Submission to the

The House Standing Committee on Agriculture and Water Resources

Inquiry into water use efficiency in Australian agriculture

7 April 2017

Prepared by Ms Jack Knowles

NFF Member Organisations

AGFORCE

Australian Dairy Farmers

AUSTRALIAN FOREST PRODUCTS ASSOCIATION afpa TREES | WOOD | PAPER

Australian Livestock Exporters' Council ALEC

ALPA

AUSTRALIAN Pork

AUSTRALIAN VETERINARY ASSOCIATION

PURE BEECHWORTH HONEY 100% Pure Australian Honey

CANEGROWERS

CATTLE COUNCIL OF AUSTRALIA

CORPORATE AGRICULTURAL GROUP

COTTON AUSTRALIA

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FCA FARMERS FOR CLIMATE ACTION

Future Farmers Network

Goat Industry Council of Australia inc.

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Grain Growers Real benefits. Real results.

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NEW SOUTH WALES IRRIGATORS' COUNCIL

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PET Primary Employers Tasmania

RICEGROWERS' ASSOCIATION OF AUSTRALIA INC

Summerfruit AUSTRALIA

SHEEPMEAT COUNCIL OF AUSTRALIA

WAFARMERS

Victorian Farmers Federation

WOOLPRODUCERS AUSTRALIA

The National Farmers' Federation (NFF) is the voice of Australian farmers.

The NFF was established in 1979 as the national peak body representing farmers and more broadly, agriculture across Australia. The NFF's membership comprises all of Australia's major agricultural commodities across the breadth and the length of the supply chain.

Operating under a federated structure, individual farmers join their respective state farm organisation and/or national commodity council. These organisations form the NFF.

The NFF represents Australian agriculture on national and foreign policy issues including workplace relations, trade and natural resource management. Our members complement this work through the delivery of direct 'grass roots' member services as well as state-based policy and commodity-specific interests.

Statistics on Australian Agriculture

Australian agriculture makes an important contribution to Australia's social, economic and environmental fabric.

Social >

There are approximately 132,000 farm businesses in Australia, 99 per cent of which are Australian family owned and operated.

Each Australian farmer produces enough food to feed 600 people, 150 at home and 450 overseas. Australian farms produce around 93 per cent of the total volume of food consumed in Australia.

Economic >

The agricultural sector, at farm-gate, contributes 2.4 per cent to Australia's total Gross Domestic Product (GDP). The gross value of Australian farm production in 2016-17 is forecast at 58.5 billion – a 12 per cent increase from the previous financial year.

Together with vital value-adding processes for food and fibre after it leaves the farm, along with the value of farm input activities, agriculture's contribution to GDP averages out at around 12 per cent (over $155 billion).

Workplace >

The agriculture, forestry and fishing sector employs approximately 323,000 employees, including owner managers (174,800) and non-managerial employees (148,300).

Seasonal conditions affect the sector's capacity to employ. Permanent employment is the main form of employment in the sector, but more than 40 per cent of the employed workforce is casual.

Approximately 60 per cent of farm businesses are small businesses. More than 50 per cent of farm businesses have no employees at all.

Environmental >

Australian farmers are environmental stewards, owning, managing and caring for 52 per cent of Australia's land mass. Farmers are at the frontline of delivering environmental outcomes on behalf of the Australian community, with 94 per cent of Australian farmers actively undertaking natural resource management.

The NFF was a founding partner of the Landcare movement, which recently celebrated its 20th anniversary.

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Executive Summary

On matters related to water and irrigation, NFF is the only national body that brings a 100% farmer-focused viewpoint. We represent the interests of farmers that are affected by water management decisions including irrigators, riparian and floodplain landholders. In this submission, NFF has largely focused its evidence on improvements to on-farm water use efficiency.

However, we encourage the committee to also explore the benefits of improving water use efficiency in the supply of irrigation water, whether this be through improved river operations, or the operations of irrigation infrastructure operators who own and manage the off-river systems that deliver water to the farm gate.

NFF encourages you to read the submissions of our member organisation, which explore in more depth the specific water use efficiency achievements, priorities and challenges in different commodities.

Australia's farm sector is on track for best-ever results with agricultural production forecast to tally a record $63.8 billion in 2016–2017[1], with predictions that Australian agriculture will be a $100 Billion sector by 2030.

Australian farmers are recognised globally as world leaders in water use efficiency. Australia's rice growers use 50 per cent less water than the global average to produce each kilogram of rice, and our cotton growers produce more lint per drop of water - 3 times the global average – than any other country in the world. Underpinned by our rural research and development model, the agriculture sector has been investing in the science, knowledge, technology and know how to improve water use efficiency for decades.

Recommendation 1: The Committee recognise the overall contribution and importance of agriculture as a key pillar of Australia's economy; and the importance of improving water use efficiency to lift farm productivity and profitability.

Recommendation 2: The Committee recognise the value of Australia's rural research and development model in improving water use efficiency, and the importance of research collaborations such as those funded under the Rural R&D for Profit Program.

In NFF's view, investment in WUE for both on-farm and off-farm distribution systems has provided the least-worst outcome for recovering water to implement the Murray-Darling Basin Plan.

[1] ABARES 2017, Agricultural commodities: March quarter 2017. CC BY 3.0.

However, appetite for on-farm irrigation upgrade programs for water recovery is much lower now than in the early stages of Basin Plan implementation. While this is in part due to the lower cost opportunities already being realised, other confounding factors include:

- The capital investment associated with on-farm upgrades means that farmers need to be confident that they will be able to access water at a price they can afford to run in the upgraded system. Tighter temporary water markets dampen this confidence.
- More water use efficient systems are, more often than not, more energy intensive. Electricity and energy price increases over the past decade, and forecasts that prices will continue to rise are central factors in decision making.
- Greater recognition that water entitlements are an appreciating asset that is important to the farm business balance sheet, and that these programs involve the relinquishment of an appreciating asset for a depreciating one (infrastructure).
- Generally healthier farm balance sheets and the ability to readily access affordable capital means that farmers are making self-funded improvements and retaining ownership of water entitlements and either growing production or maximise value by participating in the water market.

Recommendation 3: The Committee acknowledge that investments in water use efficiency can have negative social and economic impacts, but are the "least-worst" option for recovering water for the environment.

Recommendation 4: The Committee recognise that irrigator appetite for participating in water recovery programs that invest in on-farm irrigation systems is considerably lower than in the early stages of Basin Plan implementation.

There are significant opportunities to improve the water use efficiency of water managed for the environment. The goal must be to deliver improved environmental outcomes from the portfolio of water that has already been recovered for the environment – in essence more environmental outcome per unit of water held and delivered. Given the significant investment that has been made in procuring water entitlements for environmental water holders, and the ongoing costs associated with holding them, prudent and efficient management must be a focus. Priorities in this regard include:

- Investing in the science, knowledge and management approaches to enable us to better understand how the environment responds to watering events and the optimal watering regimes for specific ecosystems, and how unintended consequences can be avoided.
- Investment in non-flow opportunities that can improve outcomes, such as addressing cold water pollution from large dams and barriers to fish passage, controlling feral animals in key wetland and floodplain areas, and tackling carp infestations.

There are emerging opportunities where environmental outcomes and productivity outcomes can be achieved from the same drop of water.

Recommendation 5: The Committee recommends that Government explore to the full extent possible non-flow complementary measures that can enhance the ability to deliver outcomes from the environmental water portfolio that is already held by the Commonwealth.

