Goulburn Broken CMA

Farm Water and Dairy Australia Victorian Round 1 Case Studies - Summary

Final

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Summary

Nineteen irrigators were interviewed on the costs and benefits of changes made to their farming systems as a result of irrigation modernisation in the GMID. Of the nineteen case studies Goulburn Broken CMA funded twelve and Dairy Australia funded seven. Dairy Australia has provided permission for their data to be included with the Goulburn Broken results. Three additional farms analysed for Dairy Australia were from NSW and have not been included, as they are not part of the Farm Water Program.

When comparing the new system with the old system and assuming the same crop mix, modernisation resulted in water savings, labour savings and production increases. Based on the information collected the findings determined:

- For grazing properties yield increases of approximately 2t DM/ha and 0.4t DM/ML
- Water use reductions of 2 ML/ha/y
- NPV of the project around $4,400/ha at 7% over 30 years with a benefit/cost ratio around 1.7. Some properties, especially those that transition to beef and/or retirement had a low or negative benefit-cost ratio.

However, there was considerable variability around these averages. The new systems enabled ten farms to move to higher water use crops. When compared to the old crop and old system this resulted in a similar NPV, but with a different mix of benefits. Productivity gains were higher, but there was an increase in water use.

Some of the lessons reported by the farmers were that:

- Labour savings are linked with water savings. Some old layouts can be watered efficiently but require a lot of labour to be efficient, making them uneconomic for high water use crops such as summer crops and perennials. Old layouts also often require specialised management knowledge.
- The new layout provides the efficiency without the need for high labour inputs. However, additional vigilance is required with higher flow rates.
- Older style irrigation layouts (pre-upgrade) tended to be used for annuals only. A benefit of new layouts is that they save labour, save water and enable transition to higher water use crops and a more diverse crop mix.
- Some of the water savings are used on-farm by increased crop health (less waterlogging/stress), increased crop production and higher ET usage by the crop.

Farmers reported that the saved labour has enabled farm expansion, succession and rejuvenation of businesses. It has provided additional time for carrying out environmental works, and contributing to community activities. In some cases it has enabled transition to retirement, as less labour is needed for watering, without needing to sell the farm.

This analysis includes the farm benefits as a result of modernisation, including both the change in farm infrastructure and the benefit from the off-farm GMW modernisation (all farms had a backbone connection and benefits from the farm and off-farm upgrades cannot be separated). The benefits are compared with farm costs only. If the GMW modernisation costs were to be included in the analysis the costs would change[1].

[1] The cost of GMW modernisation would need to be offset by its other benefits and its own water savings and a value put on this saved water.

1 Purpose

The purpose of this report is to undertake an analysis of the costs and benefits of farm irrigation system modernisation.

The report aims to provide an estimate of the economic value of modernisation by comparing current practices with the practices that would have occurred without modernisation.

This analysis has been undertaken by comparing farms “with the new technology” versus those “without the new technology” using examples of upgraded irrigation properties implemented as part of Round 1 of Farm Water. This includes farms funded by NVIRP (now GMW Connections Program) and farms funded by the Commonwealth’s On-Farm Irrigation Efficiency Program (OFIEP) plus the contributions made by the farmers themselves.

Funding

The OFIEP is part of the Sustainable Rural Water Use and Infrastructure Program component of Water for the Future initiative and assists 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.

The Goulburn Broken CMA consortium received $21 million for 76 projects in 2010 under Round One of the OFIEP. This was also supported by an additional $17M investment from the Northern Victorian Irrigation Renewal Project. In total 148 projects were funded. 18,000ML of water was saved and 9,000 ML transferred to the Commonwealth and State Governments for the environment.

Goulburn Broken CMA received a further $25 million under Round Two of the OFIEP in 2012 for 90 Projects. This was added to with an additional $44 million secured for 150 Projects through the Commonwealth Government’s State Priority Projects Program. Round Two results in 34,000 ML of water saved and at least 17,000 ML transferred to the Australian Government for environmental purposes.

2 Method

Case studies

The nineteen case studies were selected in conjunction with Farm Water staff to be:

- Representative of the types of farm in Round 1. (Whilst the sample was selected to be representative, a statistical analysis has not been completed to confirm if this is the case)
- Able to provide a meaningful comparison of the new system versus the old system
- Examples where works have been completed and some experience with the new system had occurred

Farmers were given the opportunity to review early drafts of their individual write-ups to provide feedback and ensure accuracy.

Economic analysis

A partial discounted cash flow analysis was undertaken to determine the cost-benefit of the upgrade. All costs and benefits associated with the change in system were considered.

It is important to realise that if the upgrade demonstrates a large economic benefit or cost, this is not a measure of the performance of the whole farm business either before or after the upgrade. The approach has been to:-

1. Examine costs and benefits of the 'modernised' system.
2. Examine costs and benefits of the same land if not modernised.
3. Net out costs without modernisation and with modernisation, net out benefits with and without.
4. Determine a NPV over 30 years, at 7% discount rate. Thirty years was selected to be the effective life of the system with nil residual value and 7% discount rate was selected to reflect the risks of commercial farming. Capital costs are assumed to occur in year zero, whilst benefits and water savings are assumed to occur from year 1 to 30.
5. Production benefits have been estimated by determining changes in stocking rates or yields with typical industry benchmarks for gross margins.

Water savings have been listed as per:

a) The crop mix in the water savings calculator at project acceptance

b) The calculator estimate for the current crop mix

c) The estimated actual change in water use with the current crop mix as a result of the upgrade (this was used to assess the benefit of change in water use)

d) Estimated actual water saving allowing for changes in crop yield. This was calculated as yield and subsequent water use of the crop is higher with the new layout arising from reduced waterlogging, and water stress and increased growth and yield[2]. However, this estimation was not used to assess the benefits of water savings, as it would be double counting with the productivity gain.

The estimated actual change in water use ((c) above) was valued at $1,800/ML saved. This reflected the market value of Victorian High Reliability Water Shares at the time works were completed. It should be noted that this value fluctuates over time. This value was applied to all water savings regardless of the % transferred to the Commonwealth and the % retained on farm.

The benefit of farm labour savings have been estimated using a standard $25/hour rate[3] with the farmers experience to date on time savings with the new system compared to the old system. In reality this saving may not be cash saving, if the time saving does not reduce labour expenses, but it is a real benefit in terms of lifestyle and/or ability to expand the operation.

[2] See FAO Irrigation & Drainage Paper 66 Crop Yield Response to Water, 2012 for more information on this topic.

[3] This is slightly above farm labour award rates. A high rate has been adopted to reflect the time saved for the business owner doing most of this work. Note FLH 8 as of 14/2/13 was $19.97/hour on https://extranet.deewr.gov.au/ccmsv8/CiLiteKnowledgeDetailsFrameset.htm?KNOWLEDGE_REF=216329&TYPE=X&ID=3487003589121842088889912894&DOCUMENT_REF=375115&DOCUMENT_TITLE=Pastoral%20Award%202010&DOCUMENT_CODE=MA000035
.

This analysis takes the viewpoint of change in costs and benefits at the farm level. It does not discriminate if capital costs have been subsidised by any grants the farmers obtained through the Farm Water Program. Therefore, the grant payments towards capital costs have not been included as a benefit in the analysis, as they are included in the total costs of the farm investment. This is because we are interested in the benefit/cost of the investment as a whole, regardless of whether it has received a grant payment. The analysis does not include other costs beyond the farm gate that are associated with the administration of the Farm Water Program.

