Department of Primary Industries

primefact

Irrigation profitability case studies in Victoria

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Summary

Undertaking irrigation works can present a significant upfront cost. The potential financial and payback periods from investment in on-farm irrigation infrastructure and layouts are illustrated by two case studies from Victoria. Both showed positive returns due to an increased area of higher value crops with improved water use efficiency and labour savings.

Two anonymous volunteer growers provided information on their irrigation development investment costs, cropping system changes and yield performance 'before' and 'after' the investment. Crop gross margin budgets were calculated from this information as well as rate of return (on capital investment) and projected cashflow.

The 'Victoria 1' case study involved irrigation efficiency improvements to the existing border check layout and increasing the area under maize. Irrigation efficiency improvements included landforming, channel upgrades (pipes and culverts), larger border check banks and some automation. The 'Victoria 2' case study involved investment in permanent infrastructure focussed on automating the irrigation system across the farm.

Table 1: Summary

Case Study	Area (ha)	Capital cost	Annual increase in gross margin	Breakeven year
Victoria 1	700 ha	$ 1.21m ($1,728/ha)	$ 890,077	Year 2
Victoria 2	250 ha	$ 675,000 ($2,700/ha)	$ 123,402	Year 5

This Primefact is part of the 'Maximising on-farm irrigation profitability' project, which looked at six case studies. The other four case studies (two in the Murray Valley and two in the Murrumbidgee) are detailed in other Primefacts. The project was a sub-project under the overarching 'Smarter Irrigation for Profit' program which was a partnership between the major irrigation industries of cotton, rice, dairy and sugar, led by CRDC in conjunction with RIRDC/AgriFutures, Dairy Australia, Sugar Research Australia and other research partners.

Methods

The volunteer growers provided details for:

- land area involved in the irrigation system change
- type of irrigation layouts used 'before' and 'after' system change
- capital expenditure on the development
- crop rotations grown 'before' and 'after' and the area developed
- crop yields and prices, as well as variable and overhead costs.

Table 1 shows the average commodity prices used in the analysis. These prices are based on an inflation-adjusted time series from the last ten years. Annual variation in these prices will have a large impact on the profitability of irrigation investments. All prices and costs used in the analysis are ex-GST.

Table 2: Commodity prices used

Commodity	$/tonne or bale
Cotton lint	$461
Cotton seed	$399
Rice	$340
Wheat (APW)	$232
Barley (feed)	$232
Maize	$278
Soybeans	$475
Canola	$513
Faba beans	$315

Water prices per megalitre (ML) were costed by each case study grower according to their on-farm costs and were $70/ML for both farms. This can vary from farm to farm due to pumping costs, usage fees and accounting method used by individual growers.

The economic analysis methodology used gross margin calculations as inputs to rate of return (on capital investment) and cashflow calculations. The rate of return method shows the extra returns, extra costs and net gain from a development in summary form. Generally if the rate of return is well above the market interest rate (i.e. an alternative investment) then the development is worth analysing further.

The method used for calculating rate of return is:

$$Net\ benefit\ (i.e.\ extra\ average\ annual\ extra\ gross\ margin) = annual\ \ gross\ margin\ 'after'\ change - annual\ \ gross\ margin\ 'before'\ change$$

$$Net\ benefit\ after\ tax\ = Net\ benefit - Net\ benefit\ x\ marginal\ tax\ rate\ (\%)$$

$$Extra\ capital\ = New\ capital\ investment\ - capital\ sold\ (if\ any)$$

$$Extra\ return\ on\ capital\ after\ tax\ = \frac{Net\ benefit\ after\ tax}{Extra\ capital}$$

A marginal tax rate of 20% was used. The actual marginal tax rate may vary widely with business structures. Some allowance for tax is included since the tax effects are unlikely to be zero. For example, extra income attracts extra tax payments but interest on finance and some components of capital investment may be tax deductible.

Further cash flow budgeting will then indicate whether the development is viable. The net cash flow after the change has to be enough to cope with the extra financial demands after the change, such as principal and interest payments on any borrowed funds.

