry-over unused seasonal allocations above 100% of entitlement, so long as water storage capacity exists. Such allocations can be used or traded as usual. However, if a spill-risk exists, SWA water is quarantined from use/trade, or lost in the spill event.

Introduction of carry-over has significantly enhanced irrigators' capacity to make adjustments and changed the dynamics of allocation trading, and provided a valuable means by which irrigators adjust to various seasonal and market-based factors. Given its benefits, Young (2010) argues that subject to dam storage space, all entitlement holders should be allowed to carry-forward as large a volume of seasonal allocation as desired.

1.2. Market intervention issues

As of 30 September 2011, the federal market intervention programme had recovered water entitlement holdings yielding average seasonal allocations of 847 GL (DEWSPC 2011). It has been argued that alternative market involvement by EWHs is also warranted, and appropriate water recovery methods include the following: (i) allocation trade using counter-cyclical methods (Kirby *et al.* 2006); (ii) portfolio approaches coupling allocation trade with the purchase of water entitlements (Scoccimarro and Collins 2006) and (iii) derivative products such as long-term or conditional leases, option contracts and covenants[2] (Productivity Commission 2010). These approaches may provide variable sources of environmental water to help mimic 'natural' flows.

There are a range of concerns about market impacts from EWH intervention in water markets. These include the following: (i) negative impacts on irrigators' ability to source water during drought (WaterFind 2008); (ii) positive impacts on water entitlement and seasonal allocation prices (Young and McColl 2008); (iii) potential environmental water storage and delivery problems imposing constraints on effective management through mismatches between entitlements' intra-seasonal variability of supply and volumes required to meet environmental water timing requirements (Brennan 2008); and iv) potential barriers to environmental water acquisition caused by irrigator reluctance to sell water entitlements (ACIL Tasman 2008).

If EWHs incorporate allocation trade into environmental water-management programmes, it may provide increased flexibility for environmental flow delivery – compared with flows from water entitlements with variable seasonal allocations only – and reduce investment needed to provide environmental flows. Overall, such a strategy might also be more cost efficient in terms of water delivered across time (Wheeler *et al*. 2011). However, little is known about how allowing EWHs to trade might affect irrigators' allocation trade behaviour and the benefits that they derive from such trade. An important starting point to design an environmental water-management strategy including allocation trade is a sophisticated understanding of how irrigators currently use allocation markets, including an understanding of how motives for trading vary inter- and intra-seasonally. Using findings from interviews and focus groups, this paper describes irrigators' motives for trading in allocations in the southern MDB, highlighting how past institutional change regulating trade and carry-over have influenced behaviour in allocation markets inter- and intra-seasonally. Such research provides a strong basis for further large-scale quantitative work examining water trade behaviour across the Basin and a basis to consider how future institutional change allowing EWH trade may influence irrigators' allocation trading behaviour and market outcomes.

2. Irrigators' strategies in markets for allocation water

The development of water markets in Australia have allowed water to move from less efficient and low-valued uses to more efficient and higher-value uses. Traditionally, irrigators have used allocation markets to manage risk without

[2] Long-term leases or conditional leases allow irrigators to retain ownership of the water entitlement but to lease all/part of the seasonal allocations yielded for environmental use in the long-term or under specified conditions. Options allow the government to secure a right to call upon water entitlements or seasonal allocations if needed, paying a premium and strike price for the privilege. Covenants involve a land and water purchase coupled with restrictive changes to the associated use rights before returning that land and water to private hands through the market.

altering ownership of water entitlements (Bjornlund 2006). Irrigators use different inter- and intra-seasonal strategies when trading in allocation markets, depending on commodity returns, water prices, seasonal allocation levels and weather patterns (Brennan 2006). These strategies include buying allocations rather than entitlements while investing in other farm opportunities, maintaining production during periods of low allocation, protecting asset values until opportunistically exiting, or selling seasonal allocation for income to remain in the community (Bjornlund 2002). Consequently, if EWHs use allocation markets to secure environmental water, it may significantly impact market and community welfare.

