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Owing down the river

Mortgaging the future flows of the Barwon-Darling/Barka River

The Barwon-Darling/Barka River is dry. But almost 2,000 gigalitres have been consumed by the irrigation industry this year while nothing has flowed to Menindee Lakes, the site of the summer fish kills. Despite this, the river actually 'owes' water to industry, 'debts' it is unlikely to repay due to climate change and policy settings.

Discussion paper

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March 2019

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ISSN: 1836-9014

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Barwon-Darling/Barka

The Barkandji is the language group for the Traditional Owners of the Lower Darling, including the Maraura and the Barkandji, who have Native Title. ‘Barka’ is the name of the Darling in Barkandji and we refer to the Darling as the Darling/Barka.

Summary

Drought, the Menindee fish kills and the South Australian Royal Commission have put the Murray Darling firmly in the public spotlight. The management of the northern Basin and the role of the cotton industry are central to ongoing policy debate.

One response has been Senator Rex Patrick's private member's bill to ban cotton exports. While this has facilitated debate, the Royal Commission argues that attention needs to be focused on overall consumptive take rather than any particular crop.

However, as cotton uses around 80% of irrigation water in the northern Basin, it is impossible to discuss the northern Basin without discussing cotton. The key argument in favour of crops like cotton or rice is that as annual crops, they are able to adjust to water availability in each year, unlike permanent plantings such as citrus and nut trees or grape vines. In theory, water markets will help allocate water to its highest value use between crops, bringing efficiency, diversity and prosperity to the Basin.

This is simplistic. Firstly, water trading options are limited in the northern Basin. Secondly, there are few crops other than cotton to trade between. The only real incentive faced by producers is to acquire and store water and grow more cotton – at least until some other crop becomes more profitable.

While cotton is an annual crop, cotton businesses don't work on a one year timeframe. Despite the current drought, with record low rainfall and record high temperatures in parts of the Basin, over 100,000ha of irrigated cotton has been planted in the northern Basin. While down by almost half on last year's crop, 1.2 million bales of cotton will be produced - still a substantial crop by historical standards.

At least 845 and perhaps as much as 1,135 gigalitres (GL) of water will be applied to this crop and a further 1,000 GL likely evaporated while in storage before irrigation use. In the meantime, only 40 GL flowed past Bourke and a little over 11 GL reached Wilcannia in all of 2018.

This year is not an anomaly. Analysis of records from 1989 show that while water availability is highly variable, cotton production can be remarkably consistent. From 1991 to 1995 there was minimal flow at Bourke, while cotton production remained steady at around 250,000ha. From 2001/02 it took nearly six years of very low water availability before cotton production was significantly reduced. By the time cotton reached its lowest point in 2007/08, the Darling had been virtually dry for seven years.

Clearly some irrigators in the northern Basin can access significant volumes of water in years where water is very scarce further down the Darling/Barka. This is a direct result of government policy settings. While there have been examples of water theft in the northern Basin, it has been policies on calculation and application of the 'Cap' on water diversion limits, the Barwon Darling Water Sharing Plan, allocation policies and floodplain harvesting that have caused this outcome.

Perversely, the Barwon-Darling/Barka River is actually in 'debt' to irrigators, owing them water that it does not currently have. The irrigation sector 'owed' water to the river from 1997 to 2011 when, rather than changing practices, the NSW Government changed the model that calculated Cap limits. Since this change in model, the river has racked up a debt of 635GL, almost enough for this year's cotton crop. This problem has been noted by Murray Darling Basin Authority (MDBA) members.

Alas, the Barwon-Darling/Barka does not have the water to pay back these 'debts'. In years where this water cannot be delivered, the debt is 'carried over' to the next year. Irrigators can take 300% of their allocation when water is available, to make up for past years' water absence.

The annual allocations are based on the modelled long-term average and the river bears the risk if that model is wrong. However, the model for determining Barwon-Darling/Barka water allocations is notoriously unreliable and is not currently accredited by the MDBA. Reduced inflows due to climate change and increased irrigation extraction, particularly through floodplain harvesting, are also reducing the river's capacity to pay its debts.

These points contradict the NSW Water Minister's claims that water is 'prioritised' for communities and the environment. While communities may have water allocation in theory, often this water cannot be delivered as rivers have run dry. For example, Walgett in central NSW sits on the near-dry Barwon and Namoi rivers. It has run out of town water even though the town's water supply in theory has a 100% allocation. Environmental water has the same problems with delivery and is not prioritised above any other water licence holder.

To those close to Basin policy and politics, addressing these problems may seem impossible. Yet the publicity around fish kills and the Royal Commission have brought high level political attention. Unprecedented alliances between irrigation, grazing, community and environment groups are mounting powerful cases for reform. State and Federal elections are looming. The NSW Government is undertaking a review of the Barwon-Darling Water Sharing Plan and there is a parliamentary inquiry on a ban to export cotton. These are all opportunities to have a public conversation about the

sustainability of the current levels of irrigation in the northern basin. Perhaps better days for the Basin are just around the bend.

Introduction

In December and January, Australia was shocked by graphic pictures of millions of dead fish, in three separate kills within a month, at Menindee on the Darling/Barka River. A video of two local men holding dead Murray cod, more than a metre long and decades old, brought tears, outrage and a public demand to know how it happened.

No one disputes that the Basin is suffering a severe drought. But these fish have survived droughts before, including some that were much longer. Many people have laid the blame at the feet of government policies in the northern basin. Rob McBride, a Lower Darling/Barka grazier and one of the local men in the widely-viewed video said:

> This has nothing to do with drought, this is a man-made disaster brought to you by the New South Wales Government and the Federal Government.[1]

Many commentators have extended that blame to the cotton industry, because cotton is the predominant crop grown in the Northern Basin.[2] Senator Rex Patrick announced a private members bill to ban the export of cotton. Given that Australia's cotton is almost entirely exported and processed overseas, an export ban, if successful, would effectively be a ban on growing cotton.

Some commentators point out that unlike permanent plantings such as citrus or grapes, annual crops like cotton and rice can be planted or cancelled depending on water availability. While permanent plantings need water every year, the flexibility of annual crops might make them better suited to the Basin's natural water variability. In years with limited water availability, growers of annual crops such as cotton and rice are, in theory, able to forgo a crop and sell their water to a higher yielding crop, such as nuts, which require water every year to keep plantings alive. This argument was put forward by Professor Jamie Pittock, of the Wentworth Group of Concerned Scientists:

> The Murray Darling Basin is an epicentre for the impact of climate change, in terms of water availability. It's vital we have crops like rice and cotton that can produce in a good year. Then, with relatively minor consequences, not produce in a dry year when it would be better to have the remaining water going to the environment and higher value agricultural crops like citrus, stone fruit and

[1] Yahoo 7 (2019) *Farmers post disturbing video of dead 100-year-old fish,* https://au.news.yahoo.com/farmers-post-disturbing-video-dead-100-year-old-fish-042618729.html

[2] Webster and McCosker (2019) Cotton growers and conservations=ists butt heads online over Menindee fish kills, https://www.abc.net.au/news/rural/2019-01-30/cotton-growers-targeted-online-over-menindee-fish-kill/10739146

> grapes. Our rural communities need to produce a diverse range of agricultural commodities and industries to be more resilient and thrive.[3]

This argument assumes that annual crops like cotton and rice are produced and planned over a one year time frame. In reality, this is not the case. Growing and selling cotton is planned over many years, with a lot of the crop 'forward sold.' That is, crops planned to be grown in the future are sold in the present. Cotton is an annual plant, but cotton growing is not an annual business.

This is demonstrated by forecasts for this year's cotton crop. Despite widespread drought, Australia's production is forecast at 581,000 tonnes of cotton lint, harvested over 280,000 hectares.[4] While industry advocates' focus has been on how this has declined by almost half from the previous year, it demonstrates that substantial volumes of water are still used by 'annual crops' even when water is as scarce as it is in the Barwon-Darling/Barka this year. Except for two short, low flows in early 2018, one reaching Wilcannia and the other just making it to Menindee, no water has flowed in the Darling/Barka for eighteen months.

The common narrative is that when there is a drought, the river doesn't flow and no cotton is grown because there is no water. The reality is that there is a drought now, the river isn't flowing, and cotton production is 50% of last year's high base. Where did the water come from to grow this year's cotton crop?

This paper explains that cotton production does not fluctuate in response to flow variability as much as the industry and market commentators claim. Government and private storages, and water allocation policies, provide the industry with a much more regular water supply than the refrain of 'when it doesn't rain we get no water' suggests. In fact, the Barwon-Darling/Barka River and its people are labouring under a crushing but unacknowledged water debt, owing water to the irrigation industry, by virtue of state and Federal water management.

