RMCG

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"It's not all about almonds" Background on issues affecting the "Connected Murray" system.

Discussion paper

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1 Introduction

There is considerable concern around a number of issues confronting the Southern Basin including:

- Fears about the Murray choke limiting the capacity to deliver water to Sunraysia.
- Fears about overdevelopment of horticulture and the almond expansion taking water from upstream e.g. from the dairy industry.
- The Menindee fish kill and lack of flows in the downstream Darling.
- The erosion of General Security allocations (particularly in the NSW Murray) and lack of water.
- Environmental damage to the Goulburn river through inter-valley transfers.
- Fears about further water recovery i.e. the 450GL Upwater.
- The potential inability of Murray Irrigation and GMID infrastructure to remain viable.
- The very severe drought in NSW affecting dryland production and water allocations.
- The impending crisis in both the rice and the dairy industry as a result of recent and forecast low allocations.
- Farmers alleging that carryover has robbed them of “sales” allocations i.e. low security allocations have disappeared.

This has led to a large number of independent reviews/actions across the MDBA as evidenced in the recent MINCO water meeting (3 August 2019). This meeting referred to:

- Mr Mick Kelty - Interim Inspector General for Murray Darling Basin Water Resources to review compliance.
- Independent panel assessing social and economic condition of the Basin.
- ACCC review into the water markets.
- $1.5 billion Water Efficiency Program which includes the social and economic criteria agreed by the Ministers at their December meeting. The application of these criteria is potentially a cause for conflict between states.
- Independent deliverability panel to peer review the Murray River capacity constraints project
- The Victorian decision that “No new licences for extraction will be issued or limit increases granted unless it can be shown that there will be no increased risks to the environment or entitlement holders.”1 on development on the Murray River below the Barmah Choke.
- The associated Aither report on estimated horticulture demand for the “Connected Murray” system.
- Delivery of constraints project and Victoria and NSW independent modelling of flow rates under the constraints projects.

[1] https://www.premier.vic.gov.au/minister-takes-control-of-lower-murray-water-extraction/ accessed 20/8/19

Whenever these concerns are raised the rapid development of almonds is blamed as one of the main culprits. But, as usual, things are a bit more complicated and this paper tries to dig a little deeper and expose some of the key issues.

It is generally assumed that the Southern Connected system effectively acts as an interdependent system. While there is a relatively small amount of water traded between the states and systems, there is sufficient at the margins for the system to be acting as one. However, it is becoming more apparent that the Murrumbidgee component is operating physically separately to what is now being understood as the “connected Murray system. I.e. Murray/Goulburn in Vic, NSW and SA collectively. This paper concentrates on the connected Murray system though recognising the interdependence with the Lower Darling and Murrumbidgee systems.

This paper raises a wide range of issues that should be considered in the reviews currently underway. It does not attempt to be exhaustive but rather just simply raise a number of issues that should be considered.

2 Key drivers re Flows and Allocations

2.1 REDUCED INFLOWS HAVE A SIGNIFICANT ALLOCATION IMPACT

Inflows to the Southern system have declined in recent years (due to climate change or periodic seasonal variance). For example, the inflows to the Hume dam over the last 10 years (i.e. post Millennium Drought) are only 83% of the long-term average inflows. Two issues arise from this reduced inflow:

i. This reduces NSW General Security (NSW GS) and Victorian Low Security (Vic LS) allocations in three ways:

- These entitlements are the first affected when flows reduce – High Security entitlements are generally not affected except in extreme drought.
- A higher proportion of the High Security water allocated to SA is then provided from the Murray storages as flows are reduced from the Darling and the Murrumbidgee in NSW and from the Ovens, Campaspe and Loddon in Victoria. This in turn reduces NSW GS and Vic LS.
- Because the MDBA river operators wish to maximise the opportunity to capture unregulated flows from NSW and Vic downstream of Hume in Lake Victoria, they delay transferring water to SA and thus increase river transmission losses due to later in the season transfers. As overall flows reduce, this tendency increases.

ii. The impact on SUMMER river flows and the environment is not as great as this would seem because:

- Most of the reduction in diversions over the last fifteen years has occurred in diversions above the Barmah choke on the NSW and Victorian Murray and above Waranga Weir in the Victorian Goulburn system.
- The reduction in Torrumbarry irrigators water use (through reduced LS allocations and net trade out of HRWS) is offset by the system having to supply a higher % of SA water via the Murray, and by water trade to almonds in the Victorian Sunraysia.

2.2 BASIN PLAN WATER RECOVERY MOSTLY UPSTREAM

The Basin Plan recovery reduces the overall water available to irrigators, which was part of its objective. Water entitlements held by the environment in the sMDB are now almost 25% of the annual water historically used. This would be expected to cause a large reduction in downstream demand from Murray River irrigation demand and hence reduce downstream flow demands in the summer.

The MDBA records the entitlements purchased by region and hence confuses the real changes in water use occurring from the water recovery process. It is change in ‘water use patterns’ that is critical not changes in entitlement ownership. Further, the records of environmental water do not include the “bulk water” now allocated to the environment from GMW water savings. Thus, in Victoria in season 19/20 the environment was allocated 805GL compared to irrigators with 1,615GL. This 805GL for the environment, which was previously used upstream of the “choke” and Waranga weir is now delivered downstream.

So the water recovery does NOT reduce the downstream irrigator demand in the Sunraysia/Riverland area because the NET reduction in water use as a result of basin plan water recovery has NOT occurred in this area (the Government water recovery in this area has been offset by private trade into this area). This recovery did contribute to reducing water use in the Torrumbarry system which has freed upriver capacity downstream of the choke (which has been negated through water trade and the need for a higher % of SA flows coming via Murray system rather than the other tributaries such as the Darling).

2.3 WATER TRADE – DIFFERENT IMPACT TO PERCEPTION

Water Trade has also contributed to where water is used within the Southern Basin. The increase in horticulture (particularly the area of irrigated almonds) in the Sunraysia region has almost doubled the water use in Vic Sunraysia since 04/05 from around 330GL to around 590GL in season 18/19, i.e. an increase of 260GL.

At the same time the Torrumbarry region has reduced its overall water use from around 420GL with 210GL losses to 231GL with 92GL of losses in 18/19 and, at the same time has reduced its system losses, i.e. a combined reduction of around 307GL!

In the figure below RMCG has attempted to estimate total diversions from the Lower Murray NSW and Victoria over the last 30 years. This shows irrigator total water use has declined slightly or remained fairly constant.

Year	Torrumbarry inc. Woorinen & Tresco		Nyah		Mallee		NSW Murray excluding MIL		Total delivered	Total diversions
	delivered	diversions	delivered	diversions	delivered	diversions	deliveries	diversions		
1994/5	649,252	906,206	7,582	7,582	316,000	340,000	240,000	250,000	1,212,834	1,503,788
1997/8	490,641	705,267	6,196	6,905	321,799	355,182	240,000	250,000	1,058,636	1,317,354
2001/2	613,972	839,858	6,203	6,822	330,000	350,000	240,000	250,000	1,190,175	1,446,680
2004/5	419,696	633,050	5,005	7,269	332,000	352,000	240,000	250,000	996,701	1,242,319
2017/18	302,000	352,000	inc. in Torru	inc. in Torru	532,000	552,000	240,000	250,000	1,074,000	1,154,000
2020/21	302,000	352,000			650,370	660,000	240,000	250,000	1,192,370	1,262,000
	note under re	Less drainage returns			estimated					

Figure 2-1: Estimated total diversions from the Lower Murray NSW and Victoria over the last 30 years

Thus the increase in water use by almonds is offset by the reduction in Torrumbarry water use and thus there should be no impact on being able to deliver water due to the almond development.

However, the some of the water for the almond development from a different source from where the water for use in Torrumbarry traditionally used to come from, i.e.:

- There is a higher % demand from the Goulburn system - causing increased summer inter-valley flows and environmental damage to downstream in the Goulburn river
- Reduced flows are coming via the choke, suggesting an increase ability to deliver through the choke.

Thus it is NOT increased irrigator demand causing the supply problems through the choke.

However, the water trade to support almonds has caused environmental problems in the lower Goulburn.

2.4 RECENT GOULBURN INTER VALLEY TRADE CHANGES –

The increased summer flows in the Goulburn over the last two seasons is causing environmental damage to the river. These increased summer flows are associated with an increase in net inter valley trades to the Murray from the Goulburn system. This recent increase in net trade out is due to a combination of increased horticulture use (particularly in the Lower Murray Water region of Sunraysia) and the lack of allocations in NSW GS.

Victoria has proposed to introduce some temporary trading rules to limit the flows during summer down the lower Goulburn. This will mean that there will be more trade restrictions and reduced opportunity to trade water out of the Goulburn in 19/20 season. There is also a proposed review of the operating rules of the Goulburn to Murray trade rule to consider long term changes.

- This is likely to have considerable socio-economic impacts including:
- The connected southern Basin will not be quite as connected as previously occurred resulting in more regional variations with water pricing.
- Horticulture development along the Murray downstream of the choke will be limited sooner than was anticipated.
- Torrumbarry system (comprises mainly dairy farmers) will be the main source of water for downstream horticulture given the choke restrictions and the proposed Goulburn to Murray trade limits. This will encourage the further demise of the dairy industry in Torrumbarry compared to the remainder of the GMID.

2.5 WATER CAP

In 1997 a Cap was introduced whereby diversions from each state and catchment had to meet cap limitations based on 93/94 development. Each year the target cap was adjusted to reflect the climatic conditions. While it was permissible to exceed the cap in any one year the accumulated cap credits had to remain positive.

The MDBA has issued data (Murray–Darling Basin Authority Transition Period Water Take Report 2017–18) which indicates that these cap credits have slowly increased in the southern connected basin since 1997 but have significantly increased since 09/10. This suggests that the yield of the system is less than is permitted or was modelled to be available. This tends to confirm the concept that the yield of NSW General Security entitlement has been eroded.

Since 09/10 there has been on average 1200GL of underusage in the Southern Connected Basin. The explanation provided by the MDBA in its report is as follows

> *An analysis of the increase in cumulative Cap credits across the Basin since 2009–10 suggests that this is largely a result of the degree of difference between Cap model reference conditions (generally set at the 1993–94 level of development) and current water sharing policies and operational rules. The effect of these differences was masked during the millennium drought but have been revealed more clearly through several wet years since 2010–11. In the New South Wales / Victorian Murray, two thirds of the cumulative Cap credits have spilled from storage.*

This has resulted in substantially increased flows into SA as illustrated in figure 2.9 from the MDB report that indicates that on average SA has received an additional 1,000GL/year above expectations.