The following factors have been found to influence inter-season allocation trading: prices (Brooks and Harris 2008); risk-averse attitudes, irrational farmer decision behaviour (Gomez-Limon and Riesgo 2004); farm income including off-farm sources and commodity prices (Wheeler *et al.* 2008); farm investments (Bjornlund and Rossini 2005); farm sizes (Bjornlund 2006); annual versus permanent crop profiles together with drought, rainfall, and evaporation rates (Wheeler *et al.* 2008); and general market uncertainty. Additionally, strategic sale or purchase of entitlements and irrigation efficiency investment – i.e. selling entitlements and using allocation trade to continue farming – affects allocation trade decisions (Bjornlund 2004).

There has been less analysis of factors influencing intra-seasonal trade. Time of season is generally identified as an important factor, as is previous month's demand (Wheeler *et al.* 2008). This study concluded that average demand for seasonal allocation becomes more elastic throughout the year, and that late demand may be driven by account balancing requirements; that is, avoiding excess usage charges with late water acquisition to 'top-up' allocation accounts. As a consequence, closer examination of influences on intra-season decision making in allocation markets is needed.

3. Methodology

We examined motives influencing irrigators' decision-making in southern MDB allocation markets (namely irrigation regions in NSW, Victoria and SA) during the 2008/09 season. These regions experienced prolonged drought with severe impacts in the mid-2000s, resulting in unprecedented low seasonal allocation (Table 1) until 2010 when flooding provided much-needed inflows. Low seasonal allocation particularly affected irrigators in SA, as prior to 2006/07 these irrigators had never experienced more than a 5% decrease. Further, the predominance of permanent plantings among SA irrigators and low prices for their main commodities made them vulnerable to drought impacts.

Historically low seasonal allocation and drought drove prices in southern MDB allocation markets towards \$1100/ML in 2007/08 (Figure 2), compared with prices between \$60–\$120/ML under full supply. Higher prices motivated some irrigators to 'panic purchase', driven somewhat by inexperience with such events. As irrigators' drought experience increased – and

Table 1 Season-ending high security allocations for major southern Murray–Darling Basin zones

Year	Murrumbidgee System	Goulburn System	Victorian Murray System	SA Murray System
2000/01	90	100	200	100
2001/02	72	100	200	100
2002/03	95	57	129	100
2003/04	95	100	100	95
2004/05	95	100	100	95
2005/06	95	100	144	100
2006/07	90	29	95	60
2007/08	90	57	43	32
2008/09	95	33	35	18
2009/10	95	71	100	62
2010/11	100	100	100	67

Source: NWC (2011).

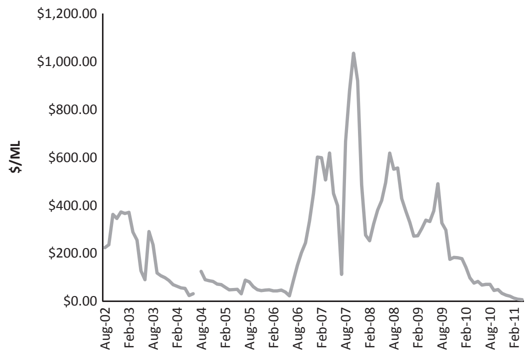

Figure 2 Southern Murray–Darling Basin allocation market trade prices per ML 2002/03–2010/11. Source: Private water market broker information.

permanent crop prices (such as wine grapes and citrus) continued to fall – the price of seasonal allocations dropped to around $500/ML in 2008/09. The drought provided a unique opportunity to examine irrigator decision making under conditions of severe seasonal allocation shortage.

Following Gladstone *et al.*'s (2006) methodology, qualitative data were collected from irrigators actively trading in southern MDB allocation markets; in this case through interviews and focus groups. Maximum variation sampling techniques (Lincoln and Guba 1985) helped select irrigators representing farm sizes ranging from small family to large corporate operations, district irrigators and private diverters, different irrigation zones and commodity groups, and a mixture of young and old irrigators. During September 2009, interviews were conducted with 39 irrigators across the southern MDB – 14 in SA, 12 in NSW and 13 in Victoria. In October, two focus groups (averaging seven irrigators each) were conducted in NSW and SA, and one with eight participants in Victoria. Following an approach utilised by Bennett

(2008) to estimate environmental flow values, interview data were refined to develop early, middle and late season water trade scenarios, which were then presented to focus groups.