[3] Pittock (2019) *Cotton and rice have an important place in the Murray-Darling Basin,* https://theconversation.com/cotton-and-rice-have-an-important-place-in-the-murray-darling-basin-109953

[4] ABARES (2018*) Agricultural commodities: December quarter 2018*, http://www.agriculture.gov.au/abares/research-topics/agricultural-commodities/dec-2018#download-report

Cotton in the Northern Basin

Cotton is the dominant irrigated crop in the Northern Murray-Darling Basin. According to Cotton Australia, it makes up around 80% of irrigation water use in the North.[5] We agree with the Royal Commissioner Brett Walker that targeting the cotton plant is a distraction from the water policy debate:

> Predictably, some generalized concerns have been expressed to the Commission to the effect that some crops are especially unsuitable to be irrigated in the Basin. It has to be said that cotton and rice have almost been demonized, by some, in this regard. The rhetoric of 'thirsty crops' (and 'greedy farmers') hovers in the background. This attitude should be rejected, as so far has been the case in the administration of the Basin water resources. [6]

> If it is perceived that cotton and rice 'use too much water', the first thing is to check that the overall consumptive take — regardless of the crop or crops — is not excessive. If not, the market does, and probably should continue to, allocate the water to chosen crops.[7]

However, because cotton is the dominant irrigation crop in the northern Basin it is a good proxy for the irrigation sector there, and it is not possible to discuss irrigation in the north without referring to cotton.

WATER MARKET AND DROUGHT

Water markets are foundational to the Basin's water reforms. The policy logic is that markets allow water to move to its highest value use maximising agricultural productivity within the Basin's natural water variability. This can be achieved through a mix of permanent and annual crops.

Whether this ideal is being realised anywhere in the Basin is debateable, with widespread reports of hardship within dairy and other industries. The Southern Basin, which has a mix of commodities, has certainly seen considerable transformation. However, the magic of the market does not work in the Northern Basin, because of the

[5] Murray (2018) *Murray darling Basin Royal Commission,* https://mdbrcsa.govcms.gov.au/sites/g/files/net3846/f/mdbrc-submission-michael-murray-cotton-australia-nsw.pdf?v=1526862945

[6] Walker (2019) *Murray Darling Basin Royal Commission Report,* https://www.mdbrc.sa.gov.au/

[7] Walker (2019) *Murray Darling Basin Royal Commission Report,* https://www.mdbrc.sa.gov.au/

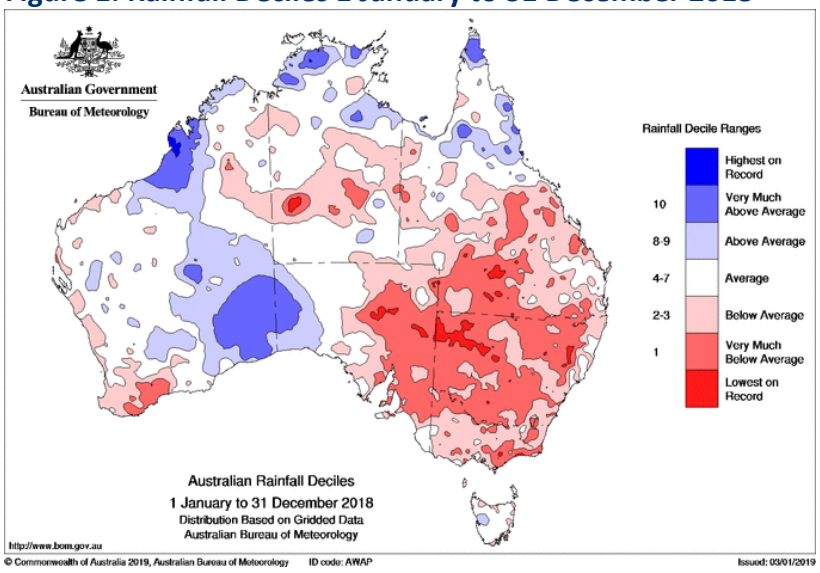
inability to trade between valleys or between annual and perennial commodities. Water cannot be traded between northern valleys (except for trade between NSW and Queensland in the Border Rivers), nor between the Northern and Southern basins.

Given that cotton uses of 80% of irrigation in the Northern Basin, there is little demand for water for permanent crops. Moving water from cotton production to high value alternate crops, such as 'citrus, stone fruit and grapes', is not what actually happens in the Northern Basin, because there are relatively few permanent plantings there. Cotton is the most profitable annual crop. With few options for trading water, growing cotton is always what the rational producer will do, using whatever water is available.

Drought

The Murray-Darling Basin is now in drought, with severely reduced flows in all Basin rivers. Figure 1 below shows the rainfall deciles for the period 1 January to 31 December 2018.

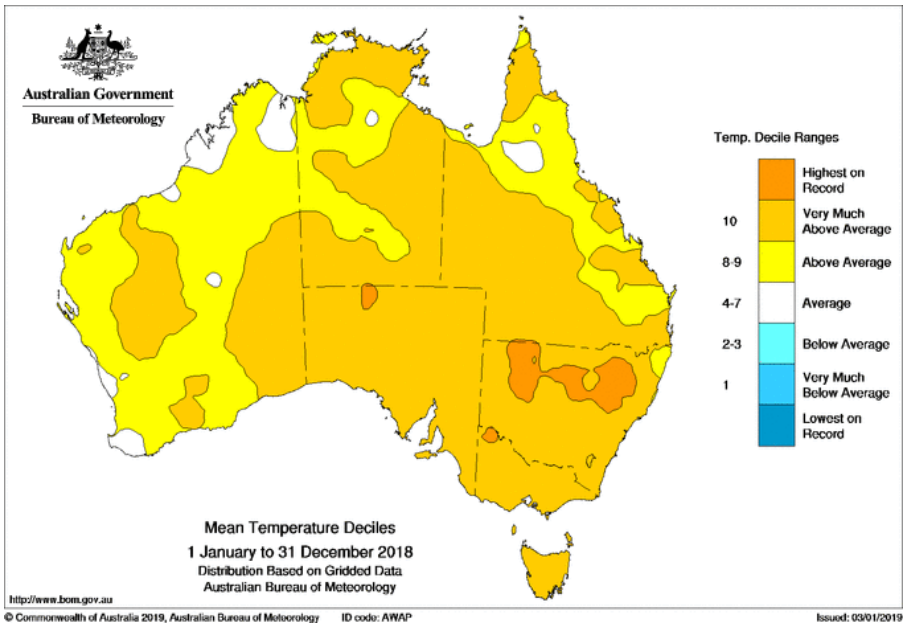
Figure 1: Rainfall Deciles 1 January to 31 December 2018



Source:http://www.bom.gov.au/jsp/awap/rain/archive.jsp?colour=colour&map=decile&period=18month&area=nat

As shown in Figure 1 above, across the Northern Basin in 2018, rainfall was below average and, in some places the lowest on record. Conditions across the Northern Basin have also been very hot. Figure 2 below shows the temperature decile ranges for the calendar year ending 31 December 2018.

Figure 2: Mean Temperature Deciles 1 January to 31 December 2018



Source:http://www.bom.gov.au/jsp/awap/rain/archive.jsp?colour=colour&map=decile&period=18month&area=nat

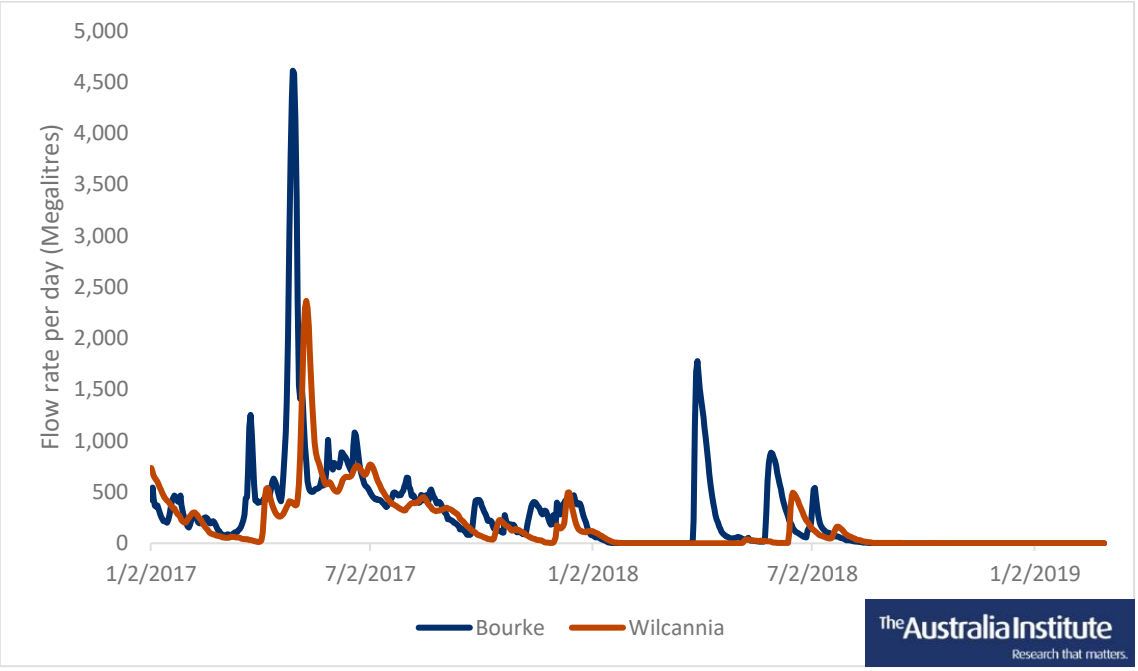
As shown in Figure 2, across the Basin, temperatures were either 'very much above average' or 'highest on record'.