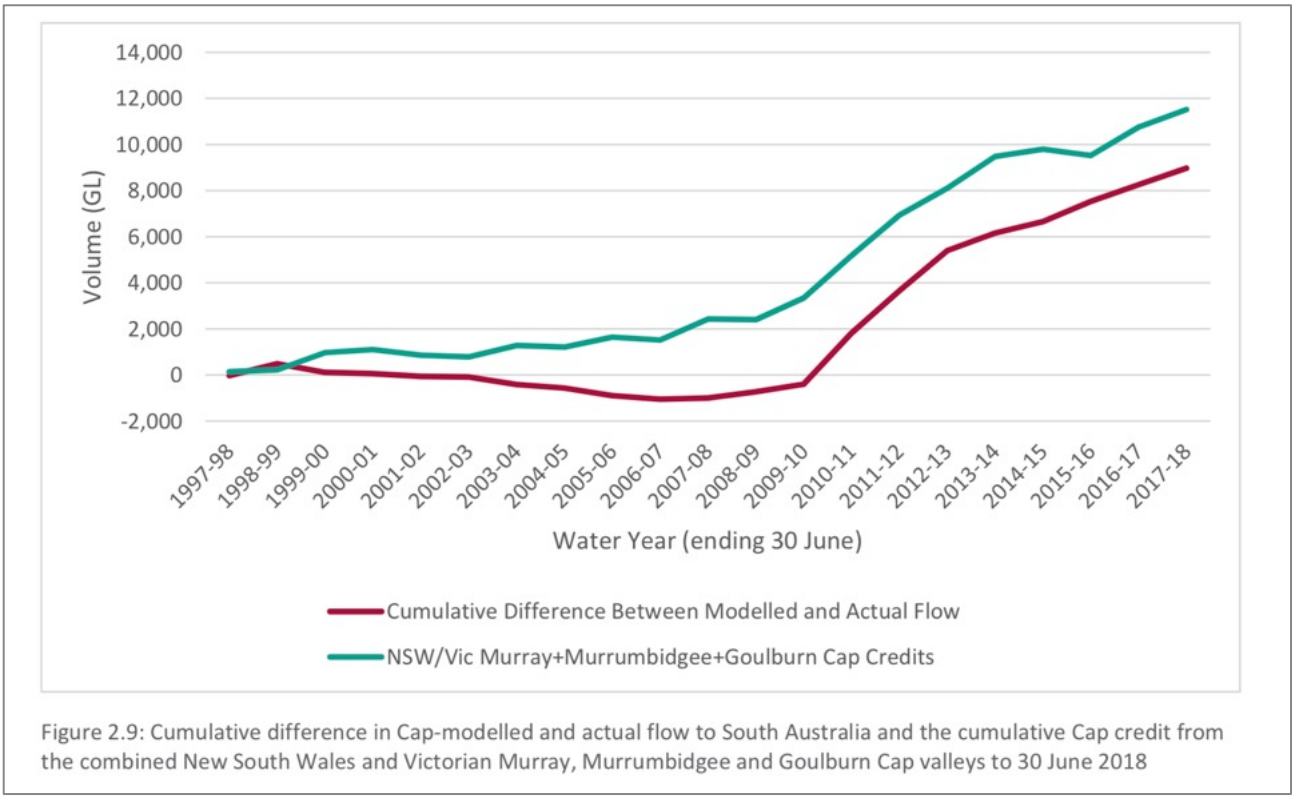

Figure 2.9: Cumulative difference in Cap-modelled and actual flow to South Australia and the cumulative Cap credit from the combined New South Wales and Victorian Murray, Murrumbidgee and Goulburn Cap valleys to 30 June 2018

Figure 2-2: Cumulative difference in Cap-modelled and actual flow to South Australia and cumulative Cap credit from the combined New South Wales and Victorian Murray, Murrumbidgee and Goulburn Cap valleys to 30 June 2018

The cap modelling provides the basis of the Basin Plan and the determination of the SDL reductions.

Under the Basin Plan the cap figures are being replaced by Sustainable Diversion Limits (SDL's) which also impose a maximum level of diversion for each catchment.

The making of the Basin Plan has set in train a seven-year process of transition (2012–13 to 2018–19) from Cap-based to SDL-based water accounting and compliance in the Basin. While some of the reporting components of SDL water accounting and compliance commenced in 2012, the Cap remains the only Basin-wide water take compliance regime that is in force.

The MDBA in the foreword of the report noted that *"Moving forward the methods used to determine how much water is permitted to be taken each year under the Basin Plan will reflect current levels of development rather than those that existed in 1993–94, which is the reference level of development for Cap".*

This report raises several issues i.e.:

- There are no recognition of the additional flows into SA and that the 450GL is no longer necessary.
- The cap underusage indicates that there are some potential policy changes that may have had third party impacts that should be investigated.
- There is a danger that the new SDL accounting will simply accept the changes in development between 1993-94 and current without considering the impacts and entrenching underuse by irrigators and transferring that water to the environment.

2.6 CARRYOVER/SPILL RULES – THIRD PARTY IMPACTS

There are a number of aspects of carryover that are changing behaviour in the river system and impacting on allocations for GS/LS.

2.6.1 CARRYOVER – INCREASES SPILLS

There has been a significant increase in carryover by individuals, the environment and from the adoption of a higher reserve (using 06/07 inflow data vs greater flows previously used). Currently the environment holds a disproportionate volume of carryover (relative to entitlements held).

All of this increased carryover has led to an increase in the amount of reservoir spills. The impact of carryover on these increasing spills is complicated but:

- ***Spills often provide an additional benefit to the environment with no credit given to irrigators***
- ***It reduces the overall water stored and used by irrigators***
- ***It reduces the yield of GS and LS allocations through adopting a higher inflow reserve.***

2.6.2 VIC CARRYOVER USING NSW WATER

The original intent of carryover was to allow individuals to store any underuse of water in one season (typically a wet season) and use it in dry season to mitigate risk.

It has become apparent that Victoria as a whole almost never uses less than is allocated and is continuously increasing its use by purchasing NSW and SA water for either use in that same year or to carryover for drier seasons. In the last 8 years it is only in the very wet 2016/17 season when Victoria used less than its allocation, i.e. Victoria is a net importer of water as shown in the figure below.

Table 17 Net allocation trade into Victoria (excluding within environment trade)

Water year	Net volume traded in (GL)		
	From NSW	From SA	Total from Interstate
2007-08	57	-45	11
2008-09	230	-18	212
2009-10	92	-27	65
2010-11	38	207	245
2011-12	-55	46	-8
2012-13	-142	-4	-146
2013-14	120	74	194
2014-15	-1	61	60
2015-16	171	52	223
2016-17	83	125	208
2017-18	-146	-7	-154

Notes on above graph and table

1. The presented volumes exclude 'Within environment' trades i.e. trades between the Commonwealth, VEWH and MDBA accounts and interstate trades with a $0 price involving environmental party on the Victorian side of the trade.
2. Negative values in this table indicate trade out of Victoria to interstate destinations

Figure 2-3: Net allocation trade into Victoria (excluding within environment trade)

Therefore, it can be argued that Victoria is using its carryover facility to access NSW GS water. This then has third party consequences in that the extra spills caused by Victorians using carryover decreases the yield of Vic low security allocations.

2.6.3 SPECIFIC CASES OF THIRD PARTY IMAPCTS

There are some occasions when the storages are full and spilling because of large volumes of carryover, yet the carryover is protected and the inflows are not credited to GS or LS allocations. This has occurred in both NSW and Victoria. In Victoria in 2016/17 the low security allocation on the Murray was only 5% but if the spills had been debited against carryover then the LS allocation would have been approx. 50%.

2.6.4 LAKE VICTORIA SPILL RULES – THIRD-PARTY IMPACTS

The MDBA does not control the Murray river operations past the SA border and is responsible for ensuring sufficient water is transferred to Lake Victoria to meet SA irrigators' needs. Water is released from Hume Dam to ensure this occurs. If Lake Victoria spills then the spill is water lost to the NSW and Vic allocation pool, unless regulated flows from Hume dam can be modified upstream.

The Lake Victoria spill accounting mechanism indirectly reduces the NSW GS and Vic LS allocations.

To minimise the risks of spills, water is transferred as late as practically possible in order to capture as much water from the Darling, Murrumbidgee and Vic rivers (Ovens, King Loddon etc). However, if it is left late and there are no additional flows from these other sources, then additional system losses are incurred as occurred in the 2018/19 season. These additional losses are worn by the NSW and Vic allocation pool.

Thus the Lake Victoria spill accounting mechanism encourages additional losses which further reduce NSW GS and Vic LS allocations.

2.6.5 ENVIRONMENT HOLDS EXTRA CARRYOVER

The environment at July 1 2019 is holding 444GL in carryover in Victoria, which represents the equivalent of 55% of total allocations whereas the irrigators hold 360GL or 22%. This suggests that the environment maybe responsible for a higher proportion of spills that eventuate.

However, the environment often uses some of this water prior to spills and thus it is yet to be seen whether the environment is responsible for a higher proportion of spills.

This means that the environment could be responsible for more of the spills than irrigators, and hence the impact on irrigator allocations.

2.7 DELIVERY OF ENVIRONMENTAL WATER - IS IT THE PROBLEM?

The environment holds a very large proportion of the available water in the Goulburn Murray system which has to be delivered downstream of Hume/Goulburn weirs. This was evidenced in the 2018/19 season in Victoria, where the irrigators were allocated 1,615GL and the environment was allocated 805GL.

2.7.1 TIMING OF USE

The environment now holds considerable allocation water and releases that water to meet both instream and end-of-river environmental needs. The release of this water is often timed to capitalise on the delivery of irrigators' consumptive water and/or natural flow periods. It is timed also as to NOT affect delivery of irrigators' consumptive water.

In summer of 2018/19, the environment delivered water to the Barmah Forest in order to increase the bird breeding program that had been started as a result of the late water delivery to SA flooding the forest. The environmental water had increased losses associated with this. These increased losses were worn by the whole system, which translates to losses in the NSW GS and Vic LS allocation pool.

Thus the delivery of environmental water can easily impact GS/LS allocations depending upon accounting of associated losses.

