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Water Reform: Socio-economic effects of investment in water infrastructure in the Murray-Darling Basin

Findings from the 2018 Regional Wellbeing Survey

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WATER REFORM: SOCIO-ECONOMIC EFFECTS OF INVESTMENT IN WATER INFRASTRUCTURE IN THE MURRAY-DARLING BASIN

FINDINGS from the 2018 Regional wellbeing survey

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INTRODUCTION

This report is part of a series examining socio-economic effects of investment in water infrastructure as part of the Murray-Darling Basin Plan (Basin Plan) and associated water reforms. It examines the socio-economic effects of modernisation of on-farm and off-farm water infrastructure, focusing on irrigators, and also examines irrigator's motivations and future intentions related to modernisation of irrigation infrastructure.

METHODS

Data from the 2018 Regional Wellbeing Survey (RWS) was drawn on to examine social effects of investment in on-farm and off-farm water infrastructure modernisation. In total, 657 irrigators participated in the 2018 survey, including 412 irrigators located in the Murray-Darling Basin, and 235 living outside the Basin. A comparison of the 2018 RWS sample with benchmark data from the Australian Bureau of Statistics (ABS) confirmed the RWS sample was broadly representative of the geographic distribution of Basin irrigators based on available information, other than slight over-sampling of irrigators in the Victorian Basin.

IRRIGATORS IN THE MURRAY-DARLING BASIN

The socio-economic impacts of water reform on irrigators can differ depending on the nature of their farm enterprise. Irrigated farm enterprises operating in the Basin are highly diverse, both in terms of geographic and economic size of the farm enterprise, and in terms of the production systems used and products harvested.

Farm and farmer characteristics

Irrigators in the Northern Basin typically operate larger enterprises than those in the Southern Basin, and are more likely to pump water directly from rivers/waterbodies or rely on groundwater compared to those in the Southern Basin. Cropping and beef irrigated enterprises are more common in the Northern Basin, and horticultural and dairy enterprises more common in the Southern Basin. However, despite Northern Basin irrigation enterprises typically being larger than those in the Southern Basin in terms of gross value of agricultural production (GVAP), the proportion of Northern Basin irrigators reporting GVAP below $100,000 rose from 27% in 2016 to 39% in 2018, likely reflecting impacts of drought. Very low GVAP (<$40,000) was most commonly reported by irrigators in the Northern Basin, and in the Goulburn Murray Irrigation District (GMID) (28% and 27% respectively, compared to an average of 23% for all irrigators). Just over one-quarter of Basin irrigators (26%) self-reported that their farm made a loss on average over the last three years, while just over half (53%) reported either breaking even or making a small profit, and 22% reported making a moderate to large profit. Irrigators living in the GMID were most likely to report making a loss (34%).

Irrigators who operate in irrigation districts generally report a much higher proportion of farm expenditure on irrigation water costs compared to those who pump water directly from rivers/waterbodies or use groundwater for irrigation. The proportion of farm expenditure spent on irrigation water was highest in Southern Basin irrigation districts, with

38% and 44% of irrigators in the GMID and Murray Irrigation Limited (MIL) districts respectively reporting that more than 30% of farm expenditure was on water, compared to only 17% of those in the Northern Basin.

Socio-demographic characteristics of irrigators in general varied less than water use and farm characteristics. Only one in three irrigators lived in households in which 100% of income is earned on farm, with one or more of the household often working off farm. Of the irrigators who responded to the survey, 48% had an off-farm job (a further 20% reported that one or more other household members worked off-farm while they did not). Irrigators, like farmers more generally, are typically aged over 50. One in five irrigators reported being in relatively poor health (20%), while 34% reported good health and 46% very good or excellent health. Those in the GMID were more likely to report poor health (24%) and less likely to report very good health (41%). Thirty per cent of irrigators reported experiencing one or more household financial stress events in the previous 12 months, such as being unable to heat or cool their home, or being unable to pay bills on time. Amongst Basin irrigators, 29% indicated they were very likely to retire in the next five years, while 23% were a little likely to, and 48% unlikely to.

Irrigation water sources

Irrigators in the Basin variously source irrigation water from irrigation channels, water pumped directly from rivers or lakes, or groundwater. They may own their own entitlements and use the water allocated to those entitlements, buy water allocation on the water market, or lease water entitlements (and the water allocated to them in a given water year) from their owners. Many irrigators use a mix of water sources and types to irrigate.

Seventy-three per cent of Basin irrigators rely on a single source of irrigation water (channels, pumping or groundwater) while 27% report using more than one of these. Using multiple sources is more common amongst Southern Basin irrigators compared to Northern Basin irrigators and those living outside the Basin. Use of irrigation channels was most common in the Southern Basin, while groundwater was most commonly used by irrigators outside the Basin (52% compared to 30% of Basin irrigators), and direct pumping was most common in the Northern Basin (55%) and less in the Southern Basin (32%). Use of irrigation channels only with no reliance on other water was most common amongst Southern Basin irrigators operating within irrigation districts, with between 58% and 68% of these irrigations relying on water delivered via irrigation channels.

Those with GVAP of $1 million or more were more likely to report using multiple sources of water, being similarly likely to report using irrigation channels as those with smaller farms, but much more likely to directly pump water (56% compared to 40% or fewer amongst farms of smaller sizes). Those who drew water from irrigation channels were much more likely to report a large proportion of farm expenditure being on water than those drawing water from other sources: 87% of those who reported farm expenditure of 30% or more on water relied at least in part on water from irrigation channels, compared to 35% of those who reported less than 10% of farm spending being on irrigation water.

Basin irrigators predominantly rely on use of water from entitlements they own, although almost 40% access at least some water through purchase on the temporary market, 9% lease entitlements from others, and some use other water sources. Those outside the Basin have much less access to water markets, and within the Basin the majority of market

purchase of temporary water occurs in the Southern Basin, with fewer opportunities for water purchase in the Northern Basin.

Modernisation of on-farm irrigation infrastructure with assistance of grants has more commonly occurred amongst irrigators relying on water from irrigation channels than from pumping or groundwater. Of those Basin irrigators who had modernised using grants since 2008, 76% used water from irrigation channels, compared to 54% of those who had not modernised. Those who have not modernised are less likely to use water from multiple sources and are less likely to engage in using water from any source other than their own entitlements (only 18% reported purchasing water allocation on the market compared to 35% of those who had self-funded modernisation activity, and 58% of those who had modernised with assistance from a grant).

Irrigation water use change and market activity

Irrigators were asked whether since 2013 their total irrigation water use had decreased, stayed about the same other than seasonal variation, or increased. Twenty eight per cent of Basin irrigators reported having decreased their irrigated water use since 2013, compared to 12% of those outside the Basin, while 18% reported increased water use, compared to 20% of those outside the Basin. Within the Basin, decreases in water use were more commonly reported by NSW Southern Basin irrigators, and least commonly by Northern Basin irrigators.

Those growing broadacre crops and those operating enterprises with a GVAP of $1 million or more were more likely to have increased irrigated water use than those running other types of farms or with smaller turnover. Forty-two per cent of those making a loss on the farm reported having decreased water use over the long-term, compared to only 23% of those who reported their farm made a moderate to large profit on average over the past three years.

Those who had modernised on-farm irrigation infrastructure with a grant were more likely to report having increased water use (23%) than those who had modernized without a grant (18%), or those who had not modernised infrastructure since 2008 (7%). Those who had modernised a greater proportion of their water infrastructure – with or without assistance from a government grant – were more likely to have increased water use than others.

Those irrigators who reported their volume of irrigation water used had increased in the past five years were asked how and for what purpose they had increased water use. Overall, increase in water use was more commonly achieved through increased use of temporary water bought on the market (40% of irrigators) than by purchase of additional entitlements (16%). Around one-third of irrigators reported they increased water use in order to irrigate a larger area of land, one-third more intensively irrigated land they already irrigated, and the other third used additional water as part of change in the type of crops/pasture grown on their land.

A key characteristic of those who had increased water use was that they were much less likely to rely solely on water entitlements they owned compared to those who had not increased water use. Sixty-two per cent of those who increased water use bought allocation on the temporary market (usually in addition to using their own water entitlements), compared to only 33% of those whose water use stayed about the same, and 38% of those whose water use had decreased.

Irrigators were asked about water market and trading activity other than purchase of water allocation in the last 12 months. Purchase of water entitlements was more commonly done by Northern Basin irrigators, grain growers, those operating enterprises with GVAP of $1 million or more, those making a profit, those who reported higher total volumes of water use, and those who had modernised on-farm infrastructure, and less commonly done by those who had not modernised. A variety of irrigators reported selling or transferring water entitlements, with less clear differences between different irrigators than for purchase of water entitlements. Selling water allocation on the temporary market was most commonly reported by those in the NSW Southern Basin. Those who had modernised a smaller proportion of their enterprise were slightly more likely to report selling allocation on the market, as were those running smaller sized enterprises (less than $500,000 GVAP), and with moderate water use (100-299 megalitres (ML)), while dairy farmers were much less likely to report doing this than other types of farmers.

Farm expenditure

Basin irrigators on average reported that 20% of their farm expenditure was on water for irrigation, compared to just over 10% of expenditure on average amongst irrigators outside the Basin. Water costs made up a higher proportion of farm expenditure for Southern Basin irrigators than Northern Basin irrigators (21% compared to 13%). For most irrigators, power costs represented around 10% to 12% of expenditure, and were on average slightly higher for those who had not modernised on-farm infrastructure compared to those who had, and for those using groundwater compared to those drawing water from irrigation channels or pumping directly from rivers/dams.

ON-FARM WATER INFRASTRUCTURE MODERNIZATION

Many irrigators invest in improving their on-farm water infrastructure. The extent of engagement in on-farm modernisation was examined, and the effects of modernisation for irrigations examined.

On-farm infrastructure modernisation by landholders since 2008

The majority of Basin irrigators – 79.4% – reported engaging in some form of on-farm irrigation infrastructure modernisation since 2008. This is higher than the 56% who reported having done this in 2016, and 59% in 2015. The difference in the figure is likely due primarily to a change in how this question was asked in the survey: in 2018, the survey asked the irrigator if they had done any of a number of specific actions, and this appears to have prompted irrigators to recognize actions they have invested in as falling into the definition of upgrading or modernising infrastructure. Of the 79.4%, 54.2% did not receive assistance from a government grant, while 19.4% received assistance from a grant (all of which were likely to have been from the Sustainable Rural Water Use and Infrastructure Program (SRWUIP), although it is possible a small number received grants from other programs that were run in the same regions as SRWUIP-related grants).

Southern Basin irrigators were much more likely to report receiving a grant to assist them in some modernisation activities than those in the Northern Basin or outside the Basin. Those who received grant assistance on average reported having modernised a larger proportion of their irrigation area compared to those who had not received grant assistance.

Irrigators who hadn't modernised were more likely than those who had modernised some or all of their irrigation infrastructure to live outside the Basin (33%), have a GVAP below $40,000 (40%), be making a loss on the farm (27%), rely primarily on groundwater (33%), use less than 100 ML of water (36% of those using less than 30 ML and 34% of those using 30-99 ML in 2017-18), and to earn 76% or more of their household income off-farm (32%).

Irrigators were most likely to report having self-funded modernisation activities since 2008 if they lived in the Northern Basin (69%), were grain growers (58%), had GVAP of between $500,000 and $999,999, relied partly or wholly on groundwater (59%) and/or earned all household income on the farm (57%).

Irrigators were most likely to report having modernised with assistance of a grant since 2008 if they lived in the GMID (31%) or MIL (30%), were dairy farmers (39%), had GVAP of $1 million or more (46%), reported a moderate or large profit over the last three years (34%), and/or relied primarily on water from irrigation channels (32%). Most irrigators who modernised with grant assistance also reported having self-funded modernisation activities, with the majority reporting having engaged in more than one type of modernisation activity.

Irrigators were also asked more specifically what types of modernization they had invested in since 2013 – in other words, more recent investment activities. This was asked as in many cases farmers engage in rolling investment: some of those who had modernised since 2008 may have invested recently (since 2013) while others may have invested some time ago and potentially be more likely to be considering further work.

Since 2013, 39% of irrigators had not modernised any part of their on-farm irrigation area (and 38% of those in the Basin), while 14% had modernised 1-19%, 18% had modernised 20-49%, 14% (and 15% in the Basin) had modernised 50-74%, and 14% had modernised 75% or more. Irrigators were more likely to report not modernising any on-farm infrastructure since 2013 if they lived in the Victorian Basin (44%), were graziers (46%), had GVAP of below $40,000 (49%) or $40,000 to $99,999 (50%), were making a loss on the farm (48%), relied primarily on groundwater (47%), were aged 75 or more (47%), and/or earned 26% or more of their household income off farm (45% to 47%).

Irrigators were most likely to have modernised 75% or more of their infrastructure since 2013 if they had a GVAP of $1 million or more (25%), were making a moderate to large profit (22%), spent a greater proportion of farm expenditure on irrigation water (16% of those who spent 20-29% of farm expenditure on water, and 15% of those who spent 30% or more), or had a tertiary qualification (19%).

On-farm modernisation – types of investment made

Irrigators were asked if they had undertaken any of several types of modernisation. The most common types reported by Basin irrigators (Table 27) were landforming (45%), improvement of farm drain re-use systems (such as increasing water run-off captured for re-use, 41%), improving irrigation channels to reduce leakage (36%), upgrading water metering (28%) and converting from manual to automatic irrigation systems (23%). Less than 20% of irrigators reported undertaking other types of modernisation including upgrading existing automated control systems (19%), introducing fertigation (13%), upgrading drip systems (12%), converting to drip-based systems from another system (10%) or converting to or upgrading overhead irrigation (7% and 8% respectively). Those who modernised with assistance from a grant were more likely than others to report doing all of the actions asked

about and were particularly more likely to report having modernised using landforming, upgrading metering, and improving farm drain re-use.

Benefits and costs of modernising on-farm infrastructure

Irrigators who had modernised on-farm water infrastructure were asked whether the works had any of a number of effects on their farm enterprise. Similarly to past years, the majority of Basin irrigators who had modernised on-farm water infrastructure since 2008 (84%) felt the works had a positive impact on their farm enterprise as a whole. The majority (65%) felt it was positive for their farm profitability, 89% that efficiency of water use had improved, and 73% that farm productivity had improved.

Similarly to past years, the area where most negative impacts were reported was in impacts on electricity/power costs, with 40% reporting negative impacts; however the large majority of these reported that overall impacts on the farm enterprise were positive, even if they reported negative impacts on power costs (or on other aspects such as farm debt levels). For example, of the 61 irrigators reporting a negative impact on water costs, only 23% felt on-farm modernisation was negative for their farm overall, while 30% felt it had neutral and 48% that it had positive impacts. Overall this suggests that on-farm modernisation is positive for the large majority of irrigators, with or without a grant; and that those who have modernised with assistance from a grant typically rate the impacts more positively than those relying on self-funding alone.

Irrigators who had / had not modernised were compared to see if there were observable differences in their farm management, experience of barriers to farm development (such as drought), future farming intentions, confidence in being able to achieve desired outcomes on the farm, self-reported farm financial performance, or wellbeing.

When asked about farm management changes made in the last 12 months, there were relatively few differences between those who had / had not modernised on-farm irrigation infrastructure. Between 10% and 14% of all irrigators had implemented long-term decreases in irrigation water use, irrespective of modernisation activity, and between 3% and 13% had increased irrigation water use in the long term, with those who had modernised more than 50% of their irrigation area most likely to report doing this (13%), but this difference is not statistically significant. Those who had modernised were more likely to report intensifying land use than those who had not (21% of those who modernised with a grant compared to 9% of those who had not modernised) and to report investing in major new machinery or equipment.

When asked about barriers to farm business performance experienced in the last three years, those who had engaged in modernisation of on-farm water infrastructure were more likely to report lack of access to reliable power (18% compared to 3% of those who had not modernised), lack of access to three-phase electricity (13% compared to 3%), high price of temporary water causing barriers to farm development (67%-70% compared to 51%), barriers related to rising costs of inputs other than water, lack of land available to buy or lease to enable farm expansion, lack of water allocation to buy on the market, and lack of adequate telecommunications infrastructure. Those who had not modernised were more likely to report experiencing lack of demand for their produce (19% to 21%).

When asking about their future farming intentions, those who had not modernised were more likely to be planning to leave farming for either retirement or other reasons, and to

downsize their farm business and/or de-intensify production. Those who had modernised were more likely to be planning to expand their farm business and intensify farm production.

Those who had modernised on-farm infrastructure were consistently more confident in their ability to achieve almost all aspects of farm management objectives in the next few years, including achieving the things they wanted to, meeting farm business objectives, making the right decisions about farm management, handling changing market conditions, and maintaining and improving the health of vegetation. However, they were not more confident in their ability to cope well with difficult conditions such as drought.

In general, those who had modernised on-farm water infrastructure felt more positive about their farm financial situation, were more likely to report being satisfied with farm business performance and to report a farm profit of $50,000 or more in 2017-18, while those who had not modernised were more likely to report making a loss or breaking even. However, those who had modernised were significantly more likely to report their farm business was under a lot of financial stress at the time of completing the survey compared to those who had not modernised.

When the wellbeing of those who had / had not modernised was compared, those who had modernised reported on average higher wellbeing than those who had not for multiple aspects of wellbeing. While not always statistically significant, the differences were highly consistent. This may reflect both that those with higher wellbeing are in a better position to modernise in the first place, and/or that modernisation may support wellbeing through better enabling irrigators to achieve desired farm outcomes.

MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

The purpose of SRWUIP on-farm modernisation grants was to support more rapid growth in water efficiency of on-farm water infrastructure through enabling modernisation to occur earlier than it would have in the absence of the grant. It is likely some irrigators would not have done the works without a grant, while others would have undertaken works in the absence of a grant, but may have taken a longer time to do so and/or only been able to fund a smaller scope of works than occurred with the grant.

In total, 48% of grant recipients (whether located within the Basin receiving a SRWUIP grant or outside the Basin receiving a different grant) felt they would not have done any of the works without the grant. Grant recipients were more likely to report this if they lived in the GMID (59%), or were making a loss on the farm (68%). In total, 52% of irrigators felt that if they hadn't received the grant they would still have done the works but it would have taken longer. Grant recipients were more likely to report this if they lived in the NSW Southern Basin (65%), in the Southern Basin not in an irrigation district (63%), or were directly pumping water from rivers or dams (78%). Sixty per cent of irrigators, and 64% of Basin irrigators who had received a grant, felt that the grant let them do more modernisation works than they would have otherwise. This was more common amongst those in the Southern Basin (67%), particularly in the Victorian Basin (68%), those engaged in horticulture (78%), those with GVAP of $1 million or more (73%), those making a farm loss in the last three years (80%), those who spent less than 10% of farm expenditure on irrigation water (74%), those using irrigation water from channels or direct pumping (68%), and irrigators aged under 55 (74%). Thirty-six per cent of all grant recipients, and 34% of

Basin grant recipients, felt they would have done all the works even if they hadn't received a grant to help.

Overall, the views reported by irrigators suggests that for half, receiving a grant enabled them to do works when otherwise none or very few would have occurred, particularly for those experiencing financial stress and living in the GMID. For 50-60%, some works would have occurred in the absence of receiving a grant, but the works would either have been done some time later than they occurred, or a smaller scope of works undertaken, indicating that grants assisted in bringing works forward from when they otherwise would have occurred. Just over one in three would have done works irrespective of the grant.

Motivations for modernising

Irrigators were asked about motivations for past on-farm modernisation investments. Improving crop/pasture growth or health was the most common motivator, reported by 77% of all irrigators, and 76% of Basin irrigators, particularly Northern Basin irrigators (87%), those moderning 20-49% (91%) or 50-74% (86%) of their irrigation area since 2013, and those aged 45 to 54 (87%). Expansion of farm production was the least common motivator, but was still a factor for a majority (62%) of irrigators who modernised (61% of those living in the Basin). Reducing irrigation costs was a motivator for 64% of all irrigators, and 67% of those in the Basin. Improving productivity during times of low water availability was a motivator for modernisation by 72% of irrigators and 75% of Basin irrigators. Reducing labour time was a motivator for 71% of irrigators and 74% of those living in the Basin, particularly those with GVAP of $1 million of more (84%), and those earning none of their household income off-farm (80%). Reducing total water use on the farm was a motivating factor for 63% of irrigators, increasing to 66% of Basin irrigators, and 73% of Northern Basin irrigators.

These findings highlight that most irrigators who modernise have more than one motivating factor driving their decision to do so, with a mix of improving productivity, improving crop/pasture growth and health, and reducing labour time the most common motivators. Expansion of farm production was a common motivator, but more so for larger farmers making a profit on the farm, while reducing irrigation costs was a more common motivator for those irrigators who were making a loss and for whom water costs represent a high proportion of total farm expenditure.

Who intends to modernise in the next five years?

Irrigators were asked about their future plans to modernise their on-farm water infrastructure. Twenty-nine per cent of Basin irrigators did not feel more modernisation of irrigation infrastructure was needed on the land they manage. Half of irrigators (51.1%) agreed they would like to do more modernisation works in the next one to two years, while 57% would like to in the next three to five years. This was more common amongst Northern Basin irrigators (61% and 70% respectively for modernising in one to two and three to five years), those who had already modernised 20% or more of their irrigation area since 2013 (59% or higher depending on the amount of irrigation area modernised), those who were grain growers (69% and 74% respectively), had GVAP of $500,000-$999,999 (63% and 71%) or of $1 million or more (78% and 77%), used 1000 ML of water or more (72% and 70%), and younger irrigators (aged under 55).

Fifty-nine per cent felt they would be more likely to modernise if given a grant to help, particularly those who had already modernised with the help of a grant (72%), dairy farmers (68%), those making a loss (65%), and younger farmers (95% of those aged under 45, and 67% of those aged 45-54). Two-thirds – 66% – felt they would not be interested in a grant if required to transfer some water entitlements in return for the grant, particularly those in the NSW Southern Basin (76%), dairy farmers (73%), those spending less than 10% of farm spending on water (73%), and those earning all their household income on the farm (75%).

OFF-FARM INFRASTRUCTURE MODERNISATION

Off-farm water infrastructure modernisation works have been undertaken in many regions with the assistance of SRWUIP grants. Irrigators who were aware of off-farm modernisation works were asked their views about the outcomes of those works on the timing of water delivery, cost of water delivery, and on overall farm productivity and profitability. Overall, 36% felt off-farm works were positive for their farm overall, 22% that they had negative impacts, and 42% that the impacts were neutral for their farm. Overall, 59% reported improved timing of water delivery to their farm, 45% positive impacts on their efficiency of water use, and 30% positive impacts on farm productivity, while 52% reported negative impacts on costs of water delivery, and around one-quarter felt impacts on farm profitability were positive and one-quarter that they were negative. Views were more positive amongst those who lived in regions where off-farm works have been completed, where 43% reported overall positive impacts on their farm, and works involving conversion of open channels to pipes and clay lining of channels to reduce leakage were viewed most positively in terms of impacts (47% and 49% respectively, with 16% or fewer reporting negative impacts from these types of works).

CONCLUSIONS

Investments in on-farm modernisation have enabled a larger scope of works to be undertaken earlier than they would have otherwise for many irrigators. For some, modernisation works would not have been undertaken at all without grants; for others, they would have occurred some years later, while there are some who would have undertaken the same scope of works irrespective of whether or not they had access to a grant.

Interest in modernising is greater amongst those irrigators who are profitable and expanding their farm enterprise: this means that those who modernise also tend to be those who are expanding the size of scope of their enterprise, and are somewhat more likely to also be expanding water use. Overall, 80% of those who modernize do not expand overall volume of water use, while around 20% do, particularly those who are in a process of farm expansion. Increases in volume of water use were similarly common amongst those who modernize whether or not they receive a grant to assist modernisation. This suggests that expansion of water use would have occurred in the absence of grants. If grants enable greater focus on water use efficiency compared to self-funded works, they may facilitate greater overall water use efficiency resulting from modernisation works, however examining whether this has actually been the case was beyond the scope of this project.

On-farm modernisation – whether self-funded or done with assistance from a grant – is typically associated with positive outcomes for a large majority of irrigators, in terms of farm productivity and production, and being associated with more positive farm outcomes and wellbeing of farmers. Off-farm modernisation is more often associated with neutral

outcomes than positive or negative, likely reflecting fewer direct impacts on individual irrigators in many cases. While many irrigators have future intentions to modernise, there are mixed views about whether irrigators are willing to exchange water entitlements for grants in future, particularly amongst those with relatively lower farm expenditure on water.

1. INTRODUCTION

This report is part of a series examining socio-economic effects of investment in water infrastructure as part of the Murray-Darling Basin Plan (Basin Plan) and associated water reforms. The different actions implemented as part of water reforms can each have their own socio-economic effects for irrigators and for communities that depend on irrigated agriculture. This report (and the preceding reports) examines the socio-economic effects for irrigators of two water reform actions: grants provided to enable modernisation of on-farm and off-farm water infrastructure. The modernisation actions are targeted to improving the water-use efficiency of irrigation networks and on-farm infrastructure, and recovering water for the environment. This report also examines irrigator's motivations and future intentions related to modernisation of irrigation infrastructure.

Modernisation of on-farm and off-farm irrigation infrastructure has been an important investment made as part of water reform actions forming part of the Murray-Darling Basin Plan. At the time of data collection, these investments were made through the Sustainable Rural Water Use and Infrastructure Program (SRWUIP).

The SRWUIP investments this report examines include:

- On-farm water infrastructure grants made as part of the On-Farm Irrigation Efficiency Program (OFIEP). This program had five rounds of funding aimed at assisting 'irrigators within the southern connected system of the Murray-Darling Basin to modernise their on-farm irrigation infrastructure while returning water savings to the environment' (Department of Agriculture 2019a).
- State priority projects which have invested in modernisation of water delivery infrastructure in several irrigation districts within the Murray-Darling Basin (Basin), including investment in improving both off-farm and on-farm water infrastructure efficiency[1]. These state priority projects have variously been led by the Commonwealth government or by State governments, with a number of partners involved (see Department of Agriculture 2019b for a description of the key projects).

The SRWUIP grants provided to increase efficiency of water use through on-farm or off-farm infrastructure modernisation typically required to return a proportion of the resulting water savings to the government in the form of transfer of water entitlements.

Since 2014, the Department of Agriculture has commissioned the University of Canberra to collect and analyse data examining the socio-economic effects of these SRWUIP investments. Data are collected as part of the Regional Wellbeing Survey, which each year examines the quality of life of between 9,000 and 13,000 people living in regional Australia, including the social and economic changes occurring in their lives and their overall

[1] This report focuses on investments in irrigated agriculture infrastructure. In addition, some investments have been made in improving water infrastructure in urban areas – the ACT Basin Priority Project, for example, focused on improving the quality of water flowing from urban Canberra into other parts of the Basin. The socio-economic effects of investments that do not focus on irrigated agriculture are not examined in this report.

wellbeing[2]. This is the fourth report from these evaluations, and examines data collected in the survey in 2018.

This report, and the three reports preceding it, examines how irrigators are experiencing the socio-economic outcomes of investment in modernisation of on-farm and off-farm water infrastructure. The focus is on understanding the direct experiences of Basin irrigators, thus ensuring that the 'real-life' outcomes of investment in programs are documented. This information can complement findings of economic modelling which typically examines the impacts of investments in irrigation modernisation based on the assumption that other factors affecting the farm enterprise remain constant. This report examines the 'real world' outcomes perceived by irrigators, helping identify whether modelled outcomes hold true in 'real world' conditions in which irrigators are experiencing a range of changes such as climatic and market variability. This helps improve understanding of whether the outcomes predicted by modelling hold in a range of differing circumstances, such as when irrigators are experiencing higher versus lower electricity costs or changes in commodity prices.

This report examines only specific aspects of investment in water reforms, and only examines their effects on one specific group (irrigators). The Basin Plan and associated water reforms include a much broader range of actions and affect a wide range of communities and groups. This report therefore should be understood to provide insight into only one specific aspect of water reform and its socio-economic effects.

This report briefly details data collection and analysis methods, and examines key characteristics of irrigators who participated in the 2018 Regional Wellbeing Survey. It examines the socio-economic effects of on-farm and off-farm water infrastructure investment, focusing on irrigator's self-reported experiences of these investments. This is followed by examination of the intentions and interests of irrigators in relation to investing in modernising irrigation infrastructure.

[2] The survey covers a wide range of topics. While this report focuses on results relevant to investment in water delivery infrastructure and purchase of water entitlements by the government, multiple reports on other topics covered in the survey are available. These are available at www.regionalwellbeing.org.au.

2. METHODS

We used data from the Regional Wellbeing Survey (RWS) to examine social effects of investment in on-farm and off-farm water infrastructure modernisation. The Regional Wellbeing Survey is an 'omnibus survey', meaning it includes questions on a large number of topics, with questions related to water infrastructure and water purchase forming only one part of a longer survey. The survey has between 9,000 and 13,000 participants each year, of which around 600 to 1,000 are irrigators. Each year, the survey examines how participants view the liveability of their communities, their own health and wellbeing, their social connections, and how they are experiencing a number of types of change or activities. In 2014, 2015, 2016, and 2018, the survey has included questions examining how irrigators experience investment in irrigation infrastructure modernisation. A detailed description of the methods used to collect data in the RWS is provided in Schirmer et al. (2015, 2016).

This report examines irrigators in 2018 and their experiences of water infrastructure modernisation as part of water reform. Where appropriate, changes over time in experience are identified, drawing on data from previous 'waves' of the survey that asked the same items. A 'wave' simply means data collected in a specific year: in this case, data collected in 2014, 2015, 2016 and 2018 were analysed where relevant. In these years the survey included a sample of 869, 833, 631 and 412 irrigators living in the Basin respectively. The survey also collected data from between 200-450 irrigators living outside the Basin each year.

This chapter provides a brief overview of aspects of the methods relevant to understanding how data relating to on-farm and off-farm water infrastructure modernisation, and the characteristics of irrigators and their farms, were collected and analysed. This description is in large part identical to reports on past waves of the survey, with updated data examining representativeness of the 2018 survey.

2.1 QUESTIONNAIRE DESIGN

Each year, survey questions are developed in a multiple step process that involves input from a number of organisations with an interest in water reform, including farming organisation representatives, and representatives of government agencies. The questions are tested in focus groups and revised, and formally pilot tested before launch of the survey (see Schirmer et al. 2016 for further detail).