Victoria 1 Case Study

Key Changes

The ‘Victoria 1’ case study involved irrigation efficiency improvements to the existing border check layout. The changes included landforming, channel upgrades (pipes and culverts), larger border check banks and some automation of water control gates. These improvements increased the water flow rate (i.e. moving water around the farm and on and off the paddocks more quickly) and thus improved efficiency. The full irrigated area (700 ha) was landformed. At the time of developing the case study, the grower had chosen to only automate 550 ha, with plans to expand the automation in the future. The capital cost of the development was $750/ha for landforming and channel upgrading, $1,250/ha for automation and $200/ha for pump upgrades, for a total of $1.21 million of capital investment.

Practical Outcomes

The major result of the development was that irrigation water could be moved around the farm faster with lower labour costs. This allowed more focus to be placed on a higher value summer and double cropping program. Table 2 shows the rotations ‘before’ and ‘after’ the development, where the colours highlight the different crops and fallow periods. The area under maize increased significantly under the new layout (from 150 ha to 400 ha) and barley was added to the rotation every five years.

Due to the increase in area for crops such as maize, total annual water use increased in all years (Table 2). The highest increases were for Years 1 and 5. This is in spite of a decrease in water use for individual crops (Table 3). The growers total water allocation was unknown in this case, so it is unclear if they would have had to purchase extra water. Purchase of extra permanent allocation would increase the capital costs.

Table 3: Victoria 1 crop rotations 'before' and 'after' development

		Crop 'before' (ha)		Crop 'after' (ha)		Annual water use 'before' (ML)	Annual water use 'after' (ML)
Year 1	Winter	Canola	150	Wheat	400	3,775	4,700
		Wheat	550	Wheat	300		
	Summer	Maize	150	Maize	400		
		Fallow	550	Fallow	300		
Year 2	Winter	Fallow	150	Fallow	400	3,475	3,500
		Wheat	550	Wheat	300		
	Summer	Maize	150	Maize	400		
		Fallow	550	Fallow	300		
Year 3	Winter	Wheat	550	Barley	400	3,775	3,880
		Canola	150	Canola	300		
	Summer	Fallow	550	Maize	400		
		Maize	150	Fallow	300		
Year 4	Winter	Wheat	550	Fallow	400	3,475	3,500
		Fallow	150	Wheat	300		
	Summer	Fallow	550	Maize	400		
		Maize	150	Fallow	300		
Year 5	Winter	Wheat	550	Canola	400	3,475	4,140
		Fallow	150	Wheat	300		
	Summer	Fallow	550	Maize	400		
		Maize	150	Fallow	300		

Ease of management improved under the new layout with less labour required to manage the system. Yields improved and water use per ha decreased for all crops (Table 3).

Table 4: Victoria 1 - Yield and water use changes

Victoria 1	**Yield (tonne or bales/ha)**			**Water Use (ML/ha)**		
Crops Grown	**'Before'**	**'After'**	**% Change**	**'Before'**	**'After'**	**% Change**
Wheat	4.50	5.25	17%	4.00	3.00	-25%
Barley	not grown	5.00	n/a	not grown	2.00	n/a
Canola	2.80	3.40	21%	2.00	1.60	-20%
Maize	10.50	14.00	33%	8.50	6.50	-24%

Economic Outcomes

The financial analysis estimated strong returns from investing in a more efficient irrigation layout with automation. The capital investment had a payback period of 2 years (excluding borrowing and repayments that may have been required).

Table 4 shows the changes in gross margin per ha and per ML. All crops showed higher returns per ha and considerably improved returns per ML as a result of higher yields and lower water use. The number of inter-row cultivations needed for maize was also reduced, reducing input costs.