The analysis was completed considering extra costs, revenue forgone, cost savings and farm productivity gains as a result of the upgrade using partial budgets. A whole farm analysis was not completed.

Identifying costs and benefits

A comparison of “with modernised irrigation system” versus “without irrigation system” is not as simple as it sounds. Many changes occur on a farm from one season to the next season and other significant changes to the farm system are made. For example, farms change size, change crop mix, upgrade dairies, experience different seasonal conditions, change personnel, all which impacts on costs and income. Often these changes are inter-related.

Irrigation farms in northern Victoria experienced very low water availability during the drought and are now experiencing much higher water availability. This has had a significant impact on the farm system. In particular, people have moved back into perennial pastures and summer crops, while during the drought they focussed their limited water on annual pastures and winter cereals.

This had made it impossible to do a simple “before upgrade” versus “after upgrade” comparison as there are large changes to the farm irrigation mix and scale that are beyond the impact of the irrigation system but need to be considered.

It was also difficult to assess actual productivity benefits as experience with the new system is limited and there is little data on the benefits that are only now being realised. This report should be considered as representing preliminary findings, which require confirmation over time.

The data collected in our interviews was used to untangle the impacts and list the additional benefits and costs that can be allocated to the upgrade using partial budgeting.

Benefits have been calculated according to the specific changes made on farm. In some cases this has been through increased cow numbers and a margin per cow has been used to determine the benefit. In other cases it is through less bought in feed or increased yield of crops. In these cases the value of the additional feed or crop has been used to assess the benefits (less any additional costs associated with the increased production). The specific methodologies are documented in each of the individual case studies.

In one case study the dairy was upgraded at the same time as the irrigation system, and this was a synergistic investment with the irrigation upgrade. In this case, rather than arbitrarily allocate costs and benefits to each separately, we have included the dairy purchase as part of the investment cost. This is because the combination of the two investments led to the production / efficiency gains.

In order to address these information gaps the approach has been to interview the farmers, and use their data where it is available and fill gaps by developing costs and benefits based on their experience to date supplemented with industry generic data.

Two types of analysis have been carried out

Two types of analysis were undertaken to compare “with” versus “without” upgrade scenarios.

The first analysis involved comparing the two scenarios with a standard crop mix that reflected the current mix. However, in some cases irrigating the current crop mix with the previous irrigation system would not be practical. Irrigating current crops with higher water requirements with the old system would mean very high water use, high labour requirement and lower production and because of this may have been uneconomic. That is often why the old systems were mainly used for low water use crops such as annual pastures and annual crops.

In these cases an important benefit of the new system is to enable more flexibility in choosing the crop type. It allows the farmer to move to higher water use crops such as perennials and summer crops, whereas previously this would not have been a practical option.

Therefore, a second analysis was undertaken to estimate the cost-benefit with a different crop mix of the old system versus the new system. This recognises that modernisation has enabled the adoption of more intensively irrigated crops such as perennial pastures, lucerne and summer crops on areas that with the old system would only have been used for annual crops.

In these cases upgraded systems have enabled people to move to a higher proportion of perennials and summer cropping (which have a higher water requirement) from land that would only ever be used for annual pastures/crops. When compared to the previous analysis this:

- Reduces the change in water use (due to higher water use crops now being selected the change in water use can be negative),
- Increases the productivity gain (more yield t/ha from the new higher water use crops) and
- Reduces the labour savings (more work per ha with the new crop versus the old crop).

Goulburn-Murray Water modernisation

The purpose of this analysis has been to evaluate the cost/benefit of farm modernisation, which is a different question to the cost/benefit of total system modernisation.

This analysis includes the farm benefits as a result of modernisation, which includes the both the change in farm infrastructure and the benefit from the off farm GMW modernisation. This is because all farms had to have a backbone connection and the benefits from the two upgrades cannot be separated.

The benefits are compared with farm costs only. If the GMW modernisation costs were to be included in the analysis the costs would change[4].

The data collected in this report would be useful to inform an evaluation of the benefits of overall modernisation.

3 Summary of Results

3.1 Assuming the same crop mix

Results of the analysis are presented in Table 3-1. To enable an easy comparison between annual and capital costs all capital items have been converted to an equivalent annual cost per ha at 7% over 30 years. The individual case study chapters provide more detail for the specific farms and Appendix 1 aggregates the information from the individual farms to allow observation of the ranges. While there is a large variation, the analysis indicates that there is a positive benefit-cost analysis for all farms except for two. One has transitioned to retirement by moving from dairy to beef and the other was a high cost small-scale development.

Table 3-1 Change in costs and benefits with current crops as a result of the upgrade

Change in costs and benefits		*lowest*	*average*	*highest*
	Area upgraded ha	*10*	*90*	*250*
Additional Costs				
Capital		*per ha*	*per ha*	*per ha*
	Total estimated cost irrigation works	*$ 1,563*	*$ 4,979*	*$ 8,529*
	lost production during upgrades	*$ -*	*$ 317*	*$ 1,327*
	other costs fencing stock water etc	*$ -*	*$ 438*	*$ 1,229*
	Other non irrigation capital required as a result of upgrade eg. new dairy	*$ -*	*$ 220*	*$ 3,968*
	total capital cost of works	***$ 2,413***	***$ 5,982***	***$ 8,706***
	equivalent annual cost of capital 7%, 30 years, nil residual value	*$ 194*	*$ 480*	*$ 702*
Annual				
	additional power costs $/y	*$ -*	*$ 41*	*$ 408*
	additional repairs and maintenance $/y	*$ -*	*$ 2*	*$ 29*
	Total additional costs/y	***$ 212***	***$ 523***	***$ 1,027***
Additional Benefits				
Capital				
ML/ha/y	Water savings calculator estimated prior to works (50% of this was transferred)	*0.9*	*2.3*	*3.8*
ML/ha/y	Water saving calculator with current crop mix	*1.2*	*2.1*	*3.8*
ML/ha/y	water saving estimated adjusted for additional yield	*1.2*	*3.7*	*6.7*
ML/ha/y	water saving adopted for assessment of water value excludes saving used for additional yield	*0.5*	*2.0*	*3.6*
	market value of water saved $1,800/ML annualised value $/y	*$ 73*	*$ 285*	*$ 520*
	saved channel structure replacement costs - not costed	*$ -*	*$ -*	*$ -*
Annual				
	saved channel costs			
	-labour $/y	*$ -*	*$ 10*	*$ 31*
	-chemicals $/y	*$ -*	*$ 4*	*$ 17*
	-wear and tear on equipment $/y	*$ -*	*$ 4*	*$ 9*
	-contractors $/y	*$ -*	*$ 12*	*$ 59*
	other saved labour $/y	*$ -*	*$ 139*	*$ 606*
	saved vehicle use $/y	*$ -*	*$ 6*	*$ 61*
				$ -
	- saved pumping costs on water saved $/y	*$ -*	*$ 1*	*$ 6*
	- saved variable water charges at $7.11/ML/y	*$ -*	*$ 13*	*$ 26*
	increased production $/y	*$ -*	*$ 382*	*$ 1,061*
	Other savings due to non irrigation capital eg. new dairy $/y	*$ -*	*$ 21*	*$ 381*
		$ -		
	Total additional benefits/y	***$ 185***	***$ 879***	***$ 2,007***
	Benefits-cost/y	***-$ 209***	***$ 356***	***$ 1,390***
	NPV	*-$ 2,599*	*$ 4,420*	*$ 17,252*
	B/C ratio	*0.64*	*1.74*	*3.41*
	old system yield t DM/ha/y	*5.00*	*9.66*	*14.30*
	new system yield t DM/ha/y	*9.80*	*11.80*	*21.00*
	production gain per ha t DM/ha/y	*0.00*	*2.15*	*7.00*
	old system water use efficiency t DM/ML/y	*0.50*	*0.81*	*1.30*
	new system water use efficiency t DM/ML	*0.80*	*1.20*	*1.80*
	production gain per ML t DM/ML	*0.06*	*0.39*	*1.10*

[4] The cost of GMW modernisation would need to be offset by its other benefits and its own water savings and a value put on this saved water.