2.2 RECRUITMENT OF SURVEY PARTICIPANTS

Survey participants are recruited through flyers and surveys sent to randomly selected households across rural and regional Australia, and promotion of the survey through social networks of a large number of rural and regional organisations. A stratified random sample is used, with irrigators specifically oversampled (see Schirmer et al. 2016 for further detail).

- A large sample of farmers was identified from the 'Farmbase' database, the largest publicly available database of Australian farmers. Farmers who were likely to be irrigators were identified in this database based on a combination of farm type and region, and those living in irrigation districts located in the Murray-Darling Basin were directly sent paper surveys.

- Flyers encouraging participation in the survey were sent to all households in irrigation regions in the Murray-Darling Basin, as well as to several major irrigation districts outside the Basin.
- Emails were sent through multiple networks of irrigators by farming organisations representing irrigators.

This process resulted in a large sample of Basin irrigators, as well as a sample of irrigators outside the Basin, in each wave of the survey, as shown in Table 1. However, as also evident from Table 1, there was a decrease in the number of Basin irrigators participating in the survey in 2016, and subsequently in 2018, compared to the previous years. This occurred due to:

- a reduction in funding available to sample irrigators in these two surveys compared to the other years
- extensive spring flooding in 2016 which affected irrigators in multiple districts within the Murray-Darling Basin, together with a severe storm that caused damage to many irrigation enterprises in parts of South Australia, north-west Victoria, south-west NSW and parts of Queensland in the same week surveys were mailed to most irrigators.

In 2018, a smaller sample of irrigators than previous years was expected due to lower funding, as well as some survey fatigue amongst irrigators. As many farmers were experiencing stress due to drought in 2018, repeat reminders were not sent regarding completing the survey, to reduce risk of creating undue survey burden for farmers experiencing significant stress due to drought. The survey was also delivered later in the year than usual in 2018: the survey was open from November 1st to December 14th. In other years, the survey has typically been open for two more weeks, from the start of October to the end of November. The delay in 2018 was due to requests from farming organisations, who requested the survey be delivered later than usual due to many farmers experiencing stress due to poor winter and early spring rain. As many livestock graziers were destocking properties in early spring, a decision was made to delay surveying; however, this contributed to lower response rates as the survey was then open for a shorter period.

Table 1 Sample of irrigators achieved in the Regional Wellbeing Survey, 2014 to 2018

Year	Sample of irrigators living in the Basin	Sample of irrigators living outside the Basin	Total sample of irrigators
2014	869	155	1024
2015	833	325	1,158
2016	631	484	1,115
2018	412	235	657[i]

[i]For a small number of irrigators (10), their geographic location in or out of the Basin could not be identified based on information provided in their survey. This meaning the total number of irrigators adds up to more than the sum of those within and outside the Basin.

2.3 REPRESENTATIVENESS OF IRRIGATOR SAMPLE

This report analyses the experiences of irrigators in the Murray-Darling Basin. The analysis for this report does not rely on the sample being precisely representative, as much of the analysis compares irrigators who have and have not engaged in water infrastructure

modernisation, rather than making claims about all irrigators. However, results will be more robust if the sample achieved is reasonably representative of irrigators.

In 2015 and 2016, the sample of irrigators in the RWS was found to be representative (see Schirmer 2016, 2017). The 2018 sample was assessed by comparing the geographic location of the 412 Basin irrigators who participated in the survey to benchmark data published by the Australian Bureau of Statistics (ABS) in their 'Water Use on Australian Farms, 2017-18' report (ABS 2019), which includes estimates of the number of irrigating agricultural enterprises by region and type of production. The benchmark data are themselves limited: in most Northern Basin catchments, the ABS estimates its sampling error is between 10% and 25%, and in Southern Basin catchments it ranges from 3% to 10%. This means that if the RWS irrigator sample varies from ABS estimates by less than 10% in the Southern Basin, and by less than 10-25% within different parts of the Northern Basin, it is within the thresholds of representativeness based on accuracy of the available benchmark data. However, the limitations of these benchmark data mean there is still uncertainty about the true representativeness of both ABS data and the RWS data. With no benchmark data available that have higher levels of accuracy, this is the best measure available.

A comparison of the 2018 RWS sample with ABS benchmark data, shown in Table 2, confirmed the RWS sample as being broadly representative of the geographic distribution of Basin irrigators based on available information, other than slight over-sampling of irrigators in the Victorian Basin. The small differences in sampling of irrigators from some parts of the Basin were as likely to result from sampling error in the benchmark data as from sampling variability in the Regional Wellbeing Survey; as such, no weighting of survey responses was used in the report as it could introduce more bias than it corrects if the source of the error is the benchmark data rather than the RWS sample.

Table 2 Representativeness of the RWS sample of irrigators living within the Murray-Darling Basin

	Proportion of 2018 RWS Basin irrigator respondents living in this region	% of ABS 2017-18 irrigating enterprises in this region of the Basin (data source: Australian Bureau of Statistics)
QLD Basin	6%	9% ±3%[a]
NSW Northern Basin	9%	8% ±3%[a]
NSW Southern Basin	27%	25% ±3%[a]
SA Basin	9%	12% ±3%[a]
VIC Basin	49%	45% ±4%[a]
Total	100%	100%

[a]Sampling error for the ABS data have been approximated based on taking the mid-point of the ABS' reported standard errors for different states and NRM regions (these should be considered indicative only of the actual standard error)

This report has a specific focus on understanding irrigators who have modernised their on-farm water infrastructure, and in particular those who have received a grant under the SRWUIP program to modernise. Irrigators who reported accessing a grant to fund all or part of their on-farm modernisation were assessed to identify which had received a grant under the SRWUIP program, using data provided by Department of Agriculture on the regions in which funding was delivered and delivery partners. The proportion of irrigators who upgraded on-farm water infrastructure with assistance from a SRWUIP grant was identified by asking those who had upgraded their on-farm infrastructure (i) how the upgrade was

funded and (ii) in what year/s upgrade works occurred. This information, together with the geographic location of the survey participant, was then compared with a dataset provided by the Department of Agriculture which identified the local government areas in which on-farm grants had been funded in different years as part of the SRWUIP. An irrigator was classified as a SRWUIP recipient if they met three criteria: (i) they reported their on-farm infrastructure was partly or wholly funded by the government or by an organisation contracted to distribute SRWUIP funds, (ii) they lived in a local government area in which SRWUIP funding had been distributed (based on Department of Agriculture data), and (iii) they reported undertaking works within two years of the dates in which SRWUIP funding agreements were signed. SRWUIP grant recipients were identified this way as it was known that many irrigators may not be able to name SRWUIP as the source of funding for their modernisation works, as SRWUIP funding was delivered via multiple organisations, including funding being delivered through on-ground organisations such as water providers.

2.4 STATISTICAL SIGNIFICANCE & PRESENTATION OF FINDINGS

It is important to note that throughout the report, the sample sizes of some groups limit our ability to state with certainty that their views are different to those of others. In particular, where there is a sample of less than 100 people in a given group, the small sample size means that it is only possible to state their views are significantly different to those of others if there is a very large difference in views. Tests of statistical significance were only applied to analyses involving outcomes experienced by irrigators who had / had not modernised on-farm infrastructure, or who did / did not live in an off-farm modernisation region. 'Outcomes' means examination of whether irrigators differed in terms of farm profitability, debt, spending on power costs, or other similar outcomes that differ depending on whether an irrigator received assistance via SRWUIP funded grants or not. Tests of statistical significance were not applied for simple descriptive analyses, for example when examining differences in overall characteristics of irrigators living in the Northern versus the Southern Basin, or identifying what proportion of irrigators had / had not received a SRWUIP grant to undertake on-farm modernisation works. Where statistical tests were used and indicated significant differences, this is indicated in tables with bold font for results that differed significantly, combined with footnotes to indicate significance testing was undertaken.

In many cases, sample sizes were relatively small for the groups being examined: this increases the likelihood of Type II errors, in which there is a 'false negative' – in other words, it is likely that in addition to the significant statistical associations identified in the report, other differences that are likely to be statistically significant are not identified as significant due to small sample size.

Throughout this report, where the analysis identifies high statistical confidence that the views of one group are significantly different to others, we state this by using the term 'significant' when describing results, or presenting the figure in bold in a table. Statistical significance is defined as there being a less than a 5% likelihood that the differences in views occurred by random chance, and was calculated using 95% confidence intervals.

Appendix 1 provides a summary of statistical tests used and findings. Where sample sizes are too small to have confidence in findings, data are presented in italics throughout.

Additionally, ‘average’ scores are reported for some results in this report. In all cases, unless otherwise specified, the term ‘average’ refers to the mean score for the group of people being analysed (not to the median or mode).

The number of responding irrigators who answered different questions is provided throughout. This varies to some extent due to a small number of irrigators who did not answer all questions: because of this, for different topics examined there are often slightly different numbers of respondents. No imputation of missing data was undertaken, with each survey question typically answered by 96% or more of those irrigators eligible to answer it.

2.5 ETHICS

The Regional Wellbeing Survey was approved by the University of Canberra Human Research Ethics Committee, protocol number 12-186.

3. RESULTS

The following four sections examine results of the 2018 survey:

- Section 4 briefly describes some key characteristics of irrigators in the Basin, focusing on characteristics not examined in previous reports in this series
- Section 5 analyses the socio-economic effects of on-farm water infrastructure grants
- Section 6 examines the motivations and future intentions of irrigators in relation to modernisation of irrigation infrastructure
- Section 7 examines off-farm infrastructure grants.

4. IRRIGATORS IN THE MURRAY-DARLING BASIN

4.1 INTRODUCTION

The socio-economic impacts of water reform on irrigators can differ depending on the nature of their farm enterprise. This section provides an overview of key characteristics of irrigators and irrigated enterprises in the Basin.

4.2 FARM AND FARMER CHARACTERISTICS

As noted in previous reports in this series, the irrigated farm enterprises operating in the Basin are highly diverse, both in terms of geographic and economic size of the farm enterprise, and in terms of the production systems used and products harvested. Schirmer (2017) provided a detailed profile of irrigators in the Basin, identifying that:

- irrigators in the Northern Basin typically operate larger enterprises than those located in the Southern Basin in terms of volume of irrigation water applied and gross value of agricultural production (GVAP)
- Northern Basin irrigators more commonly pump water directly from rivers or rely on groundwater than Southern Basin irrigators, who are more likely to irrigate from channels within an irrigation district
- Northern Basin irrigators more often operate pure cropping (e.g. cotton) and mixed cropping and beef enterprises, while Southern Basin irrigators more often operate horticultural and dairy enterprises, with some types of cropping – particularly cotton – expanding over the last decade in parts of the Southern Basin.

As shown in Table 3 and 4, these characteristics were similar for the 2018 sample. However, in 2018 a higher proportion of Northern Basin irrigators reported a GVAP under $100,000 than in previous years (39.1% compared to 26.7% in 2016), likely reflecting the impacts of drought on farm production in key parts of the Northern Basin. In addition:

- Seventeen per cent of irrigators report irrigating part of their land and dryland farming on the remainder, with incidence of ‘mixed irrigation/dryland’ higher in the Northern Basin (35%) than other regions.
- Farmers in two regions were more likely to report very low value of agricultural production (<$40,000) than others: those in the Northern Basin, and in the Goulburn Murray Irrigation District (GMID) (28% and 27% respectively, compared to an average of 23% for all irrigators).
- Northern Basin irrigators were more likely to report GVAP of $1 million or more (25% compared to 18% of all irrigators). Southern Basin irrigators (14%) and in particular GMID irrigators (12%) were less likely than average to report this. However, Southern Basin irrigators not based in irrigation districts were more likely to report farm production of $1 million or more (19%).
- Just over one-quarter of irrigators (26%) self-reported that their farm made a loss on average over the last three years, while just over half (53%) reported either breaking even or making a small profit, and 22% reported making a moderate to large profit. Irrigators living in the GMID were most likely to report making a loss (34%), and those in the MIL district, and in other NSW Southern Basin irrigation districts, were

least likely to (19% and 16% respectively). Of those operating outside irrigation districts in the Southern Basin, 24% reported making a loss.

- The proportion of farm expenditure spent on irrigation water was highest in Southern Basin irrigation districts, with 38% and 44% of irrigators in the GMID and MIL respectively reporting that more than 30% of farm expenditure was on water, compared to only 17% of those in the Northern Basin. Within the Southern Basin, only 7% of irrigators who lived outside irrigation districts (usually pumping water directly from rivers) reported spending more than 30% of farm expenditure on water costs. There is thus a large disparity in the proportion of farm expenditure spent on water costs between those living in irrigation districts and other irrigators, with much higher spending by those living in irrigation districts.
- Use of relatively small volumes of irrigation water, defined as less than 30 megalitres (ML) was more common outside the Basin and in the Northern Basin (25% and 28% respectively), and by those irrigating directly from rivers or from groundwater outside irrigation districts (21%), whereas it was comparatively rare (less than 10% of irrigators) for those whose farms were in irrigation districts. Those in the Northern Basin were most likely to report use of more than 1000 ML in the last year (28%), and those outside the Basin least likely to (11%).
- Not surprisingly, those in the Southern Basin were most likely to source the majority of their irrigation water from dedicated irrigation channels (62%), rising to around 80% for those living in irrigation districts; however even in these regions, around one in five irrigators reported using a larger volume of either groundwater or water pumped directly from rivers/reservoirs than from irrigation channels.

Socio-demographic characteristics of irrigators in general varied less than water use and farm characteristics (Table 4):

- 33% of irrigators live in households in which 100% of income is earned on farm, with this proportion higher in the MIL (55%) and lower in the GMID (29%), and in other NSW irrigation districts (24%). This does not mean 67% of irrigators work off-farm, as in many cases it may be a household member other than the irrigator who earns income off-farm, rather than the irrigator.
- When asked if they personally had off-farm work, 48% of irrigators reported having an off-farm job, with 11% working 40 hours or more a week in their off-farm job
- Around one in four irrigators was female.
- Irrigators, like farmers more generally, are typically aged over 50: of the sample, only 8.5% were aged under 45, while 54% were 55 or older. Irrigators in the GMID were older on average than those in other regions, while Northern Basin irrigators were more likely to be aged under 55 compared to other regions.
- One in five irrigators reported being in relatively poor health (20%), while 34% reported good health and 46% very good or excellent health. Those in the GMID were more likely to report poor health (24%) and less likely to report very good health (41%), while those in the Northern Basin were less likely to report poor health than average (12%).

- 30% of irrigators reported experiencing one or more household financial stress events in the previous 12 months, such as being unable to heat or cool their home, or being unable to pay bills on time.
- Three quarters of irrigators (75%) who completed the survey reported having completed either high school or a post-school qualification, although this is likely an over-representation compared to the actual population as those with higher levels of education are typically over-represented in most survey samples. Those in the GMID were less likely to report having completed high school or another qualification (67%), and were less likely to report having a university degree (21% compared to 31% of all irrigators who responded to the survey), likely in part reflecting the older average age of GMID irrigators.
- 29% of irrigators indicated they were very likely to retire in the next five years, while 23% were a little likely to, and 48% unlikely to. Those in the Northern Basin were most likely to state they were not at all likely to retire (61%). This was to some extent age related: of those aged under 55, only 1.2% reported being very likely to retire in the next five years, and 7.4% that they were a little likely to. Amongst those aged 55 to 64, 31.8% were very likely to retire in the next five years and 26.4% slightly likely to. For those aged 65 and older, 41.7% were very likely to retire in the next five years and a further 31.3% a little likely to.

In the 2018 RWS, questions examined more closely how irrigators in the Basin used water, and in particular their use of water from their own entitlements, purchased on the market, and from leased entitlements. These are examined in the next sections.

4. IRRIGATORS IN THE MURRAY-DARLING BASIN

Table 3 Farm and water use characteristics of irrigators

Description of variable	Description of response categories	All irrigators	Basin irrigator	Southern Basin	Northern Basin	Outside Basin	GMID	MIL	Southern Basin - not in irrigation district	NSW other irrigation district
	Number of responding irrigators (n)	657[i]	412	352	60	235	157	47	88	43
Engagement in irrigation and dryland farming	**Irrigates all farmed land**	83.3%	83.3%	86.4%	65.0%	83.4%	84.7%	83.0%	84.1%	90.7%
	Irrigator and dryland farmer	16.7%	16.7%	13.6%	35.0%	16.6%	15.3%	17.0%	15.9%	9.3%
Farm type	**Other**	3.7%	3.2%	3.4%	1.7%	3.8%	1.9%	0.0%	4.5%	9.3%
	Dairy farmer	14.3%	14.3%	16.2%	3.3%	14.5%	25.5%	14.9%	9.1%	2.3%
	Grain grower	7.9%	11.2%	8.8%	25.0%	2.6%	10.2%	10.6%	4.5%	18.6%
	Grazier	29.5%	30.1%	29.3%	35.0%	28.1%	36.3%	31.9%	25.0%	14.0%
	Horticulture	32.6%	24.3%	24.1%	25.0%	48.1%	12.1%	6.4%	39.8%	32.6%
	Mixed cropping & grazing	12.0%	17.0%	18.2%	10.0%	3.0%	14.0%	36.2%	17.0%	23.3%
Gross value of agricultural production, 2017-18	**GVAP < $40,000**	22.5%	23.2%	22.3%	28.1%	21.6%	27.0%	13.2%	17.5%	16.2%
	GVAP $40,000-$99,999	14.5%	14.5%	15.5%	8.8%	14.7%	16.1%	15.8%	15.0%	13.5%
	GVAP $100,000-$299,999	21.5%	22.7%	24.6%	12.3%	19.3%	21.2%	31.6%	27.5%	21.6%
	GVAP $300,000-$499,999	9.7%	9.8%	9.7%	10.5%	9.6%	10.2%	10.5%	6.3%	13.5%
	GVAP $500,000-$999,999	13.8%	13.9%	13.6%	15.8%	12.8%	13.9%	18.4%	15.0%	10.8%
	GVAP $1 million or more	18.1%	15.8%	14.2%	24.6%	22.0%	11.7%	10.5%	18.8%	24.3%
Average farm performance over last three years, self-rated	**Farm making a loss**	25.8%	27.1%	27.6%	24.1%	23.5%	34.3%	19.0%	23.5%	16.2%
	Breaking even/making small profit	52.6%	52.6%	54.7%	41.4%	52.9%	51.7%	69.0%	53.1%	48.6%
	Farm making moderate/large profit	21.7%	20.3%	17.7%	34.5%	23.5%	14.0%	11.9%	23.5%	35.1%
Proportion of farm expenditure on irrigation water	**<10% farm expenditure**	38.1%	27.2%	23.4%	52.4%	60.5%	16.1%	8.3%	54.8%	12.1%
	10-19% farm expenditure	24.0%	27.5%	27.7%	26.2%	17.2%	26.6%	25.0%	27.4%	27.3%
	20-29% farm expenditure	14.5%	15.5%	17.2%	4.8%	12.1%	19.4%	22.2%	11.3%	18.2%
	30% or more of farm expenditure	23.4%	29.7%	31.8%	16.7%	10.2%	37.9%	44.4%	6.5%	42.4%
Volume of irrigation water used in 2017-18	**<30ML**	16.7%	13.0%	10.6%	27.9%	24.7%	8.4%	5.4%	21.1%	9.4%
	30 to 99ML	19.7%	18.4%	17.6%	23.3%	22.7%	16.0%	18.9%	15.8%	18.8%
	100 to 299ML	24.4%	24.7%	25.6%	18.6%	24.0%	29.8%	18.9%	17.5%	21.9%
	300 to 999ML	23.1%	25.3%	28.9%	2.3%	18.0%	26.0%	35.1%	35.1%	21.9%
	1000ML or more	16.2%	18.7%	17.2%	27.9%	10.7%	19.8%	21.6%	10.5%	28.1%
Primary source of irrigation water (based on volume of water use reported)	**Irrigation channels**	42.0%	54.8%	61.7%	9.4%	19.1%	79.4%	83.0%	0.0%	83.7%
	Direct pumping from river, dam etc	29.7%	23.8%	21.0%	41.5%	39.6%	10.3%	6.4%	57.6%	9.3%
	Groundwater	28.4%	21.5%	17.3%	49.1%	41.3%	10.3%	10.6%	42.4%	7.0%

[i]For a small number of irrigators (10), their geographic location in or out of the Basin could not be identified based on information provided in their survey. These irrigators are included in the 'all irrigator' sample, but not in the 'Basin irrigator' or 'Outside Basin' categories, meaning the total number of irrigators adds up to more than the total of those within and outside the Basin. Note that tests of statistical significance were not conducted for data in this table as each variable is examined in more depth in subsequent tables.

4. IRRIGATORS IN THE MURRAY-DARLING BASIN

Table 4 Socio-demographic characteristics of irrigators

Description of variable	Description of response categories	All irrigators	Basin irrigator[1]	Outside Basin[1]	Southern Basin[2]	Northern Basin[2]	GMID[3]	MIL[3]	NSW other irrigation district[3]
	Number of responding irrigators (n)	657	412	235	352	60	157	47	43
Household income - % earned off-farm	**No household income earned off-farm**	32.7%	30.6%	35.3%	30.3%	32.2%	29.0%	55.3%	23.8%
	1-25% household income earned off-farm	22.2%	24.9%	17.9%	24.9%	25.4%	24.5%	17.0%	23.8%
	26-50% household income earned off-farm	13.8%	13.2%	14.9%	14.9%	3.4%	14.8%	8.5%	21.4%
	51-75% household income earned off-farm	9.9%	10.3%	9.8%	9.4%	15.3%	10.3%	8.5%	9.5%
	76% or more of household income earned off-farm	21.4%	21.0%	22.1%	20.6%	23.7%	21.3%	10.6%	21.4%
Off-farm work undertaken by irrigator	**Irrigator does not work off-farm**	51.9%	52.0%	51.3%	53.3%	44.1%	**55.5%**	**70.2%**	**43.9%**
	Irrigator works off-farm <20 hours a week	21.2%	20.8%	22.4%	20.6%	22.0%	**18.7%**	**8.5%**	**19.5%**
	Irrigator works off-farm 20-39 hours a week	16.2%	16.6%	15.5%	15.4%	23.7%	**18.1%**	**14.9%**	**7.3%**
	Irrigator works off-farm 40 hours or more a week	10.7%	10.6%	10.8%	10.7%	10.2%	**7.7%**	**6.4%**	**29.3%**
Irrigator gender	**Female**	24.7%	**26.9%**	**21.0%**	**25.7%**	**33.9%**	**20.9%**	**36.2%**	**38.1%**
	Male	75.3%	**73.1%**	**79.0%**	**74.3%**	**66.1%**	**79.1%**	**63.8%**	**61.9%**
Irrigator age	**Aged under 45**	8.5%	**7.7%**	**10.1%**	**7.6%**	**8.5%**	**5.3%**	**10.9%**	**11.6%**
	Aged 45-54	15.7%	**14.3%**	**18.1%**	**13.0%**	**23.0%**	**10.5%**	**18.4%**	**17.0%**
	Aged 55-64	24.4%	**24.6%**	**23.8%**	**24.6%**	**24.7%**	**22.1%**	**23.2%**	**25.5%**
	Aged 65-74	21.6%	**21.8%**	**21.4%**	**22.4%**	**17.5%**	**23.3%**	**25.4%**	**20.3%**
	Aged 75+	8.4%	**8.9%**	**7.4%**	**8.8%**	**9.6%**	**10.4%**	**4.9%**	**8.5%**
General health status of irrigator	**Poor/fair health**	19.7%	**20.1%**	**19.1%**	**21.5%**	**12.1%**	23.9%	18.2%	21.4%
	Good health	34.3%	**34.8%**	**33.9%**	**33.1%**	**44.8%**	35.5%	36.4%	28.6%
	Very good/excellent health	45.9%	**45.0%**	**47.0%**	**45.3%**	**43.1%**	40.6%	45.5%	50.0%
Household financial stress last 12 months	**Experienced 1+ household financial stress events**	30.2%	29.6%	31.1%	29.8%	28.8%	28.9%	31.8%	29.3%
	Experienced no household financial stress events	69.8%	70.4%	68.9%	70.2%	71.2%	71.1%	68.2%	70.7%
Formal educational attainment	**Completed high school/post-high school qual**	74.6%	74.1%	75.6%	72.7%	82.5%	**67.1%**	**83.0%**	**71.4%**
	No high school or post-high school qualification	25.4%	25.9%	24.4%	27.3%	17.5%	**32.9%**	**17.0%**	**28.6%**
	Has a university degree	30.7%	30.1%	32.5%	28.4%	40.4%	**21.3%**	**25.5%**	**33.3%**
Likelihood of retiring from work in the next 5 years	**Not at all likely to retire**	47.8%	**47.4%**	**48.5%**	**45.1%**	**60.8%**	**45.0%**	**52.8%**	**56.8%**
	A little likely to retire	23.1%	**23.8%**	**21.7%**	**25.6%**	**13.7%**	**23.7%**	**19.4%**	**13.5%**
	Very likely to retire	29.1%	**28.8%**	**29.8%**	**29.4%**	**25.5%**	**31.3%**	**27.8%**	**29.7%**

[1] Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

4.3 IRRIGATION WATER SOURCES

This section examines water sources used by Basin irrigators in more detail. Irrigators in the Basin variously source irrigation water from irrigation channels, water pumped directly from rivers or lakes, or groundwater. They may own their own entitlements and use the water allocated to those entitlements, buy water allocation on the water market, or lease water entitlements (and the water allocated to them in a given water year) from their owners. Many irrigators use a mix of water sources and types to irrigate.

To better understand use of irrigation water in the Basin, irrigators were asked:

- if they irrigate their land using water from irrigation channels, water pumped from rivers/lakes, and/or groundwater
- what proportion of water used to irrigate their farm in 2017-18 came from water entitlements they owned, water allocation bought on the temporary market, water from entitlements they leased from others, or from other sources
- whether in the last 12 months they had bought new permanent water entitlements, sold or transferred some or all of their entitlements, sold water allocation, and whether they carried water over from either the 2016-17 or 2017-18 water year to the following water year.

While Table 3 showed the primary water source used, Tables 5 to 9 provide more detailed analysis of the types of water sources (irrigation channels, direct pumping and groundwater) by geographic location and farm type.

Table 5 examines water sources used by location, and shows that:

- seventy-three per cent of Basin irrigators rely on a single source of irrigation water (channels, pumping or groundwater) while 27% report using more than one of these. Using multiple sources is more common amongst Southern Basin irrigators compared to Northern Basin irrigators and those living outside the Basin
- use of irrigation channels was most common in the Southern Basin, while groundwater was most commonly used by irrigators outside the Basin (52% compared to 30% of Basin irrigators), and direct pumping was most common in the Northern Basin (55%) and less in the Southern Basin (32%)
- use of irrigation channels only with no reliance on other water was most common amongst Southern Basin irrigators operating within irrigation districts, with between 58% and 68% of these irrigations relying on water delivered via irrigation channels.

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Table 5 Irrigation water sources – by irrigator location

		All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin[3]	SA Basin[3]	VIC Basin[3]	Southern Basin not in irrig. District[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
	n[i]	635	400	226	53	347	110	36	201	85	153	47	41
I irrigate all or part of my land… (adds to >100% as some irrigators do more than one of these)	**… from irrigation channels**	49.4%	**63.5%**	**23.9%**	**18.9%**	**70.3%**	**67.3%**	**61.1%**	**73.6%**	**1.2%**	**88.9%**	**97.9%**	**97.6%**
	… with water pumped from rivers/lakes	39.5%	**34.8%**	**47.8%**	**54.7%**	**31.7%**	**34.5%**	**58.3%**	**25.4%**	**61.2%**	**19.0%**	**14.9%**	**26.8%**
	… using groundwater	37.8%	**30.0%**	**52.2%**	**50.9%**	**26.8%**	**20.9%**	**19.4%**	**31.3%**	**45.9%**	**26.8%**	**21.3%**	**7.3%**
Irrigation water sources - detailed	**Used irrigation channels only**	29.9%	**40.0%**	**11.9%**	**3.8%**	**45.5%**	**49.1%**	**25.0%**	**47.3%**	**1.2%**	**57.5%**	**68.1%**	**65.9%**
	Used irrigation channels & groundwater	7.1%	**9.5%**	**2.7%**	**0.0%**	**11.0%**	**7.3%**	**0.0%**	**14.9%**	**0.0%**	**18.3%**	**14.9%**	**7.3%**
	Used irrigation channels & pumping	10.1%	**12.5%**	**5.3%**	**13.2%**	**12.4%**	**10.0%**	**36.1%**	**9.5%**	**0.0%**	**11.1%**	**10.6%**	**24.4%**
	Used irrigation channels, pumping & groundwater	2.4%	**1.5%**	**4.0%**	**1.9%**	**1.4%**	**0.9%**	**0.0%**	**2.0%**	**0.0%**	**2.0%**	**4.3%**	**0.0%**
	Used ground-water only	23.5%	**15.8%**	**37.6%**	**41.5%**	**11.8%**	**9.1%**	**16.7%**	**12.4%**	**37.6%**	**5.2%**	**2.1%**	**0.0%**
	Used pumping only	22.2%	**17.5%**	**30.5%**	**32.1%**	**15.3%**	**20.0%**	**19.4%**	**11.9%**	**52.9%**	**4.6%**	**0.0%**	**2.4%**
	Used pumping and groundwater	4.9%	**3.3%**	**8.0%**	**7.5%**	**2.6%**	**3.6%**	**2.8%**	**2.0%**	**8.2%**	**1.3%**	**0.0%**	**0.0%**

[1] Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

Table 6 identifies types of water used by on-farm modernisation activity for Basin irrigators, and shows that modernisation with assistance of grants has more commonly occurred amongst irrigators relying on water from irrigation channels than from pumping or groundwater. Of those Basin irrigators who had modernised using grants since 2008, 76% used water from irrigation channels, compared to 54% of those who had not modernised.