Well below average rainfall and above average temperatures combine and exacerbate record low inflows into all Basin Rivers. Historically, rainfall reduction of approximately 15% has led to a reduction to inflows between 23 and 44%.[8]

The dry conditions have affected flows in the Barwon-Darling/Barka, which has had only two small flows since May 2017; one that just reached Wilcannia in May and a second that just made Menindee, as shown in Figure 3 below:

[8] South Eastern Australia Climate Initiative (2010) *Climate Variability and Change in South Eastern Australia,* http://www.seaci.org/publications/documents/SEACI-1%20Reports/Phase1_SynthesisReport.pdf

Figure 3: Daily Flow rates at Bourke and Wilcannia (Megalitres)



Source https://realtimedata.waternsw.com.au/:

For the 2018 calendar year, only 40 gigalitres flowed past Bourke and 11.6 gigalitres flowed to Wilcannia.[9]

2018/19 cotton production

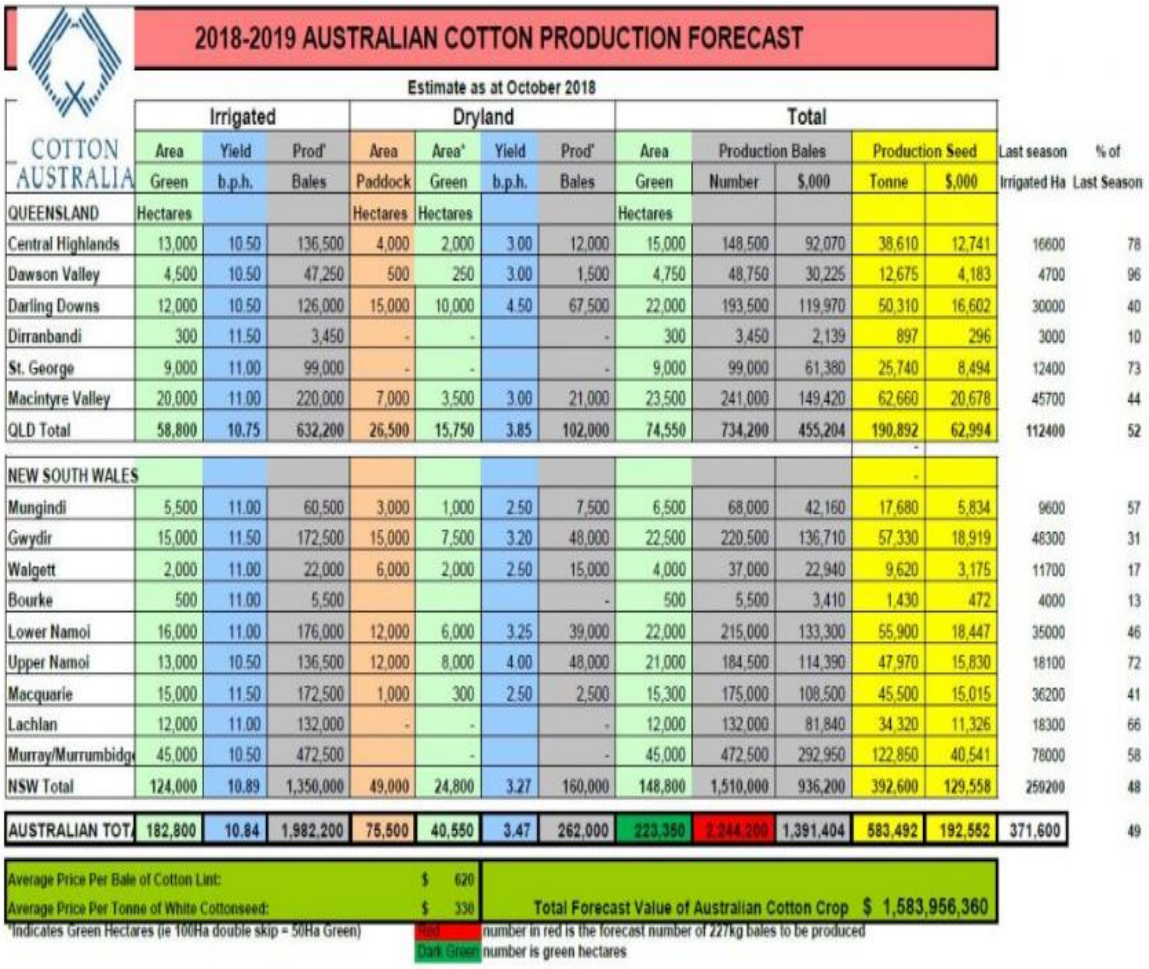
The industry estimate of 2018/19 cotton production made in October 2018 was 2.2 million bales, as shown in Figure 4.[10] This is 49% of the 2017/18 crop of 4.6 million bales, which Rabobank reported as the third most successful cotton season ever.[11]

[9] https://realtimedata.waternsw.com.au/

[10] Lyon (2018) *Water shortage cuts cotton potential in half as sowing gains momentum.* https://www.graincentral.com/cropping/cotton/water-shortage-cuts-cotton-potential-in-half-as-sowing-gains-momentum/

[11] Twomey (2018) *Cotton's rollercoaster ride to continue into 2018-19,* https://www.theland.com.au/story/5501593/global-perspective-cottons-rollercoaster-ride-to-continue-into-2018-19/

Figure 4: 2018/19 Australian Cotton Production Forecast



2018-2019 AUSTRALIAN COTTON PRODUCTION FORECAST

Estimate as at October 2018

COTTON AUSTRALIA

	Irrigated			Dryland				Total						
	Area	Yield	Prod'	Area	Area'	Yield	Prod'	Area	Production Bales		Production Seed		Last season	% of
	Green	b.p.h.	Bales	Paddock	Green	b.p.h.	Bales	Green	Number	$,000	Tonne	$,000	Irrigated Ha	Last Season
QUEENSLAND	Hectares			Hectares	Hectares			Hectares						
Central Highlands	13,000	10.50	136,500	4,000	2,000	3.00	12,000	15,000	148,500	92,070	38,610	12,741	16600	78
Dawson Valley	4,500	10.50	47,250	500	250	3.00	1,500	4,750	48,750	30,225	12,675	4,183	4700	96
Darling Downs	12,000	10.50	126,000	15,000	10,000	4.50	67,500	22,000	193,500	119,970	50,310	16,602	30000	40
Dirranbandi	300	11.50	3,450	-	-		-	300	3,450	2,139	897	296	3000	10
St. George	9,000	11.00	99,000	-	-		-	9,000	99,000	61,380	25,740	8,494	12400	73
Macintyre Valley	20,000	11.00	220,000	7,000	3,500	3.00	21,000	23,500	241,000	149,420	62,660	20,678	45700	44
QLD Total	58,800	10.75	632,200	26,500	15,750	3.85	102,000	74,550	734,200	455,204	190,892	62,994	112400	52
NEW SOUTH WALES											-			
Mungindi	5,500	11.00	60,500	3,000	1,000	2.50	7,500	6,500	68,000	42,160	17,680	5,834	9600	57
Gwydir	15,000	11.50	172,500	15,000	7,500	3.20	48,000	22,500	220,500	136,710	57,330	18,919	48300	31
Walgett	2,000	11.00	22,000	6,000	2,000	2.50	15,000	4,000	37,000	22,940	9,620	3,175	11700	17
Bourke	500	11.00	5,500				-	500	5,500	3,410	1,430	472	4000	13
Lower Namoi	16,000	11.00	176,000	12,000	6,000	3.25	39,000	22,000	215,000	133,300	55,900	18,447	35000	46
Upper Namoi	13,000	10.50	136,500	12,000	8,000	4.00	48,000	21,000	184,500	114,390	47,970	15,830	18100	72
Macquarie	15,000	11.50	172,500	1,000	300	2.50	2,500	15,300	175,000	108,500	45,500	15,015	36200	41
Lachlan	12,000	11.00	132,000	-	-		-	12,000	132,000	81,840	34,320	11,326	18300	66
Murray/Murrumbidg	45,000	10.50	472,500		-		-	45,000	472,500	292,950	122,850	40,541	78000	58
NSW Total	124,000	10.89	1,350,000	49,000	24,800	3.27	160,000	148,800	1,510,000	936,200	392,600	129,558	259200	48
AUSTRALIAN TOT	182,800	10.84	1,982,200	75,500	40,550	3.47	262,000	223,350	2,244,200	1,391,404	583,492	192,552	371,600	49

Average Price Per Bale of Cotton Lint: $ 620

Average Price Per Tonne of White Cottonseed: $ 330

Total Forecast Value of Australian Cotton Crop $ 1,583,956,360

*Indicates Green Hectares (ie 100Ha double skip = 50Ha Green)

Red number in red is the forecast number of 227kg bales to be produced

Dark Green number is green hectares

Source: https://www.graincentral.com/cropping/cotton/water-shortage-cuts-cotton-potential-in-half-as-sowing-gains-momentum/

Figure 4 shows estimates for the northern Basin areas of Darling Downs, Dirranbandi, St George, MacIntyre Valley, Mungindi, Gwydir, Walgett, Bourke, Lower Namoi, Upper Namoi and Macquarie. In total the northern Basin will produce 1.4 million bales in 2018/19, of which 1.2 million bales is irrigated.