Interviews averaged one-and-a-half hours, while focus group sessions averaged two hours in length. All sessions were audio-recorded and transcribed for analysis. Using the approach advocated by Aronson (1994), each transcript was read to identify statements of relevance to the issues under investigation. This process systematically summarised the data by relating concepts and criteria around a central issue (Strauss and Corbin 1998). Using NVivo software, the open-coded sections of text were coded axially. The resulting analysis was placed into separate interview and focus group matrices that included main and sub-category listings. At this point, the emergent categories from interviews and focus groups were compared against one another to identify convergent and divergent themes. Finally, triangulation was applied to the data set (Patton 2002) based on degrees of convergence between the findings in this research and those of earlier studies.

4. Results

Analysis of inter-season allocation trade motives corresponded well to findings from previous studies. The analysis of intra-season allocation trade motives provided new insight into how institutional change in trade and carry-over rules affects irrigators' market behaviour, particularly at different times within the water year.

4.1. Analysis results – inter-season allocation trade influences

A number of themes emerged from analysis of the interview and focus group transcripts, which grouped around common issues identified in the literature. The results for inter-season allocation trade influence themes are presented in Table 2, including frequency of appearance in interview and focus group discussions. The '#' column indicates how many irrigators or focus group sessions identified each theme. The last column compares convergence (divergence) of findings to the triangulation literature. Convergence scores are based on total theme frequency. A 'Low' score ($<25\%$) represents minimal variable importance, a 'Medium' score (26–75%) suggests possible variable importance, while a 'High' score ($>76\%$) suggests a potentially statistically significant variable in quantitative estimations.

4.1.1. Inter-season trade influences: allocation water buying

Analysis of inter-season allocation buying indicates that this is driven by the need to keep crops alive during very low seasonal allocation in unusual drought years, and irrigators' perceived adjustment needs. Under drought conditions, irrigators have reluctantly accepted the need to buy allocations. Previous analysis of allocation buying during 2008/09 indicates it was predominantly

Table 2 Inter-season allocation trade influence themes

Inter-season (Jul–Jun) Decision influence issue:	Literature themes	Interviews #	Interviews %	Focus groups #	Focus groups %	Convergence score
Inter-season allocation buying						
Unusual conditions at present/necessity for farming	Defensive buying, necessity because of scarcity or drought	25/35	71	4/5	80	High
Surviving until sale or exit	Strategic trade, adjustment	4/35	11	2/5	40	Medium
Allocation price targets	Price of allocation	—	—	1/5	20	Medium
	Season/market conditions	—	—	—	—	Medium
Inter-season allocation selling						
	Price of allocation					High
Income generation	Income generation	26/35	74	3/5	60	High
Offset fixed charges		7/35	20	3/5	60	Medium
Surplus water/history of use		3/35	9	4/5	80	Medium
Government/corporate intervention		—	—	3/5	60	Medium
Drought adjustment	Scarcity or drought	—	—	2/5	40	Medium

performed by horticultural irrigators protecting investments in permanent crops or existing stock and equipment (Kuehne *et al.* 2010). For example:

> I've been trading to keep the orchard alive. It is the only reason I am buying water… [SA citrus irrigator, age 73]

Historically, SA irrigators have not needed to purchase seasonal allocation, as land was planted according to entitlement and supply traditionally reached 100%. However, with supply below 100% they bought seasonal allocation to cover shortfalls. Few Victorian irrigators discussed buying out of necessity. In previous seasons, Victorian dairy farmers reportedly bought allocations at prices exceeding production gains to retain stock (Bjornlund and Rossini 2005). Under the continuing drought, they seem to have altered strategy to stock reduction and feed input substitution.

Many irrigators establish cut-off prices for allocation trade, above which they are not willing to purchase. This strategy minimises panic-driven purchasing. SA irrigators also suggested that reluctance to purchase stemmed from reduced industry support for grape growers and ongoing commodity downturns – grape prices have declined in recent years and irrigators expected continuing depressed wine grape prices.

4.1.2. Inter-season trading influences: allocation water selling

Analysis of inter-season trading influences on the decision to sell allocations revealed price as a major factor, consistent with economic principles. In discussions, irrigators appear to associate price influences with income generation themes; that is, irrigators sell seasonal allocations for maximised prices to generate optimal rents.