Tables 7 and 8 show water sources used by Basin irrigators by farm type and size, and expenditure and volume of water use. They show that:

- those involved in dairy were more likely to rely on irrigation channels than other types of farmers
- those with GVAP of $1 million or more were more likely to report using multiple sources of water, being similar likely to report using irrigation channels as those with smaller farms, but much more likely to directly pump water (56% compared to 40% or fewer amongst farms of smaller sizes)
- those who drew water from irrigation channels were much more likely to report a large proportion of farm expenditure being on water than those drawing water from other sources: 87% of those who reported farm expenditure of 30% or more on water relied at least in part on water from irrigation channels, compared to 35% of those who reported less than 10% of farm spending being on irrigation water.

Table 6 Irrigation water sources – participation of Basin irrigators in irrigation modernisation activity

			Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]				
		All Basin irrigators	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-19%	20-49%	50-74%	75%
	n	400	92	223	125	144	57	77	68	54
I irrigate all or part of my land… (adds up to >100% as some irrigators do more than one of these)	**… from irrigation channels**	63.5%	**53.8%**	**63.0%**	**75.5%**	60.3%	68.9%	73.7%	77.6%	63.0%
	… with water pumped from rivers/lakes	34.8%	**27.5%**	**34.3%**	**43.6%**	33.1%	24.4%	47.4%	38.8%	39.1%
	… using groundwater	30.0%	**36.3%**	**33.1%**	**17.0%**	30.6%	35.6%	28.1%	24.5%	19.6%
Irrigation water sources - detailed	**Used irrigation channels only**	40.0%	**38.8%**	**39.8%**	**42.6%**	41.3%	42.2%	38.6%	38.8%	45.7%
	Used irrigation channels & groundwater	9.5%	**6.3%**	**9.9%**	**11.7%**	8.3%	15.6%	8.8%	18.4%	4.3%
	Used irrigation channels & pumping	12.5%	**8.8%**	**9.9%**	**21.3%**	9.9%	11.1%	19.3%	18.4%	13.0%
	Used irrigation channels, pumping & groundwater	1.5%	**0.0%**	**3.3%**	**0.0%**	0.8%	0.0%	7.0%	2.0%	0.0%
	Used ground-water only	15.8%	**27.5%**	**16.0%**	**2.1%**	17.4%	17.8%	5.3%	4.1%	10.9%
	Used pumping only	17.5%	**16.3%**	**17.1%**	**19.1%**	18.2%	11.1%	14.0%	18.4%	21.7%
	Used pumping and groundwater	3.3%	**2.5%**	**3.9%**	**3.2%**	4.1%	2.2%	7.0%	0.0%	4.3%

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

Table 7 Irrigation water sources – by farm type and size

		Farm type						Gross value of agricultural production 2017-18					
		Basin irrigators	Dairy farmer	Grain grower	Grazier	Hortic-ulture	Mixed cropping/ grazing	< $40,000	40,000-$99,999	$100,000-$299,999	$300,000-$499,999	$500,000-$999,999	$1 million+
	n	400	**81**	**58**	**137**	**120**	**84**	**96**	**59**	**98**	**39**	**61**	**82**
I irrigate all or part of my land…(adds up to >100% as some irrigators do more than one of these)	**… from irrigation channels**	63.5%	**81.4%**	**62.2%**	**63.5%**	**48.5%**	**73.9%**	**58.8%**	**62.0%**	**65.4%**	**69.4%**	**58.0%**	**61.4%**
	… with water pumped from rivers/lakes	34.8%	**20.3%**	**40.0%**	**33.9%**	**46.5%**	**29.0%**	**22.5%**	**38.0%**	**35.8%**	**19.4%**	**40.0%**	**56.1%**
	… using groundwater	30.0%	**37.3%**	**31.1%**	**25.2%**	**31.3%**	**26.1%**	**43.8%**	**22.0%**	**21.0%**	**19.4%**	**36.0%**	**36.8%**
Irrigation water sources - detailed	**Used irrigation channels only**	40.0%	**44.1%**	**33.3%**	**44.3%**	**27.3%**	**52.2%**	**38.8%**	**44.0%**	**44.4%**	**61.1%**	**36.0%**	**17.5%**
	Used irrigation channels & groundwater	9.5%	**25.4%**	**11.1%**	**7.0%**	**6.1%**	**5.8%**	**8.8%**	**4.0%**	**6.2%**	**0.0%**	**8.0%**	**24.6%**
	Used irrigation channels & pumping	12.5%	**10.2%**	**17.8%**	**9.6%**	**15.2%**	**13.0%**	**10.0%**	**12.0%**	**14.8%**	**8.3%**	**8.0%**	**17.5%**
	Used irrigation channels, pumping & groundwater	1.5%	**1.7%**	**0.0%**	**2.6%**	**0.0%**	**2.9%**	**1.3%**	**2.0%**	**0.0%**	**0.0%**	**6.0%**	**1.8%**
	Used ground-water only	15.8%	**10.2%**	**15.6%**	**14.8%**	**20.2%**	**13.0%**	**30.0%**	**14.0%**	**13.6%**	**19.4%**	**16.0%**	**1.8%**
	Used pumping only	17.5%	**8.5%**	**17.8%**	**20.9%**	**26.3%**	**8.7%**	**7.5%**	**22.0%**	**19.8%**	**11.1%**	**20.0%**	**28.1%**
	Used pumping and groundwater	3.3%	**0.0%**	**4.4%**	**0.9%**	**5.1%**	**4.3%**	**3.8%**	**2.0%**	**1.2%**	**0.0%**	**6.0%**	**8.8%**

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18. See Appendix 1 for detailed data from statistical tests.

Table 8 Irrigation water sources – by farm water use characteristics

		% farm expenditure on irrigation water[1]				Farm self-reported 3-year profitability[2]			Volume of irrigation water used in 2017-18 water year[3]				
		<10%	10-19%	20-29%	30%+	Making a loss	Breaking even/small profit	Moderate or large profit	<30ML	30 to 99ML	100 to 299ML	300 to 999ML	1000ML or more
	n	91	111	59	126	126	237	90	45	64	97	99	88
I irrigate all or part of my land…(adds up to >100% as some irrigators do more than one of these)	**… from irrigation channels**	**34.6%**	**65.5%**	**77.6%**	**87.2%**	60.4%	66.1%	58.7%	**30.0%**	**63.2%**	**75.6%**	**72.5%**	**75.9%**
	… with water pumped from rivers/lakes	**45.7%**	**31.0%**	**28.6%**	**27.7%**	32.7%	32.3%	45.3%	**35.0%**	**26.3%**	**34.6%**	**35.0%**	**43.1%**
	… using groundwater	**40.7%**	**36.8%**	**20.4%**	**24.5%**	35.6%	29.7%	24.0%	**47.5%**	**28.1%**	**17.9%**	**22.5%**	**43.1%**
Irrigation water sources - detailed	**Used irrigation channels only**	**19.8%**	**37.9%**	**57.1%**	**53.2%**	35.6%	42.7%	38.7%	**17.5%**	**50.9%**	**51.3%**	**48.8%**	**24.1%**
	Used irrigation channels & groundwater	**3.7%**	**16.1%**	**6.1%**	**14.9%**	8.9%	11.5%	4.0%	**2.5%**	**3.5%**	**7.7%**	**12.5%**	**25.9%**
	Used irrigation channels & pumping	**11.1%**	**10.3%**	**10.2%**	**16.0%**	14.9%	9.9%	14.7%	**10.0%**	**8.8%**	**15.4%**	**10.0%**	**19.0%**
	Used irrigation channels, pumping & groundwater	**0.0%**	**1.1%**	**4.1%**	**3.2%**	1.0%	2.1%	1.3%	**0.0%**	**0.0%**	**1.3%**	**1.3%**	**6.9%**
	Used groundwater only	**30.9%**	**14.9%**	**8.2%**	**4.3%**	22.8%	13.5%	12.0%	**45.0%**	**19.3%**	**6.4%**	**3.8%**	**6.9%**
	Used pumping only	**28.4%**	**14.9%**	**12.2%**	**6.4%**	13.9%	17.7%	22.7%	**25.0%**	**12.3%**	**15.4%**	**18.8%**	**13.8%**
	Used pumping and groundwater	**6.2%**	**4.6%**	**2.0%**	**2.1%**	3.0%	2.6%	6.7%	**0.0%**	**5.3%**	**2.6%**	**5.0%**	**3.4%**

[1] Bold font indicates there were significant differences between irrigators whose expenditure on water made up differing proportions of total farm expenditure.
[2] Bold font indicates significant differences between irrigators who reported differing levels of profitability.
[3]Bold font indicates significant differences between irrigators who used differing volumes of irrigation water. See Appendix 1 for detailed data from statistical tests.

As shown in Tables 9 to 12, Basin irrigators predominantly rely on use of water from entitlements they own, although almost 40% access at least some water through purchase on the temporary market, 9% lease entitlements from others, and some use other water sources. Those outside the Basin have much less access to water markets, and within the Basin the majority of market purchase of temporary water occurs in the Southern Basin, with fewer opportunities for water purchase in the Northern Basin.

There are significant differences between Basin irrigators who have and have not modernised on-farm irrigation infrastructure in use of water allocated to entitlements they own versus purchase of water on the temporary market. Those who have not modernised are less likely to engage in using water from any source other than their own entitlements (only 18% reported purchasing water allocation on the market compared to 35% of those who had self-funded modernisation activity and 58% of those who had modernised with assistance from a grant) and less likely to use water from multiple sources. As identified in subsequent section of the report, this cannot be explained based on other factors such as age, as similar proportions of irrigators of most age groups have not modernised (20% to 27% have not modernised across most age groups, see Table 26 for further detail).

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Table 9 Ownership and purchase of irrigation water: use of entitlements and market purchase by irrigator location

% 2017-18 irrigation water from…		All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin	SA Basin	VIC Basin	Southern Basin not in irrig. district[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
	n	635	400	226	53	347	110	36	201	85	153	47	41
owned entitlements	None	15.3%	**14.2%**	**17.1%**	**26.0%**	**12.3%**	13.3%	10.3%	12.1%	**22.2%**	**10.8%**	**11.9%**	**2.8%**
	1-74%	14.9%	**17.5%**	**9.8%**	**10.0%**	**18.8%**	20.4%	20.7%	17.6%	**13.9%**	**20.1%**	**19.0%**	**25.0%**
	75%+	69.8%	**68.2%**	**73.1%**	**64.0%**	**68.9%**	66.3%	69.0%	70.3%	**63.9%**	**69.1%**	**69.0%**	**72.2%**
allocation bought on temporary market	None	70.2%	**61.2%**	**92.6%**	**86.5%**	**57.3%**	59.0%	57.9%	56.3%	**73.8%**	**48.2%**	**51.7%**	**53.6%**
	1-74%	23.9%	**30.6%**	**7.4%**	**13.5%**	**33.2%**	33.3%	36.8%	32.6%	**23.0%**	**38.2%**	**41.4%**	**32.1%**
	75%+	5.9%	**8.3%**	**0.0%**	**0.0%**	**9.5%**	7.7%	5.3%	11.1%	**3.3%**	**13.6%**	**6.9%**	**14.3%**
leased entitlements	None	89.4%	91.5%	84.4%	87.2%	92.3%	97.1%	82.4%	91.1%	94.6%	89.9%	100.0%	95.7%
	1-74%	9.2%	7.7%	12.8%	7.7%	7.7%	2.9%	17.6%	8.9%	5.4%	10.1%	0.0%	4.3%
	75%+	1.4%	0.8%	2.8%	5.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
other sources	None	75.1%	80.5%	63.4%	81.1%	80.4%	86.4%	86.7%	76.1%	**78.6%**	**75.3%**	**85.7%**	**95.2%**
	1-74%	11.6%	12.6%	9.8%	13.5%	12.4%	6.1%	0.0%	17.7%	**1.8%**	**22.2%**	**14.3%**	**4.8%**
	75%+	13.3%	6.9%	26.8%	5.4%	7.2%	7.6%	13.3%	6.2%	**19.6%**	**2.5%**	**0.0%**	**0.0%**

[1] Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin. [2] Bold font indicates significant differences between those in the Southern compared to Northern Basin. [3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

Table 10 Ownership and purchase of irrigation water: use of entitlements and market purchase by participation in irrigation modernisation activity

% 2017-18 irrigation water from…		Modernisation on-farm irrigation infrastructure since 2008[1]				% on-farm irrigation infrastructure modernised since 2013[2]				
		Basin irrigator	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-19%	20-49%	50-74%	75%
	n	400	151	295	110	189	66	86	70	70
owned entitlements	None	14.2%	**21.3%**	**16.4%**	**5.4%**	16.5%	9.3%	7.1%	6.3%	9.8%
	1-74%	17.5%	**13.3%**	**13.0%**	**27.2%**	12.2%	14.0%	26.8%	25.0%	24.4%
	75%+	68.2%	**65.3%**	**70.6%**	**67.4%**	71.3%	76.7%	66.1%	68.8%	65.9%
allocation bought on temporary market	None	61.2%	**81.8%**	**64.9%**	**43.0%**	**73.8%**	**57.1%**	**53.5%**	**43.2%**	**43.3%**
	1-74%	30.6%	**16.4%**	**26.0%**	**46.8%**	**21.4%**	**40.0%**	**30.2%**	**48.6%**	**40.0%**
	75%+	8.3%	**1.8%**	**9.2%**	**10.1%**	**4.8%**	**2.9%**	**16.3%**	**8.1%**	**16.7%**
leased entitlements	None	91.5%	100.0%	90.7%	88.1%	**96.2%**	**87.1%**	**84.6%**	**93.3%**	**84.6%**
	1-74%	7.7%	0.0%	7.6%	11.9%	**3.8%**	**9.7%**	**15.4%**	**6.7%**	**15.4%**
	75%+	0.8%	0.0%	1.7%	0.0%	**0.0%**	**3.2%**	**0.0%**	**0.0%**	**0.0%**
other sources	None	80.5%	74.5%	77.3%	89.5%	**83.8%**	**81.5%**	**72.2%**	**82.1%**	**64.0%**
	1-74%	12.6%	14.9%	14.3%	8.8%	**8.1%**	**14.8%**	**27.8%**	**10.7%**	**20.0%**
	75%+	6.9%	10.6%	8.4%	1.8%	**8.1%**	**3.7%**	**0.0%**	**7.1%**	**16.0%**

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

4. IRRIGATORS IN THE MURRAY-DARLING BASIN

Table 11 Ownership and purchase of irrigation water: use of entitlements and market purchase by farm type and size

% 2017-18 irrigation water from…		Farm type[1]						Gross value of agricultural production 2017-18[2]					
		Basin irrigator	Dairy farmer	Grain grower	Grazier	Horti-culture	Mixed	< $40,000	40,000-$99,999	$100,000-$299,999	$300,000-$499,999	$500,000-$999,999	$1 million+
	n	400	81	57	143	125	84	112	60	97	43	65	73
owned entitlements	None	14.2%	**5.9%**	**10.0%**	**22.2%**	**11.5%**	**14.1%**	27.9%	9.8%	20.0%	6.3%	12.5%	3.7%
	1-74%	17.5%	**31.4%**	**25.0%**	**14.8%**	**12.6%**	**12.5%**	16.2%	11.8%	15.0%	12.5%	12.5%	38.9%
	75%+	68.2%	**62.7%**	**65.0%**	**63.0%**	**75.9%**	**73.4%**	55.9%	78.4%	65.0%	81.3%	75.0%	57.4%
allocation bought on temporary market	None	61.2%	**32.6%**	**48.4%**	**75.0%**	**71.0%**	**54.2%**	**82.5%**	**77.8%**	**59.7%**	**63.0%**	**51.3%**	**30.4%**
	1-74%	30.6%	**51.2%**	**41.9%**	**17.0%**	**22.6%**	**41.7%**	**7.0%**	**19.4%**	**32.3%**	**25.9%**	**43.6%**	**56.5%**
	75%+	8.3%	**16.3%**	**9.7%**	**8.0%**	**6.5%**	**4.2%**	**10.5%**	**2.8%**	**8.1%**	**11.1%**	**5.1%**	**13.0%**
leased entitlements	None	91.5%	80.0%	90.0%	94.8%	94.7%	90.9%	**98.1%**	**94.3%**	**98.0%**	**92.3%**	**86.1%**	**73.7%**
	1-74%	7.7%	20.0%	6.7%	5.2%	5.3%	6.8%	**1.9%**	**5.7%**	**0.0%**	**7.7%**	**11.1%**	**26.3%**
	75%+	0.8%	0.0%	3.3%	0.0%	0.0%	2.3%	**0.0%**	**0.0%**	**2.0%**	**0.0%**	**2.8%**	**0.0%**
other sources	None	80.5%	**67.7%**	**76.9%**	**87.7%**	**75.0%**	**87.8%**	66.7%	100.0%	77.1%	91.3%	88.2%	70.0%
	1-74%	12.6%	**29.0%**	**23.1%**	**6.8%**	**10.7%**	**7.3%**	16.7%	0.0%	12.5%	4.3%	11.8%	26.7%
	75%+	6.9%	**3.2%**	**0.0%**	**5.5%**	**14.3%**	**4.9%**	16.7%	0.0%	10.4%	4.3%	0.0%	3.3%

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18. See Appendix 1 for detailed data from statistical tests.

Table 12 Ownership and purchase of irrigation water: use of entitlements and market purchase by farm water use characteristics

% 2017-18 irrigation water from…		% farm expenditure on irrigation water[1]				Farm self-reported 3-year profitability[2]			Volume of irrigation water used in 2017-18 water year (ML)[3]				
		<10%	10-19%	20-29%	30%+	Making a loss	Break even/ small profit	Mod-lge profit	<30ML	30-99	100-299	300-999	1000+
	n	107	115	58	115	134	244	88	59	70	90	94	81
owned entitlements	None	**20.8%**	**13.3%**	**6.4%**	**5.6%**	18.6%	12.5%	14.9%	37.8%	11.3%	8.2%	1.3%	8.6%
	1-74%	**15.6%**	**19.3%**	**12.8%**	**24.4%**	15.5%	19.3%	16.2%	10.8%	15.1%	13.7%	20.3%	34.5%
	75%+	**63.6%**	**67.5%**	**80.9%**	**70.0%**	66.0%	68.2%	68.9%	51.4%	73.6%	78.1%	78.5%	56.9%
allocation bought on temporary market	None	71.7%	60.0%	48.5%	52.8%	64.6%	60.1%	57.4%	88.9%	**72.5%**	**69.8%**	**41.7%**	**30.0%**
	1-74%	23.3%	33.8%	45.5%	31.9%	25.3%	31.9%	35.2%	7.4%	**12.5%**	**26.4%**	**46.7%**	**58.0%**
	75%+	5.0%	6.2%	6.1%	15.3%	10.1%	8.0%	7.4%	3.7%	**15.0%**	**3.8%**	**11.7%**	**12.0%**
leased entitlements	None	88.9%	89.1%	87.1%	93.8%	87.0%	95.1%	88.0%	96.0%	**97.4%**	**87.2%**	**90.4%**	**82.5%**
	1-74%	9.3%	9.1%	12.9%	6.3%	11.6%	4.9%	10.0%	4.0%	**2.6%**	**8.5%**	**9.6%**	**17.5%**
	75%+	1.9%	1.8%	0.0%	0.0%	1.4%	0.0%	2.0%	0.0%	**0.0%**	**4.3%**	**0.0%**	**0.0%**
other sources	None	75.0%	75.0%	83.3%	81.7%	78.1%	80.0%	84.4%	80.0%	93.9%	77.8%	89.6%	65.7%
	1-74%	8.3%	17.3%	13.3%	15.0%	15.6%	12.2%	8.9%	20.0%	6.1%	17.8%	8.3%	25.7%
	75%+	16.7%	7.7%	3.3%	3.3%	6.3%	7.8%	6.7%	0.0%	0.0%	4.4%	2.1%	8.6%

[1] Bold font indicates there were significant differences between irrigators whose expenditure on water made up differing proportions of total farm expenditure. [2] Bold font indicates significant differences between irrigators who reported differing levels of profitability. [3]Bold font indicates significant differences between irrigators who used differing volumes of irrigation water. See Appendix 1 for detail.

4.4 IRRIGATION WATER USE CHANGE AND MARKET ACTIVITY

Irrigators were asked whether since 2013 their total irrigation water use had decreased, stayed about the same other than seasonal variation, or increased. This question sought to identify whether long-term changes were occurring in volume of water use, and how this varied amongst different irrigators.

Irrigators were then asked if in the last 12 months they had bought new water entitlements, sold or transferred some or all of their water entitlements, sold water allocation on the temporary market, or whether they had carried water over in either of the last two water years. This, combined with prior information about use of water allocation purchased on the market versus entitlements examined earlier in this section, provides some understanding of how Basin irrigators were utilizing water markets.

As shown in Tables 13 to 16:

- Twenty-eight per cent of Basin irrigators reported having decreased their irrigated water use since 2013, compared to 12% of those outside the Basin, while 18% reported increased water use, compared to 20% of those outside the Basin. Within the Basin, decreases in water use were more commonly reported by NSW Southern Basin irrigators, and least commonly by Northern Basin irrigators.
- Those who had not modernised on-farm infrastructure were less likely to report having increased water use than those who had modernised, with 35% of those who had not modernised reducing total irrigation water use compared to 26% of those who had modernised; and 7% of those who had not modernised increasing water use compared to 18% of those who had modernised using self-funding and 23% of those who had modernised with assistance from a grant. Those who had modernised a greater proportion of their water infrastructure were more likely to have increased water use.
- Those growing broadacre crops and those operating enterprises with a GVAP of $1 million or more were more likely to have increased irrigated water use than those running other types of farm or with smaller turnover: for example, 32% of Basin irrigators with a GVAP of $1 million or more reported having increased total volume of irrigated water used since 2013, compared with an average of 18% of Basin irrigators.
- Forty-two per cent of those making a loss on the farm reported having decreased water use over the long-term, compared to only 23% of those who reported their farm made a moderate to large profit on average over the past three years.
- Those using larger volumes of irrigation water were less likely to report decreasing irrigated water use since 2013 compared to those using smaller volumes, but not significantly more likely to report increasing water use.

When asked about water market and trading activity other than purchase of water allocation in the last 12 months:

- Purchasing water entitlements: This was more commonly done by Northern Basin irrigators, grain growers, those operating enterprises with GVAP of $1 million or more, those making a profit, those who reported higher total volumes of water use,

and by those who had modernised on-farm infrastructure, and less commonly done by those who had not modernised. This suggests that many of those who modernise on-farm infrastructure increase irrigated water use through purchase of additional entitlements.

- Selling or transferring water entitlements: A variety of irrigators reported selling or transferring water entitlements, with less clear differences between different irrigators than for purchase of water entitlements. This was more commonly reported by the following types of irrigators: those who had modernised (12% of self-funded and 15% of those who had modernised with help from a grant compared to 5% of those who had not modernised); those engaged in horticulture (17% compared to 11% of all Basin irrigators); and those with medium volumes of water use (100-299 ML) – potentially indicating a trend in which those with moderately sized enterprises are more likely to sell while larger enterprises expand by purchasing entitlements.
- Selling water allocation on the temporary market: This was most commonly reported by Southern Basin irrigators, as expected, and within the Southern Basin most commonly reported by those in the NSW Southern Basin. Those who had modernised a smaller proportion of their enterprise were slightly more likely to report selling allocation on the market, as were those running smaller sized enterprises (less than $500,000 GVAP), and with moderate water use (100-299 ML), while dairy farmers were much less likely to report doing this than other types of farmers.
- Carrying water over: This was more commonly done by those who had modernised on-farm infrastructure, those with larger farm enterprises, those using larger volumes of water, those making a profit on their farm, and those who spent a greater proportion of farm expenditure on water. It was less commonly done by those engaged in horticulture compared to other types of farms.

Table 13 Irrigation water use change and market activity – by irrigator location

		All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin	SA Basin	VIC Basin	Southern Basin not in irrig. district[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
	n	635	400	226	53	347	110	36	201	85	153	47	41
Since 2013, irrigation water use…	Decreased	**22.2%**	**28.0%**	**12.2%**	**23.8%**	**28.6%**	**38.1%**	**17.2%**	**25.1%**	**23.9%**	**24.3%**	**37.2%**	**47.1%**
	Stayed about the same (other than seasonal variation)[3]	**59.3%**	**54.5%**	**67.3%**	**57.1%**	**54.2%**	**48.5%**	**55.2%**	**57.1%**	**59.7%**	**55.9%**	**53.5%**	**38.2%**
	Increased	**18.5%**	**17.5%**	**20.4%**	**19.0%**	**17.3%**	**13.4%**	**27.6%**	**17.7%**	**16.4%**	**19.9%**	**9.3%**	**14.7%**
In the last 12 months, irrigator…	Bought new water entitlements	**6.7%**	**7.6%**	**5.2%**	**10.9%**	**7.1%**	**8.1%**	**11.5%**	**5.9%**	**7.2%**	**6.9%**	**5.6%**	**18.8%**
	Sold/ transferred some/ all entitlements	**8.5%**	**11.0%**	**4.3%**	**12.8%**	**10.7%**	**12.8%**	**21.4%**	**7.8%**	**10.1%**	**7.2%**	**10.3%**	**23.3%**
	Sold water allocation on temp market	**17.3%**	**27.3%**	**0.0%**	**21.3%**	**28.3%**	**35.2%**	**25.0%**	**25.1%**	**20.6%**	**26.6%**	**36.8%**	**40.0%**
	Carried water over from 2016-17 to next water year	**32.7%**	**47.5%**	**7.0%**	**21.3%**	**52.1%**	**55.7%**	**14.8%**	**56.6%**	**27.5%**	**64.9%**	**69.4%**	**58.1%**
	Carried water over from 2017-18 to next water year	**26.1%**	**38.5%**	**5.5%**	**19.0%**	**41.7%**	**48.3%**	**7.7%**	**44.0%**	**23.5%**	**53.4%**	**50.0%**	**51.9%**

[1] Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

[3] The specific wording given to irrigators for this option was 'Other than usual seasonal variation, water use stayed about the same This means while volume of water you apply has changed with seasonal conditions you haven't aimed to permanently increase or decrease in the amount of irrigation water you use'

Table 14 Irrigation water use change and market activity – participation of Basin irrigators in irrigation modernisation activity

			Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]				
		All Basin irrigators	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-19%	20-49%	50-74%	75%
	n	400	92	223	125	144	57	77	68	54
Since 2013, irrigation water use…	**Decreased**	28.0%	34.8%	25.9%	26.1%	**29.3%**	**27.3%**	**32.1%**	**25.0%**	**18.6%**
	Stayed about the same (other than seasonal variation)	54.5%	58.0%	55.7%	51.1%	**62.1%**	**56.8%**	**48.2%**	**50.0%**	**48.8%**
	Increased	17.5%	7.2%	18.4%	22.7%	**8.6%**	**15.9%**	**19.6%**	**25.0%**	**32.6%**
In the last 12 months, irrigator…	**Bought new water entitlements**	7.6%	**1.4%**	**8.4%**	**11.3%**	1.9%	7.1%	9.6%	12.5%	15.0%
	Sold/ transferred some/ all entitlements	11.0%	**4.3%**	**12.2%**	**14.6%**	8.3%	9.8%	15.4%	12.2%	15.0%
	Sold water allocation on temp market	27.3%	27.4%	29.2%	25.9%	29.6%	31.0%	35.3%	25.6%	25.0%
	Carried water over from 2016-17 to next water year	47.5%	**36.2%**	**47.1%**	**59.8%**	**36.7%**	**64.9%**	**58.3%**	**61.9%**	**41.0%**
	Carried water over from 2017-18 to next water year	38.5%	28.4%	40.0%	46.7%	31.7%	62.2%	43.2%	51.4%	29.4%

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

Table 15 Irrigation water use change and market activity – by farm type and size

		Farm type[1]						Gross value of agricultural production 2017-18[2]					
		Basin irrigators	Dairy farmer	Grain grower	Grazier	Horti-culture	Mixed cropping/ grazing	< $40,000	40,000-$99,999	$100,000-$299,999	$300,000-$499,999	$500,000-$999,999	$1 million+
	n	400	81	58	137	120	84	96	59	98	39	61	82
Since 2013, irrigation water use…	Decreased	**28.0%**	**24.0%**	**23.7%**	**39.4%**	**19.5%**	**26.7%**	36.2%	26.7%	34.2%	31.3%	20.9%	18.5%
	Stayed about the same (other than seasonal variation)	**54.5%**	**52.0%**	**50.0%**	**50.5%**	**66.7%**	**48.3%**	47.8%	60.0%	55.3%	46.9%	62.8%	50.0%
	Increased	**17.5%**	**24.0%**	**26.3%**	**10.1%**	**13.8%**	**25.0%**	15.9%	13.3%	10.5%	21.9%	16.3%	31.5%
In the last 12 months, irrigator…	Bought new water entitlements	7.6%	2.0%	15.2%	6.8%	10.1%	7.1%	**4.4%**	**4.3%**	**4.1%**	**10.0%**	**7.0%**	**20.0%**
	Sold/ transferred some/ all entitlements	11.0%	5.8%	6.7%	8.9%	17.3%	12.3%	7.6%	10.9%	16.2%	10.7%	4.5%	16.0%
	Sold water allocation on temp market	**27.3%**	**6.0%**	**32.4%**	**35.6%**	**23.4%**	**35.1%**	21.2%	30.2%	30.7%	38.7%	18.6%	21.3%
	Carried water over from 2016-17 to next water year	**47.5%**	**64.7%**	**64.7%**	**44.6%**	**26.0%**	**57.4%**	**31.3%**	**30.8%**	**47.1%**	**48.3%**	**58.7%**	**64.0%**
	Carried water over from 2017-18 to next water year	**38.5%**	**52.1%**	**50.0%**	**37.9%**	**20.3%**	**48.1%**	**26.2%**	**25.7%**	**29.7%**	**50.0%**	**43.9%**	**61.7%**

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18. See Appendix 1 for detailed data from statistical tests.