Cotton Australia estimates that it takes about 7.8 ML/ha to irrigate cotton, net of evaporation.[12] Other figures put it at 10.5 ML/ha.[13] With 108,300 hectares of irrigated cotton grown in the northern Basin in 2018/19, this comes to a volume somewhere between 845 and 1,135 gigalitres applied to the crop, before evaporation. This water could come from a combination of sources; allocations carried over from 2017/18,

[12] Cotton Australia (2018) *Water efficiency in the cotton industry*, https://cottonaustralia.com.au/cotton-library/fact-sheets/cotton-fact-file-water

[13] Brown (6 Mar 2019) *Who should get a drink when it's dry?*, https://www.theland.com.au/story/5936957/unfair-rap-for-flexible-cotton/

groundwater, river flows in Queensland, and water harvested from the floodplain in 2016/17. Very little to none of this water has come from 2018/19 allocations.

Water captured from the floodplain in 2016/17 will have been held in private storages since then. There are few estimates of how much water is lost to evaporation from private storages. In 2007 this figure was estimated at 1,300 GL per year, excluding Menindee.[14] Since 2007 many new private storages have been built, although data is not collected by government agencies and not made public by owners. The evaporation figure may be lower if there is less water stored and some storages are dry. While an accurate estimate is beyond the scope of this paper, it seems likely that 1,000 GL is a conservative estimate of evaporation from private storages in the northern Basin since 2016/17.

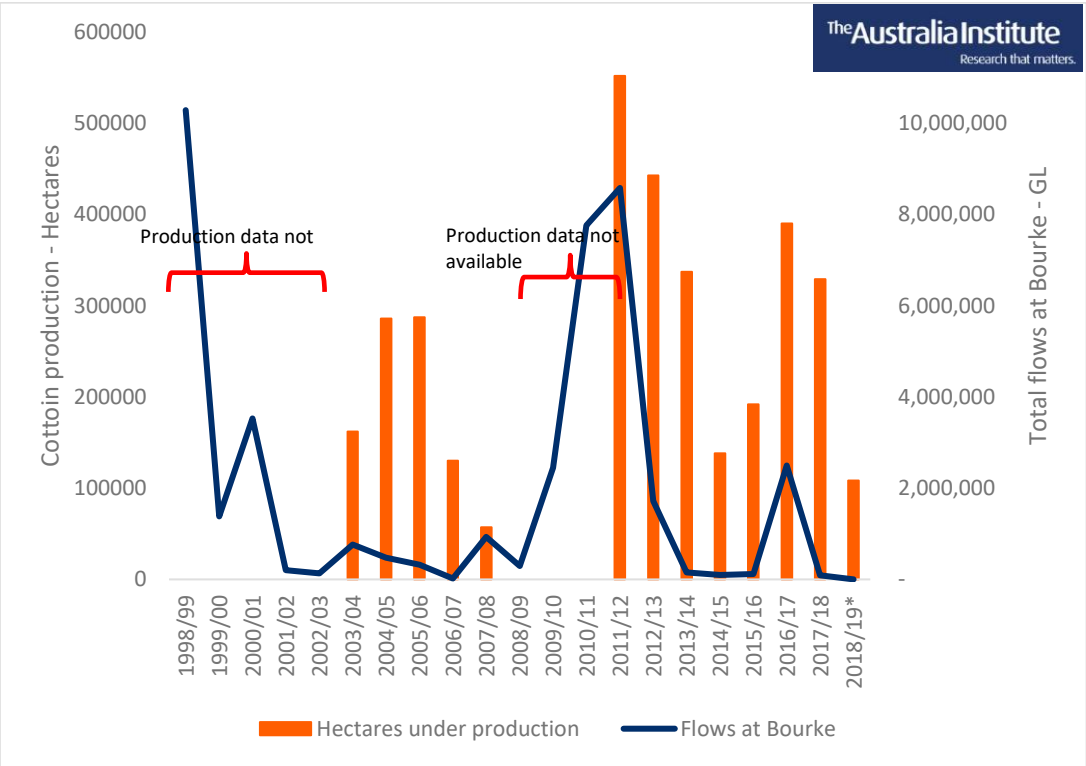
As shown in Figure 3 in the last section, only 40 gigalitres has flowed past Bourke and 11.6 gigalitres has flowed to Wilcannia. Yet between 845 and 1,135 gigalitres were applied to cotton crops and possibly a thousand more were lost in evaporation from private storage. Clearly cotton production does not vary with river flow as some commentators suggest.

Variability of cotton production

The 2017/18 and 2018/19 data above contradicts the argument that the annual nature of cotton allows production to wax and wane with water availability. Looking at data over the longer term further confirms that cotton production is not directly related to annual flows in the river. Figure 5 below shows the northern Basin's annual production of cotton in hectares compared with the average flow at Bourke on the Barwon-Darling/Barka River since 1998-99. Unfortunately, data is not available in all years. Bourke is chosen because it is downstream of most of the Barwon-Darling/Barka tributaries and most irrigation in the Northern Basin is upstream.

[14] Webb, McKeown & Associates Pty Ltd for the Murray-Darling Basin Commission (2007) *State of the Darling: Interim Hydrology Report,* https://www.mdba.gov.au/sites/default/files/archived/mdbc-SW-reports/17_State_of_the_Darling_Interim_Hydrology_Report_2007.pdf

Figure 5: Cotton production in the northern basin and annual flows at Bourke by year



Sources: Cotton Australia annual reports, and https://realtimedata.waternsw.com.au/

Figure 5 shows that that cotton production is much less affected by low water availability than the narrative of no water equals no plantings suggests. When flows at Bourke are very low, there is still cotton being grown in the Northern Basin, and sometimes a lot of it.

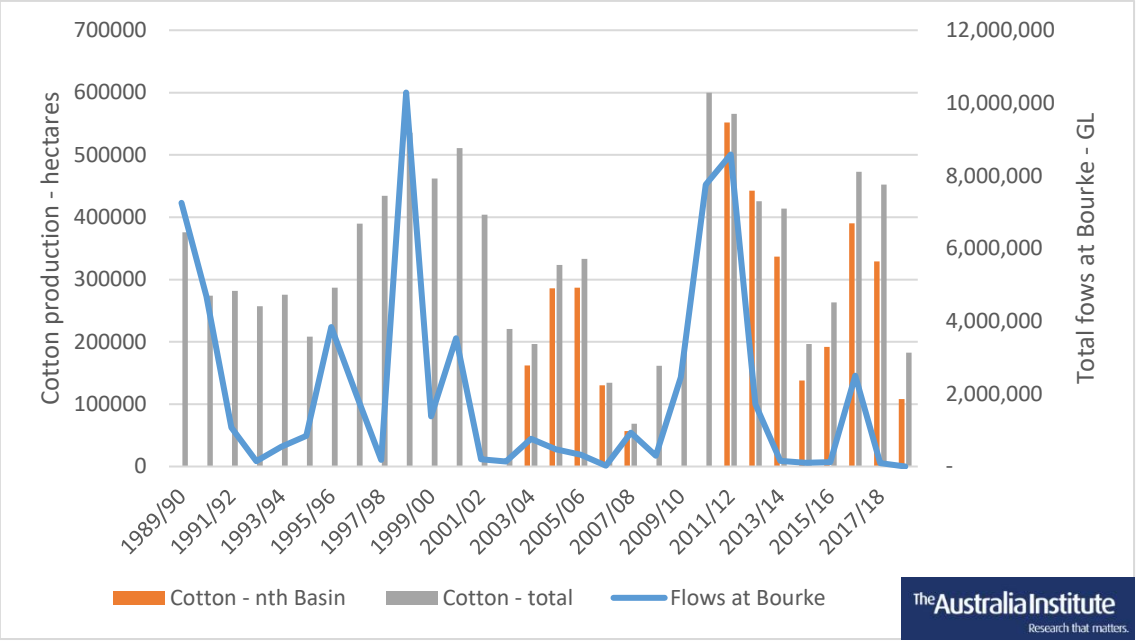
Data on northern Basin production is not published by government agencies and is only intermittently available in Cotton Australia annual reports. Reports on the Cotton Australia website go back only to 2003-04 and for the years 2008-09 to 2010-11, no breakdown of production by valley was published.