During the drought, annual-crop irrigators reported generating higher income from allocation trading than farm production, selling 80–100% of their seasonal allocation for cash flow. Other irrigators reported they would be satisfied if income from selling simply met fixed costs of water access. Fixed irrigation charges must be paid annually regardless of allocation supply and usage, constituting significant farm costs when supply is low. In 2009/10, SA irrigators within Central Irrigation Trust (CIT) accrued fixed access charges of $24.80/ML. In the Central Goulburn district fixed storage, delivery share and infrastructure access charges were $43.57/ML. Finally, Murrumbidgee Irrigation Area (MIA) high security access charges were $18.79/ML. Irrigators recognise the burden of fixed charges in low supply and use seasonal allocation sale proceeds to meet expenses:

> Fixed charges used to accrue at the end of the season, based on water use during the year. It might have been $20,000 or $30,000 per annum. But in the last five years there has not been any water to allocate to farmers, so they have put all the charges upfront to pay before the season is even finished and crop returns are in. You end up saying "Well, at least give me the water to generate an income so I can pay…" [NSW citrus irrigator, age 52].

Despite the drought, other irrigators reported holding surplus seasonal allocation because of efficiency gains. They sold this to supplement their income and maintain a history of use – fearing that if they reduced usage this might support arguments that they would require less water in future.

4.2. Analysis results – intra-season allocation trade influences

New insight into what influences allocation trading decisions intra-seasonally emerged from the research, incorporating institutional issues, water accounting arrangements, governance factors and different transaction costs. Themes are presented in relation to their influence on decisions to buy and sell seasonal allocation and whether the theme motivates early, middle or late season trade.

4.2.1. Intra-season trade influences: allocation water buying

Different motives appear relevant for irrigators when they discuss buying allocations at different times within a season.

Irrigators' risk profile and attitude

Irrigators reported early season purchasing as a risk-management strategy to minimise low supply impacts. Some paid high prices to achieve this – like an insurance premium. This risk-management strategy predominated for irrigators who had not purchased allocations last season to carry-over, or if carry-over restrictions varied between trading periods:

> It did not look like it was going to rain; prices just kept going up. When you look at the information you do not know what's going to happen. In hindsight I probably should not have bought as much [water], but if it had not rained … [SA citrus irrigator, age 42].

Possible interaction between buyer's risk profiles and capacity to access funding during drought is also evident. Even if buyers are risk averse, they can only react according to their capacity to finance early purchases. This is consistent with the indicative findings of Bjornlund's (2007) analysis of allocation buying during the 2003–2006 seasons.

Cash-flow issues

Some irrigators elaborated on these financial issues. If seasonal allocation was required to plant or support crops, cash flow issues influenced early-season decisions to buy. Some accessed debt funding to support the crop immediately, while others used commodity payments as a source of finance. If no funding was available, they could not buy, or were forced to purchase late season as and when finance became available. This also conforms to Bjornlund (2007).

Supply, market or seasonal weather uncertainties

Seasonal supply, market price and weather pattern uncertainties also influenced 2008/09 intra-season trade decisions. Once early price volatility and seasonal supply uncertainty settled, however, risk-accepting irrigators reported middle-season purchasing under lower price expectations. These irrigators estimated market prices and allocation supply using various sources of information, attempting market entry at the optimised time and price points. Middle-season purchases were also influenced by hot/dry spring and summer conditions, forcing higher than expected water use. Risk-taking or financially strained irrigators may react to early season hot/dry conditions by using allocation water ahead of time on expectations of rainfall or later increases in allocation supply. If this did not happen, they might enter allocation markets mid-season.

Market intervention – governments buying support water and cancelling entitlement purchases

SA irrigators delayed early purchases on the prospect of government assistance for horticultural growers to protect permanent crops. In 2008/09, the SA government provided seasonal allocation purchasing subsidy measures to assist irrigators with permanent crops. This programme deterred some irrigators from buying early while awaiting governments' announcement of subsidy for the season. It also allowed them to assess seasonal supply realities before committing to a purchase. Further, factors such as federal government refusal to execute contracts to purchase entitlements motivated some SA and Victorian irrigators to enter allocation markets unexpectedly during Oct/Nov of 2008/09. These irrigators needed seasonal allocations to irrigate new 'late' crops or improve existing crop quality that now again represented their major income source:

> The [federal government] have stopped buying water back; people had letters to say that their offer's been accepted, but now they're saying 'no, we are reneging because we have not got enough money'. Just in the last fortnight … it's back to square one for us [Victorian dairy farmer, age 60].