Recommendation 6: The Committee recommends that Government further explore opportunities for recognising initiatives that can deliver productivity and environmental outcomes.

1. Introduction

Australia's farm sector is on track for best-ever results with agricultural production forecast to tally a record $63.8 billion in 2016–2017[2], with predictions that Australian agriculture will be a $100 Billion sector by 2030.

Water use efficiency (WUE) has many definitions, but from a farmer's perspective, ultimately it is about sustainably maximising production per unit of water. In both irrigated and dryland cropping systems, water is the factor limiting production and so profits are very closed linked to produce as much "yield" per unit "water" as possible.

This means that when considering water use efficiency, it's about much more than just efficient in-field irrigation application systems. Innovation to improve water use efficiency includes:

- Crop varieties that are more water use efficient
- Agronomic practices and soil management that improve the water holding capacity of soils
- Farm layouts that enable more uniform watering in field
- Technologies such as in-field sensors, localised weather stations and decision support applications that enable irrigation to be better matched to plant water requirements during the growing season
- In-field irrigation application systems that enable more precise irrigation
- Improvements in on-farm storages and channels to reduce evaporation, seepage and drainage losses
- Crop rotations that utilise residual soil moisture following the harvest of an irrigated crop

As with most business decisions, a farmer will consider the full range of benefits, risks and trade-offs of any change they make that might improve water use efficiency. The availability of capital – which is ultimately what is provided by the Commonwealth's programs to invest in water use efficiency in the Murray Darling Basin (MDB) - is just one. Examples of the types of considerations that a farmer will make include:

- Disruption during the reconfiguration and construction
- The availability of skilled labour, both on-farm and the availability of localised expertise for repairs, maintenance and advice
- Management skills required to change operations
- Labour savings
- Quality improvements
- Ability to manage climatic risks such as frost
- Changes in operational costs – such as increased energy requirements

[2] ABARES 2017, Agricultural commodities: March quarter 2017. CC BY 3.0.

The agriculture sector has been investing in the science, knowledge, technology and know how to improve water use efficiency for many years. The sector's highly valued research and development model has underpinned the pursuit of water use efficiency over time.

Recommendation 1: The Committee recognise the overall contribution and importance of agriculture as a key pillar of Australia's economy, and the importance of improving water use efficiency to lift farm productivity and profitability.

Recommendation 2: The Committee recognise the value of Australia's rural research and development model in improving water use efficiency, and the importance of research collaborations such as those funded under the Rural R&D for Profit Program.

2. Adequacy and efficacy of current programs in achieving irrigation water use efficiencies

Throughout this submission, case studies are presented that demonstrate the effectiveness of on-farm efficiency investment programs in the Murray-Darling Basin that have delivered water savings for the environment and on-farm benefits such as improved quality, productivity, and labour saving.

The Sustainable Rural Water Use and Infrastructure Program (SRWUIP) was established initially under the auspices of "Water for the Future" and has been maintained largely to facilitate the recovery of water under the Murray Darling Basin Plan.

Components of the program that have included on-farm water use efficiency have included:

- Healthy HeadWaters Water Use Efficiency project (Queensland)
- Irrigated Farm Modernisation project (NSW)
- South Australian River Murray Sustainability Irrigation Industry Improvement program
- On-Farm Irrigation Efficiency Program
- Victorian Farm Modernisation Project

The delivery mechanism, and the partnerships formed to facilitate delivery, have been varied for a range of reasons. Factors influencing the implementation approach have included the need to suit local circumstances; the availability of interested partners; and to enable on-farm change to complement other investments, such as investments in off-farm delivery systems. Industry organisations, including members of NFF, have been willing delivery partners in many initiatives.

According to Government figures on water recovery to 28 February 2017[3] investment in infrastructure (on and off farm) has derived 692GL of the total 2038.5GL that has been recovered to meet the Basin Plan surface water targets.

[3] See http://www.agriculture.gov.au/water/mdb/progress-recovery/progress-of-water-recovery

3. How existing expenditure provides value for money for the Commonwealth

While the specific program settings have been modified over time, the common design element of all on-farm programs has been that the Commonwealth Government's share of saving was transferred up front, with the farmer bearing the risk that projects would not fully realise the estimated savings.

In NFF's view, investment in WUE for both on-farm and off-farm distribution systems has provided the least-worst outcome for recovering water to implement the Murray-Darling Basin Plan. For this reason, the sector has been a very active participant in past efficiency programs, both as farmer participants, and as delivery partners with the Commonwealth.

Many academic commentators have suggested that the "purchase" of environmental water by investing in water use efficiency amounts to a public subsidy[4]. This narrow view fails to acknowledge that in addition to just water recovery, other benefits are "purchased" or other costs avoided by investing in infrastructure rather than straight buyback. These additional benefits include a more productive and efficient irrigation business, maintained productivity with associated benefits for input suppliers and downstream processing, and the social and economic flow on benefits associated with the spending stimulus.

This concept is supported by independent studies conducted to inform the development of the Murray Darling Basin Plan showed that buybacks have greater localised social and economic impacts on irrigation dependent communities than investment in water efficiency projects.

Arche Consulting (2011) was commissioned by the Department of the Environment and the Murray-Darling Basin Authority to develop local case studies that modelled the impacts of different Basin Plan scenarios on irrigation communities. Scenarios included those with and without infrastructure investment. The study concluded that:

"Investment in infrastructure projects results in water savings being retained on farm, and contributing to direct employment in agriculture. There are also flow-on impacts in the local economy from the retained agricultural production".[5]

These offsetting benefits were long term, and additional to the short-term stimulus associated with increased investment in jobs during the construction phase of projects. Furthermore, the analysis conducted did not include any impacts that flow on to downstream processing industries.

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[4] See for example Crase and O'LKeefe *The Contradiction between Modernising Irrigation and Water Buyback* http://www.pc.gov.au/inquiries/completed/murray-darling-water-recovery/submissions/sub001.pdf

[5] Arche Consulting (2011) *Assessing the local economic impacts of the draft basin plan - Final report* Prepared for the Department of the Environment. http://www.mdba.gov.au/sites/default/files/archived/proposed/Arche-Basin-Case-Studies-final-report.pdf

Arche Consulting also concluded that:

The water savings outcome of the Commonwealth investment in infrastructure has a significant effect on direct agricultural employment. Across the twelve case study areas, a further 274 direct agricultural jobs would be lost without the Water for the Future infrastructure investment.

In December 2012 Dairy Australia commissioned RMCG to conduct a cost-benefit analysis of farm irrigation infrastructure upgrades on 10 dairy farms in northern Victoria and the NSW southern Riverina.[6]

Key findings from this independent study included that:

- Buybacks of irrigator entitlements for the environment cost the Australian Government around $2000/ML, but are associated with reduced regional farm productivity. This in turn reduces regional economic activity by around $4300 for every megalitre purchased by the Australian Government.

- Upgrades cost the Australian Government about $3700/ ML for the environment's share of water savings. However, upgrades delivered $9800/ML worth of increased farm productivity (annualised capital value) from the irrigator's share of savings. Using this water to increase production generates additional regional economic activity worth $6200/ML (capitalised value) based on $500/ML per year additional farm-gate production.