Regardless, Figure 5 shows that after a very wet year in 1998-99 and through the very dry years of the Millennium drought, substantial areas of cotton were sown. After wet years in 2010-11 and 2011-12, flows at Bourke declined dramatically until 2016-17 yet more than 300,000 hectares was sown in the two following years and considerable areas for two more years. Following the wetter year in 2016-17 production stayed high in 2017-18 and even in the drought of this year, more than 100,000 hectares is being irrigated.

To overcome the data limitations in Figure 5 above and go back further in time, Figure 6 below uses aggregated data on total cotton production and separate data on the

northern Basin where available. Total cotton production data is also published by Cotton Australia and includes some areas in Queensland outside of the Murray Darling Basin as well as areas in the Lower Darling/Barka and the southern Basin. While these areas are not directly relatable to water availability measured by flows at Bourke, the comparison is still useful as the majority of total cotton comes from the northern Basin. As in Figure 5 above, it is clear that cotton production does not reduce in dry years as quickly as the annual crop narrative suggests:

Figure 6: Cotton production and annual flows at Bourke by year



Sources: Cotton Australia annual reports, https://cottonaustralia.com.au/cotton-library/statistics and https://realtimedata.waternsw.com.au/.

Figure 6 shows that after wet years in 1989-90 and 1990-91, cotton was produced over 200,000 hectares through four dry years until a wetter year in 1995-96. Area harvested increased the following two years despite reduced flows at Bourke.

The wet year of 1999-00 set the tone for several years of production over 400,000 hectares despite flows plummeting with the start of the Millennium drought.

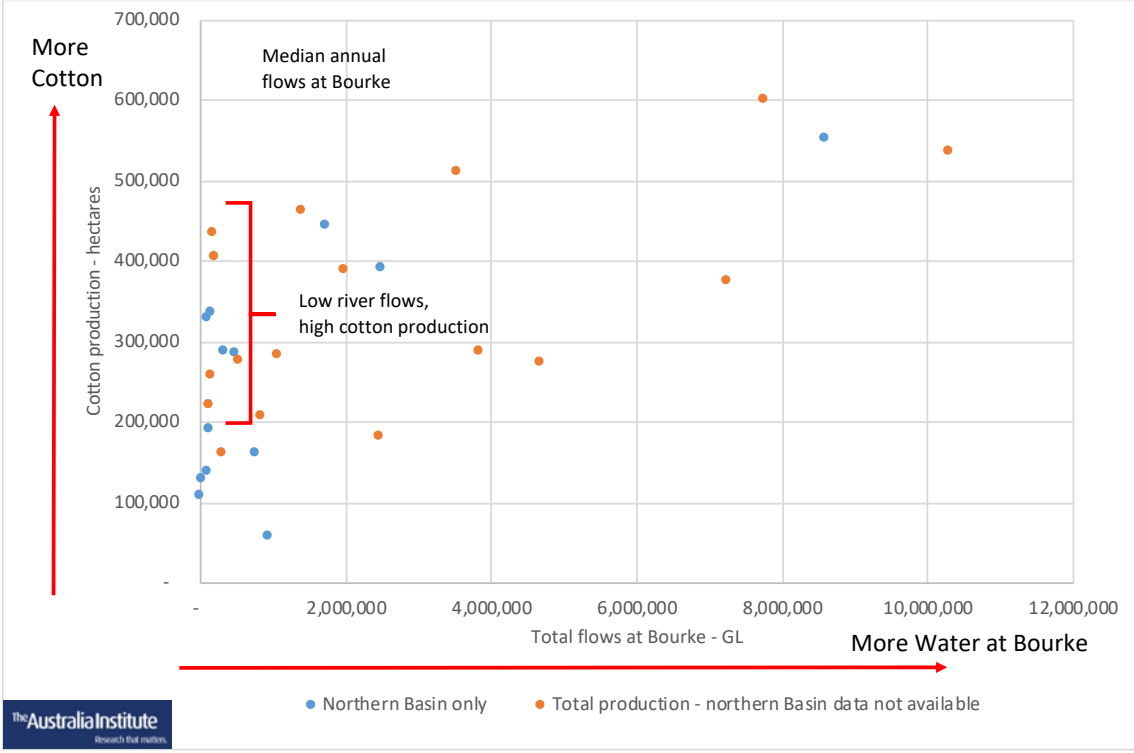
From 2001/02 it took nearly six years of very low water availability (between 2001/02 to 2007/08) before cotton production was significantly reduced. By the time cotton reached its lowest point in 2006/07 and 2007/08 the Darling had been virtually dry for seven years.

Where northern Basin estimates come in in 2003-04, it is clear that there was substantial cotton crops grown through this period. It can also be seen that in these

earlier years, very little if any cotton was grown in the southern Basin and the vast majority was in the northern Basin. In later years, the difference between total and northern basin production is greater as more cotton moves into the southern Basin.

Another way of presenting the data in Figure 6 above is to plot each year by area of production and flow at Bourke. Figure 7 below shows that cotton is grown in the Northern Basin in all years, regardless of water flow at Bourke:

Figure 7: Cotton production and flows at Bourke – scatter plot



Sources: Cotton Australia annual reports, https://cottonaustralia.com.au/cotton-library/statistics and https://realtimedata.waternsw.com.au/.

The shaded area in Figure 7 is median annual flows, and below, at Bourke. Four of the highest 13 years of production saw flows at Bourke at a fraction of median levels. Cropping over 200,000 hectares in nine years with below median flow at Bourke.

Figure 7 shows that cotton production is much less responsive to low water availability than the accepted commentary suggests. Clearly irrigators in the northern Basin have access to significant volumes of water in years where water is very scarce further down the Darling/Barka.

Barwon-Darling/Barka River in debt

The casual reader might think that because northern Basin irrigators have been able to extract significant volumes of water even in very low flow years, that irrigators might be somehow obliged to reduce volumes in the future. That perhaps the river was 'owed' some water back. In fact, the opposite is true. Policy settings have brought about the perverse outcome where the Barwon-Darling/Barka owes water to irrigation. Key factors in this outcome are:

- the Murray-Darling Basin Cap and the way it is modelled and applied;
- the Barwon-Darling Water Sharing Plan; and
- Barwon-Darling/Barka water allocation policy.

The capacity for the Barwon-Darling/Barka to pay this debt is decreasing because of:

- Allocation policies and practices in key tributaries, and
- Floodplain harvesting.

BARWON-DARLING CAP LIMIT CAP

A foundation of the Murray-Darling Basin water reform is a limit on water extracted for irrigation. In 1995, Basin governments agreed at the Council of Australian Governments meeting to limit (cap) the extraction of water to the level of development in 1993/94.[15] This policy is known as the Murray-Darling Basin Cap (the Cap) and will continue under the Murray-Darling Basin Plan as Sustainable Diversion Limits (SDL).

The Cap limit refers to annual and long-term average limits. The annual limit is adjusted up or down to correspond with water availability. After every year, an annual Cap is determined by running actual, observed flows in an accredited Cap model to determine a Cap target. Actual extractions are compared to the target. In cases where actual extractions are less than the target, a 'Cap credit' is granted. In cases where actual extractions are more than the target a 'Cap debit' is generated. Cap credits and debits accumulate over time to form a 'cumulative credit' or a 'cumulative debit.' This

[15] Guest (2016) *Sharing the water: One hundred years of River Murray politics*

policy recognises the variability of Basin water availability. If a valley exceeds Cap in one year, it can be rectified in a later year. Similarly, if a valley is under Cap in one year, it can take more in a subsequent year.