Therefore, cancelled federal entitlement trades[3] also prompted allocation market entry during mid-2008/09.

Account balancing issues

SA irrigators highlighted changes to the way water accounts are balanced through the season, influencing some to buy allocations at odd times. A plan to balance accounts monthly was extended to quarterly requirements, and these changes affected trading patterns in that state. Consequently, irrigators preferring elevated early season water use – anticipating later rain and increased supply that did not eventuate – were forced to balance water accounts mid-season under the new arrangements to avoid excess usage fees. For example in 2009/10, CIT irrigators paid $1,150/ML for the first 10% excess water use, increasing to $2,300/ML for excess use $>$10%. In the Goulburn–Murray, excess use charges are $2,000/ML, while MIA district irrigators pay penalties of $13.97/ML for excess water use – with a 5:1 deficit payback in the following season that irrigators must source at market prices.

Although account balancing could equally occur during the early or middle parts of a season, most irrigators discussed this as a driver of late season purchasing:

> The first year that they brought in heavy restrictions the authority told us that every month we had to have enough water on our license. But now that has been relaxed and we have to balance our [account] in December and again in March [SA almond irrigator, age 41].

Carry-over water demand and loss issues

Some MDB irrigators have only recently been able to carry seasonal allocations over to assist their risk management. If risk-averse, irrigators

[3] Some SA irrigators also experienced the cancellation of trades from other irrigators (usually Victorian sellers). This again required buyers to source alternative allocation deals mid-season.

anticipating low allocation levels and high opening prices in the allocation market in the next season will usually purchase seasonal allocation mid- or late current season (where available) with the intent to carry it over into the next season and avoid future buying. Irrigators preferred mid-season carry-over purchasing because of price stabilisation during that period. Mid-season decisions to buy seasonal allocation for carry-over also depended upon financing and the probability of carry-over being approved. Predominantly, late-season allocation purchasing for carry-over would result where the irrigator required additional water to supplement the forthcoming season's requirements.

4.2.2 Intra-season trade influences: allocation water selling

Allocation price issues

Profit maximisation from sales of seasonal allocation in early volatile allocation markets was not overtly discussed by participants, but it motivated irrigators with available allocation to sell during that period. NSW permanent crop irrigators even risked later season shortfalls to place available allocation on the early market. They also suggested that anyone who had not sold their allocation early in the season typically accepted whatever price was available mid-season. As seasonal allocation levels increased during 2008/09, prices on the market fell:

> …as soon as the allocation increases the price drops, because suddenly if everyone has another 10 or 20 megalitres they are going to sell. Allocations went up 11% this week, and the price went down from $400 to $280 a megalitre [Victorian irrigated seed and pasture grower, age 54].

Many mid-season allocation sellers transacted because they had surplus water to sell, possibly resulting from increased allocation supply in excess of those anticipated at the time of planting.

Surplus water

Factors such as water-use-efficiency gains, conversions of general (low) to high security water, prolonged history of use or incapacity to crop with low opening seasonal allocations provided NSW irrigators early surplus water to sell. Victorian irrigators also discussed lower water use from efficiency gains in recent seasons and unused carry-over water as sources of surplus allocation that could be sold early. However, permanent crop irrigators require certain amounts of water to sustain plants, precluding sale of surplus seasonal allocation until requirements have been met. This again is dependent upon their risk profile. However, once allocation supply met these needs, irrigators tended to sell in the allocation markets mid-season. NSW irrigators reported such behaviour, and monitored allocation markets mid-season to determine optimal selling times.

Market intervention – volumetric restrictions

The prospect of volumetric restrictions on out-of-district allocation sales also motivated irrigators to sell early season in order to avoid later market exclusion. Volumetric trade restrictions in the MIA district during 2008/09 constraining out-of-district allocation trade provided the only example of this, which appeared to have a significant influence on irrigator behaviour:

> I do not like the [restriction]; it creates a panic. Everyone has got a week to sell their water and that distorts the market … the price slowly comes down and half the people do not realise what is going on. People just want to sell, so they get in at any price … [NSW citrus & grape irrigator, age 47].

These comments highlight the important impacts government intervention have had on allocation markets, and the need to be mindful of such effects when designing environmental water-management strategies.