Analysis conducted by the Murray-Darling Basin Authority (MDBA), to inform the Northern Basin Review has also highlighted the difference in community impacts that arise from buybacks compared to water recovery by investing in infrastructure. The MDBA in its report on the Northern Basin Review acknowledged that:

"It is well understood that infrastructure improvement can boost the long-term production capacity of farms. The purchase of large volumes of water over a short period of time has had lasting effects on some towns[7].

And included a specific recommendation that:

"There be a preference for water recovery based on irrigation infrastructure improvements rather than through water entitlement purchasing. *The reason for this emphasis is that the environment still benefits, landholders receive a direct benefit to their businesses and flow-on economic benefits are more likely to stay within the community. MDBA acknowledges the*

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[6] RMCG (2013) *Cost Benefit Analysis of Farm Irrigation Modernisation Final Report*, prepared for Dairy Australia. Viewed at http://www.dairyaustralia.com.au/~/media/Documents/Industry%20overview/About%20the%20industry/Current-industry-issues/LMDB%209/RMCG%20CBA%20OnFarm%20Irrigation%20Efficiency%20Program%20May%202013%20DOC1357415.PDF

[7] *MDBA (2016) The Northern Basin Review: Understanding the economic, social and environmental outcomes from water recovery in the northern Basin* Page 34

importance of the Australian government policy for limited strategic water purchasing within a legislated cap of 1,500 GL across the Murray–Darling Basin[8].

Detailed benefit cost analysis has been conducted for the Farm Water Program which has delivered on-farm efficiency projects in northern Victoria. A synopsis of this analysis is presented in Appendix 1.

Recommendation 3: The Committee acknowledge that investments in water use efficiency can have negative social and economic impacts, but are the "least-worst" option for recovering water for the environment.

4. Possible improvements to programs, their administration and delivery

When considering future programs, it is important to keep in mind the context in which they will operate.

The broad view in the irrigation industry, is that much of the "low hanging fruit" on water use efficiency has been achieved in many parts of the Basin. While the incentive provided by Government programs has been a driver of this, other key drivers have included:

- Deeper water trading markets, with greater participation that have assisted growers recognise the value of water
- Buoyed commodity markets, with growers seeking to maximise production when prices are good.

Appetite for on-farm irrigation upgrade programs is much lower now than in the early stages of the Basin Plan. While this is in part due to the lower cost opportunities already being realised, other confounding factors include:

- The capital investment associated with on-farm upgrades means that farmers need to be confident that they will be able to access water at a price they can afford to run in the upgraded system. Many farmers systems and profitability is now closely linked to the temporary water price. Numerous studies have shown that demand from emerging industries like cotton and nuts in the southern connected MDB will continue to drive up temporary water prices.
- More water use efficient systems are more often than not more energy intensive. Electricity price increases over the past decade, and forecasts that prices will continue to rise, means that either additional capital investment is required in on-farm energy generation (eg solar/battery or diesel) or electricity price risks are factored into decision making.
- Greater recognition that water entitlements are an appreciating asset that is important to the farm business balance sheet.
- Generally healthier farm balance sheets and the ability to readily access to affordable capital means that farmers are making self-funded improvements and retaining

[8] MDBA (2016) *The Northern Basin Review: Understanding the economic, social and environmental outcomes from water recovery in the northern Basin* Page 8

ownership of water entitlements and either growing production or maximise value by participating in the water market.

The broader implications of water recovery, regardless of the manner in which it is undertaken, and its impact on water markets should also be considered by the Committee.

In the southern Murray Darling Basin for example, reductions in supply resulting from water recovery occurring largely simultaneously with growth in demand from maturing nut crops and changing crop mix has led to a deepening temporary water market, and significant competition for available water. Analysis conducted by Aither (2016) estimates that projected changes in land use away from grapes and rice to tree nuts (almonds and walnuts) and cotton will see an estimated increase in demand for water over the next five years by about 275 GL per year for cotton and 150 GL per year for nuts. These demand changes are anticipated to increase water prices by around 10 per cent in low allocation years and 7 per cent in moderate and high allocation years[9].

The reliance of the dairy industry is a good example of this. Before the Millennium Drought, dairy industry's total water consumption was about 130% of the high reliability entitlements held, with dairy farmers relying on the "sales" water arrangements in place at the time. Sales water was effectively water allocated but unused by other GMID irrigators. Now this figure sits at about 159%, with the industry in northern Victoria now more than ever exposed to the volatility of the temporary water market. It is estimated that about 164GL of water once used by the dairy industry has been sold under buyback programs, with an additional 25GL recovered under water use efficiency programs.

Research conducted by Aither Consulting[10] has shown that water recovery, regardless of how it is conducted, has impacts on the temporary water market. Key impacts, identified in a study for the dairy included:

- The price of temporary allocation is estimated to be 13 to 36 per cent higher in a moderate allocation season than they would otherwise have been without Commonwealth environmental water purchases
- The price impacts of additional on-farm water use efficiency programs could be as large as, or larger than, equivalent volumes recovered through buyback.

The second point may seem counter intuitive. The implicit assumption behind programs that invest in on-farm water use efficiency is that demand for water decreases as the farmer can produce the same with less water. Straight buybacks were often associated with people either exiting the industry or scaling back operations – thus demand for water was equally offset by the reduction in supply. Participants in on-farm programs however tend to be those farmers that are in the industry for the long haul, and keen to make capital improvements and to grow their businesses. So demand for allocation may actually be unchanged by the program, adding pressure to an already tight market as supply falls without a change in demand.

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[9] Aither (2016) *Contemporary trends and drivers of irrigation in the southern Murray-Darling Basin,* a report for the Rural Industries Research and Development Corporation. Publication No. 16/007

[10] Aither Consulting (2016) Water market drivers in the southern MDB: Implications for the dairy industry, a report prepared by Dairy Australia.

Furthermore, to ensure a return on the capital investment made in on-farm improvements means that many growers are now willing to pay more for water.

Possible improvements to on-farm programs

Given the likely context for future on-farm programs, it will be important to ensure that program settings continue to be improved should further water recovery be required.

The success of past programs has often been due to the Commonwealth partnering with the "right delivery partner, in the right location". A continuation of this model is preferred by NFF. However, a number of the program settings provide a significant disincentive for prospective partners. The following considerations should be closely examined in the design of future initiatives:

- Administration funding received is determined by both the number of individual projects approved and the value of those projects, which does not adequately reflect the true cost of administration. There is no incentive for partners to participate, when participation will mean they run a loss. Furthermore, these settings provide a disincentive for smaller on-farm opportunities to be captured.

- There is also an opportunity to review the reporting/administration demands placed on delivery partners, and to provide more guidance regarding the administration costs that can be claimed and the process of claiming these costs.

From a farmer participant perspective, opportunities to improve settings include:

- Encouraging the prudent management of funds between contract execution and construction payments. Currently, contractual obligations of the project require the participants to return all interest accrued in bank accounts to the Commonwealth.

- Lowering the minimum volume requirement that can be recovered to encourage participation by smaller irrigators.

- Broadening the types of entitlements that can be recovered. In the Northern Basin for example, on-farm efficiency programs have been limited to specific types of entitlements in specific locations.

Recommendation 4: The Committee recognise that irrigator appetite for participating in water recovery programs that invest in on-farm irrigation systems is considerably lower than in the early stages of Basin Plan implementation.

5. The relationship of water use efficiency to maintaining or increasing agricultural production

While the agriculture sector has invested significantly in recent decades to drive improved water use efficiency, the Australian industry continues to strive to better.