On average the modernisation (for the same crop mix) resulted in:

- Average annualised costs of $523/ha/y; most of which was capital cost
- Average benefits of $879/ha/y. The main benefits being water saving of 2 ML/ha or $285/ha/y5, other labour saving (associated with less labour to irrigate) $139/ha/y and production increases $382/ha/y.
- Average annualised net benefit of $356/ha/y, equivalent to a NPV of around $4,400/ha at 7% over 30 years with a benefit/cost ratio around 1.7 (very attractive).
- For grazing properties yields increasing by approximately 2t DM/ha and 0.4 t DM/ML.
- Water use reduced by 2.0 ML/ha/y and water savings adjusted for additional crop yield6 being 3.7 ML/ha/y.
- Average value for the water savings calculator, corrected for current crop mix of 2.1 ML/ha/y. This suggests that the water savings calculator was a relatively good predictor of actual change in water use, and underestimates savings when water use is adjusted for additional crop yield. But there was substantial variability around this.
- Low benefit-cost ratio for some properties, especially those that transition to beef (lower income per ha) or have high costs per ha.

The variability across the case studies for a range of parameters is shown in the graphs below (Figures 3-1 to 3-3).

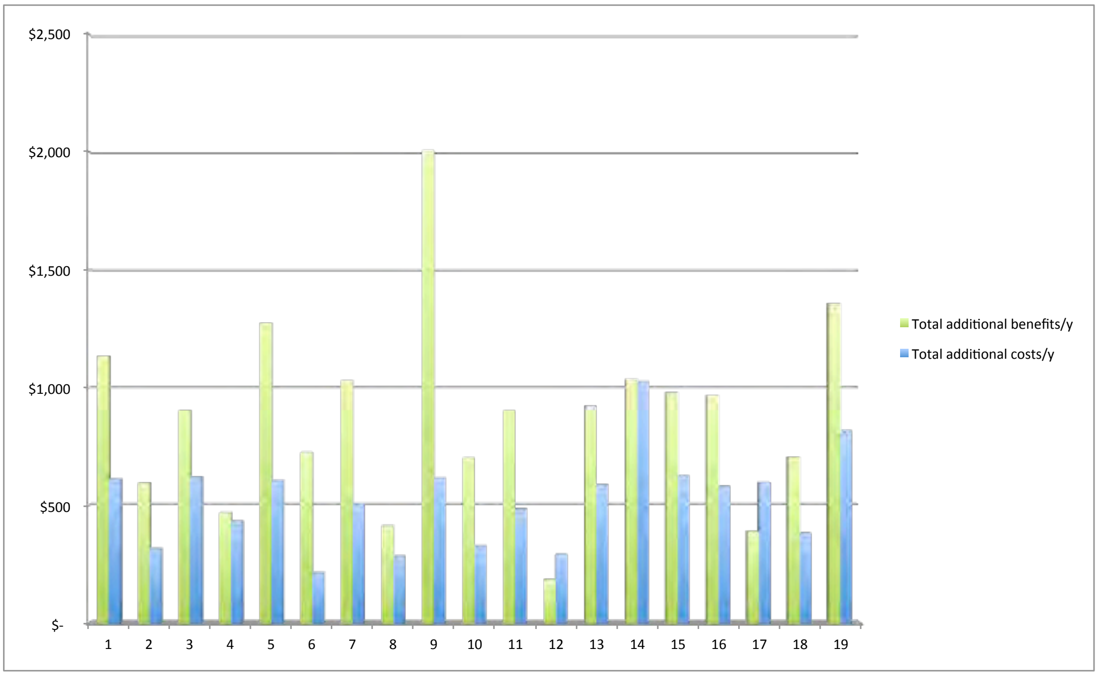


Figure 3-1 Total additional costs and total additional benefits for the 19 case studies

[5] this is for the 50% of water savings retained plus the 50% transferred all valued at $1,800/ML capital value annualised at 7% 30 years, which is $148/ML saved/y)

[6] A confounding aspect of calculating water use and savings in the “with new irrigation layout” versus “without new irrigation layout” is that with the same pasture the water use of the crop is higher with the new layout, as there is less waterlogging, less water stress and more growth and yield. Therefore, the calculation of water savings for a crop of similar yield would result in higher savings than comparing the poorer performing pasture with the old system and a higher performing pasture with the new system.

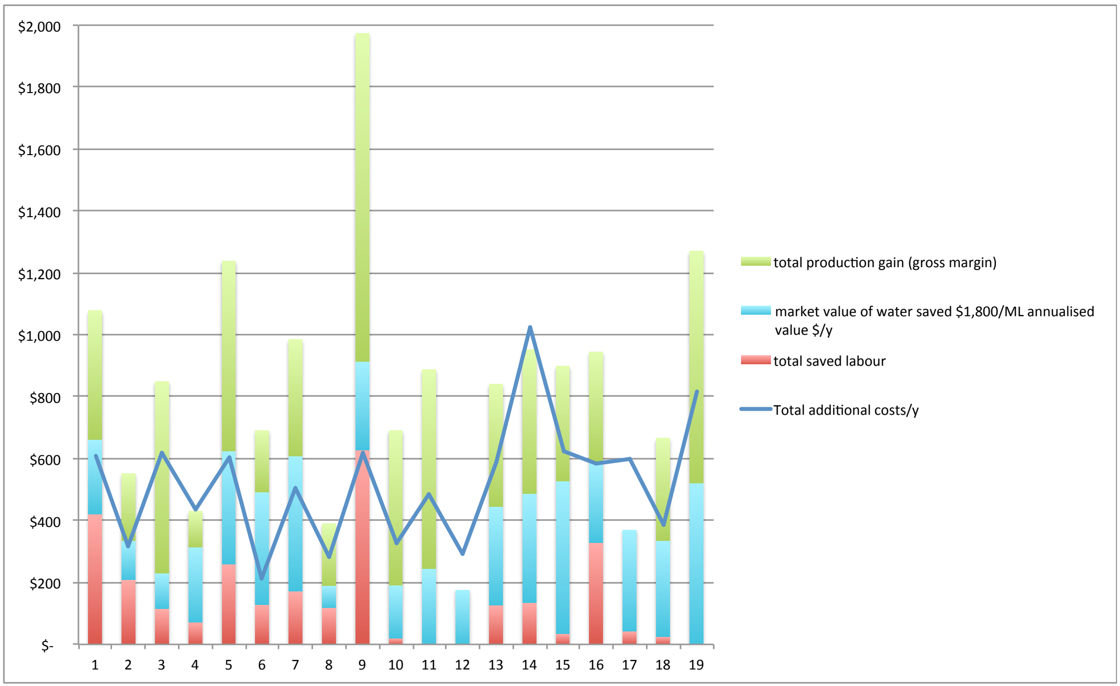


Figure 3-2 Total additional costs and split of additional benefits (into labour savings, water savings and production gains) for the 19 case studies