Carry-over issues

Carry-over capacity announcements typically occur late each season, providing irrigators with the assurance that they can carry-over surplus water and causing risk-averse irrigators to buy allocations. At that point, demand and prices for seasonal allocations tend to increase. Irrigators perceiving a need to carry-over (or indeed to balance a deficit water account) might be willing to pay high prices, thereby offering favourable late-season selling conditions. If low seasonal supply is also expected in the next season, demand for carry-over will increase among irrigators seeking risk insurance. Some irrigators discussed relying on this demand to trigger late-season price 'kicks':

> …toward March or April, from a farmer's point of view, they have to start planning [for the following season]. If they have no carry-over water from this season and they need early irrigation water then they will have to buy carry-over water … [SA grape irrigator, age 64].

Focus groups confirmed that recent seasons have witnessed slight late price rises as irrigators try to secure seasonal allocations for carry-over purposes. A small number of NSW irrigators also discussed losing water from allocation accounts because of late restrictions on total system carry-over capacity. In such circumstances, they may seek to 'park' their water on a downstream license not bound by the same arrangements, should they have access to one, or with another irrigator with surplus carry-over capacity in their account.

5. Discussion

A major focus of Australian government policy in the MDB is to return rivers to an ecologically sustainable status. The main strategy to date has been purchasing water entitlements, but the timing of entitlement releases does not correspond well with the volume and timing of water applications required to achieve environmental objectives (MDBA 2010). Thus, trade in seasonal allocation and derivative water products may well be necessary to provide a secure and flexible supply of water to meet stochastic environmental flow requirements. This paper has identified differences in the motives for irrigators' inter- and intra-season decisions in allocation markets and illustrated the influence of institutional change on trading behaviour. A primary motive is to highlight impacts EWHs may have on irrigator behaviour and to consider how best to structure institutional arrangements to provide flexibility to manage for the environment while minimising impacts on irrigators.

5.1. Market transaction framework summary

Table 3 provides a summary of inter- and intra-seasonal influences on decisions to trade seasonal allocation.

The findings confirm that southern MDB irrigators use allocation trade as a means of adjusting to seasonal fluctuations in commodity prices, precipitation, evaporation and allocation levels; particularly in the context of prolonged drought. Irrigators' trading decisions inter-season are influenced by their ability to: derive an income from the sale of seasonal allocation,

Table 3 Allocation trade influences summary

Allocations	Inter-season annually	Intra-season		
		Early	Middle	Late
Selling	**Price*** **Income generation** Offset fixed charges† Surplus water/ History of use† Government/ corporate intervention†	**Price** Risk attitude† Surplus water† Market intervention, volumetric trade restrictions†	**Price** **Surplus water, seasonal inflows**	**Surplus water, carry-over demand†** Avoiding carry-over loss†
Buying	**Necessity** Allocation price Seasonal/Market condition Scarcity/Drought/ Unusual conditions	**Risk profile†** **Allocation uncertainty** Cash flow issues Market intervention, support water† Account balance issues, SA areas†	**Price stabilisation** **Allocation, market or seasonal info** Market intervention, cancelled trades† Account balance issues	**Account balance issues** Carry-over water demand† Risk attitudes†

*Bold text denotes influence with high relevance for future research.
†Denotes where the emergent influence themes diverge from the previous literature findings.

purchase seasonal allocation to maintain permanent plantings and behave strategically in response to market uncertainty. Before 2008/09, many irrigators had not experienced such low seasonal allocation supply and were consequently adopting new strategies in the allocation markets to continue, or gradually exit from, farming. Importantly, the introduction of carry-over provisions in the southern MDB offered irrigators alternative risk-management options during drought years, which they readily incorporated. This has also significantly changed the decision making in allocation markets.

The research has shown that different factors influence trade decisions intra-season; that is within early (Jul–Oct), middle (Nov–Feb) and late (Mar–Jun) season periods. Important influences on the timing of intra-season allocation trading include irrigators' attitude to risk, timing of access to surplus water and requirements to meet fixed or excess usage charges before the close of a water accounting period. Institutional changes were also significant motivators of irrigators' intra-season allocation trade behaviour. Volumetric limits on trade, timing of announcements regarding possibilities to carry-over water and subsidised buyback are examples of changes to institutional arrangements identified by irrigators as influences on market behaviour and prices. Ultimately, while it may be true that such interventions could involve some water market efficiency loss, this research does not provide any meaningful evidence of market distortion, such as higher costs outside of SA as a result of government buying or increased transaction costs associated with changing management once it was recognised that contracts to buy water entitlements might not be honoured.