Table 16 Irrigation water use change and market activity – by farm water use characteristics

		% farm expenditure on irrigation water[1]				Farm self-reported 3-year profitability[2]			Volume of irrigation water used in 2017-18 water year[3]				
		<10%	10-19%	20-29%	30%+	Making a loss	Breaking even/small profit	Moderate or large profit	<30ML	30 to 99ML	100 to 299ML	300 to 999ML	1000ML or more
	n	91	111	59	126	126	237	90	45	64	97	99	88
Since 2013, irrigation water use…	Decreased	25.3%	23.5%	24.5%	30.7%	**41.6%**	**23.7%**	**23.1%**	37.5%	**27.3%**	**35.9%**	**23.0%**	**10.9%**
	Stayed about the same (other than seasonal variation)	58.7%	55.3%	55.1%	53.4%	**41.6%**	**57.6%**	**61.5%**	56.3%	**49.1%**	**51.3%**	**55.4%**	**63.6%**
	Increased	16.0%	21.2%	20.4%	15.9%	**16.9%**	**18.6%**	**15.4%**	6.3%	**23.6%**	**12.8%**	**21.6%**	**25.5%**
In the last 12 months, irrigator…	Bought new water entitlements	8.9%	10.0%	5.1%	7.4%	2.4%	8.2%	12.3%	5.3%	8.2%	4.3%	10.8%	13.7%
	Sold/ transferred some/ all entitlements	10.3%	11.4%	7.7%	13.3%	13.1%	8.3%	15.6%	**7.5%**	**6.7%**	**21.4%**	**10.5%**	**8.0%**
	Sold water allocation on temp market	**19.5%**	**25.0%**	**34.9%**	**30.4%**	21.0%	31.0%	25.8%	**15.0%**	**31.3%**	**37.1%**	**31.9%**	**14.9%**
	Carried water over from 2016-17 to next water year	**35.1%**	**37.8%**	**59.5%**	**63.0%**	36.3%	51.2%	49.2%	**17.9%**	**36.0%**	**51.6%**	**67.6%**	**68.6%**
	Carried water over from 2017-18 to next water year	**26.0%**	**43.8%**	**51.4%**	**46.4%**	**24.3%**	**42.9%**	**43.9%**	**18.4%**	**30.4%**	**36.8%**	**49.2%**	**67.3%**

[1] Bold font indicates there were significant differences between irrigators whose expenditure on water made up differing proportions of total farm expenditure.
[2] Bold font indicates significant differences between irrigators who reported differing levels of profitability.
[3] Bold font indicates significant differences between irrigators who used differing volumes of irrigation water. See Appendix 1 for detailed data from statistical tests.

Those irrigators who reported their volume of irrigation water used had increased in the past five years were asked if this was due to any of several reasons, including how they increased volume (via increasing use of temporary water purchased on the market or purchasing additional water entitlements), and what the increased volume of water was used for (to irrigate a larger area of land, more intensively irrigate land already irrigated, or change crops/pasture grown). Irrigators could select as many categories as applied. As shown in Table 17, comparisons of reasons for increasing water use can only be reported for a small number of groups of irrigators due to the relatively small proportion of irrigators who had increased total water use in the past five years.

Overall, increase in water use was more commonly achieved through increased use of temporary water bought on the market (40% of irrigators) than by purchase of additional entitlements (16%). Around one-third of irrigators reported they increased water use in order to irrigate a larger area of land, one-third more intensively irrigated land they already irrigated, and the other third use additional water as part of change in the type of crops/pasture grown on their land.

The findings suggest that those who had modernised on-farm infrastructure using a grant were most likely to have increased volume of water use through increasing their use of temporary water (64%), and less likely to have purchased additional water entitlements (27%). They were similarly likely to have increased irrigation in order to irrigate larger areas of land than more intensively irrigate existing land, and/or change the types of crops or pasture they grew.

Table 13 Reasons and mechanisms for increasing volume of irrigation water used

If the total volume of irrigation water used on your farm increased, was the increase due to any of the following?	Greater use of temporary water	Purchase of additional water entitlements	Irrigation of a larger area of land	More intensive irrigation of land you already irrigated	Change in type of crops/ pasture grown
All irrigators (n=105)	27.6%	18.1%	44.8%	32.4%	29.5%
Basin irrigators (n=67)[1]	**40.3%**	16.4%	**34.3%**	32.8%	34.3%
Southern Basin irrigators (n=59)[2]	**44.1%**	16.9%	**33.9%**	35.6%	35.6%
Basin irrigator, had modernised on-farm infrastructure (n=55)[3]	**40.7%**	18.6%	33.9%	33.9%	32.2%
Basin irrigator, modernised using own funds (n=34) [3]	***27.0%***	*13.5%*	*21.6%*	*43.2%*	*37.8%*
Basin irrigator, modernised using help of grant (n=21) [3]	***63.6%***	*27.3%*	*54.5%*	*18.2%*	*22.7%*

Note that while statistical significance tests were undertaken, the small sample size of those who had increased irrigation water use substantially increases likelihood that some other significant associations were not identified.
[1] Bold font indicates there was a significant difference between Basin irrigators and those living outside the Basin
[2] Bold font indicates significant difference between Southern and Northern Basin irrigators
[3] Bold font indicates significant differences between those who did and didn't modernise, and those who modernised with/without grant.

The overall finding that those with larger enterprises and those who had modernised were more likely to report increased water use was explored further by examining water sources used by those who had increased versus decreased their water use since 2013. As shown in Table 18, a key characteristic of those who had increased water use was that they were much less likely to rely solely on water entitlements they owned compared to those who

had not increased water use. While 95% relied at least in part on water entitlements they owned, compared to 86% of those whose water use stayed about the same, and 84% of those who decreased water use, 62% of those who increased water use also bought allocation on the temporary market, compared to only 33% of those whose water use stayed about the same, and 38% of those whose water use had decreased. This indicated that for many of those who increased water use, the increased volume came from purchasing water on the temporary market, in addition to purchase of additional entitlements. In addition, 22% of those who increased water use reported leasing water entitlements from others, compared to 7% of those who decreased water use or for whom water use stayed about the same. This again points to irrigators using a range of mechanisms to increase volume of water use, rather than relying on purchasing additional entitlements. This was similar for those who had modernised on-farm water infrastructure.

Table 14 Irrigation water use change by use of entitlements and temporary allocation

Change in volume of water use since 2013→		Basin irrigators			Basin irrigators who had modernised on-farm infrastructure		
% of water used that came from entitlements versus allocation↓		Decreased	Stayed about the same	Increased	Decreased	Stayed about the same	Increased
	n	95	196	57	56	132	45
owned entitlements	None	15.6%	13.8%	5.3%	13.8%	9.6%	5.9%
	1-74%	23.3%	10.6%	31.6%	21.5%	12.5%	31.4%
	75%+	61.1%	75.5%	63.2%	64.6%	77.9%	62.7%
allocation bought on temporary market	None	62.5%	66.4%	37.8%	57.1%	59.8%	38.1%
	1-74%	30.6%	27.7%	44.4%	32.7%	33.3%	45.2%
	75%+	6.9%	5.8%	17.8%	10.2%	6.9%	16.7%
leased entitlements	None	93.5%	93.4%	78.0%	92.9%	90.9%	78.9%
	1-74%	6.5%	5.7%	19.5%	7.1%	8.0%	18.4%
	75%+	0.0%	0.8%	2.4%	0.0%	1.1%	2.6%
other sources	None	80.7%	76.5%	80.6%	78.0%	80.7%	79.4%
	1-74%	17.5%	11.3%	13.9%	22.0%	9.6%	14.7%
	75%+	1.8%	12.2%	5.6%	0.0%	9.6%	5.9%

Note: As this table is descriptively comparing patterns of water use involving cross-tabulating three variables, statistical significance testing was not conducted (previous tables identify differences in volume of water use by the variables shown in this table).

4.5 FARM EXPENDITURE

Basin irrigators on average reported that 20% of their farm expenditure was on water for irrigation, compared to just over 10% of expenditure on average amongst irrigators outside the Basin (Tables 19 to 22). Water costs made up a higher proportion of farm expenditure for Southern Basin irrigators than Northern Basin irrigators (21% compared to 13%). For most irrigators, power costs represented around 10% to 12% of expenditure, and were on average slightly higher for those who had not modernised on-farm infrastructure compared to those who had, and for those using groundwater compared to those drawing water from irrigation channels or pumping directly from rivers/dams.

Table 19 Mean farm expenditure by expenditure type – by irrigator location

		All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin	SA Basin	VIC Basin	Southern Basin not in irrig. district[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
	n	635	400	226	53	347	110	36	201	85	153	47	41
Average expenditure in 2017-18 on…	**Water for irrigation**	16.6	**19.8**	**10.1**	**12.8**	**20.9**	20.4	16.2	21.9	**9.8**	**23.5**	**27.0**	**24.2**
	Electricity/ power	11.8	**11.1**	**13.0**	11.8	11.0	11.5	11.0	10.6	12.6	10.8	9.5	11.1
	Contractors	10.3	**9.1**	**12.1**	9.8	9.0	10.0	9.9	8.2	11.2	7.5	9.4	14.3
	Salaries/ wages	14.2	**11.7**	**18.2**	14.3	11.2	11.6	16.4	9.8	17.8	8.2	8.2	13.6
	Fuel (petrol, diesel, gas)	12.8	12.6	13.1	14.5	12.3	12.6	10.9	12.3	13.0	12.8	13.2	11.7
	Other inputs (e.g. feed, fertilizer, chemicals, seed)	27.4	27.4	27.3	31.1	26.9	29.0	23.9	26.2	28.9	26.3	29.3	26.0

[1]Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

Table 20 Mean farm expenditure by expenditure type – participation of Basin irrigators in irrigation modernisation activity

			Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]				
		All Basin irrigators	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-19%	20-49%	50-74%	75%
	n	400	92	223	125	144	57	77	68	54
Average expenditure in 2017-18 on…	**Water for irrigation**	19.8	**14.8**	**16.9**	**17.4**	16.6	14.8	21.3	14.7	17.6
	Electricity/ power	11.1	15.4	10.2	11.0	12.8	9.3	10.9	13.1	10.1
	Contractors	9.1	10.0	10.7	9.2	**9.2**	**9.6**	**11.0**	**8.7**	**12.6**
	Salaries/ wages	11.7	14.0	14.9	12.4	**12.5**	**12.9**	**15.9**	**16.5**	**17.0**
	Fuel (petrol, diesel, gas)	12.6	12.9	12.8	12.0	**12.2**	**11.3**	**11.7**	**12.4**	**13.6**
	Other inputs	27.4	27.9	27.2	27.0	27.0	29.0	23.7	28.5	21.9

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

Table 21 Mean farm expenditure by expenditure type – by farm type and size

		Farm type[1]						Gross value of agricultural production 2017-18[2]					
		Basin irrigators	Dairy farmer	Grain grower	Grazier	Horti-culture	Mixed cropping/ grazing	< $40,000	40,000-$99,999	$100,000-$299,999	$300,000-$499,999	$500,000-$999,999	$1 million+
	n	400	81	58	137	120	84	96	59	98	39	61	82
Average expenditure in 2017-18 on…	Water for irrigation	19.8	**15.2**	**22.5**	**18.3**	**12.3**	**21.2**	**21.5**	**16.7**	**16.8**	**13.7**	**15.7**	**11.2**
	Electricity/ power	11.1	**11.9**	**9.5**	**11.2**	**12.8**	**10.1**	**16.5**	**11.9**	**9.5**	**9.6**	**10.8**	**9.9**
	Contractors	9.1	**7.8**	**7.9**	**8.9**	**13.8**	**9.6**	**10.0**	**9.6**	**10.7**	**10.2**	**12.4**	**9.7**
	Salaries/ wages	11.7	13.1	6.8	9.7	21.1	8.8	**4.8**	**13.1**	**13.4**	**15.9**	**13.7**	**23.5**
	Fuel (petrol, diesel, gas)	12.6	**8.5**	**12.7**	**13.9**	**11.6**	**16.8**	**17.3**	**14.4**	**11.8**	**11.3**	**11.7**	**8.8**
	Other inputs	27.4	**34.6**	**27.9**	**29.0**	**22.5**	**32.5**	**24.7**	**23.4**	**24.7**	**34.4**	**34.5**	**28.9**

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18. See Appendix 1 for detailed data from statistical tests.

Table 22 Mean farm expenditure by expenditure type – by farm water use characteristics

		Farm self-reported 3-year profitability[1]			Volume of irrigation water used in 2017-18 water year[2]					Majority of irrigation water used derived from…[3]		
		Making a loss	Breaking even/small profit	Moderate or large profit	<30ML	30 to 99ML	100 to 299ML	300 to 999ML	1000ML or more	Irrigation channels	Direct pumping	Ground-water
	n	126	237	90	45	64	97	99	88	219	95	86
Average expenditure in 2017-18 on…	Water for irrigation	19.5	16.8	12.9	**12.3**	**14.2**	**23.7**	**19.0**	**16.8**	**23.6**	**13.1**	**10.3**
	Electricity/ power	**14.4**	**11.5**	**9.2**	**13.2**	**11.0**	**12.2**	**11.4**	**8.4**	10.1	12.0	14.1
	Contractors	10.7	9.8	10.7	12.9	10.6	8.5	10.4	8.7	9.1	9.3	12.8
	Salaries/ wages	**9.4**	**15.1**	**17.2**	**13.4**	**15.4**	**13.5**	**16.3**	**13.5**	**10.2**	**17.5**	**16.4**
	Fuel (petrol, diesel, gas)	14.4	12.7	11.2	13.2	12.0	13.8	11.4	10.6	11.6	12.8	13.4
	Other inputs	27.6	26.7	28.7	27.4	27.1	23.6	27.9	31.8	**25.8**	**26.2**	**28.9**

[1] Bold font indicates significant differences between irrigators who reported differing levels of profitability.
[2] Bold font indicates significant differences between irrigators who used differing volumes of irrigation water.
[3] Bold font indicates significant differences between irrigators who derived majority of irrigation water from channels, pumping or groundwater. See Appendix 1 for detailed data from statistical tests.

4.6 CONCLUSIONS

This report aims to better understand the effects of investment in irrigation infrastructure modernisation for Basin irrigators. When assessing effects, it is important to identify the extent to which characteristics of irrigators vary, together with whether they are experiencing differences in conditions: these may contribute to changes in how modernisation activity affects irrigators. Overall, there are often substantial differences in the type and structure of irrigation enterprises in different parts of the Basin. This includes differences in water use and expenditure, with those operating in irrigation districts typically reporting a much larger proportion of farm expenditure on irrigation water compared to those who rely on pumping water directly from rivers/water bodies or on groundwater. Those living in the GMID are more likely to report low GVAP, making a loss on the farm on average over the last three years, being in poor health, and a high proportion of farm expenditure being on water costs. In the Northern Basin, despite overall larger enterprises, a growing proportion of farms reported GVAP below $100,000 between 2016 and 2018, likely a consequence of drought stress.

Past investment in modernization of on-farm irrigation infrastructure, particularly with assistance from grants, has been more common amongst those relying on water from irrigation channels than from pumping or groundwater. There is clearly a strong association between profitability, farm size, investment in modernization, and also water use: more profitable, larger farms are most likely to report both investing in modernization (with or without assistance from grants) and increasing water use. This reflects typical patterns of agricultural consolidation in recent decades in Australia, with an overall trend in which smaller-sized farms are either sold or expanded to take advantage of economies of scale: those who sell are more likely to be those making a loss, while those who are profitable are more likely to be able to expand their farm enterprises. Associated with this overall pattern, as expected, those who expand farm enterprises are more likely to be increasing water use, and investing in modernising irrigation infrastructure to maximise efficiency of the water used on the farm. Those who have increased irrigation water use commonly purchase water on the temporary market to do so, suggesting that there is re-allocation of water happening within the Basin from often smaller and less profitable enterprises to larger and more profitable enterprises. There is also substantial water trade amongst larger and profitable enterprises, suggesting that water trade is being used to maximise returns season to season based on criteria such as relative price of water compared to likely return achieved from different crops/pasture.

Those growing broadacre crops and those operating enterprises with a GVAP of $1 million or more were more likely to have increased irrigated water use than those running other types of farm or with smaller turnover. Forty-two per cent of those making a loss on the farm reported having decreased water use over the long-term, compared to only 23% of those who reported their farm made a moderate to large profit on average over the past three years.

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

5.1 INTRODUCTION

Many irrigators invest in improving their on-farm water infrastructure. The goal of the on-farm infrastructure grants delivered as part of the OFIEP program within SRWUIP has been to encourage modernisation of infrastructure to improve water use efficiency, enabling transfer of water entitlements to government and contributing to meeting the sustainable diversion limits set as part of the Basin Plan. This section examines the socio-economic effects of on-farm infrastructure modernisation grants made as part of the SRWUIP. First, engagement in on-farm modernisation in general is examined, and then modernisation with the assistance of a grant. The types of on-farm modernisation investment undertaken are identified, followed by farmer views on the socio-economic effects of these grants.

5.2 ON-FARM INFRASTRUCTURE MODERNISATION BY LANDHOLDERS SINCE 2008

All irrigators who participated in the 2018 Regional Wellbeing Survey were asked whether they had upgraded their on-farm water infrastructure at any point since 2008, a period chosen as it encompassed the full life of the SRWUIP[4]. They were then asked what proportion of their irrigation area had been modernised since 2013, focusing on a shorter period to gain a better understanding of the likely future modernisation potential on irrigation properties. The majority of Basin irrigators – 79.4% – reported engaging in some form of on-farm irrigation infrastructure modernisation since 2008 (Table 23). This is higher than the 56% who reported having done this in 2016, and 59% in 2015[5]. The difference in the figure is likely due primarily to a change in how this question was asked in the survey. In 2015 and 2016 the question asked simply if the irrigator had upgraded or modernised on-farm infrastructure without asking about different specific actions. In 2018, the survey asked the irrigator if they had done any of a number of specific actions, and this appears to have prompted a higher response, likely due to irrigators being prompted to recognize actions they have invested in as falling into the definition of upgrading or modernising infrastructure.

In the 2018 survey, all Basin irrigators who reported receiving a grant were classified as having received a SRWUIP grant (in previous surveys around 4% could not be positively identified as receiving a SRWUIP grant)[6]. However, it is possible a small number received grants from other programs that were run in the same regions as SRWUIP-related grants: this number would be small (estimated at a maximum of 5 irrigators).

Southern Basin irrigators were much more likely to report receiving a grant to assist them in some modernisation activities than those in the Northern Basin or outside the Basin, although most who reported receiving a grant also reported they had self-funded many of

[4] The 2014 Regional Wellbeing Survey asked about use of infrastructure grants, but did not identify whether farmers had modernised on-farm infrastructure without a grant.

[5] Earlier years of the Regional Wellbeing Survey did not include questions identifying the proportion of irrigators who had upgraded on-farm infrastructure, and only asked about those who had received grants to do so.

[6] Irrigators who reported accessing a grant to fund all or part of their on-farm modernisation were assessed to identify which had received a grant under the SRWUIP program, using data provided by Department of Agriculture on the regions in which funding was delivered and delivery partners. See Methods section for a full description of how this was done.

their modernisation activities. Those who received grant assistance on average reported having modernised a larger proportion of their irrigation area compared to those who had not received grant assistance, consistent with survey findings reported in previous reports. Tables 23 to 26 compare the characteristics of irrigators who had and hadn't engaged in modernisation, and who had modernised differing proportions of their irrigated area.

In total, 27% of irrigators had not modernised irrigation infrastructure since 2008, and 22% of Basin irrigators. Irrigators were most likely to report not having modernised on-farm infrastructure if they lived outside the Basin (33%), were engaged in horticulture (28%), had a GVAP below $40,000 (40%), were making a loss on the farm (27%), relied primarily on groundwater (33%), used less than 100 ML of water (36% of those using less than 30 ML and 34% of those using 30-99 ML in 2017-18), or earned 76% or more of their household income off-farm (32%).

In total, 52% of Basin irrigations reported having fully self-funded modernisation activity since 2008 (54% of all irrigators). Irrigators were most likely to report having self-funded modernisation activities if they lived in the Northern Basin (69%), were grain growers (58%), had GVAP of between $500,000 and $999,999, relied partly or wholly on groundwater (59%) and/or earned all household income on the farm (57%).

In total, 26% of Basin irrigators reported having modernised with assistance from a grant (19% of all irrigators). Irrigators were most likely to report having modernised with assistance of a grant if they lived in the GMID (31%) or MIL (30%), were dairy farmers (39%), had GVAP of $1 million or more (46%), reported a moderate or large profit over the last three years (34%), or relied primarily on water from irrigation channels (32%). It is possible that younger irrigators were more likely to have received a grant, with 48% of a small sample reporting having done so, however the small sample size of young farmers means the differences observed are not statistically significant. Most irrigators who modernised with grant assistance also reported having self-funded modernisation activities, with the majority reporting having engaged in more than one type of modernisation activity.

Irrigators were also asked more specifically what types of modernization they had invested in since 2013 – in other words, more recent investment activities. This was asked as in many cases farmers engage in rolling investment: some of those who had modernised since 2008 may have invested recently (since 2013) while others may have invested some time ago and potentially be more likely to be considering further work.

Since 2013, 39% of irrigators had not modernised any part of their on-farm irrigation area (and 38% of those in the Basin), while 14% had modernised 1-19%, 18% had modernised 20-49%, 14% (and 15% in the Basin) had modernised 50-74%, and 14% had modernised 75% or more.

Irrigators were most likely to report not modernising any on-farm infrastructure since 2013 if they lived in the Victorian Basin (44%), were graziers (46%), had GVAP of below $40,000 (49%) or $40,000 to $99,999 (50%), were making a loss on the farm (48%), used larger volumes of water (37% of those applying 300-999 ML in 2017-18 and 45% of those applying 1000 ML or more), relied primarily on groundwater (47%), applied less than 30 ML (55%) or 30-99 ML (64%), were aged 75 or more (47%), and/or earned 26% or more of their household income off farm (45% to 47%).

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

Irrigators were most likely to have modernised 75% or more of their infrastructure since 2013 if they were engaged in horticulture (27%), had a GVAP of $1 million or more (25%), were making a moderate to large profit (22%), spent a greater proportion of farm expenditure in irrigation water (16% of those who spent 20-29% of farm expenditure on water, and 15% of those who spent 30% or more), or had a tertiary qualification (19%).

Table 23 Engagement in modernisation of on-farm irrigation infrastructure – by irrigator location

		All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin	SA Basin	VIC Basin	Southern Basin not in irrig. district[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
	n	635	400	226	53	347	110	36	201	85	153	47	41
Modernisation of on-farm irrigation infrastructure since 2008	**Has not modernised since 2008**	26.5%	**22.3%**	**33.3%**	**22.2%**	**22.4%**	20.2%	16.7%	24.5%	**23.2%**	**23.6%**	**16.3%**	**23.5%**
	Modernised, self-funded	54.2%	**51.8%**	**58.9%**	**68.5%**	**48.9%**	55.6%	40.0%	46.7%	**58.4%**	**45.7%**	**53.5%**	**58.8%**
	Modernised with help of grant	19.4%	**25.9%**	**7.7%**	**9.3%**	**28.8%**	24.2%	43.3%	28.8%	**18.4%**	**30.7%**	**30.2%**	**17.6%**
Proportion of on-farm irrigation infrastructure modernised since 2013	**None**	39.3%	38.3%	41.2%	30.8%	39.4%	34.5%	25.0%	44.3%	**44.0%**	**40.5%**	**33.3%**	**21.2%**
	1-19%	14.1%	14.3%	13.9%	15.4%	14.2%	10.3%	0.0%	18.6%	**15.0%**	**19.0%**	**11.1%**	**3.0%**
	20-49%	17.8%	17.8%	18.2%	23.1%	17.0%	20.7%	21.4%	14.4%	**14.0%**	**15.9%**	**27.8%**	**27.3%**
	50-74%	14.3%	15.3%	12.1%	20.5%	14.5%	12.6%	14.3%	15.6%	**12.0%**	**17.5%**	**16.7%**	**18.2%**
	75%	14.3%	14.3%	14.5%	10.3%	14.9%	21.8%	39.3%	7.2%	**15.0%**	**7.1%**	**11.1%**	**30.3%**

[1]Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

Table 24 Engagement in modernisation of on-farm irrigation infrastructure – by farm type and size

		Farm type[1]						Gross value of agricultural production 2017-18[2]						Farm self-reported 3-year profitability[3]		
		Basin irrigators	Dairy farmer	Grain grower	Grazier	Horti-culture	Mixed cropping/ grazing	<$40,000	$40,000-$99,999	$100,000-$299,999	$300,000-$499,999	$500,000-$999,999	$1 million+	Making a loss	Breaking even/ small profit	Moderate or large profit
	n	400	81	58	126	126	126	96	59	98	39	61	82	126	237	90
Modernisation of on-farm irrigation infrastructure since 2008	Has not modern-ised since 2008	22.3%	17.3%	15.0%	22.8%	27.6%	18.2%	**39.7%**	**24.5%**	**23.5%**	**27.3%**	**12.2%**	**1.8%**	26.8%	23.6%	12.9%
	Modern-ised, self-funded	51.8%	44.2%	57.5%	55.3%	50.6%	53.0%	**44.9%**	**46.9%**	**53.1%**	**51.5%**	**59.2%**	**52.7%**	49.5%	52.4%	52.9%
	Modern-ised with help of grant	25.9%	38.5%	27.5%	21.9%	21.8%	28.8%	**15.4%**	**28.6%**	**23.5%**	**21.2%**	**28.6%**	**45.5%**	23.7%	24.1%	34.3%
Proportion of on-farm irrigation infrastructure modernised since 2013	None	38.3%	**40.0%**	**28.9%**	**45.5%**	**37.2%**	**30.5%**	**49.2%**	**50.0%**	**46.1%**	**40.7%**	**25.0%**	**13.5%**	47.6%	38.2%	26.7%
	1-19%	14.3%	**24.0%**	**15.8%**	**9.1%**	**12.8%**	**16.9%**	**9.8%**	**10.0%**	**15.8%**	**22.2%**	**22.7%**	**9.6%**	11.9%	15.8%	13.3%
	20-49%	17.8%	**10.0%**	**21.1%**	**21.6%**	**11.5%**	**27.1%**	**14.8%**	**12.5%**	**17.1%**	**22.2%**	**20.5%**	**25.0%**	17.9%	16.4%	23.3%
	50-74%	15.3%	**24.0%**	**15.8%**	**12.5%**	**11.5%**	**15.3%**	**9.8%**	**12.5%**	**13.2%**	**11.1%**	**13.6%**	**26.9%**	10.7%	17.0%	15.0%
	75% or more	14.3%	**2.0%**	**18.4%**	**11.4%**	**26.9%**	**10.2%**	**16.4%**	**15.0%**	**7.9%**	**3.7%**	**18.2%**	**25.0%**	11.9%	12.7%	21.7%

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18.
[3] Bold font indicates significant differences between irrigators who reported differing levels of profitability. See Appendix 1 for detailed data from statistical tests.

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

Table 25 Engagement in modernisation of on-farm irrigation infrastructure – by farm water use characteristics

		% farm expenditure on irrigation water[1]				Source of majority of irrigation water used in 2017-18[2]			Volume of irrigation water used in 2017-18 water year[3]				
		<10%	10-19%	20-29%	30%+	Channels	Direct pumping	Ground-water	<30ML	30 to 99ML	100 to 299ML	300 to 999ML	1000ML or more
	n	91	111	59	126	196	86	73	45	64	97	99	88
Modernisation of on-farm irrigation infrastructure since 2008	**Has not modernised since 2008**	24.1%	20.0%	17.0%	21.1%	**18.9%**	**22.1%**	**32.9%**	**35.9%**	**33.9%**	**17.1%**	**12.8%**	**6.9%**
	Modernised, self-funded	51.8%	52.9%	40.4%	54.4%	**49.0%**	**48.8%**	**58.9%**	**48.7%**	**48.2%**	**57.9%**	**50.0%**	**48.3%**
	Modernised with help of grant	24.1%	27.1%	42.6%	24.4%	**32.1%**	**29.1%**	**8.2%**	**15.4%**	**17.9%**	**25.0%**	**37.2%**	**44.8%**
Proportion of on-farm irrigation infrastructure modernised since 2013	**None**	40.0%	39.2%	40.0%	33.3%	34.1%	41.0%	46.6%	**55.2%**	**64.0%**	**32.9%**	**25.7%**	**14.5%**
	1-19%	22.9%	16.5%	6.7%	14.3%	14.8%	7.7%	20.7%	**13.8%**	**10.0%**	**18.6%**	**13.5%**	**18.2%**
	20-49%	11.4%	16.5%	15.6%	26.2%	17.6%	21.8%	13.8%	**13.8%**	**6.0%**	**17.1%**	**28.4%**	**27.3%**
	50-74%	15.7%	16.5%	22.2%	9.5%	18.7%	15.4%	5.2%	**6.9%**	**12.0%**	**18.6%**	**13.5%**	**25.5%**
	75% or more	10.0%	11.4%	15.6%	16.7%	14.8%	14.1%	13.8%	**10.3%**	**8.0%**	**12.9%**	**18.9%**	**14.5%**

[1] Bold font indicates significant differences between irrigators who had different proportions of farm expenditure on irrigation water.
[2]Bold font indicates significant differences between irrigators who derived majority of irrigation water from channels, pumping or groundwater.
[3]Bold font indicates significant differences between irrigators who used differing volumes of irrigation water. See Appendix 1 for detailed data from statistical tests.

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

Table 26 Engagement in modernisation of on-farm irrigation infrastructure – by socio-demographic characteristics

		Irrigator age[1]					Formal educational attainment[2]			Proportion of household income earned off-farm[3]				
		Aged under 45	**Aged 45-54**	**Aged 55-64**	**Aged 65-74**	**Aged 75+**	**Did not complete high school**	**Has high school or post-school qualif-ication**	**Completed tertiary qualifi-cation**	**None**	**1-25%**	**26-50%**	**51-75%**	**76% or more**
	n	23	55	124	110	40	96	259	104	108	92	47	38	73
Modernisation of on-farm irrigation infrastructure since 2008	**Has not modernised since 2008**	13.0%	26.8%	21.0%	23.5%	19.5%	23.7%	21.9%	25.0%	14.3%	20.4%	27.1%	26.3%	32.4%
	Modernised, self-funded	39.1%	55.4%	53.2%	52.2%	51.2%	49.5%	52.1%	56.5%	57.1%	51.6%	50.0%	47.4%	45.9%
	Modernised with help of grant	47.8%	17.9%	25.8%	24.3%	29.3%	26.8%	26.0%	18.5%	28.6%	28.0%	22.9%	26.3%	21.6%
Proportion of on-farm irrigation infrastructure modernised since 2013	**None**	26.3%	34.7%	36.4%	40.4%	47.2%	41.2%	37.9%	39.8%	31.3%	35.4%	46.7%	45.2%	45.2%
	1-19%	5.3%	12.2%	16.8%	15.4%	8.3%	17.6%	12.5%	13.3%	18.2%	14.6%	8.9%	16.1%	11.3%
	20-49%	15.8%	28.6%	10.3%	19.2%	25.0%	18.8%	17.2%	17.3%	20.2%	25.6%	8.9%	12.9%	11.3%
	50-74%	21.1%	16.3%	17.8%	14.4%	5.6%	10.6%	16.8%	10.2%	22.2%	9.8%	17.8%	9.7%	11.3%
	75%	31.6%	8.2%	18.7%	10.6%	13.9%	11.8%	15.5%	19.4%	8.1%	14.6%	17.8%	16.1%	21.0%

[1] Bold font indicates significant differences between irrigators of different ages.
[2] Bold font indicates significant differences between irrigators with different levels of formal educational attainment.
[3] Bold font indicates significant differences between irrigators whose households earned differing amounts of household income off-farm. See Appendix 1 for detailed data from statistical tests.
Note no significant associations were identified, hence there are no bolded results in this table.