While all other valleys in the Basin managed to reach the Cap in the years following its implementation, the Barwon-Darling/Barka is a notable exception. This valley was in breach of the Cap from when it was implemented in 1997 until 2011, except for one year. An internal minute to the CEO of the MDBA explains:

> Barwon-Darling has been problematic for Cap compliance since the beginning of cap accounting in 1997/98. To support its performance it was merged with the Lower-darling in August 2000. This created the Barwon-Darling Lower-Darling Cap valley.
>
> For 6 out of 10 years between 1999/00-2008/09, the Barwon-Darling caused the Cap breaches in the combined valley. Had it not been merged with Lower Darling, the Barwon-Darling would have been in breach for continuous 14 years up to 2010-11.[16]

The issue of the Barwon-Darling/Barka consistently being in breach of the Cap was brought before the Murray-Darling Basin Ministerial Council. In 2010, The Council accepted a recommendation by the NSW Water Minster to implement a strategy to bring the valley under Cap.[17] The Barwon-Darling/Barka again breached the Cap in the 2009/10 year, but the strategy was not implemented. Advice to the NSW water minister explains:

> That a Cap exceedance management strategy response is being implemented by NSW in the Barwon-Darling sub-valley.
>
> NSW proposed that for the 2010/11 water year, users in the Barwon-Darling are restricted to use 173GL…

[16] MDBA (2014) *Minute to Chief Executive – Response to NSW: Accreditation of the Barwon-Darling Cap model,* obtained by FOI

[17] NSW Office Water – Water Management Division (2011) *WS11/162 ministerial Approval: Public Exhibition of the draft water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources,* Obtained by GIPA

> Should auditing of the 2009-10 water year by the Independent Audit Group find Barwon-Darling water users above cap, the 10-year, 143GL annual average strategy proposed will be implemented immediately. [18]
>
> Notwithstanding this, the 2009/10 audit has revealed a Cap debit for the Barwon-Darling sub-valley of 13.5GL and so the response by the NSW Officer of Water, in accordance with the agreement made on 18 June 2010, would be to ….reduce the annual allocation for the Barwon-Darling licenced users from 173GL to 143GL….commencing in 2011/12……
>
> Given the apparent changes in the Cap modelling and the recent appointment of the Coalition Government in NSW, no action has been taken to date.[19]

Instead of reducing extractions in the Barwon-Darling/Barka to comply with Cap, the NSW government increased the Cap limit retrospectively and increased the water shares in the 2012 Barwon-Darling Water Sharing Plan, as explained to the NSW Water Minister:

> The revised Barwon-Darling Cap [model] estimates the long-term Barwon-Darling Cap to be 198GL for irrigation.[20]

Compliance with Cap is assessed through a hydrological Cap model accredited by the MDBA. Rather than complying with Cap as calculated by the initial model, NSW simply developed a new model. Developed in 2012, the new model miraculously showed that the Barwon-Darling/Barka was not in breach of Cap. A minute to the CEO of the MDBA explains:

> The Barwon-Darling valley has not yet had an audited Cap model. Changes to the model have been occurring as improvements have been incorporated. However, these changes have generally created a more favourable Cap compliance outcome, especially in the last 5 years. The latest version of the

[18] NSW Office Water – Water Management Division (2011) *WS11/162 ministerial Approval: Public Exhibition of the draft water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources,* Obtained by GIPA

[19] NSW Office Water – Water Management Division (2011) *WS11/162 ministerial Approval: Public Exhibition of the draft water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources,* Obtained by GIPA

[20] NSW Office Water – Water Management Division (2011) *WS11/162 ministerial Approval: Public Exhibition of the draft water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources,* Obtained by GIPA

> Barwon-Darling model shows that the combined valley would never have breached the Cap up to 2011-12.[21]

Not only did the new Cap model relieve NSW of reducing annual allocation in the Barwon-Darling from 173 GL to 143 GL, it also allowed an increase in the annual allocation to 198GL.[22]

This change and its implications for the Barwon Darling/Barka was of concern to at least one MDBA Board member, George Warne, who wrote an email to the MDBA Board about issues in the Barwon-Darling/Barka River, which said in part:

> The cap credit issue in the Barwon Darling needs to be sorted by NSW in any future complying WRP (and NSW needs to know this). It is currently out of hand (my view), and effectively gives users a free kick in terms of access-to and using any water available, above quite a low flow threshold, for the foreseeable future.[23]

The changes that concerned Warne are a massive accumulation of Cap credit in the Barwon Darling/Barka. Before the Cap model was changed, the Barwon Darling/Barka had an accumulated breach of Cap, that is, a Cap debit. The changes to the Cap model changed this breach to a credit of 200GL in 2009/10. [24] By 2016/17 the Cap credit for the Barwon-Darling/Barka was calculated by MDBA to have increased to 635 GL.[25] Figure 7 shows the valley's performance against Cap until 2008/09 using the new model and the previous model.

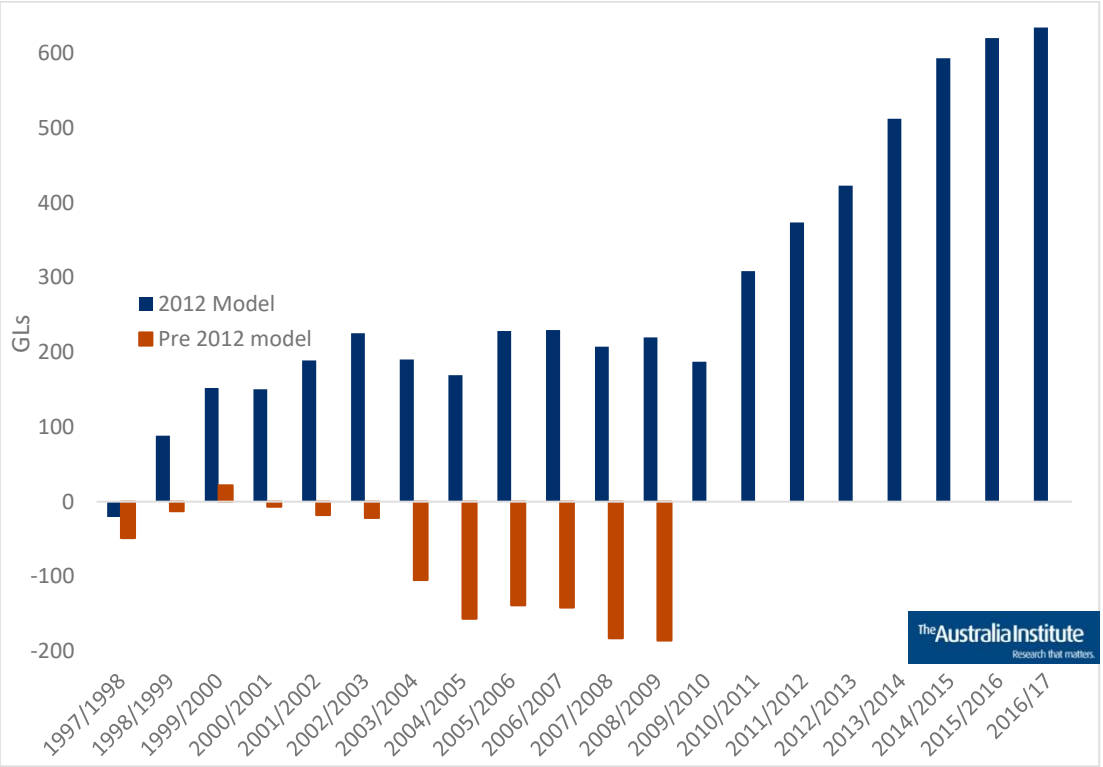
[21] MDBA (2014) *Minute to Chief Executive – Response to NSW: Accreditation of the Barwon-Darling Cap model,* obtained by FOI

[23] George Warne (2016) *Confidential memo to the Authority members,* Obtained from Four Corners

[24] NSW Office Water – Water Management Division (2011) *WS11/162 ministerial Approval: Public response to NSW: Accreditation of the Barwon-Darling Cap model,* obtained by FOI

[25] MDBA (2018), *Transition period water take report 2016/17: Report on Cap compliance and transitional SDL accounting,* https://www.mdba.gov.au/sites/default/files/pubs/transition-period-water-take-report-2016-17.pdf

Figure 5: Accumulated Cap Credits for the Barwon-Darling/Barka and Lower Darling



Source: MDBA (2018) Transition Period Water Take Report 2016–17 Report on Cap compliance and transitional SDL accounting June 2018, *https://www.mdba.gov.au/sites/default/files/pubs/transition-period-water-take-report-2016-17.pdf*

The orange columns in Figure 7 shows the cumulative Cap debits under the previous Cap model. The blue bars are the cumulative Cap credits according to the new 2012 model. In addition to the retrospective changes in Cap performance, there is a sudden increase of Cap credits since 2010/2011 as a result of the changes in the Cap modelling.

This means that the Barwon-Darling/Barka is in debt to irrigation. The annual take limit of 198GL can be exceeded by more than four-fold of the annual valley take without breaching Cap. The four-fold is the current 635GL Cap credit, plus the annual limit of 198GL, equalling 833GL, or 4.2 times 198GL.

ALLOCATION POLICY IN THE BARWON-DARLING

In the Barwon-Darling/Barka, 100% of a water share is allocated on the 1st of July every year and can be taken when pumping thresholds are reached. That is, a water licence holder can pump water when prescribed volumes of water flow past the upstream and downstream flow rates.

The rules under the 2012 Barwon-Darling Water Sharing Plan allow for 300% of the allocation to be extracted each year, indefinitely, plus anything traded onto an individual account. If there is insufficient water in the river to meet the 300% take, the water licence account will accrue a debt over time until it can be met by physical water. This is referred to as 'carry over'.

In the Barwon-Darling carry over is a function of the difference between modelled long-term average flows and actual water in the river. The Barwon-Darling/Barka is the only NSW valley that provides for the water account to accrue (be carried over) indefinitely.