Table 5: Gross margin per ha and per ML changes

	Gross Margin ($/ha)		Gross Margin ($/ML)	
Crop	**'Before' Change**	**'After' Change**	**'Before' Change**	**'After' Change**
Wheat	$243	$485	$61	$162
Barley	not grown	$536	not grown	$268
Canola	$517	$801	$259	$500
Maize	$1,327	$2,345	$156	$361

The rate of return showing the extra returns, extra costs and net gain from the development is shown in Table 5. The estimated return was high due to strong improvements in total farm gross margin, mainly due to the improved maize gross margin and increased area. If the maize gross margin was not as high as in Table 4 (e.g. due to lower yield, lower price and/or higher costs than assumed here), the rate of return would not be as high and the payback period would be longer.

Table 6: Victoria 1 - Rate of Return on capital investment

Item	
Average increase in total farm GM (Net benefit)	$890,077
Marginal tax (i.e. extra @ rate of 20%)	$178,015
Net benefit after tax	**$712,061**
Capital cost of development	$1,210,000
Extra return on capital after tax	**59%**

Figure 1 shows the total farm gross margin before and after as well as the annual net returns. It is assumed the gains in gross margin returns (such as water savings and cotton yield improvements) are immediate.

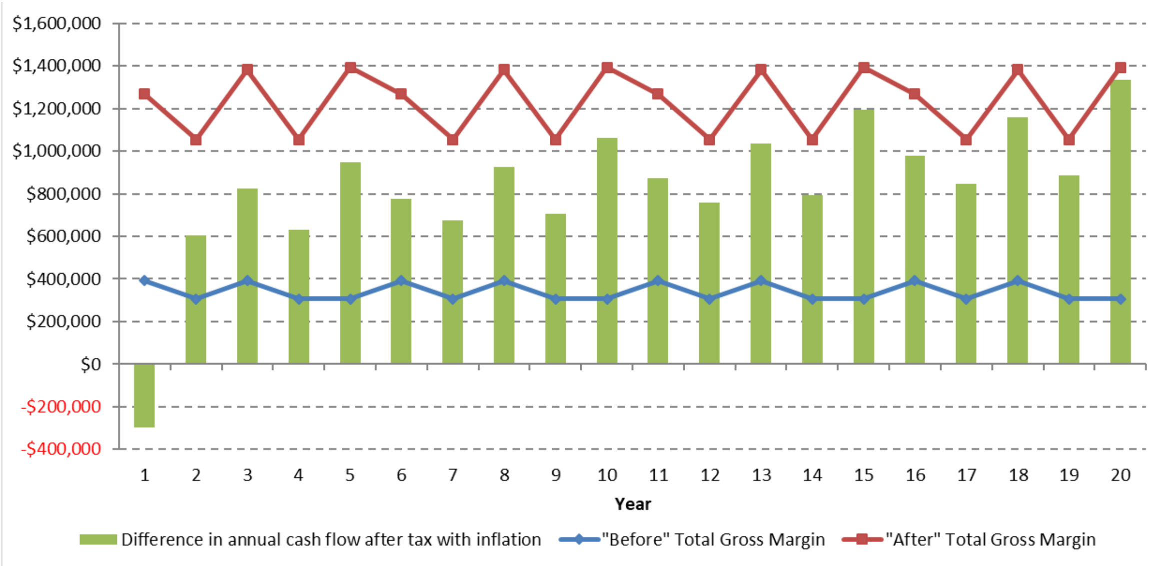

Figure 1: Victoria 1 - Annual farm gross margin and net cash flow after tax with inflation

The net cumulative cash flow after tax and including inflation is shown in Figure 2. The breakeven occurs in year two. This 20-year projection assumes the average gross margins used here remain static and excludes the cost of borrowing (principal and interest repayments).