Under the Government's Rural R&D for Profit Program, the Commonwealth, in partnership with 6 Research and Development partners and 19 farmer irrigation technology learning sites are aiming to improve the profit of 3,000 cotton, dairy, rice and sugar irrigators by $20,000 - 40,000 per annum by improving water productivity, efficiency and farmer profitability by 10-20%.

The project will focus on:

- Practical, reliable irrigation scheduling technologies,
- Precise, low cost automated control systems for a range of irrigation systems,
- A network of farmer managed learning sites located in major regions referred to as "optimised irrigation" farms.

With $4 million in Commonwealth investment, $3.4 million in partner investment and $2.9 million in partner in-kind resourcing.

In addition to this investment, the following sections provide information and case studies on the importance of water use efficiency in maintaining and increasing not only agricultural production, but agricultural profitability.

5.1. Dairy

The Australian Dairy Industry Sustainability Framework includes key targets to improve water management on farm (Target 8) and the consumptive water intensity of dairy processing (Target 9).

On farm, the latest, 2015 Framework progress report notes that 54% irrigated dairy farms have adopted automation – which enables farmers to use less water with greater precision. The industry has set itself a target for this to reach 80% of irrigated farms by 2020.

Case Study: Rodney Fletcher, "Keely Station", Torrumbarry.[11]

Rodney Fletcher runs a dairy farm in Cohuna and was looking at automating irrigation on the property when he successfully applied for Round 3 Farm Water Program funding.

[11] https://www.gbcma.vic.gov.au/downloads/Farm_Water_Program/2016_-_FWP_-_Fact_Sheet_-_Water_Service_Areas_-_Torrumbarry_-_15_08_2016.pdf

Mr Fletcher said, “The process was okay however delays due to rain were challenging. The project has exceeded our expectations and we are already seeing the benefits.”

Since its installation, automation has provided improved command across the farm making unproductive country productive. “It has given us confidence in the industry and to stay on the farm,” said Rodney. “Without the Farm Water Program we would be out of the dairy industry” and he said they are “now milking 260 (cows), up from 180.”

When asked about the value of the relationships between stakeholders, Mr Fletcher added, “We signed with Goulburn-Murray Water because we wanted to access the Farm Water Program funding.

The programs complimented each other and the CMA has been good to work with and good communicators.” The results of the project are being seen and making the farm more “user-friendly”.

Rodney said, “Flexibility of the system is huge and also saves water. Better feed production and less labour (with 85% less labour to water). The only drawback to the system would be that power costs have increased from $5.00 per megalitre to $15 per megalitre.

Tony Marwood, Rochester-Campaspe[12]

For Tony Marwood, his Farm Water Program project – to install pipes and risers on his 100 hectare dairy farm in Echuca – was “a massive job but I’d do it again.” The benefits outweighed any hurdles along the way and now, the farm has “more grass, is more efficient, and (is producing) more milk”. For Tony, the most significant benefit is that there is “more value to the property and saleability in the long term.”

Goulburn Murray Water funded the installation of an outlet to the property and a channel was also decommissioned prior to commencement of the project. While there were some initial challenges, Tony said the project will “extend my life in farming” and has encouraged him to eventually go down the path of automation”

Managing the cows is a big challenge for larger projects, as cow movement is limited due to the works and can present some layout challenges,” said Tony. “It takes a while to get to know the new system, and the consequences of making a mistake with pipe and riser are higher.”

However, now “we are using more water but we are growing more.” The farm “takes advantage of the modernised system” and water “savings will be achieved” for the long term.

[12] https://www.gbcma.vic.gov.au/downloads/Farm_Water_Program/2016_-_FWP_-_Fact_Sheet_-_Water_Service_Areas_-_Rochester_Campaspe_-_15_08_2016.pdf

Keith Lawry, Loddon Valley[13]

Keith Lawry completed works on his dairy property in Dingee through Round 3 of the Farm Water Program (Victorian Farm Modernisation Project, Tranche 2A). The project involved installing pipes and risers, irrigation scheduling, drainage reuse works and laser grading.

Keith said, "The speed of irrigation has increased efficiency of water use; and other crops are now a possibility." Adding automation to the project area had also shown clear benefits, as Keith said, "Automation has allowed me to continue to contribute to the property – easier work and safer. With the completion of this project, the whole property is now covered by pipe and risers and the water savings estimated are being seen."

Completed over the course of two years, Mr Lawry felt the program was "an excellent initiative" but has lost its value recently (April 2016) because of low value of water offered." At that time, Round 4 (the next round following Lawry's participation) had overall low participation. This was largely attributed to the difference between the price being offered for water and the price available on the water market. In Round 5 (open until 29 July 2016) the water price increased through negotiations in response to overall participant feedback.

5.2. Grains

In a climate of increasingly unreliable rainfall, improving soil water storage and uptake by crops is critical to maximising water use efficiency in rainfed grain crops. Research conducted by GRDC in partnership with grower groups that a range of pre-crop and in-crop practices have improved water use efficiency over time. These practices include:

- weed management in fallow
- variety choice to suit likely available moisture
- long term stubble retention
- minimum tillage
- optimal plant density
- Weed and nutrient management in-crop
- plant breeding innovations, with traits including maturity, frost and heat tolerance and the long-coleoptile wheat genotypes that can be deep sown into sub-soil moisture.

Irrigated grain farms have also participated in Commonwealth funded on-farm irrigation efficiency programs, with 2 case studies presented below.

[13] https://www.gbcma.vic.gov.au/downloads/Farm_Water_Program/2016_-_FWP_-_Fact_Sheet_-_Water_Service_Areas_-_Loddon_Valley_-_15_08_2016.pdf

Bill Gread, Murray Valley[14]

Mr Gread had already started extensive lasering and channel work on his farm which he bought in 2006, when funding became available through the OnFarm Irrigation Efficiency Program in 2010.

"I reckon this Goulburn-Murray valley region is a golden region – a real Garden of Eden – but because of the drought, we were watching it wither before our eyes. This modernisation work and extra funding for on-farm work is completely reinvigorating the region, it's given us all a new lease on life."

Mr Gread said he recognised that the OFIEP funding could provide him with the opportunity to carry out on-farm improvements. "The place was pretty run down when I bought it so I got to work on the re-use dam, white-rocking some of the channels, earthworks and getting rid of some of the bays in some parts of the farm," he said.

In the meantime modernisation work on nearby channels had been carried out as part of the Northern Victoria Irrigation Renewal Project. "Through the connections upgrade, I'd gone from getting five or six megs through the wheel to 20," he said. "Instead of wasting days watering it meant I could water in hours.

To make the most of this, on-farm works were obviously the way to go. "I had these paddocks that were basically full of rubbish and because of all the uneven-sized bays and gullies watering them was costly and unviable," Mr Gread said.

Following works, Mr Gread planted stands of Lucerne and some sorghum. "I reckon fast-watering is the way to go and, now, because of what we've done with the bays and channels, most of the run-off – about 98 percent I'd say – is going into there – used and that's got to be a good thing. It's a real blessing; a lot of people just couldn't have afforded to get this sort of work done," he said.

Glenn Thompson, Central Goulburn[15]

Glenn Thompson successfully applied for funding through Round 3 of the Farm Water Program (Victorian Farm Modernisation Project, Tranche2A). The project included the removal of an existing old channel, as well as the installation of pipes and risers on the 117 hectare grain property in Kyabram.