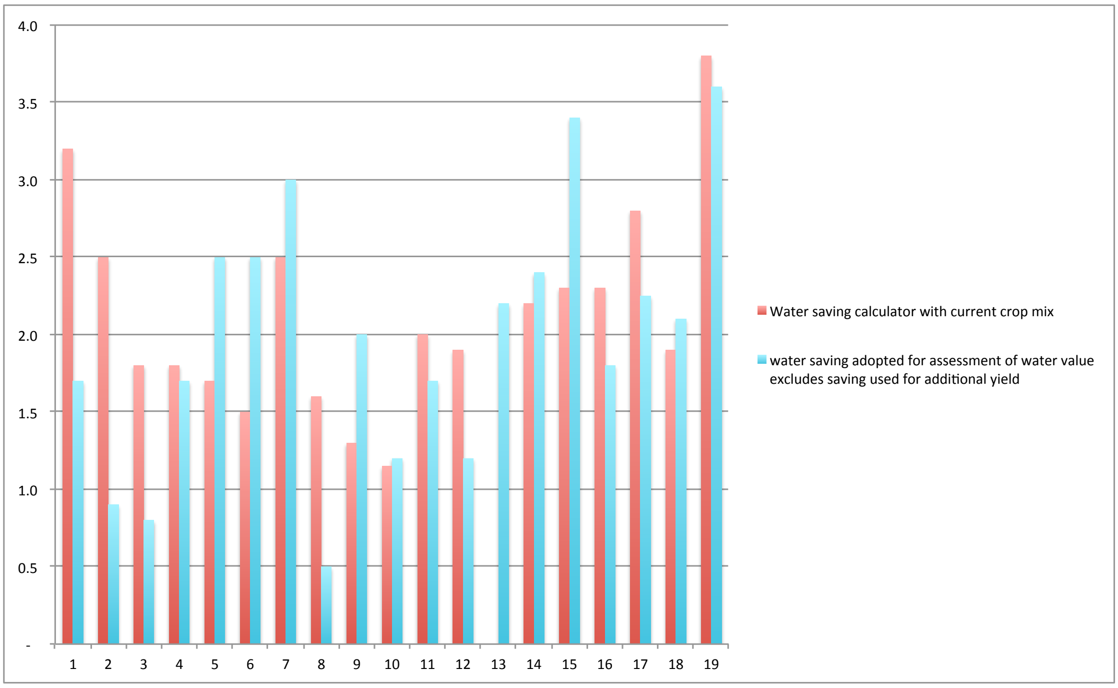


Figure 3-3 Estimated water savings for the 19 case studies

3.2 Estimating costs and benefits allowing for changed crop mix

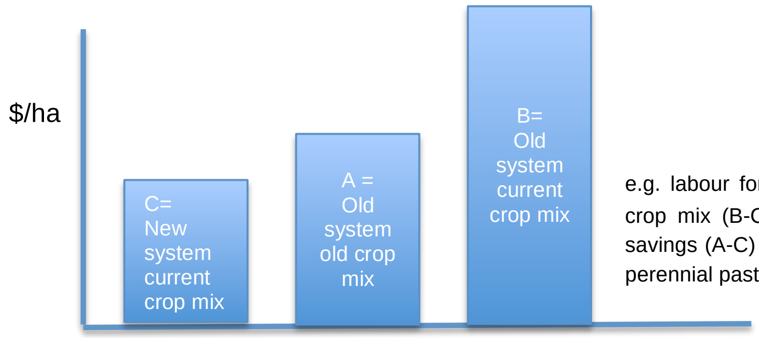
The previous analysis did not account for the fact that the modernisation has enabled the adoption of more intensively irrigated crops such as perennial pastures, lucerne and summer crops on areas that with the old system would only have been used for annual crops.

Estimating the crop mix with the old system depends very much on the state of the old system. In some instances the upgrade was from unlasered or old style irrigation areas that were too labour intensive to irrigate perennials or summer crops. In these cases it has been assumed that the crop mix with the old system would be predominantly annual pastures, which have a lower irrigation requirement than the summer irrigated crops now adopted (perennial pastures and summer cropping).

In cases where re-lasering was not required, no change in crop mix was assumed. This is because these areas were already at a modern standard and no change in crop mix would be likely. The changes to the analysis changes when allowing for the benefit of changed crop type are described in Table 3-2 and Figure 3-4.

Table 3-2 Change in costs and benefits allowing for more perennial pastures/summer crops as a result of the upgrade

Attribute	Change in analysis with for different crop mix (more perennial pasture/summer crop with upgraded system compared to non-upgraded)	Impact on analysis compared to same crop mix
Capital costs of upgrade	Same	No change
Water saved	Need to allow for less summer irrigation (higher water requirement) with previous system	Lower water use reductions (is negative when the additional crop irrigation requirement exceeds estimated savings). This impacts on the market value of saved water. Pumping cost savings, and water charge savings.
Channel maintenance costs	Less maintenance required with less summer irrigation on previous system	Theoretical decrease in maintenance savings. But this is a very minor component of the overall cost/benefit and has been left unchanged.
Saved labour and vehicle savings	Less labour required with less summer irrigation on previous system	Decrease labour /vehicle savings. Due to the individual farm differences this has been estimated on a case by case basis.
Farm productivity	Higher productivity gain as more production from summer irrigated area	Increase farm production gains. Due to the individual farm differences this has been estimated on a case by case basis. From previous stocking rates and pasture mixes. And change in annual/summer crop mixes.



e.g. labour for irrigating[7]. Big savings for current crop mix (B-C) both perennial pastures, smaller savings (A-C) allowing for move to from annual to perennial pastures.

Figure 3-4 Changes in parameters as a result of crop type changes and irrigation system changes

The previous analysis (section 3-1) compared the difference between B and C. This analysis compares A and C are described in Table 3-3 with further detail in Appendix 1.

Table 3-3 Change in costs and benefits allowing for change in crops in the upgrade

Change in costs and benefits		*lowest*	*average*	*highest*
	Area upgraded ha	10	90	250
Additional Costs				
Capital		*per ha*	*per ha*	*per ha*
	Total estimated cost irrigation works	$ 1,563	$ 4,979	$ 8,529
	lost production during upgrades	$ -	$ 317	$ 1,327
	other costs fencing stock water etc	$ -	$ 438	$ 1,229
	Other non irrigation capital required as a result of upgrade eg. new dairy	$ -	$ 220	$ 3,968
	total capital cost of works	**$ 2,413**	**$ 5,982**	**$ 8,706**
	equivalent annual cost of capital 7%, 30 years, nil residual value	$ 194	$ 480	$ 702
Annual				
	additional power costs $/y	$ -	$ 41	$ 408
	additional repairs and maintenance $/y	$ -	$ 2	$ 29
	Total additional costs/y	**$ 212**	**$ 523**	**$ 1,027**
Additional Benefits				
Capital				
ML/ha/	water saving adopted for assessment of water value excludes saving used for additional yield	- 7.8	- 0.5	3.4
	market value of water saved $1,800/ML annualised value $/y	-$ 1,130	-$ 68	$ 698
	saved channel structure replacement costs - not costed	$ -	$ -	$ -
	saved channel costs			
	-labour $/y	$ -	$ 10	$ 31
	-chemicals $/y	$ -	$ 4	$ 17
	-wear and tear on equipment $/y	$ -	$ 4	$ 9
	-contractors $/y	$ -	$ 12	$ 59
	other saved labour $/y	$ -	$ 85	$ 321
	saved vehicle use $/y	$ -	$ 6	$ 61
				$ -
	- saved pumping costs on water saved $/y	-$ 2	$ 0	$ 5
	- saved variable water charges at $7.11/ML/y	-$ 55	-$ 1	$ 24
	increased production $/y	$ -	$ 808	$ 2,100
	Other savings due to non irrigation capital eg. new dairy $/y	$ -	$ 20	$ 381
		$ -		
	Total additional benefits/y	**$ 185**	**$ 872**	**$ 2,144**
	Benefits-cost/y	**-$ 209**	$ 350	**$ 1,528**
	NPV	-$ 2,599	$ 4,339	$ 18,958
	B/C ratio	0.64	1.71	3.48