2.7.2 CHANGED LOCATION OF WATER USE

The environment's water was supposedly purchased uniformly across the basin with the assumption that the subsequent environmental use of water would be in similar areas; though some extra water was expected to get to the Lower Lakes.

However, because the MDBA records the location of entitlement purchases rather the location of the new use, it has missed that environmental water demand has resulted in water use previously diverted upstream of the choke and upstream of Goulburn Weir is now being delivered downstream. For example, the 805GL of Vic environment water in 18/19 is now ALL delivered downstream whereas the net downstream irrigator demand is unchanged.

This means that a large volume of water that was previously delivered as irrigation water or losses upstream of the Choke has now been converted to environmental use downstream of the Choke. In practice, due to river constraints, this was very difficult to achieve and has contributed to the environment in Victoria increasing its carryover by 160GL.

It is the change of location of environmental water use from upstream to downstream which is causing the Murray congestion problems in Sunraysia not increased irrigator demand (note total irrigator demand downstream of the choke is at least unchanged and most likely reduced).

2.7.3 WATER TRADE MERRY GO ROUND

The disassociation of water entitlements from land or unbundling has meant that in much of the water trade, evidence on the location of the water use (i.e. upstream and downstream of the Choke) has been lost. Thus it can become quite academic as to who was responsible for water trading upstream and downstream.

For example, the environment purchased a significant volume of water from the Sunraysia district during the almond expansion. Almond plantings dramatically increased from 4,000ha in 2003 to 20,000ha in 2012 and have since increased modestly to 25,000ha. This dramatic increase occurred at the same time as "buy-back". It also occurred at the same time that Torrumbarry reduced its water use.

Whilst buy-back officially purchased water from Sunraysia it effectively was "back traded" by the almond purchasing upstream water (temporarily and permanently).

Environmental water holders can correctly claim that some (but not all) of the increased downstream demand is a result of the almond industry expansion directly purchasing upstream water. It can also claim that some (but not all) of its purchases (and water savings) were previously delivered downstream.

This leads to the conclusion that it is both the environments purchases/ recovery and the almond industry purchases that have contributed to the increased downstream demand.

However, taking a broader overview of comparing irrigator demand versus environment demand it is suggested that because the irrigator NET demand downstream is unchanged, it is the environment's water that represents the overall net change from upstream to downstream.

2.7.4 BIDGEE AND DARLING NOT CONTRIBUTING IN DRY YEARS

A key consequence of the Basin Plan implementation to date has been that the Darling has not contributed anything to the Murray system nor has the Murrumbidgee in dry periods. This lack of contribution arises because:

- There have been considerable compliance problems within the key tributaries to the Darling System and questions raised about the appropriateness of the water sharing plans which have reduced the dry period flows to almost zero.
- In contrast, whilst the Murrumbidgee system has contributed water to the recovery pool, virtually none of the entitlements recovered have been from the 400,000ML plus pool of the Murrumbidgee High Security Entitlements, but rather recovery has been dominated by securing some General Security Entitlements and a very large number of Murrumbidgee "supplementary" water.

This lack of contribution to river flows in dry periods from both the Darling and the Murrumbidgee has put more pressure on the Murray/Goulburn system to meet the environmental demands from SA.

2.7.5 MAXIMISING ECONOMIC BENEFITS MAY AFFECT ENVIRONMENT

Water trade has facilitated water moving to the highest value agriculture and despite there being less total water available, horticulture has continued to expand, whereas rice, dairy and mixed grazing have all declined in the southern connected Murray system. This increase in economic value has primarily occurred in the Sunraysia region and has maintained a high spring & summer irrigation demand in the river.

Maximising economic outcomes means the river still runs upside down ie high summer flows/low early winter flows. Further it limits the ability of the environment to transfer water downstream without either reducing the irrigators access to water, or creating further environmental damage to the lower Goulburn and increasing system losses.

2.7.6 RELATIVE DEMAND IRRIGATORS, ENVIRONMENT AND SA

The downstream Murray system irrigator demand in the 2018/19 season was approx. 800GL (Torrumbarry, Sunraysia Vic districts and Vic diverters and NSW district and diverters). This total demand is relatively unchanged over the last 30 years as shown previously in section 2.3. By comparison the environment is now delivering 800GL that was previously used upstream (ie Murray Irrigation, GMID irrigators and losses) to be delivered downstream. The actual delivery of the environment water is also now concentrated into a very short time period. This is shown in the figure below.

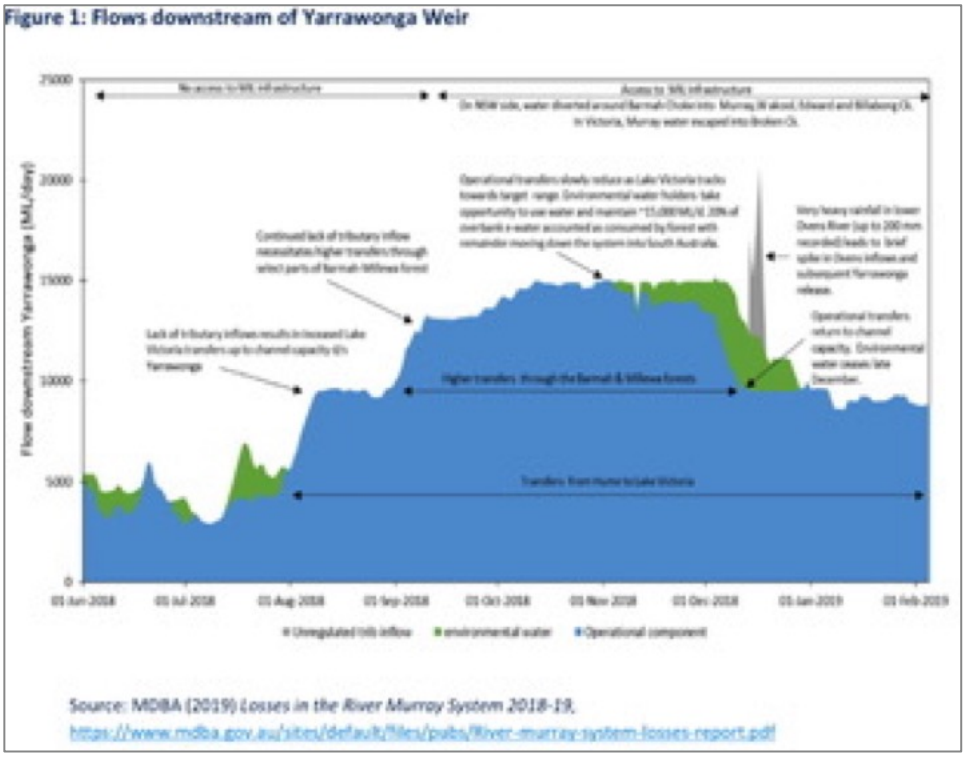

Figure 2-4: Flows downstream of Yarrawonga Weir

Whilst the demand pattern of the SA, irrigators and the environment are different, it is the addition of the environment demand that is causing the problem particularly in a season when SA needs are all met by the Murray system.

2.7.7 ENVIRONMENT INCREASING CARRYOVER IN DRY SEASONS

In the season 18/19 which has system inflows equivalent to a 10% dry season, the environment increased its carryover in the Vic Murray and Goulburn systems from 385GL to 544GL, i.e. a 159GL increase. By comparison Victorian irrigators decreased their carryover from 473GL to 360GL i.e. a 113GL decrease.

Part of the reason for the environment increasing its carryover was its inability to deliver due to Murray choke and Goulburn flow restrictions. It is not surprising that the environment wishes to have carryover to use in dry years and also to use in early winters prior to allocations becoming available.

However, it would seem a poor policy outcome that the environment increases its carryover in a dry year when irrigators' demand is so high and allocations for GS are zero.

3 Equilibrium and market failure?

3.1 MISUNDERSTANDING OF WATER RELIABILITY

There is a misconception that all water allocated is the same and ultimately will trade to the highest value user i.e. being horticulture.

What is not understood is that the system generally has three levels of water security i.e.:

i. **Super Secure water – 50% HR allocation, approx. 1,500GL/year.** This is available every year including the Millennium Drought. In simple terms, this is when there is only about 50% allocation of Victorian high security entitlements. This has about a 1 in 20 year probability.

ii. **Very Secure water – 100% HR Vic allocation, approx. 2,600GL/year.** This is available 95 years in 100 but in extreme droughts e.g. Millennium Drought, only half of the water is available.

iii. **Variable water – NSW Murray GS allocations ranging from 0 to 100%, between 0 and 2,600GL/year.** On average a 60% i.e. 1560GL/year is supposedly available (although previous chapters would indicate that its yield is being further reduced by a number of factors).

In practical terms this means that:

i. **Super Secure water** is used by Horticulture to irrigate permanent plantings without risk.

ii. **Very Secure Water** is used by the next most high value industries i.e. cotton, dairy and maize.

iii. **Variable water** is used predominantly by rice, livestock grazing and winter cereals.

The last 4 years provide an example of the water available in “very secure water scenario” i.e. 18/19 and the variable water scenarios of the three years prior to that as shown in the figure below.

Volume varies every year eg last 4 years 2,703 to 5,204 GL!!!

NSW General Security – determines everything

Season	NSW Info			Vic info	Southern Basin	
	Approx. av. of Murray & Murrumbidgee GS allocation %	MIL carryover start season GL	Rice Production tonnes	carryover start season GL	Total all-valley allocated GL (irrigator/user share)	Whole year weighted water price Av $/ML
2015/16	29	216	305,000	400	3,232	$208
2016/17	100	169	800,000	505	5,204	$63
2017/18	46	297	630,000	856	3,738	$129
2018/19	6	146	50,000 est	457	2,703	$430? est

7 2 July 2019

Figure 3-1: Volume varies every year e.g. last four years 2,703 to 5,204 GL!!! NSW General Security – determines everything

Thus the water used by different industries is shown below.