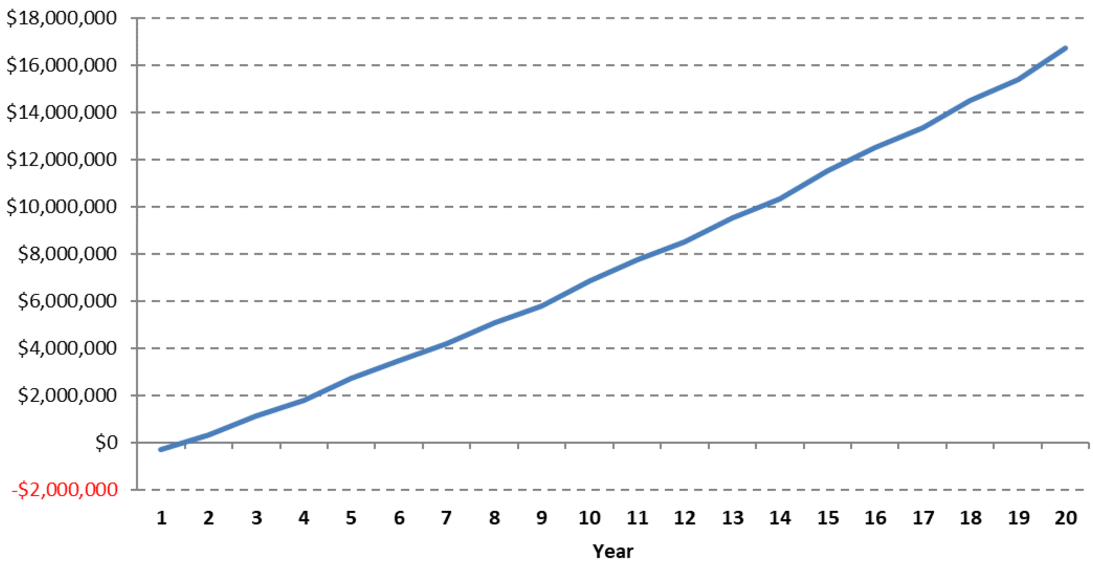

Figure 2: Victoria 1 - Cumulative cash flow after tax with inflation

Victoria 2 Case Study

Key Changes

The 'Victoria 2' farm invested in efficiency gains and continued to grow maize under a border check layout over 250 ha. There was some landforming but the majority of the investment was in permanent infrastructure, much of which was focussed on automating the irrigation system across the farm. The total capital cost was $675,000.

The efficiency gains resulted in the irrigated summer crop area (maize) increasing from 70 ha to 100 ha. Barley was removed from the cropping program and replaced with faba beans (Table 6). The rotations were tighter under the 'after' layout which meant more crops could be grown over the full cycle (i.e. increased cropping intensity). Labour costs as well as fuel and oil for vehicles were also reduced significantly.

There was an increase in total annual water demand in Year 3 due to increased maize area and the faba bean crop. There was also a slight increase in Year 4. Water use decreased in other years. The growers total water allocation was unknown in this case, so it is unclear if they would have had to purchase extra water in Year 4. Purchase of extra permanent allocation would increase the capital costs.

Table 7: Victoria 2 crop rotations 'before' and 'after' development

		Crop 'before' (ha)		Crop 'after' (ha)		Annual water use 'before' (ML)	Annual water use 'after' (ML)
Year 1	Winter	Fallow	70	Fallow	100	1,120	1,100
		Wheat	180	Wheat	150		
	Summer	Maize	70	Maize	100		
		Fallow	180	Fallow	150		
Year 2	Winter	Barley	180	Fallow	100	1,080	890
		Canola	70	Canola	150		
	Summer	Fallow	180	Maize	100		
		Maize	70	Fallow	150		
Year 3	Winter	Wheat	180	Faba beans	100	1,120	1,410
		Fallow	70	Wheat	150		
	Summer	Fallow	180	Maize	100		
		Maize	70	Fallow	150		
Year 4	Winter	Canola	70	Fallow	100	1,080	1,100
		Barley	180	Wheat	150		
	Summer	Maize	70	Maize	100		
		Fallow	180	Fallow	150		
Year 5	Winter	Rotation repeats after 4 years		Wheat	100	Rotation repeats after 4 years	1,190
				Canola	150		
	Summer			Fallow	150		
				Maize	100		
Year 6	Winter			Canola	150		1,190

			Wheat	100		
	Summer		Fallow	150		
			Maize	100		

Practical Outcomes

The result of the development was that the ease of managing the irrigation system improved significantly. The grower was able to reduce labour inputs significantly with the majority of the system now automated. Yield increased and water use per ha decreased across all comparable crops in the 'before' and 'after' systems (Table 7).