This analysis shows a similar result to that described in section 3-1. For the same costs per ha, total benefits are very similar but the mix of benefits changes:

- Average water savings are negative ($-68/ha/y above compared to $+285/ha/y assuming current crop mix applied to the old system)
- Average labour savings are smaller ($+85/ha/y compared to $+139/ha/y)

[7] The relative differences will vary with the parameter and farm. For water use typically B>C>A and dry matter yield C>B>A if there has been a major change in crop type.

- The reduction in benefits is offset by the corresponding increase in average production gain from the crops with a higher water requirement ($+808/ha/y compared to $+382/ha/y).

The difference between the two approaches is sensitive to water value. For example, using a lower water value than $1,800/ML[8] saved would improve the benefit-cost ratio for the analysis above and worsen it for the previous analysis.

The results show that the modernisation (for changing crop mix that occurred on 10 farms) resulted in:

- Average annualised costs of $523/ha/y; most of which was capital cost and is the same as the previous analysis;
- Average benefits of $872/ha/y compared to $879/ha with the previous analysis.
- Average annualised net benefit of $350/ha/y, equivalent to a NPV of around $4,400/ha at 7% over 30 years with an average benefit/cost ratio of 1.7.

In summary, the program is very economically attractive, whichever of the two analyses is performed.

4 Case study findings

It is clear that the Farm Water Program has itself been a catalyst for positive change.

The interviews and analysis of case studies highlighted the following aspects related to farm modernisation.

- Labour savings are linked with water savings. Old layouts can be watered efficiently but need considerable labour to be efficient, which tends to makes them uneconomic for summer crops and perennials. Old layouts also require specialised knowledge of how to manage the irrigation system, which often makes it more difficult to delegate irrigation to employees.
- The new layout provides the water efficiency without the need for high labour inputs and a reduced need for specialised labour (especially for pipe and riser), which means it is more likely to be delegated. Additional vigilance is required with higher flow rates however.
- When quizzed about water savings, farmers often responded that the old layout with current crops with current available labour would result in high water use, that could be improved if substituted with higher labour inputs. This additional labour is usually not available and is unlikely to be economic.
- This is why older style irrigation layouts (pre-upgrade) tended to be used for annuals only, as they require fewer irrigations. A major benefit is that new layouts save labour and save water and enable a more diverse crop mix.
- Some of the water savings are used on-farm resulting from increased crop health (less waterlogging/stress), increased crop production and higher ET usage by the crop.

[8] ($1,800/ML at 7% over 30 years is equivalent to an annual value of $145/ML/y)

- Some water savings are sometimes not picked up because of changing meters (old meters tended to under read compared to new ones).
- People with the technology for fast flows are not always using the fast flows, because of the higher vigilance required to prevent runoff. Sometimes they are running two outlets instead of one. However, if they have automation they are more likely to be using the higher flow rate.
- Small scale upgrades on average (but not always) tend to have higher costs per ha than larger scale. This is illustrated in Figure 4-1.

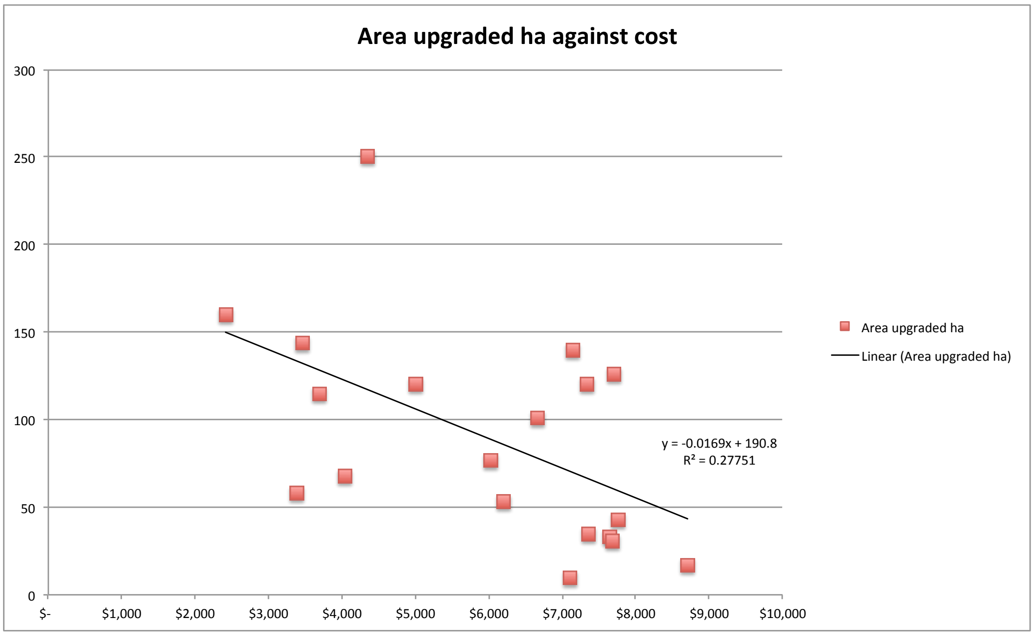


Figure 4-1 Influence of scale versus cost

Landholders advised that saved labour has enabled farm expansion, succession and rejuvenation of businesses. It provided time for carrying out environmental works, and contributing to community activities. In some cases it has enabled transition to retirement (less labour needed for watering) without having to sell the farm.

Landholders also advised that increased productivity has resulted in expanded dairy capacity and other investment to handle this additional production. The program has contributed to offsetting the impacts of less water by achieving higher production and lower costs of production. Those farmers who are transitioning to retirement have sometimes not utilised this additional production, and it may not be utilised until the farm is sold or another generation take over.

5 Program implications

Evidence from the 19 case studies indicates that the program is achieving a very positive benefit/cost ratio and this is driving regional economic growth by:

- Reducing cost of modernisation by allowing individuals to complete much larger areas and gaining economies of scale
- Bringing forward yield and labour saving benefits
- Investing in activities that activate underutilised infrastructure, meaning little additional capital is required to utilise extra production e.g. dairy sheds. This was the case at several of the dairy farms visited.
- Investing in existing skills base, no retraining, no relocation
- Enabling farm expansion, which lowers overhead costs and utilises underutilised land.
- Enabling positive structural adjustment by improving productivity and water use efficiency in irrigation industries affected by buy backs. The program has been a catalyst for farm expansion.
- Achieving environmental benefits through additional time for tree planting (if time savings are not used for expansion) plus less runoff and recharge (water quality and salinity benefits).
- Achieving social benefits, where additional time is available for sporting clubs and other community activities (if time savings are not used for expansion)
- Ensuring farms are ready for further technological advances, such as soil moisture monitoring and automation.