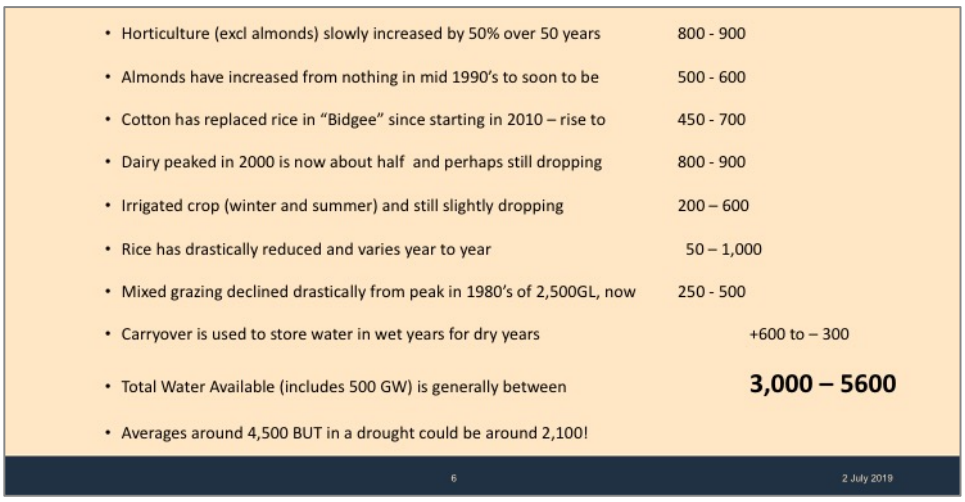

Figure 3-2: Water used by different industries

3.2 INEVITABLE EQUILBRIUM

Because the water available varies from year to year, there will always be three broad groups of industries. These industries will eventually develop an equilibrium based upon perceptions of water reliability and relative commodity prices.

The equilibrium has taken a long time to evolve with:

- Rice and Dairy pasture production replacing mixed grazing in the 80's and 90's
- Wine grapes in Sunraysia through trade replaced mixed grazing in the Kerang/Pyramid region in the 90's
- Cotton has replaced rice since the Millennium Drought
- Almonds in SA and particularly Victorian Lower Murray are replacing dairy water use since the Millennium Drought.

However, there is now a limit to how much cotton and almonds can expand because the volume of super secure water is limited. So we find the following equilibrium has now been reached.

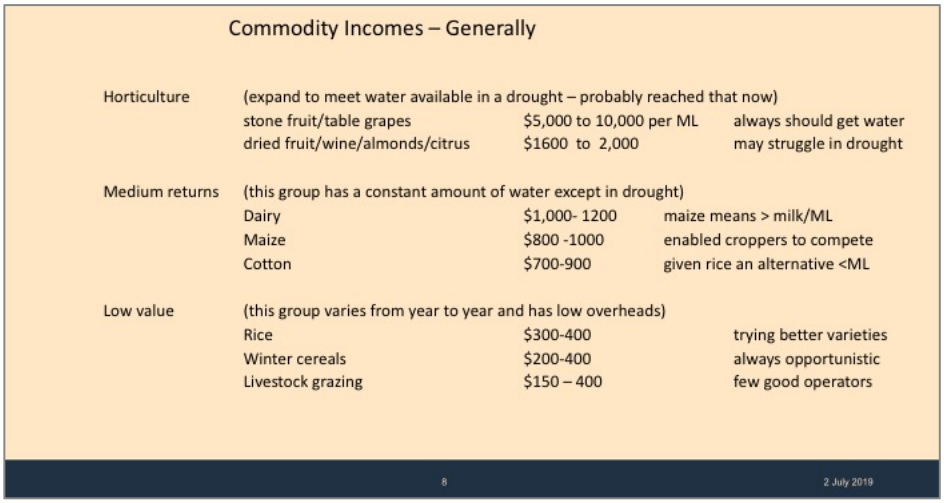

Figure 3-3: Commodity Incomes – Generally

3.3 MARKET FAILURE COMING- COULD BE THIS YEAR

Markets frequently overcompensate and overshoot with consequential market failure.

It is suggested that the development of horticulture, particularly the relative lower return of the almond industry, has over developed when contrasted with the volume of water available for perennial plantings.

When the next drought occurs, the limit of the development will be ascertained depending upon the severity of the drought. Until the next drought occurs it appears as if the development will continue, especially if NSW or SA do not apply the same limits to extraction that Victoria recently announced. The longer it is before we have a drought the bigger the impact will be. The sooner we have the next drought, the less market failure we will experience.

Season 2019/20 has a 10% chance (as at 15 July) of a repeat of the millennium drought allocations. The recent announcement of Vic allocations shows there is a 10% chance of a total Vic allocation of 793GL, comprising:

- 43% allocation in the Goulburn system i.e. approx. 309GL
- 75% allocation in the Murray system i.e. approx. 484GL

Water use in horticulture (incl vegies) in northern Victoria is now approx. 680GL per annum. This means that horticulture would require nearly 85% of the available water from both the Goulburn and Murray systems if this 10% scenario eventuated.

For comparison, during the Millennium Drought the Victoria allocations were approx. 1,050GL and the horticulture (incl vegies) demand was only 430GL or about 40%. During the last drought there was difficulty meeting all of the needs of horticulture and substantial areas of grapes being removed.

If the Murray connected system (excl Murrumbidgee but including NSW Murray, Vic Murray/Goulburn and SA) is considered then horticulture (incl vegies) requires 96% if the 10% scenario eventuated this year. (i.e. 1,213GL demand out of a predicted 1,269GL allocation).

The likely imminent horticulture development (i.e. current plantings mature and proposed plantings proceed) will result in a demand (incl vegetables) in the connected Murray of 1353GL/year. This represents 60% of the total HS entitlements in the connected Murray (Vic -1665GL, SA 392GL, NSW Murray 170GL- total 2,227GL).

Recent DELWP commissioned work by Aither predicted that the horticultural demand (excl vegies) within the connected Murray system will rise to 1,392GL/year with full maturity of existing plantings and 1,556GL/year with projected demand. RMCG's work would suggest a 330GL/year lower estimate for the projected demand and that some of the projected demand is not likely to occur given the current understanding and climatic conditions. These excessive estimates have potentially overstated problems regarding deliverability in the Murray (both current and future) and suggest that the dairy industry in northern Victoria will be reduced to half of the 18/19 levels. However whatever predictions are made the horticulture development has certainly exceeded what could be maintained in this year's 10% dry scenario.

If the Millennium Drought was to be repeated (there is a 10% chance this year!) then it is almost impossible for there to be sufficient water for horticulture plantings and there will be substantial abandonment of plantings. If it doesn't happen this year then due to ongoing expansion when it does occur it is likely to be even worse.

3.4 MARKET FAILURE TRIGGERS

There have been three drivers towards the likely horticulture market failure in a future drought.

- Firstly, the demand for water by horticulture in the connected Murray system has already increased by around 400 GL/year since the last drought and to meet current and planned plantings it will increase a further 140 GL/year.
- Secondly, the water recovery has seen a reduction in the available water in droughts within the connected Murray system of 343GL (assuming the 19/20 projected 10% , or “dry inflows sequence” event).
- Thirdly horticulture is accessing NSW GS water and using carryover to convert it to a more secure product that is suitable for horticulture (currently approx. 100-200GL/year).

In the lower connected Murray system, increased horticulture demand and water recovery have both contributed to the likely shortfall in available water for horticulture in a drought scenario. This shortfall is being offset by the use of carryover and access to trade of NSW GS.

4 Socio-economic impacts

4.1 WATER DRIVES SOCIO-ECONOMICS – DESPITE WHAT SA COMMISSION SAYS

The provision of water drives the socioeconomics of a region. Generally, the more water available and used for irrigation the greater the positive socio-economic outcome. This fundamental is glossed over by looking at changes in production and markets from year to year but the fundamentals do not change. More water means more production and more people in the regions.

This is different to the view that the effects of reduced water availability (eg. from either a buy back or trade to another region) are neutral because the prices paid by the Australian Government were equivalent to those offered by other bidders and, therefore, sale income is equivalent to the value of forgone farm income. And that even the longer-term effects are neutral because goods and services to support irrigation activity have been largely replaced with alternative purchases to support new farming activity or business activity. In practice the capital provided to exiting farmers has not resulted in alternative business production in the region but rather paid off debt following drought and funded retirement. The regions that have lost water have decreased the production and population (e.g. Wakool or Pyramid Hill) and conversely Sunraysia which has increased water use has increased production and population.

The quantum of socio-economic impact varies with different enterprises and of course market forces encourage the transfer of water to the highest use. However, as previously indicated there is an equilibrium of industries that has evolved to match the variability of the available water.

For example, we have seen in the GMID a halving of water used since the year 2000 and a corresponding halving (almost) of the dairy industry production. However, the grazing industry within the GMID has been effectively wiped-out, and the horticulture (relatively minor water use but major economic contributor) has expanded slightly.

Standard economic theory (e.g. as at the SA Royal commission) argues that reduced water has not led to a reduction in economic output, because there have been a number of ways to compensate. It is true that the overall economic value of production has increased at a whole of Basin scale. This is discussed below in the underlying trends. However, the opportunities to compensate for less water through adoption of previously successful strategies is no longer valid. For example:

- On farm efficiency – there have been massive strides in improving on-farm efficiency, such as switching to pressurised irrigation and laser grading/fast flow etc. And of course, there will be further improvements e.g. dairy switching to maize and new rice varieties etc. However, the big efficiencies have been taken.
- Switching enterprises – over the last 40 years there have been massive changes in the industries using water, where that water has been transferred to the highest value use. However as discussed, an equilibrium in water-dependent enterprise mixes has now been reached (or probably exceeded by the very rapid expansion of horticulture plantings) and the significant increase in production has occurred, largely facilitated by water trade.
- System efficiencies – the infrastructure supplying farms in the larger systems e.g. GMID, MIL and MI have all been substantially upgraded generating significant savings. This has also come a t a large capital cost. Despite this capital expenditure often being funded by Governments, it will warrant significant annual op-ex. which will need to be paid by users.

- Alternative feed sources for dairy – much has been made of dairy farmers using grain and fodder to compensate for reduced water allocations. This solution is only a seasonal or drought solution and does not provide a financially sustainable underlying benefit, compared with irrigated feed sources.. This does not deny the underlying shift to more grain feed that has lifted dairy production.
- Temporary water market – is often quoted as an alternative source of water when in fact it is just a form of financing and should not be confused with allocations and available water. This was a temporary solution for those farmers who sold water in buy back and then felt vindicated as they were able to take advantage of low annual allocation prices (in the short term only) of the wet years 10/11, 11/12 and 12/13. The tables have turned.

Any future socio-economic impacts will largely be proportional to the available water and the reliability of that water with some ongoing modest year on year efficiency improvements and variability with seasons.