This is despite advice from NSW Office of Water to the NSW Water Minister in 2011 that extractions at 300% over three consecutive years would result in the Barwon-Darling valley breaching Cap:

> In all other unregulated rivers in NSW, three-year accounting rules (essentially equivalent to a 300% individual take limit over 3 consecutive water years) allows sufficient scope for those valleys to achieve diversions equal to [Cap] – this is not the case in the Barwon-Darling where entitlements have been set using average extractions. Modelling shows that that an individual take of 300 per cent of Cap over three consecutive water years or indeed 500 per cent over 5 years and even 1,000 per cent over 10 years, would result in significant impacts on the Barwon-Darling – preventing diversions from ever achieving the [Cap]. These impacts are most significant for any individual that displays a diversion pattern that is more opportunistic than the average – generally the large irrigators with significant on-farm storages.[26]

If extractions of 300% over three consecutive years result in a significant breach of Cap, that will only be exacerbated by the current rules that allow extractions of 300% in every year.

So, from the river's perspective, when it doesn't flow it begins accruing a water debt, 'owed' by it to irrigators. When there is no water in the river, for a year, or five, or ten, irrigators accrue a water credit to their licence. The river 'owes' irrigators water, owing more for each year it doesn't flow. When it flows irrigators can take the water that the river owes them. These arrangements are extremely generous to irrigators. They are not good for the river.

[26] NSW Office Water – Water Management Division (2011) *WS11/162 ministerial Approval: Public Exhibition of the draft water Sharing Plan for the Barwon-Darling Unregulated and Alluvial Water Sources,* Obtained by GIPA

The Barwon-Darling/Barka River owes irrigators water that it does not have.

DEFICIENCIES IN THE BARWON-DARLING CAP MODEL

Allocations in the Barwon-Darling/Barka are based on the long-term average Cap calculated by the Cap model. Any errors in the model are borne by the river, because water accounts keep accruing until the river repays the debt. The river bears all the risks associated with a model that bases its calculation on long-term averages and doesn't represent the river as it is. This is despite the well understood short comings of that model, which are touched on below.

MDBA's accreditation decision was based on advice by an independent auditor engaged to assess each Cap model. Because of its identified limitations the Barwon-Darling/Barka Cap model has never been accredited. It was granted provisional accreditation by MDBA in 2012 on the proviso that it would be improved by 2014. NSW did not undertake the model improvements and the provisional accreditation has lapsed.[27]

The CEO of the MDBA was advised:

> There are reasonable doubts over the veracity of the model, as noted by the auditor.[28]

The independent auditor expressed concerns about the Barwon-Darling/Barka Cap model:

> The Independent review of the Cap model said: The Barwon-Darling IQQM (or its future SOURCE replacement) is a key model in the Basin as it links the various NSW and Queensland tributary models to the Murray/Lower Darling. The failure to improve the model's replication of flow and diversion behaviour has the potential to discredit the hydrologic modelling capabilities not only with the Valley, but within the whole Basin.
>
> The inability of the model to replicate flows is of some concern in this audit because licence extractions are tied to flow thresholds in the Valley. Failure to

[27] Walker (2019) *Murray Darling Basin Royal Commission Report,* https://www.mdbrc.sa.gov.au/

[28] Who is author – Director (Cap Transition) or MDBA??? (2014) *Minute to Chief Executive – Response to NSW: Accreditation of the Barwon-Darling Cap model,* obtained by FOI

> accurately replicate flow behavior must inevitably lead to inaccuracies in diversion estimation.[29]

MDBA staff appear to have been aware that the Cap model was reporting take that was less than actual take. Notes of a meeting between MDBA and NSW modellers indicate that the solution proposed was to change the model, rather than address extractions above Cap:

> P [MDBA] - MDBA publish long-term cap for Barwon Darling. If this number is different to what is coming out of the water sharing plan [model], then there is a problem. We won't be able to publish two lots of numbers that are very different.
>
> A [NSW] - Principle of cap is to say what diversion would have been under 1993-94, and then say what was actually used to ensure there was no water use above the Cap. If we start recording diversions that are higher than what the Cap is, then we have obviously done the modelling wrong and this needs to be corrected.[30]

MDBA staff also advised the auditor assessing the Barwon-Darling/Barka model that it could not simulate end of system flows:

> Concerns have been expressed to the auditor by the MDBA that there was a significant mismatch between the simulated and observed flows at Menindee in the target runs. Further MDBA advised that the mismatch was so significant that up until the current time, they had been unable to use simulated flows from the Barwon-Darling cap model and had reverted to using observed flows in all target runs.[31]

[29] Bewsher (2013) *Barwon-Darling Independent Audit of Cap Model,* Obtained under FOI

[30] MDBA (2015) *Meeting Notes: MDBA and NSW Bilateral regarding Barwon-Darling Cap model march 2015 (redacted),* Obtained under Freedom of Information

[31] Bewsher (2013) *Barwon-Darling Independent Audit of Cap Model,* Obtained under Freedom of Information

Less capacity to repay debt

While the Barwon-Darling/Barka is in debt to future irrigation, its capacity to repay that debt is decreasing because there are fewer low and medium flows coming into the river from its tributaries.

DECREASING LOW AND MEDIUM FLOWS

There is mounting evidence that the flows into and along the Barwon-Darling/Barka have reduced, due to both climate change and increased extractions in the northern basin. MDBA analysis shows that low and medium flows (small floods and freshes) are declining and there is less water in the river for longer periods.[32,33]

A study of the recent fish kills was led by the Chair of the MDBA's Advisory Committee on Social, Economic and Environmental Sciences. It observed that climate change is affecting upstream flows and run off into rivers:

> The recent extreme weather events in the northern Basin have been amplified by climate change. Future changes in the global climate system are likely to have a profound impact on the hydrology and ecology of the Murray–Darling Basin and exacerbate the risk of fish deaths.
>
> Runoff responses to rainfall in the northern Basin appear to have been more severely reduced during recent droughts when compared to previous droughts, compounding the impacts on long-term water availability.[34]

[32] Slattery and Campbell (2019) *A Fish Kill QandA,* http://www.tai.org.au/sites/default/files/P665%20-%20A%20Fish%20Kill%20QandA%20%255bWEB%255d.pdf

[33] MDBA (2017), *Darling River flows and Menindee Lakes inflows – long term trends and drivers*, MDBA FOI 91 obtained by The Australia Institute

[34] Vertessy et al (2019) *Independent assessment of the 2018-19 fish deaths in the lower Darling: Interim report, with provisional findings and recommendations,* https://www.mdba.gov.au/sites/default/files/pubs/Independent-assessment-2018-19-fish-deaths-interim-report.PDF

MDBA undertook a *Hydrologic assessment of flow changes in the Northern Basin* that attributed the decreased low and medium flows to increased extractions, as well as climate change:

> the flow reduction in recent years along Barwon River is also due to other factors besides climate change and variability, such as increased river regulation and irrigation development. [35]

MDBA's findings were mirrored by a second inquiry into the recent fish kills at Menindee Lakes by the Australian Academy of Science that also attributed the decrease in flows to increased diversions:

> The conditions leading to this event [Menindee fish kills] are an interaction between a severe (but not unprecedented) drought and, more significantly, excess upstream diversion of water for irrigation.[36]

Floodplain harvesting

A possible cause of decreased flows is growth in floodplain harvesting. The last officially un-recognised water source in NSW is water that flows in the many creeks and streams associated with main river channels and floodplains. The NSW government acknowledges that there has been significant growth in floodplain harvesting:

> In some areas of the northern basin, there has been a significant growth in floodplain harvesting infrastructure, causing floodplain harvesting diversions to increase above plan limits.[37]

[35] MDBA (2018) *Hydrologic assessment of flow changes in the Northern Basin*, https://www.mdba.gov.au/publications/mdba-reports/hydrologic-assessment-flow-changes-northern-basin

[36] Australian Academy of Science (2019*) Investigation of the causes of mass fish kills in the Menindee Region NSW over the summer of 2018–2019*, https://www.science.org.au/supporting-science/science-policy-and-sector-analysis/reports-and-publications/fish-kills-report

[37] NSW Department of Industry (2018) *Draft Floodplain harvesting monitoring and auditing strategy*, https://www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/monitoring-andauditing-strategy

This was also noted by the South Australian Royal Commission:

> Evidence was also provided to the Commissioner indicating that the New South Wales Government has acknowledged that floodplain diversions have been 'grossly underestimated'.[38]

The NSW government advised that:

> there is currently no monitoring of floodplain harvesting diversions.[39]

Beyond the lack of monitoring, NSW estimates of floodplain harvesting volumes are infamous for their inaccuracy. The South Australian Royal Commission noted that:

> Floodplain harvesting may present different technical challenges in this regard [measurement], but it has not been seriously suggested that it should therefore not be measured. Especially in the Northern Basin, it is an urgent issue for urgent action. It presently renders administration of the water resources in question a virtually data-free zone. And that precludes administration 'on the basis of the best available scientific knowledge'.[40]

The NSW government is proposing to regulate floodplain harvesting by issuing floodplain harvesting licences and implementing a strategy to monitor, audit and enforce floodplain harvesting take.