In terms of the relationship with the Goulburn-Murray Water system modernisation it is important to note that:

- An on demand water service maximises the benefit, as farmers with modernised systems can irrigate any paddock at any time with a pipe and riser system and are much less constrained by cattle rotations and access to channels.
- The benefits of a higher level of service and ability to irrigate on farm in a more timely manner means that soil moisture monitoring and irrigation scheduling are more likely to be adopted.
- Rationalisation of number of outlets and channels is a common feature of several farms. This is reducing GMW assets and future costs and is being implemented as part of the GMW Farm Connections Program.
- The program by targeting backbone connected properties may result in water moving to the backbone as people are now able to choose higher water use crops on areas that would only have been used for low water use crops. This means that the potential to rationalise high cost infrastructure that has lower water use and is away from the backbone may be enhanced.

Appendix 1- Case study details

Table 4 Change in costs and benefits for the 19 case studies assuming current crop mix with/without the new technology.

Change in costs and benefits- case study number		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	10	*lowest*	*average*	*highest*	*median*
	Area upgraded ha	120	115	126	120	35	160	53	144	33	68	77	58	101	31	43	140	10	250	17	*10*	*90*	*250*	*77*
Additional Costs																								
Capital		per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	*per ha*	*per ha*	*per ha*	*per ha*
	Total estimated cost irrigation works	$ 5,659	$ 3,261	$ 2,619	$ 4,167	$ 4,800	$ 1,563	$ 4,868	$ 3,465	$ 6,435	$ 4,044	$ 5,390	$ 3,190	$ 5,452	$ 6,581	$ 7,223	$ 6,429	$ 7,100	$ 3,833	$ 8,529	*$ 1,563*	*$ 4,979*	*$ 8,529*	*$ 4,868*
	lost production during upgrades	$ 1,250	$ -	$ 198	$ -	$ 1,327	$ 350	$ 377	$ -	$ 1,212	$ -	$ 519	$ 200	$ 228	$ -	$ -	$ -	$ -	$ 360	$ -	*$ -*	*$ 317*	*$ 1,327*	*$ 198*
	other costs fencing stock water etc	$ 417	$ 435	$ 437	$ 833	$ 1,229	$ 500	$ 943	$ -	$ -	$ -	$ 117	$ -	$ 983	$ 1,095	$ 465	$ 714	$ -	$ 160	$ -	*$ -*	*$ 438*	*$ 1,229*	*$ 435*
	Other non irrigation capital required as a result of upgrade eg. new dairy	$ -	$ -	$ 3,968	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	*$ -*	*$ 220*	*$ 3,968*	*$ -*
	total capital cost of works	**$ 7,326**	**$ 3,696**	**$ 7,705**	**$ 5,000**	**$ 7,356**	**$ 2,413**	**$ 6,189**	**$ 3,465**	**$ 7,648**	**$ 4,044**	**$ 6,026**	**$ 3,390**	**$ 6,663**	**$ 7,675**	**$ 7,756**	**$ 7,143**	**$ 7,100**	**$ 4,353**	**$ 8,706**	***$ 2,413***	***$ 5,982***	***$ 8,706***	***$ 6,663***
	equivalent annual cost of capital 7%, 30 years, nil residual value	$ 590	$ 298	$ 582	$ 403	$ 593	$ 194	$ 499	$ 279	$ 616	$ 326	$ 486	$ 273	$ 537	$ 619	$ 625	$ 576	$ 572	$ 351	$ 702	*$ 194*	*$ 480*	*$ 702*	*$ 537*
Annual																								
	additional power costs $/y	$ 20	$ 18	$ 39	$ 30	$ 12	$ 9	$ 8	$ 5	$ -	$ 2	$ -	$ 16	$ 52	$ 408	$ 5	$ 7	$ 24	$ 29	$ 87	*$ -*	*$ 41*	*$ 408*	*$ 16*
	additional repairs and maintenance $/y	$ -	$ -	$ -	$ -	$ -	$ 9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4	$ 29	*$ -*	*$ 2*	*$ 29*	*$ -*
	Total additional costs/y	**$ 610**	**$ 316**	**$ 621**	**$ 433**	**$ 605**	**$ 212**	**$ 506**	**$ 284**	**$ 616**	**$ 328**	**$ 486**	**$ 290**	**$ 589**	**$ 1,027**	**$ 625**	**$ 583**	**$ 597**	**$ 384**	**$ 818**	***$ 212***	***$ 523***	***$ 1,027***	***$ 583***
														$7,307	$12,739	$7,756	$7,231	$7,403	$4,764	$10,150				
Additional Benefits														$ 6,643	$ 10,616	$ 4,562	$ 8,035	$ 6,580	$ 4,537	$ 5,639				
Capital																								
ML/ha/y	Water savings calculator estimated prior to works (50% of this was transferred)	2.8	2.8	1.8	2.2	2.1	2.4	2.5	0.9	1.4	2.3	1.1	1.1		3.7	3.3	2.3	2.8	2.8	3.8	*0.9*	*2.3*	*3.8*	*2.4*
ML/ha/y	Water saving calculator with current crop mix	3.2	2.5	1.8	1.8	1.7	1.5	2.5	1.6	1.3	1.2	2.0	1.9		2.2	2.3	2.3	2.8	1.9	3.8	*1.2*	*2.1*	*3.8*	*2.0*