5.3 ON-FARM MODERNISATION – TYPES OF INVESTMENT MADE

Irrigators were asked if they had undertaken any of several types of modernisation. The most common types reported by Basin irrigators (Table 27) were landforming (45%), improvement of farm drain re-use systems (such as increasing water run-off captured for re-use, 41%), improving irrigation channels to reduce leakage (36%), upgrading water metering (28%) and converting from manual to automatic irrigation systems (23%). Less than 20% of irrigators reported undertaking other types of modernisation including upgrading existing automated control systems (19%), introducing fertigation (13%), upgrading drip systems (12%), converting to drip-based systems from another system (10%) or converting to or upgrading overhead irrigation (7% and 8% respectively). Those who modernised with assistance from a grant were more likely than others to report doing all of the actions asked about and were particularly more likely to report having modernised using landforming, upgrading metering, and improving farm drain re-use.

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

Table 27 Modernisation of on-farm irrigation areas since 2008 – type of modernisation works undertaken

	Land-forming	Improve-ment of farm drain reuse systems	Converting from manual to automated irrigation control systems	Upgrade existing autom-ated control systems	Upgrade metering	Conver-sion from surface to overhead irrigation	Upgrade of existing overhead irrigation systems	Conver-sion to drip-based irrigation system	Upgrade of existing drip-based irrigation system	Introduc-tion of fertigation	Improved irrigation channels to reduce leakage	Other moderni sation
All irrigators (n=564)	33.9%	33.3%	21.3%	19.0%	23.6%	6.7%	10.9%	11.6%	14.5%	15.3%	25.3%	15.5%
Basin irrigators (n=360)[1]	**45.3%**	**40.9%**	**22.6%**	**18.5%**	**27.5%**	**6.6%**	**7.8%**	**10.3%**	**11.5%**	**13.4%**	**36.3%**	**15.1%**
Irrigators outside the Basin (n=201)[1]	**13.4%**	**19.8%**	**19.4%**	**20.3%**	**16.6%**	**7.1%**	**16.5%**	**14.1%**	**20.1%**	**18.9%**	**5.6%**	**15.4%**
Northern Basin irrigators (n=57)[2]	**38.9%**	**44.4%**	**24.1%**	**23.5%**	**51.9%**	**3.9%**	**12.0%**	**9.8%**	**15.7%**	**15.7%**	**15.7%**	**25.5%**
Southern Basin irrigators (n=344)[2]	**46.4%**	**40.3%**	**22.3%**	**17.6%**	**23.3%**	**7.0%**	**7.1%**	**10.4%**	**10.8%**	**13.0%**	**39.7%**	**13.1%**
Southern Basin NSW (n=111)	51.0%	48.4%	21.7%	17.2%	29.8%	9.9%	7.7%	11.8%	13.3%	14.0%	42.6%	13.2%
Southern Basin Vic irrigator (n=198)	47.5%	38.9%	18.5%	12.9%	19.2%	6.1%	4.5%	5.1%	4.5%	6.2%	42.5%	13.2%
Southern Basin SA irrigator (n=35)	24.1%	23.3%	46.7%	46.7%	26.7%	3.6%	20.7%	39.3%	40.0%	51.7%	13.8%	12.5%
Southern Basin not in irrigation district (n=122)[3]	**27.9%**	**36.1%**	**20.7%**	**21.8%**	**38.0%**	**6.0%**	**12.0%**	**12.8%**	**17.9%**	**16.1%**	**16.2%**	**15.9%**
GMID (n=137)[3]	**54.7%**	**41.2%**	**18.7%**	**11.1%**	**17.2%**	**5.9%**	**3.0%**	**3.0%**	**3.0%**	**4.4%**	**46.3%**	**9.9%**
MIL (n=43)[3]	**69.8%**	**57.1%**	**26.8%**	**12.2%**	**34.1%**	**12.2%**	**4.9%**	**4.9%**	**5.1%**	**2.5%**	**56.1%**	**20.7%**
NSW other irrigation district (n=43)[3]	**52.9%**	**41.2%**	**27.3%**	**27.3%**	**24.2%**	**3.1%**	**6.5%**	**21.2%**	**18.8%**	**30.3%**	**44.1%**	**22.6%**
Basin irrigator, self-funded modernisation (n=193)[4]	**54.8%**	**52.7%**	**23.9%**	**23.0%**	**26.8%**	**6.1%**	**10.1%**	**13.2%**	**16.8%**	**17.0%**	**43.5%**	**16.1%**
Basin irrigator, modernised using help of grant (n=96)[4]	**63.8%**	**52.1%**	**38.7%**	**24.7%**	**51.6%**	**13.0%**	**10.9%**	**13.2%**	**10.9%**	**17.4%**	**53.3%**	**29.7%**

[1]Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts.
[4] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.,
See Appendix 1 for detailed data from statistical tests.

5.4 BENEFITS AND COSTS OF MODERNISING ON-FARM INFRASTRUCTURE

Modernising on-farm water infrastructure is often done to achieve changes such as reducing overall water use and making more effective and efficient use of available water (for example, through being able to deliver water in a more targeted way to achieve crop growth). Modernisation can have positive outcomes for the farm, through factors such as reducing water costs, increasing production, or saving farm labour time. Depending on the relative cost of modernisation relative to the benefits achieved, the works may have benefits or costs overall. These may take the form of monetary benefits and costs (for example, changes in input costs such as electricity and water), changes in labour time, or others. This section examines the socio-economic outcomes of modernising on-farm irrigation infrastructure, focusing on the types of benefits or costs farmers have experienced. Irrigators were asked their views on the socio-economic impacts of on-farm infrastructure modernisation works and their farm performance was then compared to farmers who had not modernised. This section shows very similar findings to those of previous surveys.

IRRIGATOR'S VIEWS

Irrigators who had modernised on-farm water infrastructure were asked whether the works had any of a number of effects on their farm enterprise. Table 28 compares overall findings from 2018 to those from 2015 and 2016, and shows close to identical results. Similarly to past years, the majority of Basin irrigators who had modernised on-farm water infrastructure since 2008 (84%) felt the works had a positive impact on their farm enterprise as a whole. The majority (65%) felt it was positive for their farm profitability, 89% that efficiency of water use had improved, and 73% that farm productivity had improved.

Similarly to past years, the area where most negative impacts were reported was in impacts on electricity/power costs, with 40% reporting negative impacts; however the large majority of these reported that overall impacts on the farm enterprise were positive, even if they reported negative impacts on power costs (or on other aspects such as farm debt levels) (Table 29).

Table 28 Irrigator self-reported impacts of modernisation for their farm

		Basin irrigators, modernised with assistance from a grant			Basin irrigators, modernised without grant		
		2018	2016	2015	2018	2016	2015
Your farm enterprise as a whole	Negative impact	8%	6%	3%	6%	3%	3%
	Neither negative or positive	9%	11%	11%	26%	11%	17%
	Positive impact	84%	83%	86%	67%	86%	80%
Your farm profitability	Negative impact	10%	18%	9%	13%	9%	9%
	Neither negative or positive	25%	17%	32%	32%	32%	31%
	Positive impact	65%	65%	60%	55%	60%	60%
Your overall farm productivity – since works were completed	Negative impact	10%	6%	5%	10%	8%	9%
	Neither negative or positive	17%	11%	16%	25%	20%	17%
	Positive impact	73%	83%	79%	65%	72%	74%
Your irrigation water costs	Negative impact	19%	28%		27%	21%	25%
	Neither negative or positive	42%	27%		37%	40%	42%
	Positive impact	39%	45%		36%	39%	33%
Your farm debt levels	Negative impact	22%	38%	31%	29%	31%	33%
	Neither negative or positive	43%	37%	43%	48%	39%	48%
	Positive impact	34%	25%	26%	23%	30%	19%
Your efficiency of water use	Negative impact	4%	9%	5%	6%	5%	4%
	Neither negative or positive	8%	10%	13%	20%	21%	13%
	Positive impact	89%	82%	83%	75%	74%	83%
Timing of water delivery to your farm	Negative impact	7%	9%	8%	9%	10%	7%
	Neither negative or positive	20%	21%	22%	36%	33%	33%
	Positive impact	74%	70%	70%	55%	57%	60%
Electricity/ power costs	Negative impact	40%	43%	39%	34%	39%	35%
	Neither negative or positive	33%	31%	31%	44%	30%	38%
	Positive impact	28%	26%	30%	22%	31%	27%
Your on-farm workload	Negative impact	13%	11%		20%	16%	Not asked
	Neither negative or positive	30%	26%	Not	30%	27%	
	Positive impact	58%	63%	asked	51%	57%	

As shown in Table 29, the small numbers of people who reported negative impacts on farm profitability (33 farmers), farm productivity (29 farmers), and efficiency of water use (19 farmers) were also more likely to report that modernising had a negative impact on their farm overall (58%, 59% and 53% respectively). However, those who felt on-farm modernisation had other types of negative impacts still predominantly considered it to be positive for their farm overall. For example, of the 61 irrigators reporting a negative impact on water costs, only 23% felt on-farm modernisation was negative for their farm overall,

while 30% felt it had neutral and 48% that it had positive impacts. Of the 81 who felt there were negative impacts on electricity/power costs, only 14% considered on-farm modernisation negative for their farm overall, while 68% reported the overall impacts to be positive. Of the 62 reporting negative impacts on farm debt, 18% reported overall negative impacts on the farm and 61% positive impacts.

Overall this suggests that on-farm modernisation is positive for the large majority of irrigators, with or without a grant; and that those who have modernised with assistance from a grant typically rate the impacts more positively than those relying on self-funding alone.

Table 29 Comparing impacts of on-farm modernisation on the farm overall with perceptions of specific impacts of modernisation, Basin irrigators

Basin irrigators who had modernised with or without a grant		Negative impact on farm overall	Neither negative or positive impact on farm overall	Positive impact on farm overall	n
Your farm profitability	Negative impact	57.6%	18.2%	24.2%	33
	Neither	1.4%	53.6%	44.9%	69
	Positive impact	0.0%	4.5%	95.5%	133
Your overall farm productivity – since works were completed	Negative impact	58.6%	27.6%	13.8%	29
	Neither	5.9%	62.7%	31.4%	51
	Positive impact	0.0%	5.9%	94.1%	153
Your irrigation water costs	Negative impact	23.0%	29.5%	47.5%	61
	Neither	2.4%	29.4%	68.2%	85
	Positive impact	4.0%	8.0%	88.0%	75
Your farm debt levels	Negative impact	17.7%	21.0%	61.3%	62
	Neither	5.0%	31.7%	63.4%	101
	Positive impact	5.4%	3.6%	91.1%	56
Your efficiency of water use	Negative impact	52.6%	21.1%	26.3%	19
	Neither	9.8%	51.2%	39.0%	41
	Positive impact	2.9%	13.5%	83.5%	170
Timing of water delivery to your farm	Negative impact	37.0%	18.5%	44.4%	27
	Neither	6.0%	43.3%	50.7%	67
	Positive impact	3.1%	10.2%	86.6%	127
Electricity/power costs	Negative impact	13.6%	18.5%	67.9%	81
	Neither	6.1%	30.5%	63.4%	82
	Positive impact	3.8%	13.5%	82.7%	52
Your on-farm workload	Negative impact	25.6%	23.3%	51.2%	43
	Neither	7.5%	38.8%	53.7%	67
	Positive impact	0.8%	10.9%	88.2%	119

[1] In all cases, there were statistically significant correlations between views about specific impacts on the farm such as farm profitability, and views about impacts on the farm overall. This means that those who reported specific positive perceptions were more likely to report modernisation was good for their farm overall, and vice versa. Effect sizes were high for all but two variables: farm debt and electricity/power costs where, as can be seen in the table, the majority of those reporting negative impacts with regard to specific outcomes (debt, power costs) still reported overall positive impacts on the farm. See Appendix 1 for details of statistical tests.

SOCIO-ECONOMIC OUTCOMES ON THE FARM

Irrigators who had / had not modernised were compared to see if there were observable differences in their:

- farm management (how their irrigation, work hours, farm employment, area of land farm and production had changed)
- experience of barriers to farm development such as drought, input costs and ability to utilise farm infrastructure
- future farming intentions, such as their intention to stay in or leave farming, or to expand, downside or intensify their enterprise in the next five years
- confidence in being able to achieve desired outcomes on the farm
- self-reported farm financial performance, including cash flow, farm financial surplus, and ability to service farm debt
- wellbeing.

Analysing this gives some insight into whether on-farm modernisation may be assisting irrigators in achieving differing outcomes on their farm. However, it is not possible to identify with certainty whether differences observed were a cause or consequence of investing in modernisation, or a result of other unidentified differences between those who had modernised and those who had not. While theoretically some of the differences observed could be distinguished by examining whether they depended on how long ago irrigators modernised, in reality a majority of irrigators had invested in modernisation activities over several years since 2008, meaning it is difficult to distinguish between those who modernised some time ago and those who did so more recently.

When asked about farm management changes made in the last 12 months (Table 30), there were relatively few significant differences between those who had / had not modernised on-farm irrigation infrastructure. Between 8% and 14% of those who had and hadn't modernised, or modernised differing proportions of farm infrastructure, decreased the area of land they irrigated as a long-term change. Conversely, those who had modernised, particularly a large proportion of their irrigation area, were more likely to report increasing the area of land irrigated (7% of those who had modernised overall, and 14% of those who had modernised 50% or more of their irrigation area since 2013). Between 10% and 14% of all irrigators had implemented long-term decreases in irrigation water use, irrespective of modernisation activity, and between 3% and 13% had increased irrigation water use in the long term, with those who had modernised more than 50% of their irrigation area most likely to report doing this (13%), but this difference is not statistically significant.

Those who had modernised were more likely to report intensifying land use than those who had not (21% of those who modernised with a grant compared to 9% of those who had not modernised) and to report investing in major new machinery or equipment.

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

Table 30 Farm management changes made in the 12 months prior to completing the survey

In the last 12 months have you done any of the following on your farm business?		Modernisation of on-farm irrigation infrastructure since 2008[1]			% infrastructure modernised since 2013[2]		
		Has not modernised	Modernised, self-funded	Modernised with grant	None	1-49%	50% or more
Decreased the area of land irrigated	**No**	**51.3%**	**52.2%**	**51.1%**	52.5%	47.5%	48.3%
	Yes, short-term	**34.2%**	**40.0%**	**38.0%**	34.7%	42.6%	42.5%
	Yes, long-term	**14.5%**	**7.8%**	**10.9%**	12.7%	9.9%	9.2%
Increased the area of land irrigated	**No**	**95.9%**	**86.6%**	**86.2%**	**98.2%**	**87.1%**	**78.7%**
	Yes, short-term	**4.1%**	**5.8%**	**6.9%**	**0.9%**	**7.5%**	**7.9%**
	Yes, long-term	**0.0%**	**7.6%**	**6.9%**	**0.9%**	**5.4%**	**13.5%**
Decreased the volume of irrigation water used on my land	**No**	**51.4%**	**45.3%**	**42.4%**	48.3%	40.8%	38.6%
	Yes, short-term	**33.8%**	**44.2%**	**43.5%**	38.8%	46.6%	50.0%
	Yes, long-term	**14.9%**	**10.5%**	**14.1%**	12.9%	12.6%	11.4%
Increased the volume of irrigation water used on my land	**No**	**88.9%**	**82.5%**	**83.9%**	**89.5%**	**84.0%**	**74.7%**
	Yes, short-term	**6.9%**	**11.1%**	**10.3%**	**7.9%**	**10.6%**	**12.6%**
	Yes, long-term	**4.2%**	**6.4%**	**5.7%**	**2.6%**	**5.3%**	**12.6%**
Purchased new land	**No**	96.2%	90.1%	95.4%	97.4%	91.4%	87.4%
	Yes, short-term	1.3%	2.3%	0.0%	0.9%	1.1%	2.3%
	Yes, long-term	2.6%	7.6%	4.6%	1.7%	7.5%	10.3%
Expanded the area I farm through leasing or sharefarming	**No**	94.9%	92.0%	93.1%	94.0%	92.6%	92.0%
	Yes, short-term	1.3%	2.3%	2.3%	0.9%	0.0%	5.7%
	Yes, long-term	3.8%	5.7%	4.6%	5.2%	7.4%	2.3%
Produced more per hectare (intensification)	**No**	**86.8%**	**79.9%**	**72.4%**	**86.6%**	**71.6%**	**71.3%**
	Yes, short-term	**3.9%**	**5.9%**	**6.9%**	**5.4%**	**5.3%**	**6.9%**
	Yes, long-term	**9.2%**	**14.2%**	**20.7%**	**8.0%**	**23.2%**	**21.8%**
Reduced stock due to drought	**No**	58.3%	32.0%	37.0%	43.6%	30.6%	44.2%
	Yes, short-term	33.3%	58.3%	54.3%	50.9%	57.1%	44.2%
	Yes, long-term	8.3%	9.7%	8.7%	5.5%	12.2%	11.5%
Reduced amount produced per hectare compared (de-intensified production)	**No**	51.9%	53.0%	60.7%	53.1%	58.2%	57.6%
	Yes, short-term	36.7%	41.0%	38.1%	37.2%	36.3%	40.0%
	Yes, long-term	11.4%	6.0%	1.2%	9.7%	5.5%	2.4%
Increased the hours I worked on the farm	**No**	64.0%	54.0%	54.0%	**68.1%**	**41.7%**	**54.1%**
	Yes, short-term	22.7%	33.3%	39.1%	**23.3%**	**44.8%**	**30.6%**
	Yes, long-term	13.3%	12.6%	6.9%	**8.6%**	**13.5%**	**15.3%**
Reduced the hours I worked on the farm	**No**	**88.3%**	**86.1%**	**81.4%**	84.3%	89.0%	85.7%
	Yes, short-term	**1.3%**	**8.5%**	**9.3%**	4.3%	5.5%	9.5%
	Yes, long-term	**10.4%**	**5.5%**	**9.3%**	11.3%	5.5%	4.8%
Reduced use of inputs e.g. fertiliser, fuel, chemicals	**No**	**53.8%**	**48.6%**	**52.3%**	53.8%	48.5%	54.0%
	Yes, short-term	**28.2%**	**37.3%**	**39.8%**	31.1%	36.1%	32.2%
	Yes, long-term	**17.9%**	**14.1%**	**8.0%**	15.1%	15.5%	13.8%
Reduced use of professional services e.g. agronomist, vet	**No**	**57.9%**	**59.8%**	**62.1%**	60.3%	57.0%	63.2%
	Yes, short-term	**21.1%**	**29.9%**	**26.4%**	22.4%	29.0%	26.4%
	Yes, long-term	**21.1%**	**10.3%**	**11.5%**	17.2%	14.0%	10.3%
Invested in major new farm machinery, tech or infrastructure	**No**	**87.2%**	**63.0%**	**62.1%**	78.6%	65.3%	57.5%
	Yes, short-term	**5.1%**	**9.2%**	**9.2%**	6.8%	8.4%	6.9%
	Yes, long-term	**7.7%**	**27.7%**	**28.7%**	14.5%	26.3%	35.6%
Reduced employees or contractors working on my farm (if applicable)	**No**	**73.0%**	**63.7%**	**72.9%**	74.3%	68.1%	65.9%
	Yes, short-term	**12.2%**	**27.4%**	**16.5%**	14.7%	22.3%	21.2%
	Yes, long-term	**14.9%**	**8.9%**	**10.6%**	11.0%	9.6%	12.9%
	n	76	180	92	118	101	87

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.

[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

5. ON-FARM WATER INFRASTRUCTURE MODERNISATION

When asked about barriers to farm business performance experienced in the last three years (Table 31), those who had engaged in modernisation of on-farm water infrastructure were more likely to report the following:

- lack of access to reliable power (18% of those who had modernised 50% of more of irrigation area compared to 3% of those who had not modernised)
- lack of access to three-phase electricity (13% of those who modernised with a grant compared to 3% of those who had not modernised)
- the high price of temporary water causing barriers to farm development (67% to 70% compared to 51% of those who hadn't modernised)
- barriers related to rising costs of inputs other than water
- lack of land available to buy or lease to enable farm expansion, likely reflecting greater desire to do so amongst those who had modernised more than objective differences in availability
- lack of water allocation to buy on the market, likely reflecting greater desire to do so amongst those who had modernised more than objective differences in availability
- lack of adequate telecommunications infrastructure.

Many of these differences may be a consequence of those who had modernised having different objectives compared to those who had not. The findings presented earlier suggest those who modernise are more likely to be seeking to expand their farm production and invest in increasing farm enterprise size than those who do not modernise. Also, many of the barriers reported are more likely to be relevant to those with these objectives compared to those not seeking to grow the size of their enterprise.

Those who had not modernised were more likely to report experiencing lack of demand for their produce (19% to 21%).

When asking about their future farming intentions (Table 32), those who:

- had not modernised were more likely to be planning to leave farming for either retirement or other reasons, and to downsize their farm business and/or de-intensify production
- had modernised were more likely to be planning to expand their farm business and intensify farm production.

Those who had modernised on-farm infrastructure were consistently more confident in their ability to achieve almost all aspects of farm management objectives in the next few years (Table 33), including achieving the things they wanted to, meeting farm business objectives, making the right decisions about farm management, handling changing market conditions, and maintaining and improving the health of vegetation. However, they were not more confident in their ability to cope well with difficult conditions such as drought.

Table 31 Barriers to farm business performance experienced in last three years

% Basin irrigators reporting this was a large barrier to managing and developing their farm they wanted to in the last three years	Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]		
	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-49%	50% or more
Drought	**51.3%**	**56.7%**	**62.6%**	49.6%	64.7%	60.0%
Lack of reliable power	5.3%	12.6%	13.2%	**3.8%**	**6.3%**	**18.0%**
Lack of access to three-phase electricity	**2.7%**	**9.7%**	**13.2%**	**8.5%**	**7.3%**	**10.2%**
Lack of demand for the goods you produce	18.7%	12.4%	13.2%	20.5%	11.3%	10.0%
Falling prices for the goods you produce	**26.0%**	**26.8%**	**33.3%**	28.2%	32.3%	31.9%
Too many regulations	45.5%	47.4%	44.3%	**42.1%**	**52.1%**	**49.4%**
High price of temporary water	**51.3%**	**56.1%**	**68.8%**	**51.3%**	**69.6%**	**66.7%**
Increases in costs associated with your water entitlement (water delivery charges and/or fixed charges)	**55.3%**	**58.7%**	**65.6%**	57.1%	68.7%	62.0%
Rising costs of electricity or gas	**62.3%**	**61.6%**	**67.0%**	60.5%	65.0%	71.3%
Rising costs of inputs other than water & electricity e.g. fertiliser, fuel	**55.1%**	**62.7%**	**68.8%**	**53.8%**	**66.3%**	**71.4%**
Difficulty obtaining labour	**24.0%**	**15.6%**	**21.7%**	15.5%	21.2%	19.8%
Lack of land available to purchase or lease for farm expansion	**10.5%**	**17.7%**	**19.4%**	**10.2%**	**23.0%**	**16.5%**
Small size of my farm	23.4%	16.0%	20.7%	21.0%	19.2%	17.4%
Reduced water allocation for one or more seasons	**43.0%**	**45.1%**	**57.4%**	**42.9%**	**56.0%**	**54.3%**
Difficulty transporting produce to market	**6.3%**	**6.7%**	**6.5%**	**2.5%**	**6.3%**	**11.0%**
Lack of available water allocation to purchase on the water market	**29.1%**	**36.5%**	**46.2%**	**24.4%**	**50.0%**	**47.3%**
Lack of adequate telecommunications infrastructure e.g. lack of phone or internet coverage	**22.8%**	**33.3%**	**30.1%**	**21.0%**	**36.7%**	**35.9%**
Inability to fully use farm infrastructure, e.g. not getting full productivity from infrastructure or machinery	**17.9%**	**21.8%**	**25.3%**	**17.5%**	**35.1%**	**18.5%**
Difficulty accessing affordable finance	**15.0%**	**7.3%**	**15.4%**	11.6%	11.3%	11.1%
n	78	187	91	119	102	90

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

Table 32 Future farming intentions

% who were likely to do this in the next five years	Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]		
	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-49%	50% or more
Retire from farming	42.9%	34.2%	37.7%	36.2%	41.8%	39.3%
Leave farming for reasons other than retirement	17.9%	13.6%	8.2%	13.6%	14.3%	15.1%
Expand my farm business	**17.9%**	**15.5%**	**27.5%**	**9.0%**	**18.8%**	**28.6%**
Downsize my farm business	20.5%	22.3%	21.6%	31.3%	16.0%	16.4%
Change my enterprise mix	**25.0%**	**22.3%**	**30.8%**	26.5%	26.4%	21.8%
De-intensify production (reduce the amount produced from a given area of land)	12.5%	14.3%	15.4%	17.6%	6.0%	10.7%
Intensify production (increase the amount produced from a given area of land)	**12.5%**	**18.8%**	**32.7%**	**11.8%**	**24.0%**	**32.1%**
Seek additional off-farm work	17.5%	17.6%	11.5%	13.4%	14.0%	18.2%
Purchase land some distance from my current land to reduce climate-related risk	5.0%	3.6%	3.8%	2.9%	5.8%	5.4%
Purchase land some distance from my current land for other reasons	15.0%	8.2%	7.7%	13.2%	7.8%	5.5%
n	42	117	53	69	55	56

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

Table 33 Confidence in ability to farm successfully

When I think about my farm over the next few years, I am confident that…	Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]		
	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-49%	50% or more
…I can achieve the things I want to on my farm	48.8%	54.0%	58.1%	**45.5%**	**52.9%**	**62.6%**
…I can meet my farm business objectives	**48.7%**	**54.3%**	**57.6%**	47.5%	52.5%	61.5%
…I can make the right decisions about farm management e.g. stocking, crop timing	**59.5%**	**72.8%**	**78.3%**	68.1%	68.6%	77.8%
…I can handle changing market conditions on the farm	41.0%	54.8%	60.0%	50.8%	46.5%	62.6%
…I can cope well with most difficult conditions e.g. drought, pest outbreaks	46.2%	46.5%	43.0%	46.7%	39.6%	46.2%
…I can maintain and improve the health of vegetation, land & water on my farm	**53.2%**	**60.3%**	**63.7%**	55.8%	54.1%	69.2%
…my skills and education are adequate for the needs of my farm business	64.1%	76.5%	80.6%	75.8%	65.3%	83.7%
I feel optimistic about my farming future	46.8%	55.6%	55.9%	**45.5%**	**52.0%**	**63.4%**
When I think about how my farm is going, I feel good	44.3%	56.9%	56.5%	42.6%	50.5%	68.5%
n	80	187	93	121	102	91

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

In general, those who had modernised on-farm water infrastructure felt more positive about their farm financial situation (Table 34), were more likely to report being satisfied with farm business performance and to report a farm profit of $50,000 or more in 2017-18, while those who had not modernised were more likely to report making a loss or breaking even. However, those who had modernised were significantly more likely to report their farm business was under a lot of financial stress at the time of completing the survey compared to those who had not modernised.

When the wellbeing of those who had / had not modernised was compared, those who had modernised reported on average higher wellbeing than those who had not (Table 35) for multiple aspects of wellbeing. While not always statistically significant, the differences were highly consistent. This may reflect both that those with higher wellbeing are in a better position to modernise in the first place, and that modernisation may support wellbeing through better enabling irrigators to achieve desired farm outcomes.

Table 34 Farm financial performance

% who agreed or reported specific condition	Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]		
	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-49%	50% or more
My farm business is under a lot of financial stress at the moment	**23.8%**	**45.7%**	**41.9%**	37.7%	42.6%	40.2%
I am satisfied with my farm business performance	**41.3%**	**51.6%**	**58.1%**	**44.6%**	**46.0%**	**57.0%**
Low commodity prices are making it very difficult to keep my farm viable	43.0%	42.7%	46.2%	48.8%	45.5%	42.9%
Reported making a farm loss of $50,000 or more in 2017-18	**16.9%**	**11.4%**	**6.5%**	**11.4%**	**7.3%**	**13.6%**
Reported a farm return of between $50,000 loss and $50,000 profit in 2017-18	**75.3%**	**63.4%**	**60.9%**	**75.4%**	**61.5%**	**55.7%**
Reported farm profit of $50,000 or more in 2017-18	**7.8%**	**25.1%**	**32.6%**	**13.2%**	**31.3%**	**30.7%**
Found it difficult to service farm debt	**45.0%**	**29.6%**	**31.1%**	**33.3%**	**39.1%**	**20.0%**
Found it easy to service farm debt	**22.5%**	**24.0%**	**26.2%**	**24.2%**	**20.3%**	**29.2%**
Reported poor farm cash flow	36.0%	28.7%	31.4%	33.3%	30.2%	29.3%
Reported good farm cash flow	26.7%	35.1%	32.6%	34.2%	29.2%	32.9%
n	79	187	93	121	100	93

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

Table 35 Wellbeing of irrigators by modernisation activity

	Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]		
	Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-49%	50% or more
Global life satisfaction	**68.9**	**74.6**	**78.3**	74.2	74.0	73.1
Personal Wellbeing Index	**68.2**	**74.3**	**76.5**	73.3	72.6	75.3
Satisfaction with standard of living	**71.2**	**77.0**	**79.8**	75.6	75.7	77.1
Satisfaction with what achieving in life	**67.8**	**71.6**	**75.0**	71.7	69.1	73.8
Satisfaction with feeling part of community	**65.6**	**75.9**	**78.7**	72.6	78.2	74.6
Satisfaction with future security	**66.4**	**71.0**	**71.8**	69.1	67.9	73.2

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

5.5 CONCLUSIONS

A majority of irrigators invested in some modernization of irrigation infrastructure modernisation between 2008 and 2018, and most of these did so without assistance from government grants (those who did receive grants typically also self-funded other modernization works). However, there were differences between those who modernised with and without a grant: those modernizing with a grant typically undertook a broader range of modernization activities, particularly landforming, upgrading metering, and improving farm drain re-use. Those who modernised reported largely positive effects for their farm enterprise overall, even where there were some negative effects on power costs or debt. This was the case for all of those who modernised, however those who had assistance from a grant typically rated the impacts more positively than those who self-funded all modernization works. There are differences in future intentions of those who have and haven't modernised, with those who have not modernised being more likely to be planning to leave farming for either retirement or other reasons, and to downsize their farm business and/or de-intensify production. Those who had modernised were more likely to be planning to expand their farm business and intensify farm production, and reported more positive farm outcomes in the form of being able to achieve desired outcomes on the farm, higher satisfaction with farm performance, and higher wellbeing of farmers.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

6.1 INTRODUCTION

This section examines the factors that have motivated irrigators to modernise on-farm infrastructure in recent years, and their future intentions regarding modernisation of on-farm irrigation infrastructure.