6. Conclusions

The research results documenting responses to institutional changes provide particularly new and important insights for EWHs tasked with incorporating allocation trading into the recovery (and application) of water for environmental flows. For instance, early selling patterns similar to that induced by volumetric trade restrictions in the MIA could be created by EWHs who announce their intention to purchase bulk seasonal allocations from irrigator groups. This would have negative impacts on irrigators interested in buying allocations during this period, largely as a result of the positive impact on market prices EWH market intervention would initiate. This would in turn provide positive impacts for selling irrigators. However, the incorporation of option contracts and entitlement leasing, along with allocation trade, could off-set some of the short-term impacts. Similarly if EWHs offered large parcels of surplus seasonal allocation to irrigators in allocation markets, this may mimic the impact of offering subsidised purchasing, resulting in depressed market prices for sellers and welfare benefits for buyers. It is likely that both irrigators and EWHs would engage in learning over time that may provide strategic behaviour opportunities common to other markets. Further quantitative research is required to fully understand the impact of government buy-back of water entitlements.

Late-season EWH efforts to accumulate carry-over water for the following water year, or to recoup excess water use to balance water accounts, could also have significant impact on the price of seasonal allocations and compete directly with irrigators. This would be especially true if the EWH was able to purchase seasonal allocation to accumulate in their allocation account as carry-over for environmental inundation, as this would add to the total demand in a given season. Finally, the issue of government-cancelled trade contracts in 2008/09 suggests for irrigators a potentially higher level of sovereign risk involved with government, as opposed to private party, agreements to buy and sell water. Although resultant changes to welfare may or may not undermine surpluses generated, if allowed to continue this uncertainty may work against EWHs' efforts to secure allocation water for the environment at lower transaction costs.

A final implication of this research relevant to the design of EWH strategy is that timing of intra-season allocation trading to meet stochastic environmental flow requirements will likely significantly influence irrigator behaviour, especially if activities are undertaken in one large transaction. Ultimately, there are many alternatives to structure EWH market intervention. While, the findings from this study offer useful insights for policy makers and EWHs charged with effectively reallocating water resources, there is clearly the need for considerable further research.

References

ACIL Tasman (2008). *Australia's Working Rivers: The Role of Infrastructure and Water Buybacks in Recovering Environmental Flows*. Prepared for Crane Group Limited, Melbourne.

Aronson, J. (1994). A pragmatic view of thematic analysis, *The Qualitative Report* 2, 4.

Bennett, J. (2008). Defining and managing environmental flows: inputs from society, *Economic Papers* 27, 167–183.

Bjornlund, H. (2002). The socio-economic structure of irrigation communities: water markets and the structural adjustment process, *Rural Society* 12, 123–147.

Bjornlund, H. (2004). Formal and informal water markets: drivers of sustainable rural communities? *Water Resources Research* 40, W09S07.

Bjornlund, H. (2006). Can water markets assist irrigators managing increased supply risk? Some Australian experiences, *Water International* 31, 221–232.

Bjornlund, H. (2007). *The Monitoring of, and Reporting on, Water Trading within the Goulburn-Murray Irrigation District (2)*, Research Report. CRMA, University of South Australia, Adelaide.

Bjornlund, H. and Rossini, P. (2005). Fundamentals determining prices and activities in the market for water allocations, *Water Resources Development* 21, 355–369.

Brennan, D. (2006). Water policy reform in Australia: lessons from the Victorian seasonal water market, *Australian Journal of Agricultural and Resource Economics* 50, 403–423.

Brennan, D. (2008). Missing markets for storage and the potential economic cost of expanding the spatial scope of water trade, *Australian Journal of Agricultural & Resource Economics* 52, 471–485.

Brooks, R. and Harris, E. (2008). Efficiency gains from water markets: empirical analysis of Watermove in Australia, *Agricultural Water Management* 95, 391–399.