Glenn said his involvement with the Farm Water Program was an "overall positive experience" and that the project would result in "time and management savings". Glenn

[14] https://www.gbcma.vic.gov.au/downloads/Farm_Water_Program/2016_-_FWP_-_Fact_Sheet_-_Water_Service_Areas_-_Murray_Valley_-_15_08_2016.pdf

[15] https://www.gbcma.vic.gov.au/downloads/Farm_Water_Program/2016_-_FWP_-_Fact_Sheet_-_Water_Service_Areas_-_Central_Goulburn_-_15_08_2016.pdf

highlighted project benefits a "reduced losses through the transmission of water", as well as the opportunity for fertigation through the addition of fertiliser to the water supply.

By reclaiming the land through the removal of the channel, not only will the time and labour spent maintaining the channel be removed, but there will also be the potential for further water savings and increased productivity. When asked about the project 20 months post-completion, Glenn said his "power costs have increased utilising the new pipe and riser system; however he has saved half a day in irrigating (each irrigation)."

5.3 Cotton

The Australian Cotton industry has for many decades invested in the science, knowledge and know to improve water use efficiency[16]. The Australian Grown Cotton Sustainability Report (2014) reported that cotton growers are using a range of techniques to constantly improve water use efficiency:

- 70 percent of farmers use soil moisture probes, up from 40 percent in 2006 (highest of all agriculture industries in Australia)
- 96 percent of irrigators have improved their furrow irrigation system or changed to an alternate irrigation system
- 49 percent of irrigators had made changes to the flow or size of their siphons
- 35 percent have redesigned fields. For example, growers use laser-levelling to ensure uniform, well drained fields using GPS guidance equipment and position storage dams closer to cotton fields to reduce evaporation losses
- Other practices include irrigating to deficits, using drip and overhead sprinkler systems, better accounting of soil variations, changed bed shapes, using irrigation scheduling probes, furrow irrigation system optimisation evaluations, pump optimisation and reducing distribution losses.

Additional water use efficiency driving practices include:

- Before planting their crop, cotton growers use sophisticated weather forecasting software to predict how much crop can be sustained before planting. Zero and minimum till farming is also used to help retain soil moisture
- Growers use information and technology (including soil moisture probes, satellites and drones) so they water only when and how much is needed. Irrigation channels that pump water to the fields are lined to reduce loss through seepage
- Adhering to the Australian cotton industry's environmental management program – myBMP. myBMP includes a water management module covering water quality, efficiency of storage and distribution for both dryland and irrigated farming practices to improve farming practices and carefully manage our natural resources

[16] For example, The Australian Cotton Water Story produced by the Cotton Catchment Communities CRC (2005–12) documents water use efficiency research and development. Available at http://www.moreprofitperdrop.com.au/wp-content/uploads/2013/02/Cotton_Water_Story.pdf

- Farmers are changing to alternative irrigation systems such as centre pivots and lateral move systems and it is expected there will be an increasing number of these machines in the future. These systems can achieve labour savings and with some soil types, water savings (about 30 percent), but have significantly higher energy costs associated with water pumping and machine operation
- Mobile electromagnetic meters are used for easy and rapid assessment of soils for their suitability for irrigation
- Tail water recycling systems are implemented so that water is reused
- Covering storages to minimise evaporation
- Reducing evaporation by shortening row lengths
- Avoiding unnecessary water storage on farm by only purchasing water as it is needed and not putting water directly into dry storages which soak up water
- Growers are and lining storages and channels with clay or non-porous materials to avoid seepage. Thermal imaging and electromagnetic surveys can be used to identify "leaky" dams, pipes and channels so they can be repaired
- Mulching and stubble retention helps to retain soil moisture, reducing the need for irrigations
- Permanent wheel beds to reduce soil compaction and increase water infiltration
- Implementing software packages such as Water Track (http://www.watertrack.com.au)

Case Study: Craig and Sharon Saunders, Queensland[17]

Craig and Sharon Saunders own and run three irrigated cotton, dryland wheat and grazing properties in the St George area (part of the Balonne River Catchment) in Queensland.

Four years ago Craig joined forces with Justin Schultz of WaterBiz to investigate alternatives to traditional siphon irrigation. As a result Craig and Justin designed and constructed a siphon-less watering utilising pipes through the bank (PTB) with variable rates of flow. Each pipe waters 11 furrows or 12 metres and is designed to suit the 12-metre machinery in use.

It was initially thought that the main motivator for change four years ago was water savings, and a 25 per cent water saving has been achieved. But looking back, the team have realised that the real motivator was actually labour. The team have not only achieved this water saving, but have also had a labour saving of 50 per cent and yield increase of 20 per cent.

Justin has found that the main water savings are not a result of the pipes but actually by optimising the flow rate and the run times. In the 2010–11 season the traditionally lowest yielding farm actually out yielded the original farm for the first time. This improvement was associated with reduced water logging as they are now able to get water on and off fields quickly.

[17] http://www.moreprofitperdrop.com.au/wp-content/uploads/2013/02/Cotton_Water_Story.pdf

Saunders Farming has found a number of benefits of using the PTB irrigation system, including:

- Water savings of 25%
- Labour savings of 50%
- Increased yields of 50% due to less water logging and better water management
- Easily adaptable to existing siphon systems
- Optimising irrigation to eight-hour shifts
- Simpler irrigation

5.4 Rice

The Australian rice industry leads the world in improving water use efficiency. Over the past 20 years, rice growers have drastically improved their water use efficiency, using 50 per cent less water than the global average to produce each kilogram of rice.

Case study: Focus on water use efficiency drives productivity in the rice industry.

Significant investment have been made by industry, in partnership with the Government, in developing new rice varieties – that meet both customer demand and produce more rice using less water per tonne of production.

Given that it often takes more than 10 years to develop a new variety of rice, this has been a sustained commitment by the industry over many years. New varieties have qualities such as shorter grower seasons or improve cold tolerance that mean less water can be used to produce more rice.

YRK5 is one of the latest varieties to hit the paddock and has a much shorter growing season than older varieties – and provides a real opportunity for rice farmers to change their traditional crop rotations, maximise soil moisture availability, and water use efficiency.

For most rice varieties, the ideal planting window is early to mid – October, while YRK5 can be planted up until early December – which means it can be either drill sown or aerially sown into a November harvested canola or cereal crop stubble. While rice growers have sown cereals following rice, the new variety means a rotation of winter / summer / winter crop is now a reality. This harnesses the residual soil moisture from the last cereal irrigation thereby further reducing the water requirements of the rice crop, and the cereal crop benefits from the weed and disease control provided by the anaerobic soil conditions during the rice season.

The new variety also provides greater flexibility in a cropping and livestock system. A 12 month rotation of fat lambs reared on a clover based pasture turned off in early winter; followed by a clover hay crop cut in late spring which can then be sown to YRK5 provides the multiple benefits of three complementary production cycles - with livestock, the nitrogen fixing action of clover, and the weed control benefits of rice.

Case Study: The Herrmanns, Surface Irrigation System Update

Ray Herrmann believes that being able to participate in the On Farm Irrigation Efficiency Program has provided the opportunity to modernise a larger part of his irrigation layout a number of years before he would have been able to by relying on using farm cash flow alone.