6.2 EFFECTIVENESS OF GRANTS IN MOTIVATING ACTIVITY

The purpose of SRWUIP on-farm modernisation grants was to support more rapid growth in water efficiency of on-farm water infrastructure through enabling modernisation to occur earlier than it would have in the absence of the grant. It is likely some irrigators would not have done the works without a grant, while others would have undertaken works in the absence of a grant, but may have taken a longer time to do so and/or only been able to fund a smaller scope of works than occurred with the grant. To test these assumptions, irrigators who had modernised with assistance from a grant were asked the extent to which they agreed or disagreed with the following statements (Tables 36 to 39):

- 'I would not have done any of the works without the grant'
- 'If I didn't receive a grant I would still have done the works, but it would have taken a lot longer'
- 'The grant let me do more modernisation works than I would have otherwise'
- 'I would have done all the works even if I hadn't received a grant to help'.

In total, 48% of grant recipients (whether located within the Basin receiving a SRWUIP grant or outside the Basin receiving a different grant) felt they would not have done any of the works without the grant. Grant recipients were more likely to report this if they lived in the GMID (59%), had GVAP between $300-$999,999 (57%), were making a loss on the farm (68%), irrigated using water from channels (53%), or had not completed high school (52%). Other irrigator groups were also highly likely to report this, but sample sizes were too small to have confidence that the difference was meaningful.

In total, 52% of irrigators felt that if they hadn't received the grant they would still have done the works but it would have taken longer. Grant recipients were more likely to report this if they lived in the NSW Southern Basin (65%), in the Southern Basin not in an irrigation district (63%), or were directly pumping water from rivers or dams (78%). While some other irrigator groups were also highly likely to report this, sample sizes in other groups were too small to have confidence that the difference was meaningful.

Sixty per cent of irrigators, and 64% of Basin irrigators who had received a grant, felt that the grant let them do more modernisation works than they would have otherwise. This was more common amongst those in the Southern Basin (67%), particularly in the Victorian Basin (68%), those engaged in horticulture (78%), those with GVAP of $1 million or more (73%), those making a farm loss in the last three years (80%), those who spent less than 10%

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of farm expenditure on irrigation water (74%), those using irrigation water from channels or direct pumping (68%), and irrigators aged under 55 (74%).

Thirty-six per cent of all grant recipients, and 34% of Basin grant recipients, felt they would have done all the works even if they hadn't received a grant to help. This was more common for those who had very small or very high GVAP (42% of those with GVAP under $40,000 and 41% of those with GVAP of $1 million or more) and those reporting moderate to high profit (42%).

Overall, the views reported by irrigators suggests that for half, receiving a grant enabled them to do works when otherwise none or very few would have occurred, particularly for those experiencing financial stress and living in the GMID. For 50-60%, some works would have occurred in the absence of receiving a grant, but the works would either have been done some time later than they occurred, or a smaller scope of works undertaken, indicating that grants assisted in bringing works forward from when they otherwise would have occurred. Just over one in three would have done works irrespective of the grant.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 36 Effectiveness of grants in triggering on-farm modernisation activity – by irrigator location

% of grant recipients who agreed with the statement	All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin	SA Basin	VIC Basin	Southern Basin not in irrig. district[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
I would not have done any of the works without the grant	47.8%	48.0%	50.0%	Sample too small to report	50.4%	44.4%	Sample too small to report	55.6%	35.5%	59.3%	Sample too small to report	Sample too small to report
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	51.9%	51.6%	50.0%		52.6%	64.7%		42.9%	63.3%	41.5%		
The grant let me do more modernisation works than I would have otherwise	59.7%	63.6%	44.8%		66.7%	59.4%		68.3%	60.0%	66.7%		
I would have done all the works even if I hadn't received a grant to help	35.8%	33.6%	43.8%		31.3%	41.2%		25.4%	40.0%	26.4%		
n	161	125	34	10	115	36	16	63	31	54	19	11

[1]Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.
No significant relationships were identified likely reflecting small sample sizes.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 37 Effectiveness of grants in triggering on-farm modernisation activity – by farm type and size

	Farm type[1]					Gross value of agricultural production 2017-18[2]						Farm self-reported 3-year profitability[3]		
% of grant recipients who agreed with the statement	**Dairy farmer**	**Grain grower**	**Grazier**	**Horti-culture**	**Mixed cropping/ grazing**	**< $40,000**	**40,000-$99,999**	**$100,000-$299,999**	**$300,000-$499,999**	**$500,000-$999,999**	**$1 million+**	**Making a loss**	**Breaking even/ small profit**	**Moderate or large profit**
I would not have done any of the works without the grant	56.0%	33.3%	50.0%	40.0%	53.6%	36.8%	60.0%	44.8%	57.1%	57.9%	37.9%	67.7%	34.9%	48.1%
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	43.5%	66.7%	51.4%	56.5%	50.0%	40.0%	43.8%	56.7%	80.0%	50.0%	55.6%	48.5%	50.8%	62.5%
The grant let me do more modernisation works than I would have otherwise	60.9%	63.6%	64.7%	78.3%	53.8%	50.0%	80.0%	58.6%	60.0%	52.9%	73.1%	80.0%	56.5%	54.5%
I would have done all the works even if I hadn't received a grant to help	20.8%	50.0%	44.1%	32.0%	27.6%	42.1%	31.3%	24.1%	16.7%	36.8%	41.4%	21.2%	35.5%	42.3%
n	25	12	34	25	28	19	15	29	7	19	29	31	63	27

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18.
[3] Bold font indicates significant differences between irrigators who reported differing levels of profitability. See Appendix 1 for detailed data from statistical tests.
No significant relationships were identified likely reflecting small sample sizes.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 38 Effectiveness of grants in triggering on-farm modernisation activity – by farm water use characteristics

% of grant recipients who agreed with the statement	% farm expenditure on irrigation water[1]				Source of majority of irrigation water used in 2017-18[2]			Volume of irrigation water used in 2017-18 water year[3]				
	<10%	**10-19%**	**20-29%**	**30%+**	**Channels**	**Direct pumping**	**Ground-water**	**<30ML**	**30 to 99ML**	**100 to 299ML**	**300 to 999ML**	**1000ML or more**
I would not have done any of the works without the grant	45.0%	41.9%	60.9%	42.4%	53.2%	41.4%	37.5%	33.3%	68.8%	33.3%	54.5%	41.7%
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	60.0%	54.8%	61.9%	45.7%	44.9%	77.8%	37.5%	44.4%	43.8%	50.0%	62.5%	51.5%
The grant let me do more modernisation works than I would have otherwise	73.7%	63.3%	65.0%	54.5%	68.1%	67.9%	40.0%	44.4%	81.3%	54.5%	63.3%	62.5%
I would have done all the works even if I hadn't received a grant to help	35.0%	29.0%	27.3%	32.4%	25.6%	46.4%	43.8%	55.6%	26.7%	22.7%	47.1%	22.9%
n	20	31	23	33	77	29	16	9	16	21	33	36

[1] Bold font indicates significant differences between irrigators who had different proportions of farm expenditure on irrigation water.
[2]Bold font indicates significant differences between irrigators who derived majority of irrigation water from channels, pumping or groundwater.
[3]Bold font indicates significant differences between irrigators who used differing volumes of irrigation water. See Appendix 1 for detailed data from statistical tests.
No significant relationships were identified likely reflecting small sample sizes.

Table 39 Effectiveness of grants in triggering on-farm modernisation activity – by socio-demographic characteristics

	Irrigator age[1]					Formal educational attainment[2]			Proportion of household income earned off-farm[3]				
% of grant recipients who agreed with the statement	Aged under 45	Aged 45-54	Aged 55-64	Aged 65-74	Aged 75+	Did not complete high school	Has high school or post-school qualification	Completed tertiary qualifi-cation	None	1-25%	26-50%	51- 75%	76% or more
I would not have done any of the works without the grant	30.0%	33.3%	51.1%	42.1%	85.7%	51.5%	46.7%	44.0%	42.1%	56.1%	50.0%	33.3%	50.0%
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	50.0%	46.2%	53.3%	57.9%	40.0%	42.4%	54.9%	45.8%	56.4%	50.0%	57.1%	41.7%	47.6%
The grant let me do more modernisation works than I would have otherwise	70.0%	76.9%	48.8%	61.1%	100.0%	53.3%	67.0%	70.8%	55.9%	71.8%	76.9%	54.5%	57.1%
I would have done all the works even if I hadn't received a grant to help	30.0%	35.7%	40.4%	29.7%	21.4%	32.4%	34.1%	20.8%	37.5%	27.5%	42.9%	45.5%	25.0%
n	10	15	45	38	14	33	92	25	38	41	14	12	20

[1] Bold font indicates significant differences between irrigators of different ages.
[2] Bold font indicates significant differences between irrigators with different levels of formal educational attainment.
[3] Bold font indicates significant differences between irrigators whose households earned differing amounts of household income off-farm. See Appendix 1 for detailed data from statistical tests.

6.3 MOTIVATIONS FOR MODERNISING

Irrigators were asked whether their past on-farm modernisation investments had been motivated by a desire to achieve one or more of the following, with irrigators able to select as many as applied (Tables 40 to 44):

- expanding farm production
- reducing irrigation costs
- improving productivity during times of low water availability
- reducing labour time required for irrigation activities
- reducing total water use on the farm
- improving crop/pasture growth or health.

Expansion of farm production was a motivator for 62% of irrigators who modernised (61% of those living in the Basin). Irrigators were more likely to report expansion of farm production as a motivating factor if they lived in the Northern Basin (69%), had modernised 75% or more of irrigation area since 2013 (69%), had GVAP of $500,000 or more (74% and 77% of those with GVAP of $500,000-999,999 and $1 million or more respectively), those making a moderate to large profit (68%), those using groundwater (67%), and those using 300-999 ML (70%) or 1000 ML or more (76%).

Reducing irrigation costs was a motivator for 64% of all irrigators, and 67% of those in the Basin. This was more common amongst Northern Basin irrigators (77%), those in the NSW Southern Basin (73%), those making a loss (73%), as well as those who spent a higher proportion of irrigation costs on water (76% of those spending 20-29% and 70% of those spending 30% or more).

Improving productivity during times of low water availability was a motivator for modernisation by 72% of irrigators and 75% of Basin irrigators. This was more common amongst Northern Basin irrigators (87%), those who modernised with assistance of a grant (83%), and who modernised a greater proportion of on-farm infrastructure, grain growers (84%), those with GVAP of $500,000 or greater (84%), those making a moderate to large profit (80%), those using larger volumes of water (81% of those who had used 300 ML or more in the last year), and those earning all their household income from the farm (83%).

Reducing labour time was a motivator for 71% of irrigators and 74% of those living in the Basin, particularly those with GVAP of $1 million or more (84%), and those earning none of their household income off-farm (80%).

Reducing total water use on the farm was a motivating factor for 63% of irrigators, increasing to 66% of Basin irrigators, and 73% of Northern Basin irrigators.

Improving crop/pasture growth or health was the most common motivator, reported by 77% of all irrigators, and 76% of Basin irrigators, particularly Northern Basin irrigators (87%), those moderning 20-49% (91%) or 50-74% (86%) of their irrigation area since 2013, and those aged 45 to 54 (87%).

INFRASTRUCTURE

These findings highlight that most irrigators who modernise have more than one motivating factor driving their decision to do so, with a mix of improving productivity, improving crop/pasture growth and health, and reducing labour time, the most common motivators. Expansion of farm production was a common motivator, but more so for larger farmers making a profit on the farm, while reducing irrigation costs was a more common motivator for those irrigators who were making a loss and for whom water costs represent a high proportion of total farm expenditure.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 40 Motivations for past on-farm modernisation works – by irrigator location

% who reported this partly/wholly motivated past modernisation	All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin	SA Basin	VIC Basin	Southern Basin not in irrig. district[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
Expanding your farm production	62.1%	60.9%	64.4%	68.8%	59.8%	66.7%	60.0%	56.2%	64.9%	61.2%	58.1%	57.7%
Reducing irrigation costs	63.6%	**67.1%**	**57.1%**	76.7%	65.8%	72.6%	69.2%	61.2%	65.3%	64.7%	75.8%	75.0%
Improving productivity during times of low water availability	71.5%	**74.7%**	**65.4%**	**87.1%**	**73.0%**	79.5%	74.1%	69.2%	**75.3%**	**72.8%**	**81.8%**	**78.6%**
Reducing labour time required for irrigation activities	71.2%	**73.7%**	**65.9%**	74.2%	73.7%	77.8%	81.5%	69.8%	71.4%	71.3%	81.8%	81.5%
Reducing total water use on the farm	63.1%	**66.4%**	**57.0%**	73.3%	65.5%	70.4%	66.7%	62.6%	**62.7%**	**64.1%**	**78.1%**	**82.1%**
Improving crop/pasture growth or health	76.7%	75.9%	78.7%	86.7%	74.5%	79.2%	77.8%	71.2%	76.9%	72.8%	90.9%	69.2%
n	393	261	130	31	230	73	27	130	77	103	33	28

[1]Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 41 Motivations for past on-farm modernisation works – by engagement in on-farm modernisation

% who reported this partly/wholly motivated past modernisation	All Basin irrigators	Modernisation of on-farm irrigation infrastructure since 2008[1]		Proportion of on-farm irrigation infrastructure modernised since 2013[2]				
		Modernised, self-funded	Modernised with help of grant	None	1-19%	20-49%	50-74%	75%
Expanding your farm production	60.9%	**65.2%**	**65.9%**	**49.1%**	**57.9%**	**64.7%**	**63.6%**	**69.0%**
Reducing irrigation costs	67.1%	**70.9%**	**67.4%**	**60.7%**	**60.5%**	**75.5%**	**72.7%**	**71.4%**
Improving productivity during times of low water availability	74.7%	**75.7%**	**82.6%**	**62.5%**	**71.1%**	**79.2%**	**77.3%**	**81.4%**
Reducing labour time required for irrigation activities	73.7%	**77.6%**	**79.3%**	**55.4%**	**78.9%**	**87.0%**	**72.7%**	**83.3%**
Reducing total water use on the farm	66.4%	**71.1%**	**67.8%**	**53.4%**	**57.9%**	**77.4%**	**72.1%**	**70.7%**
Improving crop/pasture growth or health	75.9%	**82.1%**	**79.1%**	**51.7%**	**73.7%**	**90.9%**	**86.0%**	**76.2%**
n	261	144	86	56	38	53	44	43

[1] Bold font indicates there were significant differences between irrigators who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.
Note that the significant associations identified resulted from differences in

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 42 Motivations for past on-farm modernisation works – by farm type and size

	Farm type[1]					Gross value of agricultural production 2017-18[2]						Farm self-reported 3-year profitability[3]		
% who reported this partly/wholly motivated past modernisation	Dairy farmer	Grain grower	Grazier	Horti-culture	Mixed cropping/ grazing	< $40,000	40,000-$99,999	$100,000-$299,999	$300,000-$499,999	$500,000-$999,999	$1 million+	Making a loss	Breaking even/ small profit	Moderate or large profit
Expanding your farm production	**67.4%**	**59.4%**	**65.7%**	**50.9%**	**64.8%**	**44.2%**	**60.6%**	**51.9%**	**50.0%**	**74.4%**	**76.5%**	63.1%	56.5%	67.9%
Reducing irrigation costs	**51.2%**	**72.7%**	**66.7%**	**71.2%**	**74.1%**	**53.5%**	**75.0%**	**69.2%**	**65.2%**	**74.4%**	**68.0%**	73.1%	64.9%	66.7%
Improving productivity during times of low water availability	**72.1%**	**84.4%**	**75.4%**	**69.5%**	**80.0%**	**55.6%**	**78.4%**	**71.2%**	**81.8%**	**84.2%**	**84.3%**	**71.6%**	**74.2%**	**80.0%**
Reducing labour time required for irrigation activities	**69.8%**	**81.3%**	**69.1%**	**79.3%**	**72.7%**	**54.5%**	**80.0%**	**73.6%**	**81.8%**	**76.9%**	**84.3%**	70.6%	74.8%	74.1%
Reducing total water use on the farm	53.5%	69.7%	66.2%	74.1%	64.8%	62.8%	69.4%	66.0%	68.2%	62.5%	72.0%	72.5%	64.4%	62.3%
Improving crop/pasture growth or health	**72.1%**	**71.0%**	**76.1%**	**76.3%**	**81.5%**	**64.6%**	**74.3%**	**76.9%**	**86.4%**	**79.5%**	**82.0%**	72.5%	79.1%	71.2%
n	43	32	69	59	55	45	37	52	22	38	51	67	132	55

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18.
[3] Bold font indicates significant differences between irrigators who reported differing levels of profitability. See Appendix 1 for detailed data from statistical tests.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 43 Motivations for past on-farm modernisation works – by farm water use characteristics

% who reported this partly/wholly motivated past modernisation	% farm expenditure on irrigation water[1]				Source of majority of irrigation water used in 2017-18[2]			Volume of irrigation water used in 2017-18 water year[3]				
	<10%	10-19%	20-29%	30%+	Channels	Direct pumping	Ground-water	<30ML	30 to 99ML	100 to 299ML	300 to 999ML	1000ML or more
Expanding your farm production	55.1%	57.4%	68.6%	57.1%	58.4%	62.7%	67.4%	**33.3%**	**60.0%**	**49.1%**	**69.7%**	**75.5%**
Reducing irrigation costs	64.0%	61.2%	76.3%	70.4%	69.3%	70.5%	56.5%	64.0%	75.7%	60.0%	80.6%	56.6%
Improving productivity during times of low water availability	70.6%	75.0%	80.6%	70.8%	77.5%	74.2%	67.4%	**54.2%**	**75.7%**	**70.2%**	**80.6%**	**81.1%**
Reducing labour time required for irrigation activities	65.3%	76.1%	86.8%	67.1%	**76.0%**	**80.6%**	**58.7%**	60.0%	80.0%	66.7%	83.6%	74.1%
Reducing total water use on the farm	**54.0%**	**59.1%**	**81.6%**	**69.9%**	**69.7%**	**68.9%**	**53.3%**	54.2%	73.0%	64.9%	74.2%	62.3%
Improving crop/pasture growth or health	60.8%	77.3%	97.4%	71.6%	78.7%	77.4%	65.2%	**60.0%**	**72.2%**	**68.4%**	**86.6%**	**79.2%**
n	51	68	36	72	151	62	46	24	37	57	67	53

[1] Bold font indicates significant differences between irrigators who had different proportions of farm expenditure on irrigation water.
[2] Bold font indicates significant differences between irrigators who derived majority of irrigation water from channels, pumping or groundwater.
[3] Bold font indicates significant differences between irrigators who used differing volumes of irrigation water. See Appendix 1 for detailed data from statistical tests.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 44 Motivations for past on-farm modernisation works – by socio-demographic characteristics

	Irrigator age[1]					Formal educational attainment[2]			Proportion of household income earned off-farm[3]				
% who reported this partly/wholly motivated past modernisation	**Aged under 45**	**Aged 45-54**	**Aged 55-64**	**Aged 65-74**	**Aged 75+**	**Did not complete high school**	**Has high school or post-school qualification**	**Completed tertiary qualifi-cation**	**None**	**1-25%**	**26-50%**	**51-75%**	**76% or more**
Expanding your farm production	60.7%	60.0%	65.8%	59.8%	60.3%	52.9%	63.6%	54.3%	65.9%	65.2%	53.1%	66.7%	48.9%
Reducing irrigation costs	65.1%	66.7%	60.5%	71.0%	65.0%	64.7%	67.7%	62.9%	72.0%	61.4%	58.8%	76.9%	65.9%
Improving productivity during times of low water availability	72.2%	81.3%	76.3%	78.5%	72.8%	65.7%	77.9%	73.6%	82.9%	70.6%	66.7%	92.6%	60.9%
Reducing labour time required for irrigation activities	76.9%	73.3%	70.3%	73.6%	76.3%	72.1%	73.8%	62.9%	80.2%	75.4%	66.7%	78.6%	63.0%
Reducing total water use on the farm	64.1%	80.0%	62.2%	65.9%	66.3%	68.1%	65.1%	60.3%	70.2%	63.8%	54.3%	80.8%	65.1%
Improving crop/pasture growth or health	75.3%	86.7%	83.8%	76.9%	72.0%	66.2%	79.4%	72.9%	81.5%	75.0%	71.4%	82.1%	66.0%
n	194	16	38	93	81	67	190	72	82	68	36	27	46

[1] Bold font indicates significant differences between irrigators of different ages.
[2] Bold font indicates significant differences between irrigators with different levels of formal educational attainment.
[3] Bold font indicates significant differences between irrigators whose households earned differing amounts of household income off-farm. See Appendix 1 for detailed data from statistical tests.
No significant relationships were identified.

INFRASTRUCTURE

6.4 WHO INTENDS TO MODERNISE IN THE NEXT FIVE YEARS?

Irrigators were asked about their future plans to modernise their on-farm water infrastructure. In 2016, 52% of Basin irrigators reported they had no plans to modernise or upgrade their on-farm water infrastructure in the next five years, while 24% planned to modernise/upgrade in the next 2 years, and 24% in 3-5 years time (Schirmer 2017). In 2018, this question was asked slightly differently: instead of being asked to indicate which of three options they would select, irrigators were asked the extent to which they agreed or disagreed that they intended to modernise (or not modernise) in coming years. They were asked the extent to which they agreed or disagreed that (Tables 45 to 49):

- 'No more modernisation of irrigation infrastructure is needed on the land I manage'
- 'I'd like to do more irrigation modernisation works in the next 1-2 years'
- 'I'd like to do more irrigation modernisation works in the next 3-5 years'
- 'I'd be more likely to modernise on-farm infrastructure if given a grant to help'
- 'I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return'.

Twenty-nine per cent of irrigators did not feel more modernisation of irrigation infrastructure was needed on the land they manage. This did not differ significantly based on geographic location of the irrigator, although with larger sample sizes it is possible differences would be identified. Perhaps surprising, it did not differ significantly based on the area of land modernised since 2013, indicating that perceptions of the need to modernise depend on a wide range of factors and that, similarly to past reports (Schirmer 2017), those who invest in modernising are just as much or more likely to feel there are potential benefits from doing further modernisation works as those who have not invested in modernising. Irrigators were more likely to report this if they had a horticulture enterprise (41%), used less than 30 ML of water (46%), and had not completed high school (37%).

Half of irrigators (51.1%) agreed they would like to do more modernisation works in the next 1 to 2 years, while 57% would like to in the next 3 to 5 years. This was more common amongst Northern Basin irrigators (61% and 70% respectively for modernising in one to two and three to five years), those who had already modernised 20% or more of their irrigation area since 2013 (59% or higher depending on the amount of irrigation area modernised), were grain growers (69% and 74% respectively), had GVAP of $500,000-$999,999 (63% and 71%) or of $1 million or more (78% and 77%), used 1000 ML of water or more (72% and 70%), and were younger (63% and 72% of those aged under 45, and 60% and 70% of those aged 45-54).

Fifty-nine per cent felt they would be more likely to modernise if given a grant to help, particularly those who had already modernised with the help of a grant (72%), dairy farmers (68%), those making a loss (65%), and younger farmers (95% of those aged under 45, and 67% of those aged 45-54). Two-thirds – 66% – felt they would not be interested in a grant if required to transfer some water entitlements in return for the grant, particularly those in

the NSW Southern Basin (76%), dairy farmers (73%), those spending less than 10% of farm spending on water (73%), and those earning all their household income on the farm (75%).

6.5 CONCLUSIONS

The purpose of SRWUIP on-farm modernisation grants was to support more rapid growth in water efficiency of on-farm water infrastructure through enabling modernisation to occur earlier than it would have in the absence of the grant. It is likely some irrigators would not have done the works without a grant, while others would have undertaken works in the absence of a grant, but may have taken a longer time to do so and/or only been able to fund a smaller scope of works than occurred with the grant.

Overall, the views reported by irrigators suggests that for half, receiving a grant enabled them to do works when otherwise none or very few would have occurred. For 50-60%, some works would have occurred in the absence of receiving a grant, but the works would either have been done some time later than they occurred, or a smaller scope of works undertaken, indicating that grants assisted in bringing works forward from when they otherwise would have occurred. Just over one in three would have done works irrespective of the grant. Motivations for modernizing are typically focused on benefits for farm production and productivity, with reduction in water use a somewhat less common motivator (although still important to almost two-thirds of irrigators).

The majority of irrigators feel more modernization work was needed on their land and wanted to invest in more within the next five years. However there are some differences in views about the usefulness of grants, with many feeling that while a grant would be helpful, they would not be willing to transfer water entitlements in return for a grant, particularly many Southern Basin irrigators.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 45 Future on-farm modernisation intentions – by irrigator location

% of irrigators who agreed with the statement	All irrigators	Basin irrigator[1]	Outside Basin irrigator[1]	Northern Basin irrigator[2]	Southern Basin[2]	NSW Southern Basin	SA Basin	VIC Basin	Southern Basin not in irrig. district[3]	GMID[3]	MIL[3]	NSW other irrigation district[3]
No more modernisation of irrigation infrastructure is needed on the land I manage	28.8%	28.6%	29.0%	22.7%	29.5%	25.0%	55.2%	27.3%	**19.4%**	**29.4%**	**23.1%**	**44.8%**
I'd like to do more irrigation modernisation works in the next 1-2 years	51.1%	49.8%	53.5%	61.0%	48.2%	53.4%	34.6%	47.5%	55.7%	46.8%	61.5%	41.9%
I'd like to do more irrigation modernisation works in the next 3-5 years	57.3%	54.4%	62.4%	69.8%	51.9%	60.0%	39.3%	49.7%	65.3%	47.0%	62.2%	54.8%
I'd be more likely to modernise on-farm infrastructure if given a grant to help	58.7%	57.9%	60.2%	45.2%	59.9%	60.7%	40.7%	62.7%	57.6%	61.3%	64.1%	41.9%
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	65.7%	65.5%	66.3%	60.5%	66.3%	75.6%	62.1%	62.1%	69.8%	61.2%	69.2%	71.0%
n	490	319	169	43	276	86	29	161	96	129	39	31

[1]Bold font indicates there were significant differences between irrigators who lived within compared to outside the Basin.
[2] Bold font indicates significant differences between those in the Southern compared to Northern Basin.
[3]Bold font indicates significant differences between irrigators living in different irrigation districts & outside irrigation districts. See Appendix 1 for detailed data from statistical tests.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 46 Future on-farm modernisation intentions – by engagement in on-farm modernisation

% of irrigators who agreed with the statement	All Basin irrigators	Modernisation of on-farm irrigation infrastructure since 2008[1]			Proportion of on-farm irrigation infrastructure modernised since 2013[2]				
		Has not modernised since 2008	Modernised, self-funded	Modernised with help of grant	None	1-19%	20-49%	50-74%	75%
No more modernisation of irrigation infrastructure is needed on the land I manage	28.6%	30.9%	28.4%	25.8%	29.8%	17.1%	30.9%	18.2%	37.2%
I'd like to do more irrigation modernisation works in the next 1-2 years	49.8%	**28.4%**	**54.7%**	**56.0%**	**38.0%**	**51.3%**	**66.1%**	**62.8%**	**58.5%**
I'd like to do more irrigation modernisation works in the next 3-5 years	54.4%	**27.7%**	**61.3%**	**62.4%**	**42.9%**	**53.8%**	**70.4%**	**67.5%**	**62.8%**
I'd be more likely to modernise on-farm infrastructure if given a grant to help	57.9%	**40.3%**	**57.6%**	**70.8%**	57.3%	56.4%	56.4%	77.3%	48.8%
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	65.5%	**50.0%**	**71.3%**	**66.7%**	60.2%	81.0%	75.0%	56.8%	65.0%
n	319	66	164	87	103	42	56	44	40

[1] Bold font indicates there were significant differences between irrigators who had not modernised, who had modernised using self-funding, and had modernised with help from grants.
[2] Bold font indicates significant differences between those who had modernised differing proportions of their irrigation infrastructure. See Appendix 1 for detailed data from statistical tests.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 47 Future on-farm modernisation intentions – by farm type and size

% of irrigators who agreed with the statement	Farm type[1]					Gross value of agricultural production 2017-18[2]						Farm self-reported 3-year profitability[3]		
	Dairy farmer	Grain grower	Grazier	Horti-culture	Mixed cropping/ grazing	< $40,000	40,000-$99,999	$100,000-$299,999	$300,000-$499,999	$500,000-$999,999	$1 million+	Making a loss	Breaking even/ small profit	Moderate or large profit
No more modernisation of irrigation infrastructure is needed on the land I manage	21.6%	25.0%	22.7%	40.7%	27.1%	32.3%	32.5%	31.5%	32.3%	20.5%	17.0%	27.6%	28.1%	30.0%
I'd like to do more irrigation modernisation works in the next 1-2 years	44.0%	68.6%	54.1%	39.2%	54.2%	43.3%	38.1%	43.5%	41.9%	62.8%	78.0%	55.8%	45.4%	53.6%
I'd like to do more irrigation modernisation works in the next 3-5 years	47.9%	74.3%	52.5%	47.5%	62.7%	43.1%	41.0%	48.5%	50.0%	70.7%	77.4%	59.5%	49.7%	58.9%
I'd be more likely to modernise on-farm infrastructure if given a grant to help	68.0%	52.8%	59.5%	50.0%	63.9%	50.8%	57.5%	57.1%	48.4%	61.4%	66.0%	64.7%	59.0%	40.4%
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	72.5%	63.9%	65.9%	59.5%	68.3%	48.3%	74.4%	68.6%	64.5%	71.1%	71.2%	60.2%	66.7%	68.9%
n	51	36	88	79	60	60	43	70	31	45	52	83	168	61

[1] Bold font indicates there were significant differences between irrigators operating different types of farms.
[2] Bold font indicates significant differences between those operating farms with differing GVAP in 2017-18.
[3] Bold font indicates significant differences between irrigators who reported differing levels of profitability. See Appendix 1 for detailed data from statistical tests.
No significant relationships were identified.