Table 8: Victoria 2 -Yield and water use changes

	Yield (tonne/ha)			Water Use (ML/ha)		
Crop	**'Before' Change**	**'After' Change**	**% Change**	**'Before' Change**	**'After' Change**	**% Change**
Wheat	4.50	5.25	17%	3.50	3.00	-14%
Barley	4.00	not grown	n/a	2.50	not grown	n/a
Canola	2.80	3.40	21%	2.00	1.60	-20%
Fababeans	not grown	4.57	n/a	not grown	3.1	n/a
Maize	10.50	14.00	33%	7.00	6.50	-7%

Economic Outcomes

The financial analysis estimated strong returns from investing in a more efficient irrigation layout with automation. The capital investment had a payback period of 5 years (excluding borrowing and repayments that may have been required).

The gross margins per ha and per ML are shown in Table 8. Gross margins for crops that remained before and after the development (wheat, canola and maize) all improved due to higher yields and reduced irrigation water use per ha.

Table 9: Victoria 2 - Gross margin per ha and per ML changes

	Gross Margin ($/ha)			Gross Margin ($/ML)		
Crop	**'Before' Change**	**'After' Change**	**% Change**	**'Before' Change**	**'After' Change**	**% Change**
Wheat	$ 278	$485	75%	$ 79	$162	104%
Barley	$ 289	not grown	n/a	$116	not grown	n/a
Canola	$ 517	$801	55%	$259	$500	93%
Fababeans	not grown	$738	n/a	not grown	$238	n/a
Maize	$1,432	$2,345	64%	$ 205	$361	76%

Table 9 shows extra profit from the development was reasonable, expressed as a percentage return on the extra capital invested. The positive return is mostly attributed to the improvement in maize, wheat and canola gross margins, increased cropping intensity and labour and vehicle cost savings.

Table 10: Victoria 2 - Rate of Return on capital investment

Item	
Average increase in total farm GM (Net benefit)	$123,402
Marginal tax (i.e. extra @ rate of 20%)	$24,680
Net benefit after tax	**$98,721**
Capital cost of development	$675,000
Extra return on capital after tax	**15%**

Figure 3 shows the total annual farm gross margin 'before' and 'after' the change. For simplicity, it is assumed the gains in gross margin returns (such as water savings and cotton yield improvements) are immediate.