"This has been an incredible kick start that means I can now look at increasing the efficiencies over the rest of the farm". Once the momentum builds we are in a much better position to not only keep developing areas of the farm but to continually upgrade the new system as technologies improve. New and more efficient bay outlets are currently being installed in other areas on the farm. Automation of bay outlets will probably be the next step and with this layout and outlet technology, what was once a dream can now be a reality.

There is little doubt in Ray's mind that this modernisation has helped to further increase not only his productivity but the sustainability of the farm and business.

Poor drainage and the ability to get water on and off quickly was always the limiting factor for the efficient operation and production of this farm. This is the main issue that the Herrmann family were looking to overcome with the new layouts.

Ray says, "It has surpassed all expectations".

"The effectiveness of this layout now means we can put beds within the bays, thus opening up a whole range of crop and rotational options that we never had access to before. Since waterlogging and poor drainage are no longer a barrier we can just about grow whatever crop we like"

The higher water use soils previously limited to ponded rice production can now grow alternative crops with less water use as pondage is not required. Cotton is now an additional summer crop grown on beds within the bays on these soil types. In addition rice can now be grown very effectively as a delayed permanent water system. This system alone has additional savings of up to 2ML/ha for the same production.

A single irrigation would use between 1.2 and 1.5 ML/ha with the 'old' system. Now water use per irrigation is down to 0.5ML/ha.

Water savings and greatly enhanced water efficiencies are both a real and measurable benefit of this project.

Case Study: The McDonells, Surface Irrigation System

John, Sharron and son Brad McDonell operate a mixed irrigated farming enterprise at Murrami, within the Murrumbidgee Irrigation Area. John considered there were three factors that were limiting the growth of the family farming business:

- Firstly, productivity was capped due to issues with waterlogging. The layout for rice required water to be ponded in a bay, yet this posed a limitation to his winter crop rotation as it took too long to get water on and off bays. Bays were sometimes under water for up to 40 hours as water backed up into upstream bays when filling the next bay downstream. This limited not only his winter crop yields but also the way he could grow rice.

- Secondly, and as a consequence of the waterlogging issues, his rotation was limited to rice, winter cereals and pasture. There was no flexibility in his rotation to take advantage of market forces, climatic conditions or varying water allocations.

- Thirdly, with the time spent in ground preparation and in watering paddocks, John always felt time poor. Machinery efficiencies in individual bays of around three hectares, with some triangle shaped were very poor. In addition irrigating was a full time job alone, with 120ha requiring water to be changed around 50 times.

Participating in the On Farm Irrigation Efficiency Program has allowed John and Sharron to ad dress what they consider erred limiting factors to the growth of their farm in business.

John says "The Program has certainly allowed us to develop this area a good number of years ahead of what we could have achieved if we were to use our business cash flow. This will help us gain the momentum to help develop the next area of the farm".

So John's verdict having after having experience of putting his new layout into practice. "Our onfarm irrigation efficiency works have delivered far more than we expected. This has ticked all the boxes and more."

After experiencing the severe lack of water and production during the millennium drought, John now sees the production potential and the efficiencies that can be gained with infrastructure improvements. John and son Brad are already gearing up to make a start on the development of the next area of area of development on the farm.

Case Study: The Gribble Family, Surface Irrigation System

Chris and Belinda Gribble of 'Rope' operate an irrigated cropping property near Yenda, in the Murrumbidgee Irrigation Area. Depending on water allocations their rotation is based around rice as the main summer crop, with wheat, canola and faba beans in the winter crop phase.

They began laser land forming paddocks in the early '80's, having a mixture of border check and parallel contour systems. The layout for rice (needing ponded water) always compromised other crops which invariably suffered some degree of water logging during irrigation due to the time required for water to completely drain off the bay. This not only limited yield and subsequent water efficiency, but also the flexibility of the winter crop rotation with winter legumes such as faba beans not an option on the 'rice' layout.

With this in mind Chris participated in the On Farm Irrigation Efficiency Program. He redeveloped an area of his property to not only gain increased yields and water efficiencies, but to provide more flexibility in rotational choices for increased efficiencies within the whole system.

It was originally budgeted that this project would save approximately 37ML/year 33ML was transferred to the CEWH to assist in achieving environmental outcomes for the Murray Darling Basin, however Chris believes this figure is a conservative one with actual water savings higher.

Previously when watering winter crops on the 'old' system, Chris could irrigate around 7ha/day and use1.2ML/ha per irrigation with water staying on a bay for up to 48 hours. Now he can irrigate 20ha/day using 0.8ML/ha per irrigation with water on and off a bay with in 12hours.

5.5 Horticulture

Case Study: The Sergis, Twin Line Drip Irrigation System

John Sergi manages his family's citrus orchards in Tharbogang, a few kilometres west of Griffith, New South Wales. Their project, undertaken in Round 3, involved converting the irrigation system on 91ha of orange trees on Farm 1784 from furrow to the more efficient twin line dripper system.

Before the conversion, John's citrus was watered by the traditional open furrow system, where water is flooded via gravity from a head ditch into furrows that run beside the tree line. This flooding irrigates the whole root zone and surrounding area of the tree. John found it often difficult to manage as he had little control. Over the quantity of water supplied and found as a result watering was often uneven and wasteful.

John is thrilled with the huge water savings he is achieving. His water use went from 560 ML in 2013 and 486ML in 2014 using his furrow irrigation to 280ML in 2015 after the drip system was installed and 261ML in 2016. In addition, the flexibility of management means not only the right amount of water and nutrients can be applied at the right time, but also other operations such as spraying and picking can be done without delay. These opera tons can even now be done whilst the trees are being ire gated.

John said "The on Farm Irrigation Effy cogency Program has allowed us to upgrade this whole section of the orchard at the one time. This would have been very difficult to achieve out of cash flow alone. Having the funds available from OFIEP has enabled us to install an efficient system without disrupting normal business ac trinities or putting strain on financials, and saving water at the same time."

Case Study: The Turnells, Drip Irrigation System

Barry and Yvonne Turnell own and manage a 19Ha citrus farm just west of Griffith. Barry's citrus was watered by the traditional open furrow system, that is, water is flooded via gravity from a head ditch into furrows that run beside the tree line. This flooding irrigates the whole root zone and surrounding area of the tree. Other than managing irrigation frequency, Barry had little control over the amount of water applied with each irrigation. In addition, since the whole area around the tree was watered, access and traceability was severely limited. Therefore, when the farm was being irrigated, other activities like picking and spraying had to be postponed until the soil around the trees had dried out sufficiently. This delay in spraying operations and picking often resulted in poorer fruit quality and profitability.

Barry was keen to be involved in the OnFarm Irrigation Efficiency program because the new hi-tech drip system is a better all-round management tool and it would allow him increased flexibility particularly through the vital harvest times.

"I am very happy with the new system as I can now properly manage the amount of water each block gets". Barry estimates the new system has cut his water use by about 60% of his previous water use. Also since water and nutrients can now be applied at the optimum volume and frequency, the results in tree health and production are better on a per megalitre basis. This combined with the fact that other operations such as spraying and picking can be done at the optimum time without having to wait for the orchard to dry out (as was the case with the furrow irrigation system) means overall orchard productivity has increased substantially.

Barry believes the On Farm Irrigation Efficiency Program has been a win: win all round. He has been able to modernise his farm a lot earlier than he would have managed if he had had to fund the whole project himself; his orchard is much more productive and operations can be carried out in a timelier manner; the orchard now has the ability to be irrigated remotely so trees can be watered when they require, not what fits in with his busy schedule.