6. MOTIVATIONS FOR AND INTENTION TO MODERNISE IRRIGATION INFRASTRUCTURE

Table 48 Future on-farm modernisation intentions – by farm water use characteristics

% of irrigators who agreed with the statement	% farm expenditure on irrigation water[1]				Source of majority of irrigation water used in 2017-18[2]			Volume of irrigation water used in 2017-18 water year[3]				
	<10%	10-19%	20-29%	30%+	Channels	Direct pumping	Ground-water	<30ML	30 to 99ML	100 to 299ML	300 to 999ML	1000ML or more
No more modernisation of irrigation infrastructure is needed on the land I manage	24.6%	30.0%	26.7%	28.6%	33.7%	23.8%	20.7%	45.5%	24.0%	28.4%	29.3%	14.5%
I'd like to do more irrigation modernisation works in the next 1-2 years	43.8%	51.9%	46.3%	53.6%	46.9%	57.5%	50.0%	**35.5%**	**52.0%**	**47.0%**	**50.0%**	**71.7%**
I'd like to do more irrigation modernisation works in the next 3-5 years	55.6%	53.8%	58.5%	51.3%	**48.8%**	**67.1%**	**55.4%**	**46.7%**	**53.2%**	**52.4%**	**56.9%**	**70.4%**
I'd be more likely to modernise on-farm infrastructure if given a grant to help	50.0%	60.0%	72.1%	59.8%	60.0%	59.0%	51.8%	55.2%	64.0%	57.6%	62.2%	57.1%
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	73.0%	67.9%	57.8%	65.1%	64.8%	67.1%	66.1%	**56.3%**	**56.9%**	**75.4%**	**69.3%**	**71.4%**
n	63	81	45	86	182	79	56	32	51	69	75	56

[1] Bold font indicates significant differences between irrigators who had different proportions of farm expenditure on irrigation water.
[2] Bold font indicates significant differences between irrigators who derived majority of irrigation water from channels, pumping or groundwater.
[3] Bold font indicates significant differences between irrigators who used differing volumes of irrigation water. See Appendix 1 for detailed data from statistical tests.

Table 49 Future on-farm modernisation intentions – by socio-demographic characteristics

	Irrigator age[1]					Formal educational attainment[2]			Proportion of household income earned off-farm[3]				
% of irrigators who agreed with the statement	Aged under 45	Aged 45-54	Aged 55-64	Aged 65-74	Aged 75+	Did not complete high school	Has high school or post-school qualification	Completed tertiary qualifi-cation	None	1-25%	26-50%	51-75%	76% or more
No more modernisation of irrigation infrastructure is needed on the land I manage	25.0%	22.0%	30.3%	31.4%	30.3%	36.9%	25.6%	25.8%	32.0%	29.1%	16.7%	27.3%	30.6%
I'd like to do more irrigation modernisation works in the next 1-2 years	**63.2%**	**60.0%**	**50.9%**	**45.4%**	**30.3%**	**33.8%**	55.6%	54.3%	49.5%	52.4%	53.7%	38.7%	48.3%
I'd like to do more irrigation modernisation works in the next 3-5 years	**72.2%**	**70.0%**	**60.0%**	**43.0%**	**35.3%**	**41.6%**	59.3%	61.1%	53.3%	61.9%	43.6%	48.4%	54.1%
I'd be more likely to modernise on-farm infrastructure if given a grant to help	**95.0%**	**66.7%**	**58.5%**	**53.1%**	**33.3%**	**47.5%**	61.6%	60.8%	52.1%	61.4%	58.5%	59.4%	59.7%
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	52.9%	67.3%	64.5%	68.6%	63.9%	63.9%	65.9%	68.4%	**75.3%**	**63.4%**	**59.5%**	**57.1%**	**63.9%**
n	17	49	107	102	36	83	232	95	97	82	42	35	61

[1] Bold font indicates significant differences between irrigators of different ages.
[2]Bold font indicates significant differences between irrigators with different levels of formal educational attainment.
[3]Bold font indicates significant differences between irrigators whose households earned differing amounts of household income off-farm. See Appendix 1 for detailed data from statistical tests.

7. OFF-FARM INFRASTRUCTURE MODERNISATION

7.1 INTRODUCTION

Off-farm water infrastructure modernisation works have been undertaken in many regions with the assistance of SRWUIP grants. These projects involve a range of activities, often funded in partnership between SRWUIP and state governments (see Schirmer 2017 for further discussion and examples). This section examines whether investment in off-farm infrastructure modernisation investment is associated with positive or negative outcomes for the irrigators living in these regions. As was done in previous years, data provided by the Department of Agriculture was used to identify which irrigators lived in irrigation districts in which off-farm modernisation funded partly or wholly by the SRWUIP had occurred or was underway.

7.2 BENEFITS AND COSTS OF MODERNISING OFF-FARM INFRASTRUCTURE

Irrigators who reported that their water provider had upgraded irrigation infrastructure since 2008 were asked their views about the benefits and costs of the modernisation works for them, focusing on changes in timing of water delivery, cost of water delivery, and effects on overall farm productivity and profitability.

Irrigators who were aware of off-farm modernisation works were asked their views about the outcomes of those works on the timing of water delivery, cost of water delivery, and on overall farm productivity and profitability.

Overall, 36% felt off-farm works were positive for their farm overall, 22% that they had negative impacts, and 42% that the impacts were neutral for their farm (Table 50). Overall, 59% reported improved timing of water delivery to their farm, 45% positive impacts on their efficiency of water use, and 30% positive impacts on farm productivity, while 52% reported negative impacts on costs of water delivery, and around one-quarter felt impacts on farm profitability were positive and one-quarter that they were negative. Views were more positive amongst those who lived in regions where off-farm works have been completed, where 43% reported overall positive impacts on their farm, while works involving conversion of open channels to pipes and clay lining of channels to reduce leakage were viewed most positively in terms of impacts (47% and 49% respectively, with 16% or fewer reporting negative impacts from these types of works).

Views about impacts have not changed significantly over time (Table 51), with relatively similar proportions of irrigators reporting positive and negative impacts. There was lower reporting of positive impacts in 2018 compared to 2016 for some aspects, however the small numbers of respondents mean these differences are not statistically significant.

7.3 CONCLUSIONS

Overall, off-farm modernization views tend to be more neutral and less positive than irrigators views about the impacts of on-farm modernization. This is likely in large part to reflect that many irrigators do not directly or immediately experience impacts from off-farm modernization in day-to-day operations; thus views about effects of off-farm modernization reflect in many cases a lack of direct impact of these operations on individual irrigators. Views may also be influenced by broader views about water reform.

7. OFF-FARM INFRASTRUCTURE MODERNISATION

Table 50 Irrigator views about impacts of off-farm infrastructure modernisation for their farm - 2018

Overall, how did the off-farm infrastructure investment affect…	Your farm enterprise as a whole			Your overall farm productivity			Your farm profitability			Your efficiency of water use			Timing of water delivery to your farm			Cost of water delivery to your farm		
	Nega-tive impact	Nei-ther	Posi-tive impact	Nega-tive impact	Nei-ther	Posi-tive impact	Nega-tive impact	Nei-ther	Posi-tive impact	Nega-tive impact	Nei-ther	Posi-tive impact	Nega-tive impact	Nei-ther	Posi-tive impact	Nega-tive impact	Nei-ther	Posi-tive impact
Basin irrigator, SRWUIP region (n=168)	22.0%	41.7%	36.3%	19.4%	50.3%	30.3%	25.8%	49.7%	24.5%	20.2%	35.1%	44.6%	13.1%	28.0%	58.9%	52.4%	32.3%	15.2%
Southern Basin VIC irrigator, SRWUIP region (n=102)	23.5%	43.1%	33.3%	21.0%	50.0%	29.0%	24.0%	54.0%	22.0%	21.6%	32.4%	46.1%	11.7%	24.3%	64.1%	57.0%	31.0%	12.0%
Basin irrigator, off-farm works still being completed (n=83)	15.7%	48.2%	36.1%	12.3%	53.1%	34.6%	21.0%	50.6%	28.4%	14.5%	38.6%	47.0%	9.6%	28.9%	61.4%	50.6%	33.3%	16.0%
Basin irrigator, off-farm works completed (n=83)	26.5%	30.1%	43.4%	22.5%	41.3%	36.3%	30.4%	41.8%	27.8%	22.9%	24.1%	53.0%	18.1%	22.9%	59.0%	51.2%	30.5%	18.3%
Type of work - Automation of water delivery or other upgrade to technology used to deliver water (n=142)	20.4%	37.3%	42.3%	16.1%	47.4%	36.5%	24.3%	47.1%	28.7%	17.7%	31.2%	51.1%	9.9%	20.4%	69.7%	53.2%	29.5%	17.3%
Type of work - Conversion of open channels to pipes (n=49)	16.3%	36.7%	46.9%	16.7%	47.9%	35.4%	19.1%	51.1%	29.8%	12.2%	24.5%	63.3%	10.4%	16.7%	72.9%	46.8%	40.4%	12.8%
Type of work - Clay lining of channels or other works to reduce leakage (n=35)	11.4%	40.0%	48.6%	15.2%	48.5%	36.4%	24.2%	48.5%	27.3%	11.4%	31.4%	57.1%	8.6%	28.6%	62.9%	44.1%	44.1%	11.8%
Type of work - improved metering (n=112)	16.1%	42.9%	41.1%	13.8%	50.5%	35.8%	21.1%	50.5%	28.4%	15.2%	34.8%	50.0%	12.3%	27.2%	60.5%	50.9%	35.5%	13.6%

While data were explored to identify whether there were statistically significant differences in views of impacts of off-farm infrastructure investment between irrigation districts, type of works undertaken, and whether works were still being completed (see Appendix 1), no significant differences were identified.

7. OFF-FARM INFRASTRUCTURE MODERNISATION

Table 51 Irrigator views about impacts of off-farm infrastructure modernisation for their farm – 2015 to 2018

Overall, how did the off-farm infrastructure investment affect…		Negatively	Neither negatively or positively	Positively
	2018	22%	42%	36%
	2016	13%	33%	54%
Your farm enterprise as a whole	2015	20%	40%	41%
	2018	13%	28%	59%
	2016	9%	27%	63%
Timing of water delivery to your farm	2015	10%	30%	59%
	2018	20%	35%	45%
	2016	12%	39%	49%
Your efficiency of water use	2015	14%	41%	46%
	2018	19%	50%	30%
	2016	16%	43%	41%
Your overall farm productivity	2015	16%	54%	30%
	2018	26%	50%	25%
	2016	21%	47%	32%
Your farm profitability	2015	22%	61%	18%
	2018	52%	32%	15%
	2016	51%	33%	16%
Cost of water delivery to your farm	2015	51%	35%	14%

8. CONCLUSIONS

Investments in on-farm modernisation have enabled a larger scope of works to be undertaken earlier than they would otherwise have been for many irrigators. For some, modernisation works would not have been undertaken at all without grants; for others, they would have occurred some years later, while there are some who would have undertaken the same scope of works irrespective of whether or not they had access to a grant.

Interest in modernising is greater amongst those irrigators who are profitable and expanding their farm enterprise: this means that those who modernise also tend to be those who are expanding the size of scope of their enterprise, and are somewhat more likely to also be expanding water use (albeit with only one in five expanding overall water use amongst those who invest in modernisation). Overall, 80% of those who modernize do not expand overall volume of water use, while around 20% do, particularly those who are in a process of farm expansion. Increases in volume of water use were similarly common amongst those who modernize whether or not they receive a grant to assist modernisation (18% of those who self-funded modernize expand water use compared to 23% of those receiving a grant). This suggests that expansion of water use would have occurred in the absence of grants. If grants enable greater focus on water use efficiency compared to self-funded works, they may facilitate greater overall water use efficiency resulting from modernisation works. However examining the relative water use efficiencies achieved through self-funded versus grant-assisted modernisation activities is outside the scope of this report, so it cannot be confirmed whether this has actually been the case.

On-farm modernisation – whether self-funded or done with assistance from a grant – is typically associated with positive outcomes for a large majority of irrigators, in terms of farm productivity and production, and being associated with more positive farm outcomes and wellbeing of farmers. Off-farm modernisation is more often associated with neutral outcomes than positive or negative, likely reflecting fewer direct impacts on individual irrigators in many cases.

While many irrigators have future intentions to modernise, there are mixed views about whether irrigators are willing to exchange water entitlements for grants in future, particularly amongst those with relatively lower farm expenditure on water. Those who operate larger farms and younger irrigators were more likely to intend to modernise. Given that more profitable farmers are most likely to have modernised in the past, it is likely that future investment in grants may successfully bring forward modernisation if targeted to those who are likely to have greater difficulty in self-funding works – particularly those making a loss on the farm, smaller farmers and those earning more income off-farm – however it is questionable whether targeting grants to less profitable farmers is overall the most effective approach to achieving reduced irrigation water use per unit of agricultural production and transfer of entitlements for use in environmental watering.

9. REFERENCES

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10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

This appendix provides findings from tests of statistical significance used to identify where some groups of irrigators differed significantly to others in their behaviour or perceptions related to modernisation. Three types of test were used to identify statistical association:

- Pearson chi square test. This test was used to identify whether there were significant differences between two categorical variables. For example, this was used to identify if engagement in modernization was different for irrigators living in different irrigation districts.
- Kruskal-Wallis H test. This test was used where (i) a categorical variable and (ii) an ordinal or non-normally distributed continuous variable were being analysed. This identified whether different categories of people had differing distributions of results for the ordinal/continuous variable
- Spearman's correlation test. This test was used to examine associations between two variables where both were ordinal/continuous. Spearman's test was used in preference to Pearson's correlation as in most cases data were either ordinal or non-normally distributed in nature, meaning it was more appropriate to use a non-parametric than a parametric test.
- Independent samples t-test. This test was used to compare distribution of a continuous variable between two independent groups.

The following tables provide results of statistical tests, including the names of the variables examined, the type of statistical test used, and the findings, with both effect size and p-values reported. The tables have the same numbering as their equivalents in the main report, to enable easy matching of tables in the Appendix to the descriptive data presented in the report.

Where statistical results were significant at the 5% level, the table is shaded to indicate a significant statistical difference was identified. It is important to note that due to small sample sizes, there is a high risk of Type II statistical error (in which there is a significant relationship but it is not identified in statistical significance testing due to lower sample sizes).

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A4 Socio-demographic characteristics of irrigators

	Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
Variable	**Test**	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**
Household income - % earned off-farm	Pearson chi-square	2.13	0.712	Pearson chi-square	4.19	0.839	Pearson chi-square	27.61	0.277
Off-farm work undertaken by irrigator	Pearson chi-square	.793	0.851	Pearson chi-square	1.25	0.974	Pearson chi-square	35.29	0.009
Irrigator gender	Pearson chi-square	31.51	<0.000	Pearson chi-square	34.68	<0.000	Pearson chi-square	169.99	<0.000
Irrigator age	Pearson chi-square	43.19	<0.000	Pearson chi-square	54.97	<0.000	Pearson chi-square	64.82	<0.000
General health status of irrigator	Pearson chi-square	6.01	0.049	Pearson chi-square	9.85	0.043	Pearson chi-square	7.09	0.852
Household financial stress last 12 months	Pearson chi-square	0.790	0.374	Pearson chi-square	14.14	0.001	Pearson chi-square	13.35	0.038
Formal educational attainment	Pearson chi-square	0.457	0.499	Pearson chi-square	2.57	0.276	Pearson chi-square	69.78	<0.000
Likelihood of retiring from work in the next 5 years	Pearson chi-square	1025.4	<0.000	Pearson chi-square	1041.2	<0.000	Pearson chi-square	197.68	<0.000

Table A5 Irrigation water sources – by irrigator location

	Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
	Test	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**
Irrigation water sources (irrigation, pumping, groundwater)	Pearson chi- square	75.6	<0.000	Pearson chi- square	128.3	<0.000	Pearson chi- square	368.6	<0.000

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A6 Irrigation water sources – participation of Basin irrigators in irrigation modernisation activity

	Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
	Test	Effect size	p-value	Test	Effect size	p-value
Irrigation water sources (irrigation, pumping, groundwater)	Pearson chi- square	17.6	0.002	Pearson chi- square	12.6	0.126

Table A7 Irrigation water sources – by farm type and size

	Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Irrigation water sources (irrigation, pumping, groundwater)	Pearson chi- square	19.6	0.033	Pearson chi- square	19.9	0.030	Pearson chi- square	4.0	.367

Table A8 Irrigation water sources – by farm water use characteristics

	% farm expenditure on irrigation water			Volume of irrigation water used in 2017-18 water year		
	Test	Effect size	p-value	Test	Effect size	p-value
Irrigation water sources (irrigation, pumping, groundwater)	Pearson chi- square	35.83	<0.000	Pearson chi- square	29.36	<0.000

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A9 Ownership and purchase of irrigation water: use of entitlements and market purchase by irrigator location

% 2017-18 irrigation water from…	Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
owned entitlements	Kruskal Wallis H	12.862	0.000	Kruskal Wallis H	13.400	0.000	Pearson chi-square	153.57	<0.000
allocation bought on temporary market	Kruskal Wallis H	61.927	0.000	Kruskal Wallis H	18.598	0.000	Pearson chi-square	150.88	<0.000
leased entitlements	Kruskal Wallis H	0.354	0.552	Kruskal Wallis H	0.912	0.340	Pearson chi-square	28.81	0.227
other sources	Kruskal Wallis H	2.530	0.112	Kruskal Wallis H	1.703	0.192	Pearson chi-square	66.33	<0.000

Table A10 Ownership and purchase of irrigation water: use of entitlements and market purchase by participation in irrigation modernisation activity

% 2017-18 irrigation water from…	Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
	Test	Effect size	p-value	Test	Effect size	p-value
owned entitlements	Pearson chi-square	20.04	0.01	Spearman's Rho	-0.025	0.671
allocation bought on temporary market	Pearson chi-square	31.39	<0.000	Spearman's Rho	.265	0.000
leased entitlements	Pearson chi-square	10.15	0.255	Spearman's Rho	.145	0.038
other sources	Pearson chi-square	10.35	0.241	Spearman's Rho	.147	0.043

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A11 Ownership and purchase of irrigation water: use of entitlements and market purchase by farm type and size

% 2017-18 irrigation water from…	Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
owned entitlements	Pearson chi-square	35.07	0.020	Spearman's Rho	0.077	0.16	Spearman's Rho	0.089	0.104
allocation bought on temporary market	Pearson chi-square	43.44	0.002	Spearman's Rho	0.344	<0.000	Spearman's Rho	0.096	0.122
leased entitlements	Pearson chi-square	21.70	0.357	Spearman's Rho	0.249	<0.000	Spearman's Rho	0.090	0.168
other sources	Pearson chi-square	34.38	0.024	Spearman's Rho	-0.082	0.227	Spearman's Rho	-0.080	0.234

Table A12 Ownership and purchase of irrigation water: use of entitlements and market purchase by farm water use characteristics

	% farm expenditure on irrigation water			Source of majority of irrigation water used in 2017-18			Volume of irrigation water used in 2017-18 water year		
% 2017-18 irrigation water from…	**Test**	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**
owned entitlements	Spearman's Rho	0.147	0.011	Pearson chi-square	18.87	0.016	Spearman's Rho	0.044	0.448
allocation bought on temporary market	Spearman's Rho	0.116	0.080	Pearson chi-square	11.57	0.172	Spearman's Rho	0.382	<0.000
leased entitlements	Spearman's Rho	-0.042	0.553	Pearson chi-square	3.75	0.879	Spearman's Rho	0.180	0.01
Other sources	Spearman's Rho	-0.121	0.097	Pearson chi-square	24.43	0.02	Spearman's Rho	0.118	0.11

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A13 Irrigation water use change and market activity – by irrigator location

Change in irrigation water use since 2013 (decreased, stayed about the same, increased)		Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas		
		Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
		Pearson chi square	18.23	<0.000	Pearson chi square	18.52	0.001	Pearson chi square	34.72	0.001
In the last 12 months, irrigator…	Bought new water entitlements	Pearson chi square	22.64	<0.000	Pearson chi square	33.13	<0.000	Pearson chi square	63.13	<0.000
	Sold/ transferred some/ all entitlements	Pearson chi square	24.37	<0.000	Pearson chi square	33.98	<0.000	Pearson chi square	72.70	<0.000
	Sold water allocation on temp market	Pearson chi square	82.01	<0.000	Pearson chi square	94.64	<0.000	Pearson chi square	120.31	<0.000
	Carried water over from 2016-17 to next water year	Pearson chi square	103.61	<0.000	Pearson chi square	134.35	<0.000	Pearson chi square	214.36	<0.000
	Carried water over from 2017-18 to next water year	Pearson chi square	77.61	<0.000	Pearson chi square	98.57	<0.000	Pearson chi square	162.88	<0.000

Table A14 Irrigation water use change and market activity – participation of Basin irrigators in irrigation modernisation activity

		Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
		Test	Effect size	p-value	Test	Effect size	p-value
Change in irrigation water use since 2013 (decreased, stayed about the same, increased)		Pearson chi square	7.58	0.108	Pearson chi square	16.48	0.036
In the last 12 months, irrigator…	Bought new water entitlements	Pearson chi square	9.54	0.049	Pearson chi square	12.50	0.130
	Sold/ transferred some/ all entitlements	Pearson chi square	9.59	0.048	Pearson chi square	4.62	0.797
	Sold water allocation on temp market	Pearson chi square	6.39	0.172	Pearson chi square	3.54	0.896
	Carried water over from 2016-17 to next water year	Pearson chi square	10.25	0.036	Pearson chi square	16.61	0.034
	Carried water over from 2017-18 to next water year	Pearson chi square	6.04	0.196	Pearson chi square	14.89	0.061

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A15 Irrigation water use change and market activity – by farm type and size

		Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
		Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Change in irrigation water use since 2013 (decreased, stayed about the same, increased)		Pearson chi square	19.57	0.034	Pearson chi square	16.07	0.098	Pearson chi square	11.42	0.022
In the last 12 months, irrigator…	**Bought new water entitlements**	Pearson chi square	14.34	0.158	Pearson chi square	19.06	0.039	Pearson chi square	6.46	0.167
	Sold/ transferred some/ all entitlements	Pearson chi square	12.63	0.245	Pearson chi square	11.51	0.320	Pearson chi square	3.65	0.455
	Sold water allocation on temp market	Pearson chi square	24.64	0.006	Pearson chi square	9.70	0.468	Pearson chi square	4.57	0.335
	Carried water over from 2016-17 to next water year	Pearson chi square	32.15	<0.000	Pearson chi square	22.70	0.012	Pearson chi square	8.01	0.091
	Carried water over from 2017-18 to next water year	Pearson chi square	22.41	0.013	Pearson chi square	24.90	0.006	Pearson chi square	9.61	0.047

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A16 Irrigation water use change and market activity – by farm water use characteristics

		% farm expenditure on irrigation water			Source of majority of irrigation water used in 2017-18			Volume of irrigation water used in 2017-18 water year		
		Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Change in irrigation water use since 2013 (decreased, stayed about the same, increased)		Pearson chi square	2.19	0.902	Pearson chi square	6.23	0.183	Pearson chi square	17.25	0.028
In the last 12 months, irrigator …	**Bought new water entitlements**	Pearson chi square	10.99	0.089	Pearson chi square	26.71	<0.000	Pearson chi square	14.24	0.076
	Sold/ transferred some/ all entitlements	Pearson chi square	9.23	0.161	Pearson chi square	9.59	0.048	Pearson chi square	18.95	0.015
	Sold water allocation on temp market	Pearson chi square	14.18	0.028	Pearson chi square	16.80	0.002	Pearson chi square	18.85	0.016
	Carried water over from 2016-17 to next water year	Pearson chi square	22.28	0.001	Pearson chi square	36.76	<0.000	Pearson chi square	35.75	<0.000
	Carried water over from 2017-18 to next water year	Pearson chi square	14.90	0.021	Pearson chi square	19.67	0.001	Pearson chi square	28.78	<0.000

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Table A17 Reasons and mechanisms for increasing volume of irrigation water used

If the total volume of irrigation water used on your farm increased, was the increase due to any of the following?		Greater use of temporary water	Purchase of additional water entitlements	Irrigation of a larger area of land	More intensive irrigation of land you already irrigated	Change in type of crops/ pasture grown
Located within Basin compared to outside Basin	Test	Pearson chi square	Pearson chi square	Pearson chi square	Pearson chi square	Pearson chi square
	Effect size	15.34	0.281	7.395	0.003	2.274
	p-value	<0.000	0.596	0.007	0.958	0.132
Northern Basin compared to Southern Basin	Test	Pearson chi square	Pearson chi square	Pearson chi square	Pearson chi square	Pearson chi square
	Effect size	18.88	0.376	7.43	1.70	2.66
	p-value	<0.000	0.829	0.024	0.427	0.265
Comparison of those who self-funded modernization versus received a grant	Test	Pearson chi square	Pearson chi square	Pearson chi square	Pearson chi square	Pearson chi square
	Effect size	32.20	5.81	5.78	2.38	3.27
	p-value	<0.000	0.325	0.328	0.794	0.659

Note: there is no Table A18 as the equivalent table in the main body of the report did not have associated testing of statistical significance of associations between variables reported in the table.