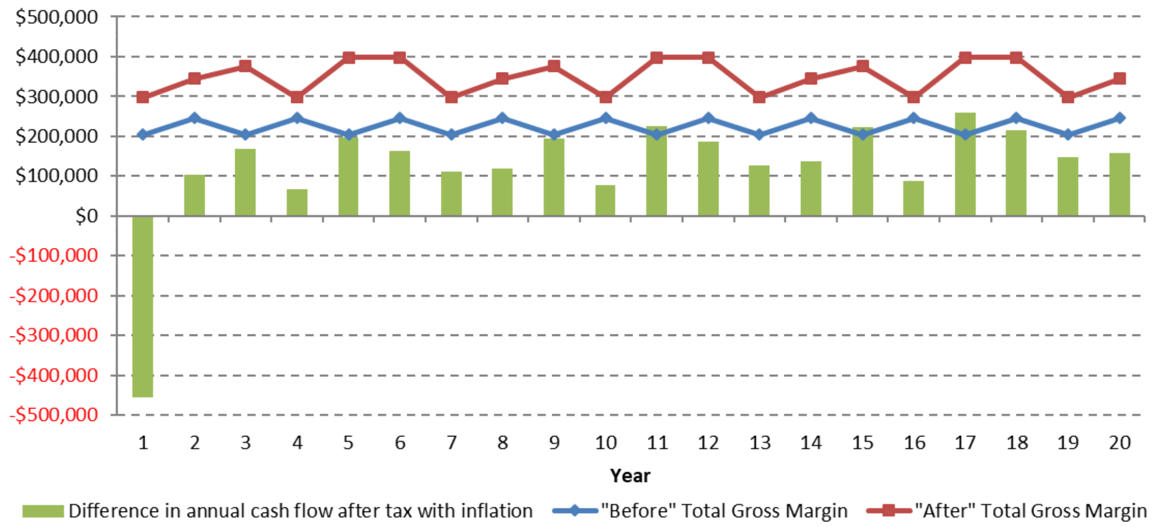

Figure 3: Victoria 2 - Annual farm gross margin and net cash flow after tax with inflation

The net cumulative cash flow after tax and including inflation is shown in Figure 4. Cash flow returns break even by year five. This 20-year projection assumes the average gross margins used here remain static and excludes the cost of borrowing (principal and interest payments).

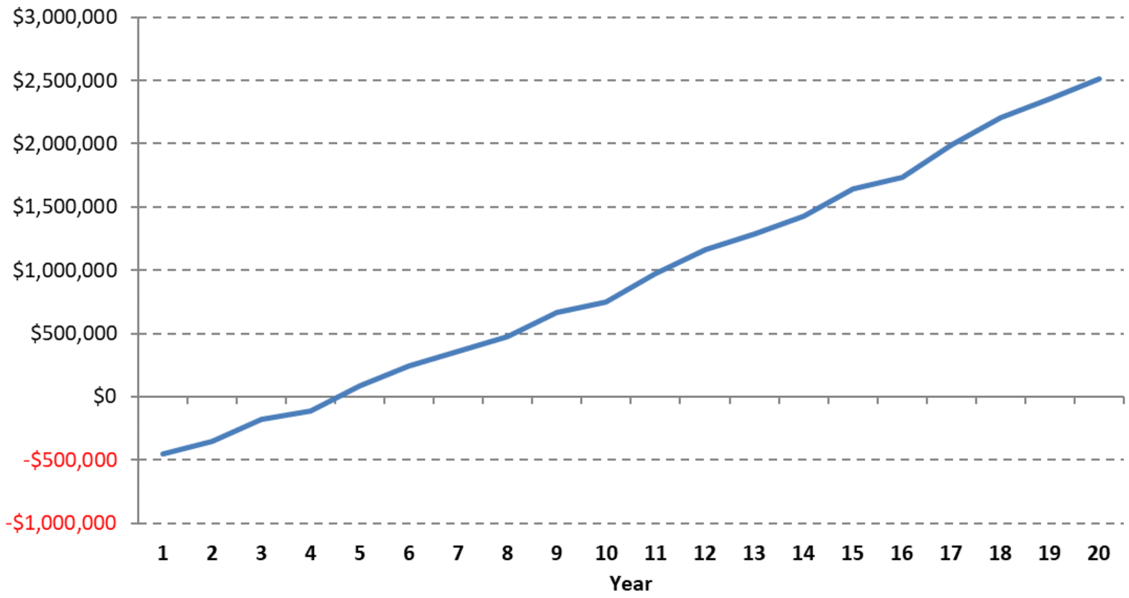

Figure 4: Victoria 2 - Cumulative cash flow after tax with inflation

Conclusion

These two case studies regarding modified border check layouts demonstrate the financial returns possible through upgrades in irrigation technology. The initial level of upfront costs and scale significantly differ, but in both cases, the investment gave strong returns. This was due to increased areas of higher value, more water use efficient crops, and labour savings.

However, growers need to undertake detailed individual development and financial plans before investing in any capital development. Rates of return can vary widely, due to weather and seasonal variability, different levels of capital expenditure, cost savings and impact on gross margin returns.

If funds are borrowed to invest in the development, subsequent interest and principal repayments will affect the payback period. In practice, future variability in key factors such as yields, commodity prices and input costs may result in more variable returns. This should be considered in individual financial projections.

Acknowledgements

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