ML/ha/y	water saving estimated adjusted for additional yield	3.9	1.7	4.8	3.1	3.9	4.0	5.9	2.3	5.3	3.9	2.9	1.2		3.8	4.7	1.8	2.3	5.1	6.7	*1.2*	*3.7*	*6.7*	*3.6*
ML/ha/y	water saving adopted for assessment of water value excludes saving used for additional yield	1.7	0.9	0.8	1.7	2.5	2.5	3.0	0.5	2.0	1.2	1.7	1.2	2.2	2.4	3.4	1.8	2.3	2.1	3.6	*0.5*	*2.0*	*3.6*	*2.0*
	market value of water saved $1,800/ML annualised value $/y	$ 242	$ 126	$ 115	$ 242	$ 365	$ 363	$ 435	$ 73	$ 286	$ 171	$ 245	$ 175	$ 319	$ 351	$ 493	$ 259	$ 326	$ 310	$ 520	*$ 73*	*$ 285*	*$ 520*	*$ 286*
	saved channel structure replacement costs - not costed	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	*$ -*	*$ -*	*$ -*	*$ -*
Annual																								
	saved channel costs																							
	-labour $/y	$ 20	$ -	$ 20	$ 30	$ 6	$ 6	$ 31	$ 7	$ 21	$ -	$ -	$ -	$ 12	$ 6	$ 9	$ 7	$ 15	$ 8	$ -	*$ -*	*$ 10*	*$ 31*	*$ 7*
	-chemicals $/y	$ 2	$ 17	$ 4	$ 17	$ 3	$ -	$ 7	$ 7	$ 3	$ -	$ -	$ -	$ 3	$ 6	$ 2	$ 2	$ -	$ 2	$ -	*$ -*	*$ 4*	*$ 17*	*$ 2*
	-wear and tear on equipment $/y	$ 8	$ 9	$ 8	$ 8	$ 3	$ -	$ 7	$ 7	$ 3	$ -	$ -	$ -	$ 4	$ 6	$ 7	$ 2	$ -	$ 6	$ -	*$ -*	*$ 4*	*$ 9*	*$ 4*
	-contractors $/y	$ 28	$ -	$ 32	$ -	$ 3	$ -	$ 7	$ -	$ -	$ -	$ -	$ -	$ 44	$ 6	$ 47	$ 4	$ -	$ 8	$ 59	*$ -*	*$ 12*	*$ 59*	*$ 3*
	other saved labour $/y	$ 400	$ 209	$ 95	$ 42	$ 254	$ 123	$ 142	$ 111	$ 606	$ 21	$ -	$ -	$ 114	$ 129	$ 26	$ 321	$ 28	$ 17	$ -	*$ -*	*$ 139*	*$ 606*	*$ 111*
	saved vehicle use $/y	$ -	$ 4	$ 4	$ -	$ 9	$ 7	$ 1	$ 6	$ 11	$ 1	$ -	$ -	$ 10	$ 61	$ -	$ -	$ -	$ -	$ -	*$ -*	*$ 6*	*$ 61*	*$ 1*
																							$ -	
	- saved pumping costs on water saved $/y	$ 4	$ 5	$ -	$ -	$ -	$ 6	$ -	$ -	$ -	$ -	$ -	$ -	$ 3	$ -	$ -	$ -	$ -	$ 5	$ -	*$ -*	*$ 1*	*$ 6*	*$ -*
	- saved variable water charges at $7.11/ML/y	$ 12	$ 6	$ 6	$ 12	$ 18	$ 18	$ 21	$ -	$ 14	$ 8	$ 12	$ 9	$ 16	$ -	$ 24	$ 13	$ 16	$ 15	$ 26	*$ -*	*$ 13*	*$ 26*	*$ 13*
	increased production $/y	$ 417	$ 217	$ 238	$ 117	$ 614	$ 200	$ 377	$ 200	$ 1,061	$ 500	$ 643	$ -	$ 396	$ 466	$ 372	$ 357	$ -	$ 330	$ 750	*$ -*	*$ 382*	*$ 1,061*	*$ 372*
	Other savings due to non irrigation capital eg. new dairy $/y	$ -	$ -	$ 381	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	$ -	$ -	$ -	*$ -*	*$ 21*	*$ 381*	*$ -*
																					$ -			
	Total additional benefits/y	**$ 1,135**	**$ 595**	**$ 903**	**$ 469**	**$ 1,276**	**$ 724**	**$ 1,030**	**$ 412**	**$ 2,007**	**$ 701**	**$ 901**	**$ 185**	**$ 923**	**$ 1,035**	**$ 979**	**$ 966**	**$ 387**	**$ 704**	**$ 1,358**	***$ 185***	***$ 879***	***$ 2,007***	***$ 903***
	Benefits-cost/y	**$ 524**	**$ 279**	**$ 282**	**$ 36**	**$ 671**	**$ 512**	**$ 524**	**$ 128**	**$ 1,390**	**$ 374**	**$ 416**	**-$ 105**	**$ 334**	**$ 9**	**$ 358**	**$ 384**	**-$ 209**	**$ 321**	**$ 540**	***-$ 209***	***$ 356***	***$ 1,390***	***$ 358***
	NPV	$ 6,504	$ 3,463	$ 3,504	$ 442	$ 8,324	$ 6,355	$ 6,502	$ 1,591	$ 17,252	$ 4,638	$ 5,160	-$ 1,299	$ 4,144	$ 110	$ 4,440	$ 4,760	-$ 2,599	$ 3,977	$ 6,707	*-$ 2,599*	*$ 4,420*	*$ 17,252*	*$ 3,965*
	B/C ratio	1.86	1.88	1.45	1.08	2.11	3.41	2.03	1.45	3.26	2.14	1.86	0.64	1.57	1.01	1.57	1.66	0.65	1.83	1.66	*0.64*	*1.74*	*3.41*	*1.66*
	old system yield t DM/ha/y	8.30	10.78	6.30	8.70	14.30		8.20		9.10	5.00	10.70	13.00	8.04	8.00	11.50	10.80	10.30	7.12	14.00	*5.00*	*9.66*	*14.30*	*9.10*
	new system yield t DM/ha/y	10.00	11.70	11.10	10.00	15.50		10.60		12.70	10.00	11.90	13.00	10.00	10.00	12.25	10.80	10.30	9.80	21.00	*9.80*	*11.80*	*21.00*	*10.80*
	production gain per ha t DM/ha/y	1.70	0.92	4.80	1.30	1.20		2.40		3.60	5.00	1.20	0.00	1.96	2.00	0.75	0.00	0.00	2.68	7.00	*0.00*	*2.15*	*7.00*	*2.05*
	old system water use efficiency t DM/ML/y	0.65	1.09	0.70	0.69	0.82		0.50		0.60	0.70	0.80	1.30	0.75	1.00	0.85	0.91	0.95	0.65	0.80	*0.50*	*0.81*	*1.30*	*0.80*
	new system water use efficiency t DM/ML	1.00	1.29	1.30	0.92	1.04		0.80		1.10	1.80	1.00	1.50	1.20	1.40	1.20	1.10	1.01	1.10	1.60	*0.80*	*1.20*	*1.80*	*1.10*
	production gain per ML t DM/ML	0.35	0.20	0.60	0.23	0.22		0.30		0.50	1.10	0.20	0.20	0.45	0.40	0.35	0.19	0.06	0.45	0.80	*0.06*	*0.39*	*1.10*	*0.35*