4.2 UNDERLYING INDUSTRY PRODUCTION TRENDS – OFTEN IGNORED

Many communities when examining the impact of the Basin Plan or water trade generally compare things to the immediate past, whereas there are often underlying trends or previous changes conveniently ignored. On the other hand, some economists assume the underlying trends are able to continue without realising that there is an equilibrium due to water supply variability that has been reached or exceeded.

Over time we have seen growth in use, a usage cap imposed, and then large-scale water recovery all occurring within the underlying trend of market forces reaching an equilibrium to share the available water.

The following graphs in Figure 4-1 of the dairy industry and the rice industry illustrate the changes in production in their industries, showing growth, cap and then the impact of recovery leading to a new equilibrium position.

Figure 4-1: Dairy industry and the rice industry illustrated the changes in production in their industries

In some ways the recent cotton and almond expansion at the expense of the dairy and rice industry is no different to what has happened in the past in the rice, dairy and wine industries as they expanded at the expense of the irrigated grazing industry. It is expected that both cotton and almond production and water-use will eventually settle to a constant level.

Recent demands by the horticulture industry to restrict development to protect the existing recent horticulture development from future developments is symptomatic of industries attitudes changing as they evolve from expansion to consolidation and sometimes even restructuring. However, if over-development then leads to industry crashes, then this is of considerable concern to the socioeconomics of the regions.

4.3 FARM WATER USE EFFICIENCIES ARE ALWAYS IMPROVING

Water-use efficiencies on farm have been continually improving for the last 100 years or so of irrigation. RMCG's analysis of different industries production versus water-use would suggest that the rice industry for example has gone from 0.3t/ML applied to 1.0t/ML applied over the last 50 years. It is already possible to achieve up to 1.2t/ML with the 2019 crop-award won by a MIA Reiziq crop of 14.0t/ha using less than 12ML/ha. This has come about through a combination of factors including the less efficient growers leaving the industry, better varieties, improved irrigation technology (laser grading) and, most importantly, better site selection for soil types to grow a ponded crop such as rice.

Similarly, the dairy industry has increased its production from 1,500litres of milk per ML of irrigation water applied to 2,000l/ML during the last 35 years. It is possible to achieve up to 4,000l/ML if different farming systems (such as barns and maize feeding) are utilised. The change has come about in similar ways to rice but also includes the introduction of more purchased grain feeding to supplement irrigated crops, meaning less irrigation water is required.

Other industries including horticulture have made similar changes to improve water use efficiency over the long-term, although this has often been driven by factors related to better crop and better fruit production, rather than simply introducing new technologies and practices to save water.

These improvements have been and will remain being a keyway (along with the constant challenge of labour efficiency improvements) of enabling irrigated agriculture to remain viable.

Therefore, it is important to recognise the importance of constantly seeking to achieve water use efficiency improvements but not see them as a panacea for constant and continuing reductions in water availability.

4.4 RURAL POPULATIONS ARE DECLINING AND FARMS ARE GETTING BIGGER

An inexorable trend in agriculture is the reduction in the number of people engaged in agricultural pursuits. The 2016 GMID socio-economic reported provided an analysis of population trends and aging.

This data showed that there were some underlying trends associated with agriculture and rural communities. This showed that irrigation communities were far more resilient than dryland regions. It also indicated that changes in the volumes of available water and the type of industries undertaken also impact on population.

Farms are continually getting bigger. For example, the number of dairy farms in Victoria has halved every 20 years since the 1950's whilst production overall has more than doubled. Individual dairy farms have doubled production every 15 years.

Separating out the impact of changes in water from the underlying trends is a critical task in evaluating the socio-economic impacts. Updating this analysis and including 2016 census would be a valuable insight into the impact of changed water use across the 5 regions in the southern catchment.

4.5 REGIONAL IMPACTS OF CHANGED WATER USE VARY

Some industries continued to expand and others decline as the water availability has reduced through a combination of climate change, the Basin Plan and changed irrigator behaviour. Similarly, some regions have expanded and others have declined.

In general terms since 1999/00 when water use across the basin was at its peak, it is observed that:

- SA Riverland region has maintained its overall level of water use through two mechanisms. It has increased its utilisation of SA water entitlements held and its irrigators are actively buying water entitlements and water allocations from interstate, particularly from Victoria.
- The Victorian/NSW Mallee region has expanded its water use significantly – almost doubled.
- NSW Murrumbidgee has maintained its High Security water use but decreased its GS water use. BUT the decrease in water use has been offset by the expansion of cotton which uses less water per ha than rice growing.
- The 1100 irrigation farmers in the 760,000Ha NSW Murray Irrigation Ltd area of operations has significantly reduced its water use, as the rice industry has declined. The water use is now about half of what it used to be, and is much more variable from year to year.
- Over the last twenty years the GMID has had a net decline in water use of 1,000GL/y (almost 50%), with half of this due to the Basin Plan and the other 500GL due to water trade, improved canal operations, climate, carryover, new reserve policies and earlier water recovery such as the Living Murray.

In simple terms three regions have prospered and two regions have substantially reduced production.

4.6 BASIN PLAN OFFSETS TO COMMUNITIES

The volume of water and the associated enterprises drives each region's socio-economic outcomes, and thus any socio-economic evaluation of regions concentrates on volumes and industries. However, some specific initiatives have been taken to offset the impacts, i.e. primarily on-farm efficiency programs and regional delivery efficiency programs (e.g. NVIRP/Connections).

In general terms, the on-farm efficiency has simply brought forward works that would have eventually occurred anyway, but effectively provided a "subsidy" by purchasing the savings at a significant premium compared to "buyback", or the water market price at the time. However, any reduction from the transfer of water to the environment was generally restored through back-trade from other regions. This means that the long-term impact of the water transferred was different in each region i.e.:

- Sunraysia/Riverland – the reduction in water use was ultimately felt by trade of water back into these areas from the GMID and particularly the GMID the dairy industry.
- Murrumbidgee – the reduction in water use was felt by the rice industry but offset by the shift to cotton. Often water sales, or water-swaps for on-farm infrastructure funded farm redevelopment to facilitate cotton growing.
- Murray Irrigation – the reduction in water use was felt by the rice industry.
- GMID – the reduction in water use was felt by primarily by the dairy industry.

The infrastructure investment was a genuine addition to each region that received funds, particularly the GMID.

Buyback was seen to provide capital for alternative investment into the regions and it is argued by economists that this has had a significant benefit. An alternative view is that buyback generally:

- Assisted restructuring of the wine, dairy and rice industries at times of extreme stress for each industry caused by drought and low prices for the industry. It probably put a “floor” in the value of entitlements.
- Provided an alternative source of financing for those irrigators who were in debt coming out of the drought and wanted to continue farming, or at least living on the farm. However, although these farmers initially were at an advantage because of the wet years that ensued and low temporary water prices, in recent times, this advantage has completely soured and they have suffered from being very exposed to raised water allocation prices.
- In Riverland where ‘efficiency projects’ attracted even greater premiums over market water values, and even in Victoria’s Sunraysia the permanent sales of entitlement were often offset by “back trade” purchases of entitlements and or participation in the temporary market, thus resulting in a neutral outcome.
- Most of the capital was used to pay back debt and assist farmers retiring, particularly in the GMID and the Murray Irrigation regions. It did not encourage alternative investments.

There is evidence emerging that the current dry period is crystallising a buyback/farm efficiency “hangover” where those farms who sold water and now rely on the temporary market (particularly cereal and maize cropping, rice and dairy farms) are unable to compete in the market and are now exiting agriculture.

There have been some benefits associated with the significant cash injected through a variety of investments associated with the Basin Plan but the impacts vary from positive to very negative between irrigators, communities, commodity types, and regions.

4.7 THE PRICE OF ALLOCATION WATER

4.7.1 SUPPLY DRIVEN TEMPORARY MARKET

The sale of water both permanently as entitlements, and temporarily as allocations, has enabled water to move both long term and short term to find the most economic use and thus maximise total southern basin economic output. This was most evident during the Millennium Drought, but is also evident through the evolution of the “equilibrium” of industries that has evolved.

RMCG has plotted the average annual temporary price of water versus annual allocations and found a very good relationship (not unexpected) as is shown in Figure 4-2 below.

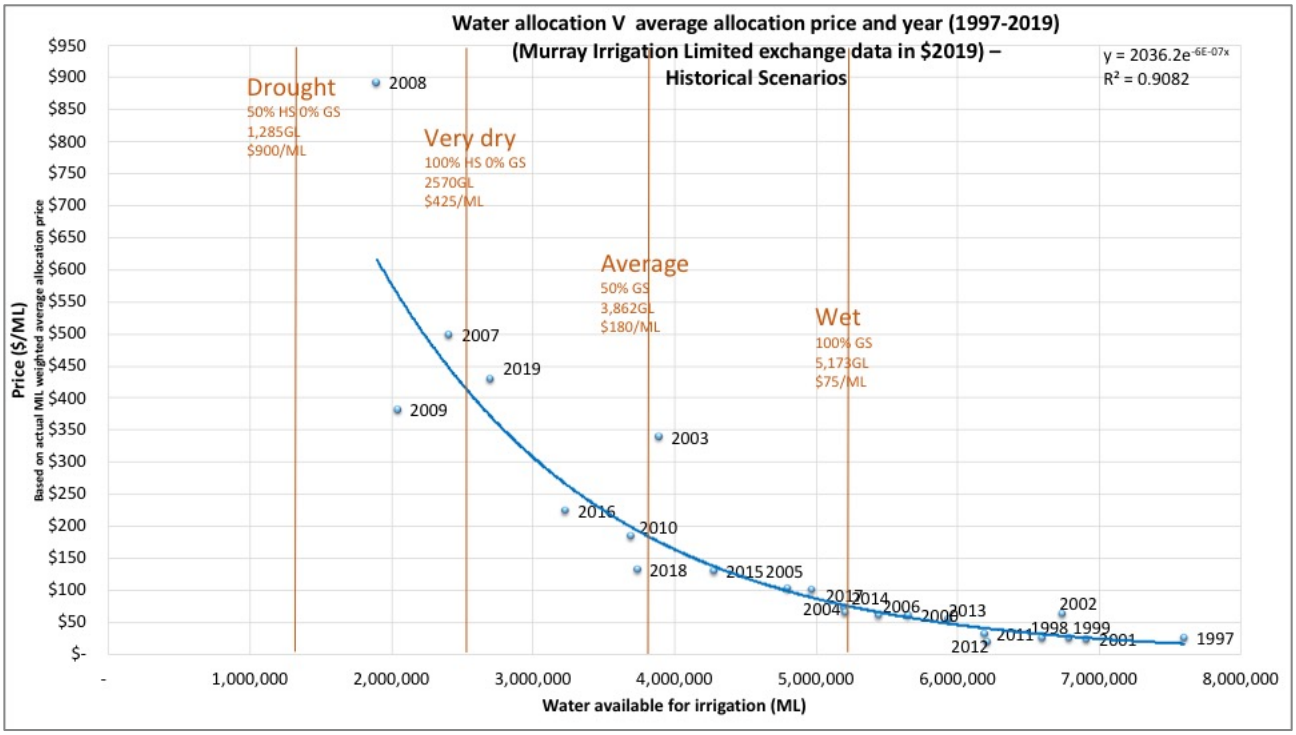

Figure 4-2: Water allocation vs average allocation price and year (1997-2019) (Murray Irrigation Limited exchange data in $2019) – Historical Scenarios