Under the NSW Water Management Act, floodplain harvesting licences should be limited to the 1993/94 level of development. The NSW government has not provided any evidence publicly to demonstrate the proposed new licence amount will not exceed 1993/94 level of development.

The MDBA has advised that the Sustainable Diversion Limits (SDL), which are the legal limits of extraction, will be increased by the new floodplain harvesting licence volumes. The South Australian Royal Commissioner was very critical of the approach taken to floodplain harvesting. This is summarised in more detail in The Australia Institute's joint submission to the Draft Floodplain Harvesting, Monitoring and Auditing Strategy.[41] In short:

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[38] Walker (2019) *Murray Darling Basin Royal Commission Report,* https://www.mdbrc.sa.gov.au/

[39] NSW Department of Industry (2018) *Draft Floodplain harvesting monitoring and auditing strategy*, https://www.industry.nsw.gov.au/water/plans-programs/healthy-floodplains-project/monitoring-andauditing-strategy

[40] Walker (2019) *Murray Darling Basin Royal Commission Report,* https://www.mdbrc.sa.gov.au/

[41] Slattery, Campbell et al (2019) *Joint submission to the Draft Floodplain harvesting monitoring and auditing strategy,*

> Ultimately, the MDBA's proposal to increase SDLs by reference to increases to BDLs is unjustifiable.[42]

The proposed accounting rules for floodplain harvesting are similar to the allocation policy in the Barwon-Darling/Barka. One hundred percent of the licensed share is allocated on the 1st July each year, regardless of water availability. If water is not available, the account balance can accrue, or 'carry over' to a limit of 500%. Up to 500% of the allocation can be taken in any one year. The licence holder will start with a 500% account balance, so the Barwon-Darling will be in debt to future floodplain harvesting as soon as licences are issued.

ALLOCATION POLICIES IN THE TRIBUTARIES

The major tributaries into the Barwon-Darling/Barka allocate water to a water licence based on the type of licence, other system commitments and water availability.[43] NSW Department of Industry explains that the allocations are prioritised to water licences in the following order:

- domestic and stock
- town water supply
- high security water licences
- conveyance
- general security water licences. [44]

The NSW Water Minister has said that:

> This dam [Lake Keepit on the Namoi River] when it's full, about 18% can go to irrigators.
>
> The water out of this dam has been prioritised for communities further downstream and the environment.[45]

http://www.tai.org.au/sites/default/files/P684%20Submission%20on%20FPH%20draft%20strategy%20%5BWEB%5D_0.pdf

[42] Walker (2019) *Murray Darling Basin Royal Commission Report,* https://www.mdbrc.sa.gov.au/

[43] NSW Department of Primary Industry *How water is allocated,* https://www.industry.nsw.gov.au/water/allocations-availability/allocations/how-water-is-allocated

[44] NSW Department of Primary Industry *How water is allocated,* https://www.industry.nsw.gov.au/water/allocations-availability/allocations/how-water-is-allocated

[45] 7 News Sydney (2019) *7 News Sydney at Lake Keepit State Park,* https://www.facebook.com/7newssydney/posts/nearly-2000-fish-have-died-near-the-nsw-victorian-border-one-week-after-a-mass-f/2506952992662152/

Minister Blair's statement is consistent with Principle Three of the NSW Water Management Act, which specifies water is prioritised for the river and ecosystems, then basic landholder rights and lastly other water rights. However, this not how water allocations are determined in practice.[46]

It is correct that water is set aside for domestic and stock and town water supply in a valley, which typically receive 100% of their licence value before allocations are made for other licence holders. However, that is water set aside in the public dam. There is no guarantee that that water can be delivered if the river runs dry. For example, Walgett recently ran out of town water from the river and was relying on bottled water brought to town when a pump on the town's bore water supply failed during a blackout.[47, 48]

At the time of writing, Walgett's town water supply from the river has a 100% allocation, High Security water supply is at 100% and General Security water is at 19%.[49] Walgett is at the confluence of the Namoi and the Barwon, but the rivers can't deliver Walgett's town water.

The 'environment', or 'water source and its dependent ecosystem', is not prioritised above any other water licence holder. The 'environment' could refer to either Held Environmental Water (HEW) or Planned Environmental Water (PEW).

HEW is water that is bought and held by an environmental water holder.[50] These are mostly general security licences, with some high security. There is no preferential treatment for these licences, or the environment. The amount of water allocated against these licences is exactly the same as other water holders with that licence type and it is allocated at the same time. PEW is water that is specified in a plan as set aside to achieve environmental outcomes, and for no other purpose.[51]

Contrary to Minister Blair's assertion, water for the environment other than that held by a water holder, is only what is left after all licence holders receive their allocation.

[46] s5(3) *Water Management Act 2000*, http://www8.austlii.edu.au/cgi-bin/download.cgi/au/legis/nsw/consol_act/wma2000166

[47] Allam (2019) *Walgett's water crisis: NSW considers options after 'concerning' sodium levels found,* https://www.theguardian.com/australia-news/2019/jan/22/walgetts-water-crisis-nsw-considers-options-after-concerning-sodium-levels-found

[48] Heyman-Reber (2019) *Walgett water supply reconnected, says Mayor,* https://www.sbs.com.au/nitv/article/2019/01/04/walgett-water-supply-reconnected-says-mayor

[49] https://www.industry.nsw.gov.au/water/allocations-availability/allocations/dashboard

[50] s4 Water Act 2007 (Cwth), https://www.legislation.gov.au/Details/C2017C00151

[51] s6 Water Act 2007 (Cwth), https://www.legislation.gov.au/Details/C2017C00151

Allocating future inflows

In some regulated rivers in NSW, the water available for allocation to irrigation is calculated using estimated future inflows, typically up to two years ahead. It is assumed that this water will flow into dams and be available before it is needed. The volume assumed to arrive in the future was formerly based on the historical 'drought of record', the driest period of inflows recorded. At a minimum, the flows during the driest year were assumed to arrive in the relevant storages.

However, in 2004 the NSW Minister for Water changed the NSW Water Management Act 2000 so that new droughts of record did not have to be considered in calculating water allocations:

> The water supply system shall be managed so that it would be capable of maintaining supply to those exercising domestic and stock rights through a repeat of the worst period of low inflows into this water source (based on historical flow information held by the Department as at 1 July 2004). [52]

In a radio interview at the time, a former Chair of Macquarie River Food and Fibre explained:

> … while the water allocated in October may not have technically existed in Burrendong Dam at that time (as it was based on a revisal of predicted minimum inflows into the dam and therefore did not have to be underpinned by actual physical water set aside for other purposes) … the water was effectively 'paid back'.[53]

The view expressed, that water allocations 'did not have to be underpinned by actual physical water' shows that sections of the industry, and the NSW government, believed that this was reasonable. Since 2004 there have been new droughts of record, but allocations are still based on data to 2004. In some valleys the NSW government has found itself unable to supply the water allocated to irrigators and the environment.

This approach is still in place, making estimation of future inflows less conservative than it would be if data was up to date.

[52] NSW Government (2016) *Water Sharing Plan for the Gwydir Regulated River Water Source 2016,* https://www.legislation.nsw.gov.au/regulations/2015-629.pdf

[53] Johnson (2005) *Adaptive management of a complex social–ecological system: the regulated Macquarie River in south-eastern Australia*, M. Res. Sci. thesis, University of New England, Armidale.

Conclusion

The problems of the Murray Darling Basin, highlighted by the recent fish kills and Royal Commission reports, are actually very simple. Too much water is being taken for irrigation, particularly in the northern Basin. While the current drought is a factor, there is water in the system, and the industry has it.

The rules, regulations and policies that have led to this outcome are far more complex. A lot of political, policy and engineering work will need to be done to reverse the power structures, policy mechanisms, business models and physical infrastructure that have led to the current situation and that benefit from it.

The first step is to understand these processes. Claims that annual crops such as cotton adjust efficiently to water market supply and price rely more on an 'economics 101' style faith in market theories rather than on real world data or an understanding of the industry.

The next step is reform. Serious measurement and reform of floodplain harvesting is necessary. Implementing sustainable diversion limits in line with science, including in laggard areas like the Barwon-Darling/Barka will be crucial. Working to eliminate the rivers of debt via cap credits in the Barwon-Darling/Barka is required.

To those close to Basin policy and politics, these reforms may seem impossible. Yet the publicity around fish kills and the Royal Commission have brought high level political attention. Unprecedented alliances between irrigation, grazing, community and environment groups are calling for these policies. State and Federal elections are looming. Perhaps better days for the Basin are just around the bend.