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Table A19 Mean farm expenditure by expenditure type – by irrigator location

		Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
		Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Average expenditure in 2017-18 on…	Water for irrigation	Kruskal-Wallis	44.54	<0.000	Kruskal-Wallis	15.38	<0.000	Pearson chi square	356.62	<0.000
	Electricity/ power	Kruskal-Wallis	4.29	0.038	Kruskal-Wallis	0.013	0.908	Pearson chi square	16.27	0.996
	Contractors	Kruskal-Wallis	7.46	0.006	Kruskal-Wallis	0.001	0.978	Pearson chi square	21.78	0.905
	Salaries/ wages	Kruskal-Wallis	20.86	<0.000	Kruskal-Wallis	0.751	0.386	Pearson chi square	27.87	0.934
	Fuel (petrol, diesel, gas)	Kruskal-Wallis	0.18	0.670	Kruskal-Wallis	1.08	0.299	Pearson chi square	22.87	0.852
	Other inputs (e.g. feed, fertilizer, chemicals, seed)	Kruskal-Wallis	0.02	0.899	Kruskal-Wallis	0.759	0.384	Pearson chi square	47.04	0.613

Table A20 Mean farm expenditure by expenditure type – participation of Basin irrigators in irrigation modernisation activity

		Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
		Test	Effect size	p-value	Test	Effect size	p-value
Average expenditure in 2017-18 on…	Water for irrigation	Kruskal Wallis H	6.45	0.040	Spearman's rho	0.049	0.415
	Electricity/ power	Kruskal Wallis H	4.69	0.096	Spearman's rho	0.006	0.920
	Contractors	Kruskal Wallis H	2.15	0.342	Spearman's rho	0.164	0.012
	Salaries/ wages	Kruskal Wallis H	0.60	0.740	Spearman's rho	0.233	0.000
	Fuel (petrol, diesel, gas)	Kruskal Wallis H	0.13	0.937	Spearman's rho	0.131	0.028
	Other inputs (e.g. feed, fertilizer, chemicals, seed)	Kruskal Wallis H	0.66	0.718	Spearman's rho	-0.054	0.373

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Table A21 Mean farm expenditure by expenditure type – by farm type and size

		Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
		Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Average expenditure in 2017-18 on…	Water for irrigation	Pearson's chi square	259.17	0.012	Spearman's rho	-.183	0.001	Spearman's rho	-0.074	0.195
	Electricity/ power	Pearson's chi square	222.58	0.017	Spearman's rho	-.164	0.003	Spearman's rho	-0.115	0.041
	Contractors	Pearson's chi square	173.62	0.014	Spearman's rho	.185	0.003	Spearman's rho	0.076	0.220
	Salaries/ wages	Pearson's chi square	178.63	0.149	Spearman's rho	.523	0.000	Spearman's rho	0.219	0.001
	Fuel	Pearson's chi square	292.01	<0.000	Spearman's rho	-.136	0.015	Spearman's rho	-0.055	0.325
	Other inputs	Pearson's chi square	338.39	0.016	Spearman's rho	.244	0.000	Spearman's rho	0.039	0.500

Table A22 Mean farm expenditure by expenditure type – by farm water use characteristics

		Source of majority of irrigation water used in 2017-18			Volume of irrigation water used in 2017-18 water year		
		Test	Effect size	p-value	Test	Effect size	p-value
Average expenditure in 2017-18 on…	Water for irrigation	Kruskal Wallis H	34.69	<0.000	Spearman's rho	0.119	0.047
	Electricity/ power	Kruskal Wallis H	7.66	0.022	Spearman's rho	-0.069	0.246
	Contractors	Kruskal Wallis H	0.76	0.684	Spearman's rho	0.103	0.111
	Salaries/ wages	Kruskal Wallis H	9.15	0.010	Spearman's rho	0.201	0.003
	Fuel (petrol, diesel, gas)	Kruskal Wallis H	3.08	0.214	Spearman's rho	-0.030	0.611
	Other inputs (e.g. feed, fertilizer, chemicals, seed)	Kruskal Wallis H	2.79	0.248	Spearman's rho	0.155	0.010

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Table A23 Engagement in modernisation of on-farm irrigation infrastructure – by irrigator location

	Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Modernisation of on-farm irrigation infrastructure since 2008	Pearson chi-square	44.93	<0.000	Pearson chi-square	63.65	<0.000	Pearson chi-square	69.88	<0.000
Proportion of on-farm irrigation infrastructure modernised since 2013	Pearson chi-square	3.29	0.511	Pearson chi-square	5.34	0.721	Pearson chi-square	45.61	0.001

Table A24 Engagement in modernisation of on-farm irrigation infrastructure – by farm type and size

	Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Modernisation of on-farm irrigation infrastructure since 2008	Pearson chi-square	16.39	0.089	Pearson chi-square	36.81	<0.000	Pearson chi-square	6.25	0.181
Proportion of on-farm irrigation infrastructure modernised since 2013	Pearson chi-square	39.31	0.006	Pearson chi-square	39.21	0.006	Pearson chi-square	10.18	0.25

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Table A25 Engagement in modernisation of on-farm irrigation infrastructure – by farm water use characteristics

	% farm expenditure on irrigation water			Source of majority of irrigation water used in 2017-18			Volume of irrigation water used in 2017-18 water year		
	Test	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**
Modernisation of on-farm irrigation infrastructure since 2008	Pearson chi-square	6.54	0.365	Pearson chi-square	17.55	0.002	Pearson chi-square	30.96	<0.000
Proportion of on-farm irrigation infrastructure modernised since 2013	Pearson chi-square	15.45	0.218	Pearson chi-square	12.62	0.126	Pearson chi-square	44.08	<0.000

Table A26 Engagement in modernisation of on-farm irrigation infrastructure – by socio-demographic characteristics

	Irrigator age			Formal educational attainment			Proportion of household income earned off-farm		
	Test	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**
Modernisation of on-farm irrigation infrastructure since 2008	Pearson chi-square	8.56	0.381	Pearson chi-square	4.75	0.093	Pearson chi-square	9.91	0.271
Proportion of on-farm irrigation infrastructure modernised since 2013	Pearson chi-square	22.93	0.116	Pearson chi-square	4.69	0.320	Pearson chi-square	24.25	0.084

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Table A27 Modernisation of on-farm irrigation areas since 2008 – type of modernisation works undertaken

		Land-forming (including laser levelling, bankless channel irrigation systems)	Improve-ment of farm drain reuse systems (e.g. improving capturing water run-off for reuse)	Converting from manual to automated irrigation control systems	Upgrade existing autom-ated control systems	Upgrade metering	Conver-sion from surface to overhead irrigation	Upgrade of existing overhead irrigation systems	Conver-sion to drip-based irrigation system	Upgrade of existing drip-based irrigation system	Introduc-tion of fertigation (injection of fertiliser into irrigation system)	Improved irrigation channels to reduce leakage	Other modern isation of on-farm water infrastr ucture
Located within Basin compared to outside Basin	Test	Pearson chi-square											
	Effect size	68.97	35.88	27.19	12.22	25.93	19.05	15.17	14.77	12.54	9.78	86.28	16.88
	p-value	<0.000	<0.000	<0.000	0.007	<0.000	<0.000	0.002	0.002	0.006	0.021	<0.000	0.001
Northern Basin compared to Southern Basin	Test	Pearson chi-square											
	Effect size	86.03	46.39	41.80	27.33	74.46	27.72	23.61	28.46	20.11	23.27	117.76	27.21
	p-value	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	0.001	<0.000	0.003	0.001	<0.000	<0.000
Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)	Test	Pearson chi-square											
	Effect size	169.89	73.51	97.45	108.79	69.79	63.79	75.79	92.15	52.14	120.43	186.05	55.12
	p-value	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000
Comparison of those who self-funded modernization versus received a grant	Test	Pearson chi-square											
	Effect size	355.37	330.08	262.95	191.24	341.85	104.33	98.48	149.19	138.58	144.60	230.09	169.41
	p-value	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000

Note: there is no Table A28 as the equivalent table in the main body of the report did not have associated testing of statistical significance of associations between variables reported in the table.

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Table A29 Comparing impacts of on-farm modernisation on the farm overall with perceptions of specific impacts of modernisation, Basin irrigators

	Impact on farm overall		
	Test	**Effect size**	**p-value**
Your farm profitability	Spearman's rho	0.728	<0.000
Your overall farm productivity – since works were completed	Spearman's rho	0.799	<0.000
Your irrigation water costs	Spearman's rho	0.455	<0.000
Your farm debt levels	Spearman's rho	0.282	<0.000
Your efficiency of water use	Spearman's rho	0.607	<0.000
Timing of water delivery to your farm	Spearman's rho	0.555	<0.000
Electricity/power costs	Spearman's rho	0.200	0.003
Your on-farm workload	Spearman's rho	0.504	<0.000

Table A30 Farm management changes made in the 12 months prior to completing the survey

In the last 12 months have you done any of the following on your farm business?	**Modernisation of on-farm irrigation infrastructure since 2008**			**Proportion of on-farm irrigation infrastructure modernised since 2013**		
	Test	**Effect size**	**p-value**	**Test**	**Effect size**	**p-value**
Decreased the area of land irrigated	Pearson chi-square	25.77	<0.000	Pearson chi-square	17.88	0.12
Increased the area of land irrigated	Pearson chi-square	17.83	0.007	Pearson chi-square	46.61	<0.000
Decreased the volume of irrigation water used on my land	Pearson chi-square	33.11	<0.000	Pearson chi-square	12.11	0.44
Increased the volume of irrigation water used on my land	Pearson chi-square	23.40	0.001	Pearson chi-square	32.39	0.001
Purchased new land	Pearson chi-square	4.27	0.640	Pearson chi-square	10.12	0.605
Expanded the area I farm through leasing or sharefarming	Pearson chi-square	5.58	0.472	Pearson chi-square	17.98	0.116
Produced more per hectare (intensification)	Pearson chi-square	15.23	0.019	Pearson chi-square	24.95	0.015
Reduced stock due to drought	Pearson chi-square	5.92	0.432	Pearson chi-square	10.57	0.566
Reduced amount produced per hectare compared (de-intensified production)	Pearson chi-square	10.92	0.091	Pearson chi-square	18.88	0.092
Increased the hours I worked on the farm	Pearson chi-square	11.40	0.077	Pearson chi-square	27.53	0.006
Reduced the hours I worked on the farm	Pearson chi-square	13.51	0.036	Pearson chi-square	12.28	0.423
Reduced use of inputs e.g. fertiliser, fuel, chemicals	Pearson chi-square	12.69	0.048	Pearson chi-square	16.56	0.167
Reduced use of professional services e.g. agronomist, vet	Pearson chi-square	14.69	0.023	Pearson chi-square	7.71	0.807
Invested in major new farm machinery, tech or infrastructure	Pearson chi-square	36.00	<0.000	Pearson chi-square	11.68	0.472
Reduced employees or contractors working on my farm (if applicable)	Pearson chi-square	38.75	<0.00	Pearson chi-square	55.59	0.211

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Table A31 Barriers to farm business performance experienced in last three years

% Basin irrigators reporting this was a large barrier to managing and developing their farm they wanted to in the last three years	Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
	Test	Effect size	p-value	Test	Effect size	p-value
Drought	Kruskal Wallis H	10.08	0.006	Spearman's rho	0.091	0.109
Lack of reliable power	Kruskal Wallis H	5.52	0.063	Spearman's rho	.173	0.034
Lack of access to three-phase electricity	Kruskal Wallis H	5.64	0.06	Spearman's rho	.132	0.022
Lack of demand for the goods you produce	Kruskal Wallis H	1.79	0.407	Spearman's rho	-0.030	0.605
Falling prices for the goods you produce	Kruskal Wallis H	8.51	0.014	Spearman's rho	0.084	0.141
Too many regulations	Kruskal Wallis H	5.88	0.053	Spearman's rho	0.045	0.040
High price of temporary water	Kruskal Wallis H	49.68	<0.000	Spearman's rho	0.142	0.012
Increases in costs associated with your water entitlement (water delivery charges and/or fixed charges)	Kruskal Wallis H	60.04	<0.000	Spearman's rho	0.068	0.234
Rising costs of electricity or gas	Kruskal Wallis H	23.93	<0.000	Spearman's rho	0.069	0.224
Rising costs of inputs other than water & electricity e.g. fertiliser, fuel	Kruskal Wallis H	12.67	0.002	Spearman's rho	0.116	0.041
Difficulty obtaining labour	Kruskal Wallis H	7.26	0.027	Spearman's rho	0.089	0.120
Lack of land available to purchase or lease for farm expansion	Kruskal Wallis H	9.947	0.007	Spearman's rho	0.134	0.019
Small size of my farm	Kruskal Wallis H	0.156	0.925	Spearman's rho	-0.046	0.424
Reduced water allocation for one or more seasons	Kruskal Wallis H	52.26	<0.000	Spearman's rho	0.127	0.026
Difficulty transporting produce to market	Kruskal Wallis H	10.04	0.007	Spearman's rho	0.164	0.004
Lack of available water allocation to purchase on the water market	Kruskal Wallis H	42.28	<0.000	Spearman's rho	0.184	0.001
Lack of adequate telecommunications infrastructure e.g. lack of phone or internet coverage	Kruskal Wallis H	12.67	<0.000	Spearman's rho	0.154	0.007
Inability to fully use farm infrastructure, e.g. not getting full productivity from infrastructure or machinery	Kruskal Wallis H	12.67	0.002	Spearman's rho	0.113	0.049
Difficulty accessing affordable finance	Kruskal Wallis H	8.53	0.014	Spearman's rho	0.075	0.191

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Table A32 Future farming intentions

	Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
% who were likely to do this in the next five years	Test	Effect size	p-value	Test	Effect size	p-value
Retire from farming	Kruskal Wallis H	1.20	0.549	Spearman's rho	0.000	0.996
Leave farming for reasons other than retirement	Kruskal Wallis H	3.82	0.148	Spearman's rho	-0.011	0.889
Expand my farm business	Kruskal Wallis H	12.36	0.002	Spearman's rho	0.229	0.003
Downsize my farm business	Kruskal Wallis H	3.31	0.191	Spearman's rho	-0.114	0.138
Change my enterprise mix	Kruskal Wallis H	7.63	0.022	Spearman's rho	-0.029	0.705
De-intensify production	Kruskal Wallis H	3.53	0.171	Spearman's rho	-0.048	0.529
Intensify production	Kruskal Wallis H	13.32	0.001	Spearman's rho	0.284	<0.000
Seek additional off-farm work	Kruskal Wallis H	0.59	0.746	Spearman's rho	0.094	0.218
Purchase land some distance from my current land to reduce climate-related risk	Kruskal Wallis H	2.45	0.294	Spearman's rho	0.121	0.111
Purchase land some distance from my current land for other reasons	Kruskal Wallis H	2.51	0.286	Spearman's rho	0.053	0.487

Table A33 Confidence in ability to farm successfully

	Modernisation of on-farm irrigation infrastructure since 2008			% on-farm irrigation infrastructure modernised since 2013		
When I think about my farm over the next few years, I am confident that…	Test	Effect size	p-value	Test	Effect size	p-value
…I can achieve the things I want to on my farm	Pearson chi-square	17.16	0.144	Spearman's rho	0.110	0.052
…I can meet my farm business objectives	Pearson chi-square	23.07	0.027	Spearman's rho	0.103	0.068
…I can make the right decisions about farm management e.g. stocking, crop timing	Pearson chi-square	36.63	<0.000	Spearman's rho	0.058	0.309
…I can handle changing market conditions on the farm	Pearson chi-square	17.73	0.124	Spearman's rho	0.075	0.187
…I can cope well with most difficult conditions e.g. drought, pest outbreaks	Pearson chi-square	9.58	0.653	Spearman's rho	0.025	0.664
…I can maintain and improve the health of vegetation, land & water on my farm	Pearson chi-square	25.28	0.014	Spearman's rho	0.053	0.350
…my skills and education are adequate for the needs of my farm business	Pearson chi-square	19.43	0.079	Spearman's rho	0.027	0.630
I feel optimistic about my farming future	Kruskal Wallis H	2.54	0.281	Spearman's rho	0.150	0.008
When I think about how my farm is going, I feel good	Kruskal Wallis H	0.84	0.657	Spearman's rho	0.075	0.078

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Table A34 Farm financial performance

	Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
% who agreed or reported specific condition	Test	Effect size	p-value	Test	Effect size	p-value
My farm business is under a lot of financial stress at the moment	Kruskal Wallis H	13.778	0.001	Spearman's rho	0.034	0.426
I am satisfied with my farm business performance	Kruskal Wallis H	7.185	0.028	Spearman's rho	.116	0.007
Low commodity prices are making it very difficult to keep my farm viable	Kruskal Wallis H	0.373	0.830	Spearman's rho	-0.041	0.348
Farm loss/profitability	Kruskal Wallis H	16.977	0.000	Spearman's rho	.106	0.016
Ability to service farm debt	Kruskal Wallis H	10.823	0.004	Spearman's rho	.168	0.000
Farm cash flow	Kruskal Wallis H	2.534	0.282	Spearman's rho	0.010	0.814

Table A35 Wellbeing of irrigators by modernisation activity

	Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
	Test	Effect size[1]	p-value[1]	Test	Effect size	p-value
Global life satisfaction	Independent samples t-test	3.16 15.6	0.076 <0.000	Spearman's rho	-0.009	0.837
Personal Wellbeing Index	Independent samples t-test	12.89 27.69	<0.000 <0.000	Spearman's rho	0.024	0.593
Satisfaction with standard of living	Independent samples t-test	4.59 17.72	0.033 <0.000	Spearman's rho	0.020	0.643
Satisfaction with what achieving in life	Independent samples t-test	2.41 11.73	0.122 0.001	Spearman's rho	0.014	0.738
Satisfaction with feeling part of community	Independent samples t-test	19.64 25.78	<0.000 <0.000	Spearman's rho	0.011	0.804
Satisfaction with future security	Independent samples t-test	1.88 4.26	0.171 0.041	Spearman's rho	0.015	0.733

[1] Top row of values indicates findings of comparison of those who didn't modernise with those who self-funded modernisation. Bottom row indicates findings of comparison of those who didn't modernise with thse who modernised with assistance from a grant.

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Table A36 Effectiveness of grants in triggering on-farm modernisation activity – by irrigator location

	Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
I would not have done any of the works without the grant	Kruskal-Wallis H	0.149	0.700	Kruskal-Wallis H	4.72	0.030	Pearson chi-square	23.29	0.466
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	Kruskal-Wallis H	0.026	0.871	Kruskal-Wallis H	0.41	0.520	Pearson chi-square	38.24	0.144
The grant let me do more modernisation works than I would have otherwise	Kruskal-Wallis H	2.56	0.109	Kruskal-Wallis H	4.73	0.030	Pearson chi-square	10.53	0.957
I would have done all the works even if I hadn't received a grant to help	Kruskal-Wallis H	1.16	0.281	Kruskal-Wallis H	1.74	0.187	Pearson chi-square	22.93	0.818

Table A37 Effectiveness of grants in triggering on-farm modernisation activity – by farm type and size

	Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
I would not have done any of the works without the grant	Pearson chi-square	42.34	0.067	Spearman's rho	-0.062	0.507	Spearman's rho	-0.116	0.210
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	Pearson chi-square	26.50	0.650	Spearman's rho	0.091	0.330	Spearman's rho	-0.018	0.846
The grant let me do more modernisation works than I would have otherwise	Pearson chi-square	26.46	0.383	Spearman's rho	0.049	0.606	Spearman's rho	-0.021	0.822
I would have done all the works even if I hadn't received a grant to help	Pearson chi-square	31.46	0.393	Spearman's rho	0.142	0.126	Spearman's rho	0.110	0.234

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Table A38 Effectiveness of grants in triggering on-farm modernisation activity – by farm water use characteristics

% of grant recipients who agreed with the statement	% farm expenditure on irrigation water			Source of majority of irrigation water used in 2017-18			Volume of irrigation water used in 2017-18 water year		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
I would not have done any of the works without the grant	Spearman's rho	-0.062	0.525	Kruskal-Wallis H	1.74	0.418	Spearman's rho	-0.115	0.219
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	Spearman's rho	-0.120	0.218	Kruskal-Wallis H	11.19	0.004	Spearman's rho	0.147	0.120
The grant let me do more modernisation works than I would have otherwise	Spearman's rho	-0.148	0.137	Kruskal-Wallis H	4.34	0.114	Spearman's rho	-0.022	0.820
I would have done all the works even if I hadn't received a grant to help	Spearman's rho	-0.012	0.901	Kruskal-Wallis H	7.93	0.019	Spearman's rho	0.095	0.315

Table A39 Effectiveness of grants in triggering on-farm modernisation activity – by socio-demographic characteristics

% of grant recipients who agreed with the statement	Irrigator age			Formal educational attainment			Proportion of household income earned off-farm		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
I would not have done any of the works without the grant	Spearman's rho	.184	0.042	Pearson chi-square	3.91	0.69	Spearman's rho	0.062	0.491
If I didn't receive a grant I would have still done the works, but it would have taken a lot longer	Spearman's rho	-0.034	0.712	Pearson chi-square	4.59	0.597	Spearman's rho	-0.069	0.448
The grant let me do more modernisation works than I would have otherwise	Spearman's rho	0.017	0.856	Pearson chi-square	3.85	0.571	Spearman's rho	0.057	0.540
I would have done all the works even if I hadn't received a grant to help	Spearman's rho	-0.128	0.159	Pearson chi-square	5.19	0.519	Spearman's rho	-0.052	0.568

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A40 Motivations for past on-farm modernisation works – by irrigator location

	Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			Irrigation areas (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Expanding your farm production	Kruskal-Wallis H	0.002	0.962	Kruskal-Wallis H	1.31	0.252	Pearson chi-square	28.96	0.520
Reducing irrigation costs	Kruskal-Wallis H	9.30	0.002	Kruskal-Wallis H	0.16	0.693	Pearson chi-square	36.63	0.188
Improving productivity during times of low water availability	Kruskal-Wallis H	9.88	0.002	Kruskal-Wallis H	3.91	0.048	Pearson chi-square	53.95	0.005
Reducing labour time required for irrigation activities	Kruskal-Wallis H	6.22	0.013	Kruskal-Wallis H	0.23	0.633	Pearson chi-square	39.03	0.125
Reducing total water use on the farm	Kruskal-Wallis H	10.96	0.001	Kruskal-Wallis H	0.08	0.772	Pearson chi-square	54.97	0.004
Improving crop/pasture growth or health	Kruskal-Wallis H	1.316	0.251	Kruskal-Wallis H	0.95	0.330	Pearson chi-square	31.42	0.395

Table A41 Motivations for past on-farm modernisation works – by engagement in on-farm modernisation

% who reported this partly/wholly motivated past modernisation	Modernisation of on-farm irrigation infrastructure since 2008 (modernised without grant vs with grant)			Proportion of on-farm irrigation infrastructure modernised since 2013		
	Test	Effect size	p-value	Test	Effect size	p-value
Expanding your farm production	Kruskal-Wallis H	14.57	0.001	Spearman's rho	.155	0.019
Reducing irrigation costs	Kruskal-Wallis H	5.54	0.063	Spearman's rho	.152	0.020
Improving productivity during times of low water availability	Kruskal-Wallis H	10.16	0.006	Spearman's rho	.214	0.001
Reducing labour time required for irrigation activities	Kruskal-Wallis H	13.40	0.001	Spearman's rho	.196	0.003
Reducing total water use on the farm	Kruskal-Wallis H	7.68	0.022	Spearman's rho	.190	0.004
Improving crop/pasture growth or health	Kruskal-Wallis H	19.34	<0.000	Spearman's rho	.218	0.001

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Table A42 Motivations for past on-farm modernisation works – by farm type and size

% who reported this partly/wholly motivated past modernisation	Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Expanding your farm production	Pearson chi-square	56.98	0.002	Spearman's rho	.280	0.000	Spearman's rho	0.118	0.068
Reducing irrigation costs	Pearson chi-square	48.42	0.018	Spearman's rho	.146	0.023	Spearman's rho	0.061	0.344
Improving productivity during times of low water availability	Pearson chi-square	58.91	0.001	Spearman's rho	.263	0.000	Spearman's rho	.127	0.047
Reducing labour time required for irrigation activities	Pearson chi-square	46.17	0.030	Spearman's rho	.205	0.001	Spearman's rho	.136	0.033
Reducing total water use on the farm	Pearson chi-square	40.01	0.105	Spearman's rho	0.080	0.215	Spearman's rho	-0.032	0.615
Improving crop/pasture growth or health	Pearson chi-square	48.21	0.019	Spearman's rho	.193	0.002	Spearman's rho	0.043	0.497

Table A43 Motivations for past on-farm modernisation works – by farm water use characteristics

% who reported this partly/wholly motivated past modernisation	% farm expenditure on irrigation water			Source of majority of irrigation water used in 2017-18			Volume of irrigation water used in 2017-18 water year		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Expanding your farm production	Spearman's rho	0.015	0.821	Kruskal-Wallis H	2.74	0.254	Spearman's rho	.241	0.000
Reducing irrigation costs	Spearman's rho	0.115	0.085	Kruskal-Wallis H	3.78	0.151	Spearman's rho	0.053	0.418
Improving productivity during times of low water availability	Spearman's rho	0.016	0.815	Kruskal-Wallis H	0.39	0.824	Spearman's rho	.198	0.002
Reducing labour time required for irrigation activities	Spearman's rho	0.036	0.591	Kruskal-Wallis H	11.33	0.003	Spearman's rho	0.095	0.144
Reducing total water use on the farm	Spearman's rho	.141	0.034	Kruskal-Wallis H	6.54	0.038	Spearman's rho	0.003	0.964
Improving crop/pasture growth or health	Spearman's rho	0.097	0.145	Kruskal-Wallis H	3.65	0.162	Spearman's rho	.135	0.037

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Table A44 Motivations for past on-farm modernisation works – by socio-demographic characteristics

% who reported this partly/wholly motivated past modernisation	Irrigator age			Formal educational attainment			Proportion of household income earned off-farm		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
Expanding your farm production	Spearman's rho	-0.040	0.531	Pearson chi-square	4.53	0.605	Spearman's rho	-0.114	0.069
Reducing irrigation costs	Spearman's rho	0.012	0.846	Pearson chi-square	3.88	0.692	Spearman's rho	-0.009	0.881
Improving productivity during times of low water availability	Spearman's rho	-0.085	0.179	Pearson chi-square	0.93	0.988	Spearman's rho	-0.097	0.121
Reducing labour time required for irrigation activities	Spearman's rho	-0.008	0.896	Pearson chi-square	11.20	0.083	Spearman's rho	-0.057	0.359
Reducing total water use on the farm	Spearman's rho	-0.022	0.730	Pearson chi-square	7.64	0.266	Spearman's rho	-0.035	0.580
Improving crop/pasture growth or health	Spearman's rho	-0.104	0.099	Pearson chi-square	2.51	0.867	Spearman's rho	-0.066	0.291

Table A45 Future on-farm modernisation intentions – by irrigator location

	Located within Basin compared to outside Basin			Northern Basin compared to Southern Basin			**Irrigation areas** (compared GMID, MIL, other NSW/VIC irrigation districts, those in Southern Basin not in irrigation districts)		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
No more modernisation of irrigation infrastructure is needed on the land I manage	Kruskal-Wallis H	1.35	0.245	Kruskal-Wallis H	1.17	0.280	Pearson chi-square	46.09	0.030
I'd like to do more irrigation modernisation works in the next 1-2 years	Kruskal-Wallis H	2.16	0.142	Kruskal-Wallis H	1.89	0.170	Pearson chi-square	37.60	0.160
I'd like to do more irrigation modernisation works in the next 3-5 years	Kruskal-Wallis H	3.76	0.052	Kruskal-Wallis H	2.13	0.145	Pearson chi-square	40.66	0.093
I'd be more likely to modernise on-farm infrastructure if given a grant to help	Kruskal-Wallis H	0.32	0.571	Kruskal-Wallis H	3.68	0.055	Pearson chi-square	23.72	0.790
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	Kruskal-Wallis H	0.03	0.869	Kruskal-Wallis H	0.67	0.412	Pearson chi-square	25.00	0.725

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A46 Future on-farm modernisation intentions – by engagement in on-farm modernisation

	Modernisation of on-farm irrigation infrastructure since 2008			Proportion of on-farm irrigation infrastructure modernised since 2013		
	Test	Effect size	p-value	Test	Effect size	p-value
No more modernisation of irrigation infrastructure is needed on the land I manage	Kruskal-Wallis H	0.255	0.880	Spearman's rho	0.034	0.569
I'd like to do more irrigation modernisation works in the next 1-2 years	Kruskal-Wallis H	12.62	0.002	Spearman's rho	.187	0.002
I'd like to do more irrigation modernisation works in the next 3-5 years	Kruskal-Wallis H	17.19	<0.000	Spearman's rho	.175	0.004
I'd be more likely to modernise on-farm infrastructure if given a grant to help	Kruskal-Wallis H	13.19	0.001	Spearman's rho	0.071	0.234
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	Kruskal-Wallis H	8.12	0.017	Spearman's rho	-0.037	0.532

Table A47 Future on-farm modernisation intentions – by farm type and size

	Farm type			Gross value of agricultural production 2017-18			Farm self-reported 3-year profitability		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
No more modernisation of irrigation infrastructure is needed on the land I manage	Pearson chi-square	36.67	0.187	Spearman's rho	-.123	0.032	Spearman's rho	0.014	0.805
I'd like to do more irrigation modernisation works in the next 1-2 years	Pearson chi-square	34.09	0.277	Spearman's rho	.269	0.000	Spearman's rho	0.028	0.636
I'd like to do more irrigation modernisation works in the next 3-5 years	Pearson chi-square	31.96	0.369	Spearman's rho	.289	0.000	Spearman's rho	0.046	0.439
I'd be more likely to modernise on-farm infrastructure if given a grant to help	Pearson chi-square	24.26	0.760	Spearman's rho	0.093	0.111	Spearman's rho	-0.091	0.116
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	Pearson chi-square	19.78	0.922	Spearman's rho	.195	0.001	Spearman's rho	0.087	0.133

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A48 Future on-farm modernisation intentions – by farm water use characteristics

	% farm expenditure on irrigation water			Source of majority of irrigation water used in 2017-18			Volume of irrigation water used in 2017-18 water year		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
No more modernisation of irrigation infrastructure is needed on the land I manage	Spearman's rho	0.056	0.358	Kruskal-Wallis H	2.75	0.253	Spearman's rho	-0.040	0.503
I'd like to do more irrigation modernisation works in the next 1-2 years	Spearman's rho	0.068	0.267	Kruskal-Wallis H	5.37	0.068	Spearman's rho	.188	0.002
I'd like to do more irrigation modernisation works in the next 3-5 years	Spearman's rho	-0.007	0.913	Kruskal-Wallis H	8.92	0.012	Spearman's rho	.175	0.004
I'd be more likely to modernise on-farm infrastructure if given a grant to help	Spearman's rho	0.069	0.255	Kruskal-Wallis H	0.83	0.662	Spearman's rho	-0.026	0.662
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	Spearman's rho	-0.032	0.593	Kruskal-Wallis H	0.16	0.924	Spearman's rho	.117	0.049

Table A49 Future on-farm modernisation intentions – by socio-demographic characteristics

	Irrigator age			Formal educational attainment			Proportion of household income earned off-farm		
	Test	Effect size	p-value	Test	Effect size	p-value	Test	Effect size	p-value
No more modernisation of irrigation infrastructure is needed on the land I manage	Spearman's rho	0.098	0.082	Pearson chi-square	6.88	0.332	Spearman's rho	-0.050	0.370
I'd like to do more irrigation modernisation works in the next 1-2 years	Spearman's rho	-.205	0.000	Pearson chi-square	9.55	0.145	Spearman's rho	-0.003	0.959
I'd like to do more irrigation modernisation works in the next 3-5 years	Spearman's rho	-.220	0.000	Pearson chi-square	7.87	0.248	Spearman's rho	-0.023	0.685
I'd be more likely to modernise on-farm infrastructure if given a grant to help	Spearman's rho	-.201	0.000	Pearson chi-square	8.99	0.175	Spearman's rho	0.059	0.295
I'm not interested in grants to modernise if it means having to hand some of my water entitlements over to the government in return	Spearman's rho	0.062	0.273	Pearson chi-square	7.09	0.313	Spearman's rho	-.175	0.002

10. APPENDIX: TESTS OF STATISTICAL SIGNIFICANCE

Table A50 Irrigator views about impacts of off-farm infrastructure modernisation for their farm - 2018

Overall, how did the off-farm infrastructure investment affect…		GMID irrigators compared to others	Works completed or still being completed	Type of work - Automation of water delivery or other upgrade to technology used to deliver water	Type of work - Conversion of open channels to pipes	Type of work - Clay lining of channels or other works to reduce leakage	Type of work - improved metering
Your farm enterprise as a whole	Test	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H
	Effect size	2.01	1.78	1.95	2.36	1.69	0.79
	p-value	0.156	0.618	0.162	0.125	0.193	0.373
Your overall farm productivity	Test	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H
	Effect size	0.801	4.20	3.23	0.499	0.54	0.60
	p-value	0.371	0.241	0.072	0.480	0.462	0.438
Your farm profitability	Test	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H
	Effect size	0.113	2.31	1.36	1.14	0.34	0.18
	p-value	0.736	0.510	0.243	0.285	0.560	0.674
Your efficiency of water use	Test	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H
	Effect size	0.743	6.17	2.43	3.27	2.04	0.55
	p-value	0.389	0.104	0.119	0.071	0.153	0.457
Timing of water delivery to your farm	Test	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H
	Effect size	0.230	8.69	11.64	0.730	0.04	0.28
	p-value	0.631	0.034	0.001	0.393	0.844	0.596
Cost of water delivery to your farm	Test	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H	Kruskal Wallis H
	Effect size	3.28	1.96	0.002	0.290	0.55	0.175
	p-value	0.070	0.580	0.965	0.590	0.460	0.68