This demonstrates the enormous range of possible allocations between years and so the large range in likely water prices. It also demonstrates that the NSW General Security allocations are key to the available water in all but the drought years. This is the market at work. The temporary market reflects the marginal value of the water to the industry that is accessing the water. In simple terms the relative prices for different climatic seasons are as follows:

- Wet - $ 75/ML – value to a rice farmer for next year
- Average - $180/ML – max value to a rice farmer
- Very dry - $425/ML – max to a dairy/cotton/maize
- Drought - $900/ML – max to a horticulture enterprise.

This suggests that the price of water is driven by the level of available supply. Therefore, any change in supply will directly affect the price of water.

4.7.2 SPECIFIC SEASON EG 2019/20

During the season the government agencies make predictions on the likely allocations and these can be translated onto the price curve. For example, the following figure shows the predicted allocations for various scenarios for season 19/20 as estimated at 15 July 2019. At the moment (Aug 2019) the market is trading at around $600/ML although it is understood relatively small volumes are being traded. This suggests that the market is anticipating the prospect of a very dry remaining 2019/20.

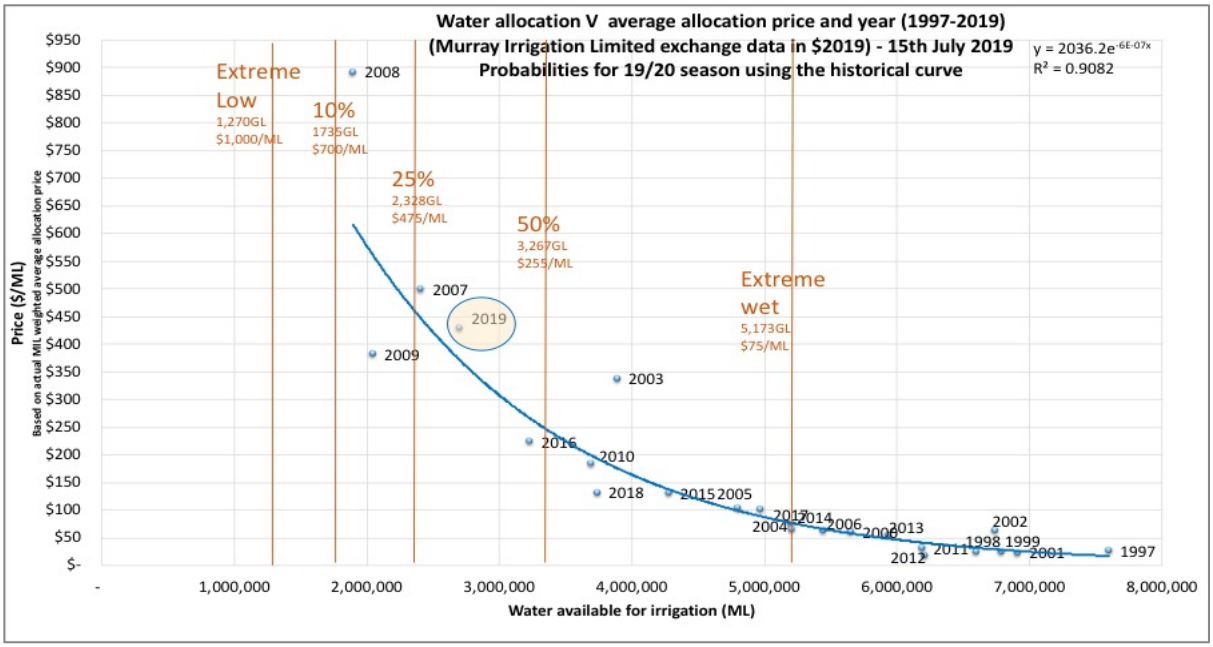

Figure 4-3: Predicted allocations for various scenarios for season 19/20 as estimated at 15 July 2019

The market also varies throughout the season depending upon the perception of the likely allocations. This is shown below in the figure below. It is interesting to note that the November allocation price generally reflects the average weighted annual price. This is not unexpected as November is the time when allocations typically peak, summer cropping decisions for rice, corn/maize and cotton are locked in, and it is the time when the most certainty around allocations and seasonal demand crystallises.

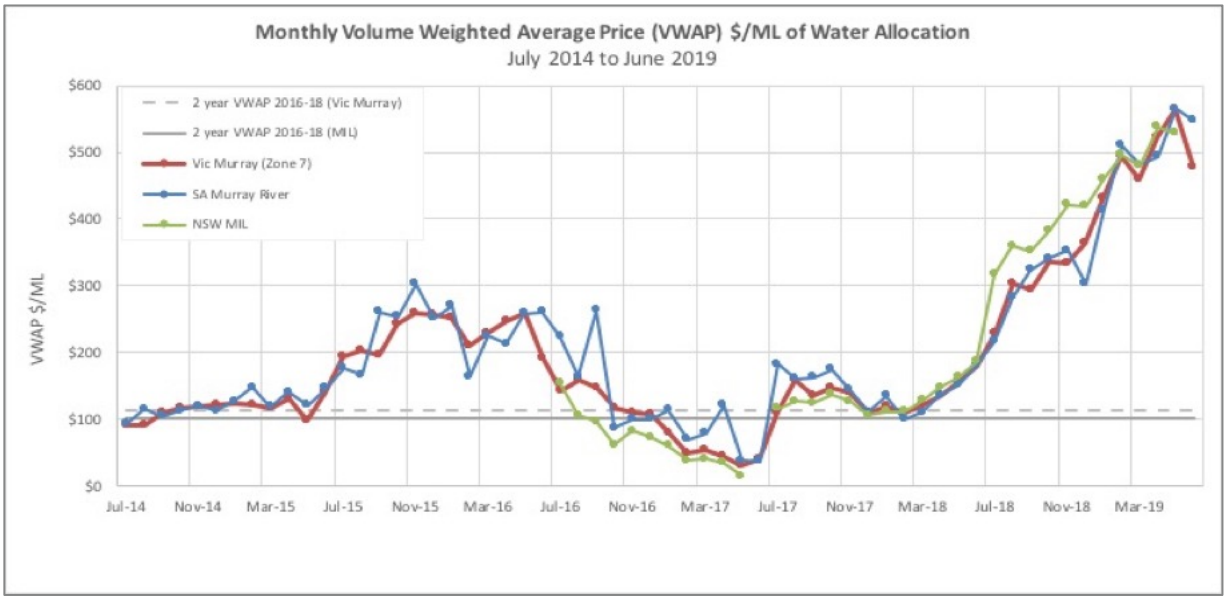

Figure 4-4: Reported allocation traded/transferred (Murray River, excluding NSW State registry) July 2014 to June 2019[2] (excludes $0 trades)

*Note: Volumes transferred for $0.00 include transfers within one business, 'call-outs' by the Murray Darling Basin Authority and Government E-Water transfers. The transactions at zero dollars have been excluded from price averages quoted, as have trades reported outside of the bounds $5/ML to $3,000/ML. Allocation transfer data was available for the MIL Exchange for the 11 months up to 1 June 2019 as trading closed for the scheduled MIL Exchange closure in mid-June each year. MIL holds more than 60% of all NSW Murray GS Murray entitlements, although significant volumes of NSW allocation trades are conducted outside the MIL exchange.

[2] Victorian Water Register: http://waterregister.vic.gov.au, NSW Murray Irrigation Limited: http://www.murrayirrigation.com.au/water/water-trade/, and South Australia WaterConnect: https://www.waterconnect.sa.gov.au/Systems/WTR/Pages/Default.aspx,

Seasonal allocation prices reflect the markets understanding of allocations and thus transparency in this is critical.

4.7.3 ACCESS TO MARKET DATA AND MULTIPLE TRANSACTIONS

It is difficult to access good data for either allocation trades or entitlement trades across all three states, even for the seasoned observer. There are numerous organisations mining the data and attempting to provide some insights. RMCG is one of those. RMCG has found that the extremely high number of transactions for allocation trade suggests either there is an inefficient recording system or there is "churning" of sales.

The one data source that is believed to provide the most accurate data is the Murray Irrigation exchange as this acts and reports as an "exchange".

RMCG suggest that generally the market is effective, however lack of transparency and potential for large corporations to manipulate the market (because of size and relative low volume of water trade both permanently and temporarily) is a real threat.

4.7.4 RELATIONSHIP OF ALLOCATION TO ENTITLEMENT PRICES

RMCG has also compared the value of entitlements to the temporary market by using weighted probabilities and found that the temporary value reflects about an annual 5-6% of the entitlement price (regardless of which of the multiple mainstream Southern MDB entitlement or water-share products are purchased). This is a reasonable refection of the cost of capital.

RMCG suggest that the relationship between entitlements and allocation prices is within expectations.

4.7.5 HAVE WE SEEN A STEP INCREASE IN PRICES?

It appears as if there may have been a step price increase in the 2018/19 season. Although the price appears to be broadly aligned with the historical price curve, there is some suggestion that the declining volume of water stored in carryover accounts, while increasing availability in earlier years, has now led to price escalation.

This view is supported by the continued high price this season so far (i.e. around $600/ML) even though the most likely outcome of the season is for more allocation than last year.

This may also be due to the recent increase in horticulture and cotton demand on the market. It may be because cotton famers entered into contracts based on the carryover availability or it may reflect the higher dairy prices. On the other hand it may have been affected by the lack of transparency and number of transactions relative to a "thin" market.