Finally, real water savings have been achieved of over 47.5 ML annually in a more productive and easier to operate orchard.

5.6 Cane

While outside the Murray-Darling Basin, the Australian cane industry has also made significant improvements in water use efficiency.

More than 60% of all cane production is irrigated. Irrigation is costly, with water and associated pumping costs accounting for one third of all costs. The cane industry recognises that saving water is good business and environmentally responsible.

Water Use Efficiency is a key element of "SmartCane" – the industry led best management practice program. Under BMP, practices are promoted that improve water use efficiency and productivity and include:

- soil moisture monitoring
- efficient in-field application such as drip and trickle systems, as well as low-pressure, overhead irrigation systems
- recycling and reuse of water in tailwater dams that has the added benefit of reducing off-farm movement of nutrients

6. Achieving greater water use efficiency of environmental flows

It is the view of the NFF that there are still many gains to be made in relation to the efficient use of environmental water and the management of environmental flows. The goal must be to deliver improved environmental outcomes from the portfolio of water that has already been recovered for the environment – in essence more environmental outcome per unit of water held and delivered.

We recognise that the active management of an environmental water portfolio is still a relatively new endeavour for Governments, and continuous improvement has been a focus for agencies such as the Commonwealth Environmental Water Holder, and state based equivalent entities.

However, continued concerted effort is required to ensure that we make the most of the water that has been recovered from production for the benefit of the environment. In NFF's view, further opportunities to maximise the outcomes from water held by ensuring:

- sound processes to identify water priorities, including the opportunity for local knowledge of systems to be incorporated
- continued investment in the science and knowledge to better understand how environments have respond to water events and the optimal watering regimes for specific ecosystems
- ensuring that we monitor for any unintended consequences of environmental water and how these could be avoided or managed in the future. Blackwater events and carp population explosions are examples of this.
- Effort is focused on non-flow opportunities to improve outcomes.

Better outcomes can be achieved if 'non-flow' issues such as addressing cold water pollution (see case study below) and fish passage, controlling feral animals in key wetland and floodplain areas, and tackling carp infestations. Improving land management in valued ecosystems is also important (see case study below). These opportunities have been partially recognised by the Murray Darling Basin Authority, which as part of its Northern Basin Review process included recommendations for a 'toolkit' of complementary measures to achieve improved water management in the north basin[18]. In NFF's view, the toolkit is narrow in focus, and realistic alternatives to achieve environmental outcomes remain largely unexplored. These opportunities must be pursued as a priority, rather than a continued focus on water recovery.

Recommendation 5: The Committee recommends that Government explore to the full extent possible non-flow complementary measures that can enhance the ability to deliver outcomes from the environmental water portfolio that is already held by the Commonwealth.

[18] https://www.mdba.gov.au/sites/default/files/pubs/Northern-basin-review-report-FINAL.pdf

Burrima – a case study in sound ecological management[19]

The purchase and subsequent management of a property in central NSW illustrates the potential and advantage of complementary environmental measures in managing water and land.

In 2005 a group of landholders in the Macquarie Valley banded together to form the Macquarie Marshes Environmental Trust (MMET), with the purpose of buying a small, 259ha property outside Warren in central NSW.

The MMET named the property 'Burrima', which means 'black swan' in the language of the Wailwan People, the traditional Aboriginal owners of the Macquarie Marshes.

More than 150 years of settlement and farming had taken its toll on Burrima, and the Macquarie Marshes in general. European settlement in the 1840s brought animals with it, and this intrusion significantly affected the district. In some areas, overgrazing by sheep, cattle and rabbits had removed all vegetation, exposing the topsoil which then blew away to reveal bare claypans.

In dry years cattle lived in the reed beds, eating vegetation and trampling pathways which then eroded into channels during the next wet spell. Water travelling down these channels no longer flooded into the reed beds, which then died. By 1963, an estimated 60% of the reed beds of the South Marsh – close to 2200ha had been lost. Significantly, this occurred before the construction of the Burrendong Dam, which had been blamed for the loss.

In the 1970s, huge areas of the Macquarie Marshes were cleared for pasture and cropping. In addition, since the 1980s farmers actions to block waterways or add levees to increasing flooding of their land had inadvertently reduced flooding of downstream wetlands.

However, things changed after 2005 when the MMET implemented a plan to de-stock Burrima and return the land to sound environmental health.

The remediation of Burrima is important because, although small in area, the property exemplifies the diverse range of vegetation to be found in the Macquarie Marshes, and how landholders working to a sound ecological plan can help restore the land to health.

There are four main terrain-and-vegetation types at Burrima, and the MMET applied different strategies to remediate each: By implementing these measures, among others, the MMET was able to return the natural wet-and-dry cycle to Burrima, improving the flora and fauna health of the property.

The MMET continues to manage Burrima for conservation outcomes, and hopes to expand its landholding to remediate and preserve more marshlands into the future.

[19] https://farmers.org.au/content/nff/en/community/blog/Burrima-a-case-study-in-sound-ecological-management-02022017.html

Fixing cold water pollution to let fish breed[20].

Cold water pollution is the artificial lowering of water temperatures that commonly occurs downstream of large dams. This is because the outlets for most dams are at the bottom of the dam wall, resulting in the release of the cold water from the depths of the dam. It's estimated in NSW that water temperatures can be between 10 and 17 degrees colder as a result of cold water pollution.

The breeding cycle of many native fish species is finely tuned to the spring warming of water, which triggers spawning. Native fish generally have well defined, and often narrow temperature windows for spawning, and for the successful recruitment of juvenile fish. The cold water released from the bottom of dams means that often the temperature window for spawning is never – or rarely achieved. Unsurprisingly, many invasive fish species – like carp - are able to breed very successfully in the colder temperatures.

Even if native fish are able to breed, cold water pollution can significantly reduce their chance of survival. A study by NSW Fisheries[21] at Burrendong Dam showed that silver perch had a 100% survival rate in in the warm water releases (18 to 24ºC) compared to a 25% survival rate in the cold releases (12 to 14ºC).

Raising water temperatures offers a high probability of inducing significant beneficial response within aquatic ecosystems: higher productivity at all trophic levels; a greater number of native fish breeding events; more successful breeding events; and greater diversity of aquatic invertebrates, fish and other cold-blooded animals such as turtles and frogs

In the NSW portion of the Northern Basin, Pindari, Copeton & Keepit Dams have all been identified by the NSW Government as dams with significant potential to cause cold water pollution. Glenlyon Dam, in the upper reaches of the Dumaresq River on the NSW Queensland Border is another.

We've known for decades that fixing cold water pollution is important for particularly for improving outcomes for native fish, and yet, with the exception of Burrendong Dam on the Macquarie River, little has been done in the Basin to address it

While often the water debate is polarising and pitched as environment versus irrigators, there are emerging opportunities where environmental outcomes and productivity outcomes can be achieved from the **same** drop of water. The case study of the Bitterns in Rice project below highlights this concept in more detail.

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[20] Adapted from https://farmers.org.au/content/nff/en/community/blog/cold-water-pollution-native-fish-041016.html

[21] For more see http://www.dpi.nsw.gov.au/fishing/habitat/threats/cold-water-pollution

Growing bittern friendly rice.