Crase, L., O'Keefe, S. and Dollery, B. (2011). Presumptions of linearity and faith in the power of centralised decision-making: two challenges to the efficient management of environmental water in Australia, *Western Economic Association International Conference, 26–29 April*, Brisbane.

DEWSPC (2011). Progress of water recovery under the restoring the balance in the Murray-Darling Basin program, Available from URL: http://www.environment.gov.au/water/policy-programs/entitlement-purchasing/2008-09.html [accessed 23 May 2011].

DSE (2010). *Background Report 7B – A proposal for Future Carryover Arrangements: Northern Region Sustainable Water Strategy*. Victorian Department of Sustainability & Environment, Melbourne.

Gladstone, J., Dupuis, S. and Wexler, E. (2006). Changes in family involvement following a relative's move to a long-term care facility, *Canadian Journal on Aging* 25, 93–106.

Gomez-Limon, J. and Riesgo, L. (2004). Water pricing: analysis of differential impacts on heterogeneous farms, *Water Resources Research* 40, W07S05.

Grafton, Q. and Peterson, D. (2007). Water trading & pricing, in Hussey, K. and Dovers, S. (eds), *Managing Water for Australia: The Social and Institutional Challenges*. CSIRO Publishing, Collingswood, Victoria, pp. 73–84.

Hughes, N. and Goesch, T. (2009). *Management of Irrigation Water Storages: Carryover Rights and Capacity Sharing*, ABARE Report. ABARE, Canberra.

Kirby, M., Qureshi, M., Mainuddin, M. and Dyack, B. (2006). Catchment behaviour and counter-cyclical water trade: an integrated model, *Natural Resource Modeling* 19, 483–510.

Kuehne, G., Bjornlund, H. and Loch, A. (2010). *An Investigation of Farmers' Non-Profit Decision Drivers During a Period of Extreme Stress*. Rural Industries Research & Development Corporation, Canberra.

Leroux, A. and Crase, L. (2010). Advancing water trade: a preliminary investigation of urban irrigation options contracts in the Ovens Basin, Victoria, Australia, *Economic Papers: A journal of applied economics and policy* 29, 251–266.

Lincoln, Y. and Guba, E. (1985). *Naturalistic Inquiry*. Sage Publications Inc., Beverly Hills CA.

MDBA (2010). *Guide to the Proposed Basin Plan: Overview*. Murray-Darling Basin Authority, Canberra.

NWC (2011). *Australian Water Markets: Trends and Drivers, 2007–08 to 2009–10*. National Water Commission, Canberra.

Patton, M.Q. (2002). *Qualitative Evaluation and Research Methods*. Sage Publications, Thousand Oaks, CA.

Productivity Commission (2010). *Market Mechanisms for Recovering Water in the Murray–Darling Basin, Final Report*, Productivity Commission. Productivity Commission, Canberra.

SA Department of Water (2011). Long term storage rights come into effect today, Available from URL: http://www.waterforgood.sa.gov.au/wp-content/uploads/2011/09/river-murray-storage-rights.pdf [accessed 15 September 2011].

Scoccimarro, M. and Collins, D. (2006). *Natural Resource Buybacks and their Use to Secure Environmental Flows*. Land & Water Australia, Canberra.

Strauss, A. and Corbin, J. (1998). *Basics of Qualitative Research*. Sage Publications, Thousand Oaks CA.

WaterFind (2008). Analysis of the effect of the Federal Government's buy back of permanent water entitlements, Adelaide.

Wheeler, S., Bjornlund, H., Shanahan, M. and Zuo, A. (2008). Price elasticity of water allocation demand in the Goulburn-Murray irrigation district, *Australian Journal of Agricultural and Resource Economics* 52, 37–55.

Wheeler, S., Garrick, D., Loch, A. and Bjornlund, H. (2011). *Incorporating Temporary Trade with the Buy-Back of Water Entitlements in Australia*, CWEEP Working Paper Series. Centre for Water Economics, Environment & Policy, ANU, Canberra.

Young, M. (2010). Managing environmental water, in Bennett, J., Kingsford, R., Norris, R. and Young, M. (eds), *Making Decisions about Environmental Water Allocations*. Australian Farm Institute, Surrey Hills, Australia, pp. 51–60.

Young, M. and McColl, J. (2008). *A Future-Proofed Basin: A New Water Management Regime for the Murray–Darling Basin*. University of Adelaide, Adelaide.