Alternatively, it may just reflect the time lag that occurs in a market to react to the progressive change in allocations during the season.

The next 6 months may confirm one way or the other whether we have seen a step increase of around $50-100/ML in allocation prices.

4.7.6 DISCONNECTION OF THE MARKET

The recent changes to the Victorian Inter Valley Trade rules (IVT), likely Barmah choke restrictions combined with the lack of NSW GS allocations has meant that the trade of water between regions is now limited. Thus we are seeing water prices for the first time reflecting the local industry. For example the downstream Murray water prices are higher due to horticulture demand than the Murray Irrigation which is rice dominant and which is different to the Goulburn which is dairy dominant again possibly different to the Murrumbidgee that is cotton dominant.

It is possible that the southern basin wide prices which have been relatively uniform may no longer be so.

4.8 PRICE OF ENTITLEMENT WATER

4.8.1 THE PRICE HAS INCREASED

The price of entitlements has increased over time as shown in the figure below.

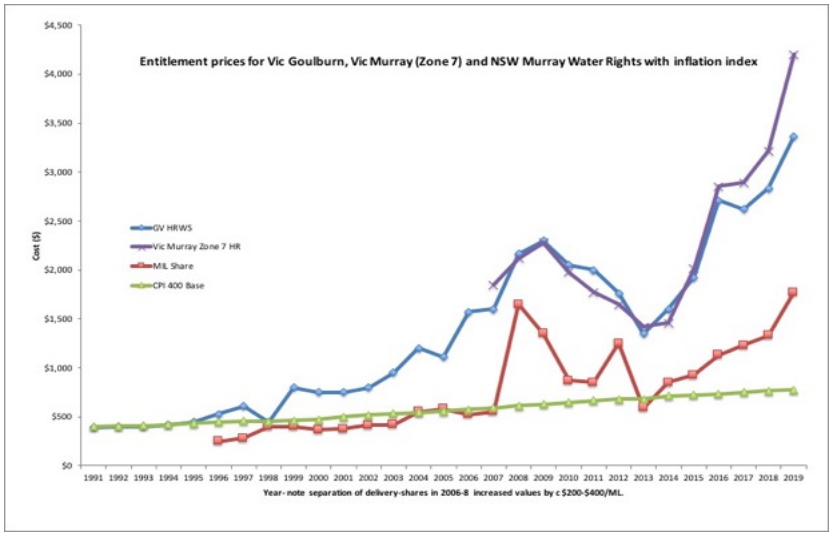

Figure 4-5: Longer term entitlement price trends

The graph is based on data on long term annual weighted average annual entitlement prices paid ($/ML) for NSW Murray GS (Murray Irrigation Ltd trades 1996-2019), Victorian Murray HRWS, Goulburn HRWS (1991-2019) all presented in the current price base using Australian CPI (1991-2019).

The graph also indicates that the price appears to reflect dry/wet seasons.

For sellers or holders of entitlements there has been a windfall gain of substantial amounts, particularly recently. By contrast, those wishing to develop new enterprises or expand existing enterprises have been disadvantaged.

The increase in the entitlement price has occurred despite the previous price/allocation graph indicating that the real price of water relative to allocations has not changed over time. Therefore, it is proposed that what has changed is the probability of different allocated volumes.

Thus the price of water has increased due to less water being available not because the overall systems price/supply curve has substantially changed.

The change in available water is a result of two things:

a) Climate change/reduced inflows – it is difficult to quantify the reduced volumes without substantial modelling however, as previously indicated, there has been a 17% reduction in Hume inflows in the last 10 years compared to the long term.
b) Basin Plan water recovery – the basin plan recovery volumes vary depending upon allocations but on average are around 23% of allocations.

4.8.2 BASIN IMPACT

Assessing the impact of the Basin Plan water recovery on price requires the calculation of the "counterfactual", i.e. what would have been the case if the Basin Plan had not been implemented. MDBA modelling has used a demand model relationship to generate the counterfactual. The previous curve challenges this approach and suggests that the price is "supply" driven i.e. all the changes over the last 20 year (e.g. changes in commodity prices, improvements in water use efficiencies, changes in enterprise mix across the southern basin) have all balanced each other out so that the price/supply curve is unchanged.

Therefore, the simple counterfactual is to assume that if the basin plan had not happened then the price/supply curve would still hold. Of course, there is no way of proving or disproving this.

Assuming the price/supply curve would be unchanged in the counterfactual, then removing the 23% reduction basin plan water recovery, results in halving the water price.

Therefore, using this approach indicates that without the basin plan providing a 23% reduction in water availability in all seasons, the water price would have been half its current value. More specifically, prices for allocations on annual markets will continue to fluctuate, but in almost all season-types the annual price of a ML of water from a willing seller will be double what it would have been if the recovered water was still in the total Southern MDB 'pool'.

This indication is a much greater impact than MDBA modelling indicates but is considered a valid and supportable approach.

4.9 LIKELY SOCIO-ECONOMIC IMPACTS OF ADDITIONAL WATER REDUCTIONS

CLIMATE CHANGE

Climate change has already been factored into water policy where the volume of water held in reserve is now based on the 06/07 inflows which have to date been the minimum recorded (by almost 50%). This has maintained the security of run-of-river and high reliability entitlements but has reduced the reliability of GS and LS.

There is the likelihood that future climate change will further reduce inflows into the Southern Basin. This would affect the environment by reducing its allocations and also by increasing the number of years of very low flows. Approximately half of the inflows into the Southern Basin are not diverted but rather make up the "unregulated" and "rules based" water i.e. evaporation, flooding, groundwater losses, flows to river mouth etc. These impacts would increase the pressure to recover even more water from irrigators.

The impact of climate change on irrigators would be primarily felt by reducing the volumes for all industries, although it would potentially affect the GS allocations most i.e. the rice industry.

4.9.1 ADDITIONAL BASIN RECOVERY – 450GL

There is the potential for further basin water recovery through implementing the 450GL Upwater program.

It makes little difference whether the recovery occurs from direct buyback or farm efficiencies as the consumptive pool is ultimately reduced in both cases. This is because farm efficiencies bring forward works that are likely to have occurred anyway and ultimately this is an expensive form of buy-back but with greater benefit for the irrigator participating.

Which industry would be affected depends upon the type of entitlement purchased and from which region the purchase was made. The impact of any purchase is often not felt in the same region as where the purchase occurred. For example, the ultimate impact of purchases is listed below, assuming all comes from sMDB and with no northern Basin recoveries.

High security purchases from:

a) Murrumbidgee: initially impact Cotton and ultimately limit the Murrumbidgee's horticulture production.
b) Murray NSW, Vic and SA: all of these would initially further impact Vic dairy and Murray River Horticulture (Vic, NSW and SA collectively).

GS purchases from:

a) Murrumbidgee: would primarily impact the rice industry, livestock grazing and irrigated cereals within Murrumbidgee but would also have some impact on reducing the cotton industry.
b) Murray: would primarily impact the rice industry, livestock grazing and irrigated cereals within the Murray NSW region. May also impact the viability of the large irrigation schemes which have extensive shared infrastructure.

If the recovery was proportioned pro-rata according to relative entitlements as follows then the industry impacts would be of the order of

i. Connected Murray system
   - 220 HR Murray/Goulburn — 110GL reduction in horticulture – mainly Sunraysia
110GL reduction in dairy industry
   - 150 GS Murray — 90GL average reduction in rice industry

ii. Murrumbidgee
   - 40 HR Bidgee — 40GL reduction in cotton
   - 165 GS Bidgee — 100GL on average reduction in the rice industry and possibly cotton

This reduction represents about 12% of the average available water.

In simple terms this reduction can be expressed as representing:

- 8,000ha of almonds reduction (15% of the industry in the connected Murray - $200M)
- 110 dairy farmers exiting (12% of the industry - $120M production)
- 200,000 tonnes of rice (30% of the rice industry - $80M production)
- 50,000 bales of cotton (10% of the cotton industry - $25M production)

Therefore, any future water recovery socio-economic impact will depend upon the type and location of the purchase and will not necessarily be in the same location as the purchase.

4.10 SPECIFIC INDUSTRY WATER ISSUES

4.10.1 DAIRY INDUSTRY CURRENT CRISIS

So what does all this mean for the dairy sector in northern Victoria?

Twenty years ago there were 3,000 dairy farms. Now there are fewer than 1,000. Part of that reduction is an ongoing trend and part is due to the Basin Plan. Dairy farmers across northern Victoria have doubled production roughly every 20 years. That means half the number of farmers at a steady production level, i.e. down to 1,500 farms. But at the same time production has halved due to the Basin Plan and other impacts on water availability, as the level of water available drives the level of production.

This has cut the numbers down again to less than 1,000 and heading for 750 farms in the near future when the current shake-out is completed. This restructuring is painful and happens in steps i.e. each crisis precipitates a shake out and the dairy industry is currently going through that.

The restructuring was immediate after the Millennium Drought but then was delayed for a number of reasons as buyback and the farm efficiency scheme provided funds to develop and to pay back debt. However, this left farmers reliant on accessing the temporary market. This was fine for the wet periods following the drought but the recent drought has exhausted carryover and the chickens have now come home to roost.

The current impact is evident in the GMID, where the continuing drought has reduced water availability and so dairy production. The level of dairy production since 2004/05 is down 45%. The position in the 2018/19 season hit dairy farmers with multiple blows:

- Allocations against entitlements were very low. GMW delivered only 1,060Gl in the season, and allocations against NSW General Security were zero for the first time since the 2008/09 drought.
- There was little water available to buy and market prices were well beyond the dairy farmer's ability to pay (at $430/ML) as prices were pushed up by continuing horticultural demand, with Victorian horticulture now using 700GL/year where they only used 430GL in the last drought.
- Carryover was depleted with only 800GL available compared with the 2,600GL available in 2016/17
- Low milk prices left farmers with empty reserves.

The position in 2019/20 won't be much better and could be far worse. The most likely outcome is that:

- Dairy farmers may get broadly the same total volume as last year - but this is looking increasingly unlikely as determinations in the Vic Murray and Goulburn were only 26% and 32% respectively on 19 August.
- Water prices will remain very high, with allocation trades in Zone 7 Vic Murray - Barmah to SA trading at a median price of $620/ML on 19 August - although many trades did not record the price paid.
- Horticultural development and water demand will continue to grow as previous plantings mature. This means that at 50% allocations horticulture will take 700GL of a possible Victorian allocation of 830GL
- But at least milk prices have improved.