The drive for irrigation water use efficiency has seen the development of new agronomic practices within the Australian rice industry. The adoption of new short season rice varieties and the adoption of "delayed permanent water" management by Riverina rice farmers is allowing a reduction in water use of up to 2.5 megalitres per hectare against traditional aerially seeded rice.

In water use efficiency terms this is a remarkable achievement however as Riverina rice crops support the largest known population of the internationally threatened Australasian Bittern this saving is reducing the period of flooding within rice fields. A reduced ponding period delays the natural development of prey (bittern food) in the crop and reduces the time these birds have to nest and have the offspring fully fledge. The widespread adoption of "delayed permanent water" and the planting of short season rice varieties will significantly reduce Riverina rice fields capacity to provide the surrogate wetlands that will be necessary to assist the recovery of this critically endangered waterbird.

As shown in the Central Valley of California, the use of rice farming irrigation infrastructure (layouts) can create surrogate wetlands out of rice fields. These are ponded by the efficient supply of environmental water through irrigation infrastructure at controlled depths and for targeted timeframes. This practice is providing habitat for hundreds of thousands of waterbirds, comprising over 230 water bird species including migratory waders.

Australian rice growers want to support the recovery of the Australasian Bittern however as water is the most significant input cost they will need to receive support so they can provide the ponding period required for successful Bittern breeding. Through the Bitterns in Rice Project, opportunities to recognise the additional costs to growers of producing Bittern Friendly rice continue to be explored.

To quote lead ecologist for the Bitterns in Rice Project, Matt Herring[22]:

"The overly simplistic division of water, with one bucket for the environment and another for agriculture, belies an awful lot of ecological reality and foregoes valuable opportunities for integrated management".

Recommendation 6: The Committee recommends that Government further explore opportunities for integrated management of water that can deliver productivity and environmental outcomes.

[22] Herring, M (2017) *Rice Friendly Bittern Farming* a blog first published on Australian Farmers https://www.farmers.org.au/content/nff/en/community/blog/rice-friendly-bittern-farming-24022017.html

Appendix A – Benefits and Costs of the Farm Water Program

Farm Water Program overview

The Farm Water Program (FWP) is a consortium of State and regional Victorian partners led by the Goulburn Broken Catchment Management Authority. The FWP helps irrigators in northern Victoria increase production and water efficiency by modernising their farm irrigation systems.

Since 2010, the FWP has secured more than $200 million from the Australian Government's On-Farm Irrigation Efficiency Program ($46 million); the Victorian Government's NVIRP ($16 million); the Victorian On Farm State Priority Projects initiative ($43 million); and the Victorian Farm Modernisation Project ($100 million).

The FWP is one of several delivery partners in the southern Murray-Darling Basin that has secured OFIEP funding. It has funded the majority of OFIEP upgrades in northern Victoria, particularly in the Goulburn Murray Irrigation District, but other delivery partners have also funded farm upgrades in the region as well. Upgrades almost always involve part, not all, of the farm area, and any productivity gains are limited to the upgraded area, not the whole farm.

FWP water savings are shared between farmers and the environment, with participating farmers transferring entitlements equal at least half the savings to the Federal or State Governments for the environment.

Since 2010, the FWP has funded 524 projects, comprising

- 301 dairy farms
- 73 mixed farming
- 101 grains, 38 beef & sheep
- 11 'other'.

The FWP has generated 69GL in water savings, including more than 30GL in water entitlements that farmers have transferred to the Commonwealth as part of meeting Victoria's share of water recovery targets for the environment under the Murray-Darling Basin Plan.

FWP case studies, business as usual

Case studies[23] developed through the FWP indicate that a modernised farm, connected to a modernised supply system[24] and continuing with the same crops as before, can achieve:

- A 2 ML/ha water saving (from an average 12 ML/ha down to 10 ML/ha, an 16% saving) (Water saving range across all FWP projects: 0.5ML/ha – 3.6 ML/ha).

[23] '2016 - February - Farm Water Program - Case Studies - All Rounds - Summary' https://www.gbcma.vic.gov.au/publications/published_documents/farm_water_program#casestudies.

[24] Pers. Comm Charles Thompson, FWP evaluation consultant for GBCMA.

- Increased pasture yield of 2.2 tonnes of dry matter DM per hectare (from an average 11 tonnes DM/ha up to 13.3 tonnes DM/ha, a 20% gain) (productivity range 0 – 7 tonnes DM/ha).
- An 0.4 tonnes DM increase per megalitre of water used (from an average 0.9 tonnes DM/ML up to 1.3 tonnes DM/ML, a 44% increase) (productivity range 0 – 1.1 tonnes DM/ML)
- An average $300 per modernised hectare increase in gross margin (range $0/ha -- $600/ha)
- Labour savings of $140 per hectare (at $25/hr) (range $0/ha to $400/ha).

The total additional annualised cost per upgraded hectare is an average $500/ha (range $200/ha -- $1000/ha).

The additional annualised benefit per upgraded hectare is an average $700/ha (range $200/ha to $2000/ha).

The Net Present Value per hectare of the upgraded system was $2000 (range -$2000 to $18,000. The NPV accounts for the effective life of the system over 30 years, including water savings and benefits.

All the above added up to a Benefit-Cost ratio of 1.5 (range across all case studies 0.6 to 3.5).

FWP case studies, changes in crop and production systems.

In almost every FWP case study, however, participants changed the crops and pastures they were growing as the upgraded systems could support species and cultivars that couldn't be grown before.

The change meant using more water per hectare than the species grown before the upgrade, more than offsetting the water saving gain from the works, but delivered a higher gross margin than staying with the old crops and pastures.

The case studies[25] developed through the FWP indicate that a modernised farm, connected to a modernised supply system[26] but with changing their crops and pastures, are:

- Increasing their water use by an average 0.5 ML/ha (from an average 12 ML/ha up to 12.5 ML/ha, a 4% increase) (range across all case studies: plus 0.8ML/ha -- minus 3.4 ML/ha).
- An average $600 per modernised hectare increase in gross margin (range $0/ha -- $210000/ha)
- Labour savings of $90 per hectare (at $25/hr) (range $0/ha to $300/ha).

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[25] '2016 - February - Farm Water Program - Case Studies - All Rounds - Summary' https://www.gbcma.vic.gov.au/publications/published_documents/farm_water_program#casestudies.

[26] Pers. Comm Charles Thompson, FWP evaluation consultant for GBCMA.

The total additional annualised cost per upgraded hectare, with the change in crops and pastures, was still an average $500/ha (range $200/ha -- $1000/ha).

Similarly, the additional annualised benefit per upgraded hectare was still an average $700/ha (range $200/ha to $2000/ha).

However, the increased water use meant the Net Present Value per hectare was $2000 (range -$2000 to $18,000), down from the $3000 NPV for the business as usual scenario above.

This meant a lower Benefit-Cost Ratio at 1.3 (range across all case studies 0.6 to 3.5).

Individual BCR versus broader market and other impacts

The benefit cost-ratio for individual participating farmers does not take account the broader impacts on water availability and price in the market resulting participating farmers transferring entitlements to the environment in return for the government co-investment in the works, and thereby reducing the total irrigation pool available for use, trade or carryover.

Nor does the benefit-cost ratio take account of the pricing implications for shared irrigation districts from less water being used, and therefore less revenue for the water corporation to maintain the off-farm supply infrastructure.