Note case studies 6 and 8 were cropping farms and water use efficiency t dry matter/ML have not been calculated. All other farms were irrigated pastures.

Table 5 Change in costs and benefits for the 19 case studies including the change in crop mix with/without the new technology.

Change in costs and benefits- case study number		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	10	*lowest*	*average*	*highest*	*median*
	Area upgraded ha	120	115	126	120	35	160	53	144	33	68	77	58	101	31	43	140	10	250	17	*10*	*90*	*250*	*77*
Additional Costs																								
Capital		per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	per ha	*per ha*	*per ha*	*per ha*	*per ha*
	Total estimated cost irrigation works	$ 5,659	$ 3,261	$ 2,619	$ 4,167	$ 4,800	$ 1,563	$ 4,868	$ 3,465	$ 6,435	$ 4,044	$ 5,390	$ 3,190	$ 5,452	$ 6,581	$ 7,223	$ 6,429	$ 7,100	$ 3,833	$ 8,529	*$ 1,563*	*$ 4,979*	*$ 8,529*	*$ 4,868*
	lost production during upgrades	$ 1,250	$ -	$ 198	$ -	$ 1,327	$ 350	$ 377	$ -	$ 1,212	$ -	$ 519	$ 200	$ 228	$ -	$ -	$ -	$ -	$ 360	$ -	*$ -*	*$ 317*	*$ 1,327*	*$ 198*
	other costs fencing stock water etc	$ 417	$ 435	$ 437	$ 833	$ 1,229	$ 500	$ 943	$ -	$ -	$ -	$ 117	$ -	$ 983	$ 1,095	$ 465	$ 714	$ -	$ 160	$ -	*$ -*	*$ 438*	*$ 1,229*	*$ 435*
	Other non irrigation capital required as a result of upgrade eg. new dairy	$ -	$ -	$ 3,968	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	-	$ -	$ -	$ -	$ -	*$ -*	*$ 220*	*$ 3,968*	*$ -*
	total capital cost of works	**$ 7,326**	**$ 3,696**	**$ 7,705**	**$ 5,000**	**$ 7,356**	**$ 2,413**	**$ 6,189**	**$ 3,465**	**$ 7,648**	**$ 4,044**	**$ 6,026**	**$ 3,390**	**$ 6,663**	**$ 7,675**	**$ 7,756**	**$ 7,143**	**$ 7,100**	**$ 4,353**	**$ 8,706**	***$ 2,413***	***$ 5,982***	***$ 8,706***	***$ 6,663***
	equivalent annual cost of capital 7%, 30 years, nil residual value	$ 590	$ 298	$ 582	$ 403	$ 593	$ 194	$ 499	$ 279	$ 616	$ 326	$ 486	$ 273	$ 537	$ 619	$ 625	$ 576	$ 572	$ 351	$ 702	*$ 194*	*$ 480*	*$ 702*	*$ 537*
Annual																								
	additional power costs $/y	$ 20	$ 18	$ 39	$ 30	$ 12	$ 9	$ 8	$ 5	$ -	$ 2	$ -	$ 16	$ 52	$ 408	$ 5	$ 7	$ 24	$ 29	$ 87	*$ -*	*$ 41*	*$ 408*	*$ 16*
	additional repairs and maintenance $/y	$ -	$ -	$ -	$ -	$ -	$ 9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4	$ 29	*$ -*	*$ 2*	*$ 29*	*$ -*
	Total additional costs/y	**$ 610**	**$ 316**	**$ 621**	**$ 433**	**$ 605**	**$ 212**	**$ 506**	**$ 284**	**$ 616**	**$ 328**	**$ 486**	**$ 290**	**$ 589**	**$ 1,027**	**$ 630**	**$ 583**	**$ 597**	**$ 384**	**$ 818**	***$ 212***	***$ 523***	***$ 1,027***	***$ 583***
Additional Benefits																								
Capital																								
ML/ha/	water saving adopted for assessment of water value excludes saving used for additional yield	- 0.6	0.9	- 0.7	1.7	- 0.7	0.1	- 7.0	- 2.8	- 1.0	1.2	1.7	1.2	2.2	- 5.2	3.4	1.8	2.3	- 0.4	- 7.8	*- 7.8*	*- 0.5*	*3.4*	*0.1*
	market value of water saved $1,800/ML annualised value $/y	-$ 92	$ 126	-$ 107	$ 242	-$ 99	$ 19	-$ 1,015	-$ 399	-$ 147	$ 171	$ 245	$ 175	$ 319	-$ 818	$ 698	$ 259	$ 326	-$ 55	-$ 1,130	*-$ 1,130*	*-$ 68*	*$ 698*	*$ 19*
	saved channel structure replacement costs - not costed	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	*$ -*	*$ -*	*$ -*	*$ -*
	saved channel costs																							
	-labour $/y	$ 20	$ -	$ 20	$ 30	$ 6	$ 6	$ 31	$ 7	$ 21	$ -	$ -	$ -	$ 12	$ 6	$ 9	$ 7	$ 15	$ 8	$ -	*$ -*	*$ 10*	*$ 31*	*$ 7*
	-chemicals $/y	$ 2	$ 17	$ 4	$ 17	$ 3	$ -	$ 7	$ 7	$ 3	$ -	$ -	$ -	$ 3	$ 6	$ 2	$ 2	$ -	$ 2	$ -	*$ -*	*$ 4*	*$ 17*	*$ 2*
	-wear and tear on equipment $/y	$ 8	$ 9	$ 8	$ 8	$ 3	$ -	$ 7	$ 7	$ 3	$ -	$ -	$ -	$ 4	$ 6	$ 7	$ 2	$ -	$ 6	$ -	*$ -*	*$ 4*	*$ 9*	*$ 4*
	-contractors $/y	$ 28	$ -	$ 32	$ -	$ 3	$ -	$ 7	$ -	$ -	$ -	$ -	$ -	$ 44	$ 6	$ 47	$ 4	$ -	$ 8	$ 59	*$ -*	*$ 12*	*$ 59*	*$ 3*
	other saved labour $/y	$ 200	$ 209	$ 95	$ 42	$ 254	$ -	$ -	$ -	$ 303	$ 21	$ -	$ -	$ 114	$ -	$ 26	$ 321	$ 28	$ -	$ -	*$ -*	*$ 85*	*$ 321*	*$ 26*
	saved vehicle use $/y	$ -	$ 4	$ 4	$ -	$ 9	$ 7	$ 1	$ 6	$ 11	$ 1	$ -	$ -	$ 10	$ 61	$ -	$ -	$ -	$ -	$ -	*$ -*	*$ 6*	*$ 61*	*$ 1*
																							$ -	
	- saved pumping costs on water saved $/y	-$ 2	$ 5	$ -	$ -	$ -	$ 0	$ -	$ -	$ -	$ -	$ -	$ -	$ 3	$ -	$ -	$ -	$ -	-$ 1	$ -	*-$ 2*	*$ 0*	*$ 5*	*$ -*
	- saved variable water charges at $7.11/ML/y	-$ 4	$ 6	-$ 5	$ 12	-$ 5	$ 1	-$ 50	$ -	-$ 7	$ 8	$ 12	$ 9	$ 16	$ -	$ 24	$ 13	$ 16	-$ 3	-$ 55	*-$ 55*	*-$ 1*	*$ 24*	*$ 1*
	increased production $/y	$ 838	$ 217	$ 603	$ 117	$ 1,616	$ 422	$ 1,777	$ 1,120	$ 1,957	$ 500	$ 643	$ -	$ 396	$ 1,799	$ 373	$ 357	$ -	$ 524	$ 2,100	*$ -*	*$ 808*	*$ 2,100*	*$ 524*
	Other savings due to non irrigation capital eg. new dairy $/y	$ -	$ -	$ 381	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	*$ -*	*$ 20*	*$ 381*	*$ -*
																					$ -			
	Total additional benefits/y	**$ 998**	**$ 595**	**$ 1,034**	**$ 469**	**$ 1,789**	**$ 455**	**$ 764**	**$ 747**	**$ 2,144**	**$ 701**	**$ 901**	**$ 185**	**$ 923**	**$ 1,068**	**$ 979**	**$ 966**	**$ 387**	**$ 489**	**$ 974**	***$ 185***	***$ 872***	***$ 2,144***	***$ 901***
			$ -		$ -						$ -	$ -	$ -											
	Benefits-cost/y	**$ 388**	**$ 279**	**$ 413**	**$ 36**	**$ 1,184**	**$ 243**	**$ 258**	**$ 463**	**$ 1,528**	**$ 374**	**$ 416**	**-$ 105**	**$ 334**	**$ 41**	**$ 358**	**$ 384**	**-$ 209**	**$ 105**	**$ 156**	***-$ 209***	*$ 350*	***$ 1,528***	*$ 334*
	NPV	$ 4,810	$ 3,463	$ 5,126	$ 442	$ 14,689	$ 3,017	$ 3,199	$ 5,750	$ 18,958	$ 4,638	$ 5,160	-$ 1,299	$ 4,144	$ 512	$ 4,440	$ 4,760	-$ 2,599	$ 1,302	$ 1,932	*-$ 2,599*	*$ 4,339*	*$ 18,958*	*$ 4,144*
	B/C ratio	1.64	1.88	1.67	1.08	2.96	2.15	1.51	2.63	3.48	2.14	1.86	0.64	1.57	$ 1.04	1.57	1.66	0.65	1.27	1.19	*0.64*	*1.71*	*3.48*	*1.64*

Note nine properties (2, 4, 10, 11, 12) and (Dairy Australia 1, 3, 4, 5) are not expected to have changed crop mix significantly as a result of the upgrade and their results have not been modified.