Looking further ahead the position for dairy farmers will continue to be very challenging:

- Horticultural demand will continue to grow until the next drought - up by a further 130GL - mainly at the expense of dairy in the GMID.
- The sector will therefore take all the available Victorian allocation in a drought year. In that year horticulture will face severe production constraints.

- As a result, dairy will only receive a total volume of around 750GL (including access to groundwater), with Victoria buying water from NSW General Security in wetter seasons but reducing production in drier years.
- The water market will stay high at above $450/ML.
- As a result, milk production levels will stick at around the total volume produced in 2018/19.
- The number of individual dairy farms will continue to decline as total production levels become established and farm sizes continue to increase.
- It appears that the NSW Murray Irrigation dairy farmers will almost disappear as the reliance on GS water is insufficient in the dry years like we have just had.
- The Cohuna/Leitchville dairy farmers are going to face considerable extra water price pressure due to inter valley trading restrictions and the increasing demand from Horticulture particularly in Sunraysia.

Unfortunately, several studies during the wet years following the drought suggested that milk production was not related to water availability as they assumed that dairy farmers had access to other options, including buying in feed and fodder. In particular Professor Wheeler of Adelaide undertook farm surveys, Marsden Jacob undertook farm surveys and the MDBA's Phil Townsend evaluated industry data and all concluded that the reduction of water had had only a modest effect on milk production.

Clearly if these studies were undertaken now and took a longer longitudinal approach they would come to a very different conclusion.

4.10.2 RICE INDUSTRY

The Rice industry production is dominated by production in the three large NSW irrigation districts – the Murrumbidgee Irrigation area operated by MI, The Coleambally irrigation area (CICL) and the Murray Irrigation area operated by MIL.

Production by the c 1000 growers is equally split between the Murray and the Murrumbidgee. The growers effectively own the industry from the "paddock to the packet" which traditionally has instilled loyalty, and created a strong impetus for this large group of water-entitlement owners to prioritise rice-growing with any available water.

This has changed. In 2001 total rice production peaked at almost 1.6m tonnes (paddy) but has since steadily declined to now regularly fall below 500,000t per annum. The Southern NSW rice growing regions have high mid-summer temperatures, warm nights and flat, clay-based soils. These are all conditions well suited to rice growing. The region also has well-developed irrigation canal supply infrastructure, dedicated, grower-owned rice storage & rice milling facilities and sophisticated vertically integrated & successful marketing arms.

Sunrice has worked with growers and researchers to both improve yields per Ha, and to reduce water demand per ha. The marked and continuing improvement in yield per Ha and in yield per ML applied is a result of better yielding varieties, shorter season varieties, improved on-farm water management, investment in better farm irrigation layouts and a move away from growing rice on more permeable soils. Growers are now regularly achieving yields of 1.0 tons of rice per ML of irrigation-water applied.

Despite improving yields, grower/shareholder loyalty, and a strong crop price signal for growers each season since 2014, the NSW rice production area has not recovered since the millennium drought (2006-10).

Some years of lower water availability, water-entitlement recovery programs, late allocation announcements, the sale of available water on annual markets to growers of other crops, and the opportunity to use the water on-farm for alternate irrigated crops that require less water per Ha (particularly cotton) have all contributed to the decline observed.

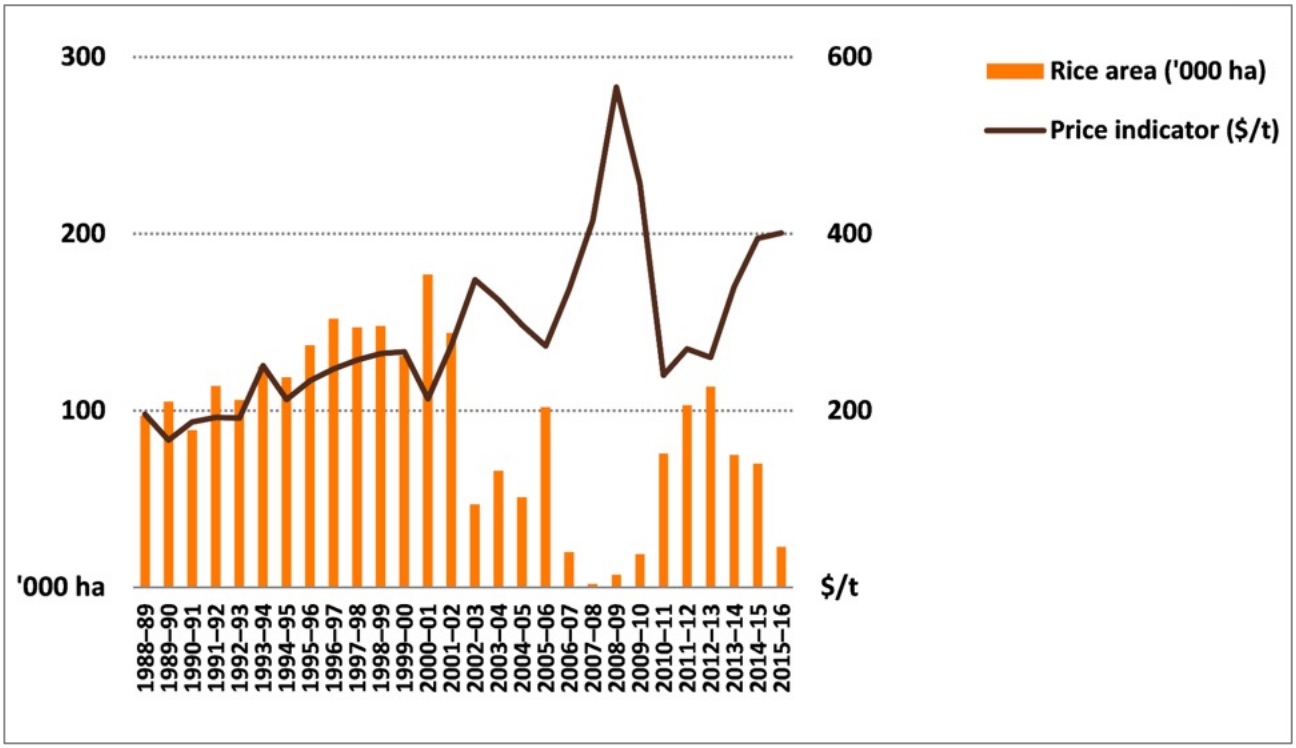

Figure 4-6: Australian (NSW Riverina) rice area and paddy-rice price indicator 1988-2016. ABS

The area of rice planted in the period since the drought of 2006-2010 remains closely aligned to the announced General Security allocation levels in the NSW Murray and Murrumbidgee valleys. However, even a series of higher allocations in 2011, 2012, 2013 and 2014 failed to increase production area to the levels of the late 1990's and early 2000's. Production in 2017, 2018 and 2019 has remained subdued.

Possibly in response to competition from high cotton prices, The Ricegrowers Cooperative Limited (Sunrice) has introduced attractive contracts for growers of future rice crops and a series of other initiatives to encourage their large shareholder base to continue to prioritise rice production with available irrigation allocations. Given the market price of water in recent years, this is proving challenging.

OUTLOOK for 2019/20: The position in 2019/20 for Riverina rice production is unlikely to improve, and like the dairy industry rice production could deteriorate further. The most likely outcome is that:

- As August 2019 draws to a close, it is increasingly likely NSW rice growers may receive only the same total (near zero) volume allocated in the NSW Murray and Murrumbidgee as last year but with a much lower reserve of carry-over, particularly within the main irrigation corporation Bulk Licences (CICL, MI and MIL) where most rice is traditionally grown. Rice production could again fall.
- Water allocation prices will remain very high, with allocation trades in Zone 10 and 11 in the NSW Murray - Barmah to SA trading at a median price of $620/ML on 19 August.
- Horticultural development and water demand will continue to grow as recent significant areas of new plantings mature. This means that the maturing almond crops in the Murrumbidgee valley will continue to increase their demand for the c 400,000ML of Murrumbidgee HS water and 200,000Ml of NSW Murray water available.
- Cotton prices remain at well above long term average prices, and it is understood a number of cotton growers are compelled to grow cotton in the 2019/20 year to meet forward delivery contracts. This will place significant pressure on ground water resources, and available water sold on annual markets.

Medium term outlook based on current allocation "settings": Looking further ahead the position for rice growers will continue to be very challenging:

- Horticultural demand in the connected Murray and in the Murrumbidgee valleys will continue to grow until the next severe drought sequence.
- Unless cotton prices fall significantly, there will be continuing pressure for water to be used on cotton crops, often on the irrigation farms of Sunrice cooperative members. Cotton area planted in 2017/18 of more than 60,000Ha in the Southern Riverina exceeded long term industry maximum area projections, and may have taken as much as 500,000ML out of rice production in that year. A return in increased allocation levels may see this occur again.
- Even in years with better water availability, the late announcement of allocations is very limiting for growers of rice which need to commit fully by November and are very reluctant to be at the mercy of late-season water markets to finish crops. As a result of this trend towards regularly late allocations (even in ultimately very good allocation-years) it appears likely that significant volumes of water is being traded away from traditional rice farms during the latter part of the irrigation season.
- The water market will stay at levels exceeding $200/ML in many more years in 10 than was traditionally the case, with prohibitive prices for rice growers wishing to augment allocations to maximise production.
- As a result, rice production levels will remain at depressed levels, or even continue to fall.
- The number of years rice growers actually have enough water to commit to growing rice will continue to decline. Buying extra water allocations from the marketplace to expand rice areas will occur very infrequently. I.e. only owners of NSW GS water will grow rice, and then possibly only 5 years out of 10.

Factors that may aid maintain or increase NSW rice production:

- A return to more normal or average rainfall and run off.
- New rice varieties that use less water, with a shorter growing season that can be planted later.
- High rice prices, innovative contracting-terms for potential growers.
- Any initiatives that encourage use of water and discourage farmers carrying water over (unless it is committed to a rice crop).
- Trade restrictions limiting the flow of water from rice growing areas.
- Increasing access for irrigators to NSW Murray and Murrumbidgee supplementary water in years when surplus flows are available.
- Increasing allocations above the current 100% (or 105%) maximum "allowable" in years of extended below-dam inflows or flooding, when water is available for allocation.

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