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primefact

Irrigation profitability case studies in southern NSW - Murrumbidgee

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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 case studies from the Murrumbidgee Valley. Both showed positive returns due to an increased area of higher value crops with improved water use efficiency.

Two anonymous volunteer growers provided information on their irrigation development investment costs, cropping system changes and crop 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.

These case studies give a broad picture of economic performance of irrigation investments (Table 1). Future commodity price and input cost variability will likely result in the net cumulative cash flow reported for the case studies being more variable.

The 'Murrumbidgee 1' case study involved landforming and automation for part of an existing irrigation layout, along with an increase in area under cotton. The 'Murrumbidgee 2' case study involved a significant change from a contour layout to a terraced bankless layout across the whole farm and change in crops grown from cereal crops to exclusively cotton.

Table 1: Summary

Case Study	Area (ha)	Capital cost	Annual increase in gross margin	Breakeven year
Murrumbidgee 1	250	$237,500 ($950/ha)	$ 195,429	Year 1
Murrumbidgee 2	1,600	$5,120,000 ($3,200/ha)	$1,055,533	Year 6

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 Victoria) 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 2 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	$346
Wheat	$233
Barley	$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 $60/ML for both farms. This cost 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 an investment in summary form. It shows the gain from the extra capital invested. 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:

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

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

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

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

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, such as principal and interest payments on any borrowed funds.

Murrumbidgee 1 Case Study

Key Changes

The 'Murrumbidgee 1' farm underwent an irrigation efficiency improvement over 250 ha of the existing developed irrigation area of 800 ha. The irrigation layout 'before' and 'after' was furrow based. Earthworks were conducted (landforming and channels) and automated water control gates were installed. The capital cost of the development was $350/ha for landforming and channel upgrading and $600/ha for new control gates and automation, for a total of $237,500 of capital investment.

Practical Outcomes

The result of the development was that irrigation water could be moved around the farm more rapidly. This improved water use efficiency for summer crops and reduced labour costs by $35,000/year. In addition, there was a small increase in estimated repairs and maintenance.

Table 3 shows the rotations 'before' and 'after' the development, where the colours highlight the different crops and fallow periods. In this case, the crop sequence remained the same.

The development allowed an additional 50 ha of cotton to be grown each season and a corresponding reduction in the area under summer fallow from 150 ha to 100 ha. Due to the short summer crop planting window in the region, the planting window for cotton can close before the soil is warm enough to plant. This has occurred in practice on the farm of the volunteer grower, and in that year, soybeans were grown instead of cotton. The grower expected this may be the case in future years, so an assumption was made in the analysis that cotton is replaced with soybeans every five years.

There was an increase in total annual water demand in Year 1, 4 and 5, with a decrease in Year 3 (Table 3). However, assuming the farm allocation was 2,300 ML, as the maximum needed for the 'before' case in Year 3, the grower would not necessarily have to purchase extra water.

Table 3: Murrumbidgee 1 crop rotations 'before' and 'after' the development

		Crop 'before' (ha)		Crop 'after' (ha)		Annual water use 'before' (ML)	Annual water use 'after' (ML)
Year 1	Winter	Wheat	150	Wheat	100	1080	1170
		Fallow	100	Fallow	150		
	Summer	Cotton	100	Cotton	150		
		Fallow	150	Fallow	100		
Year 2	Winter	Canola	150	Canola	100	1350	1350
		Fallow	100	Fallow	150		
	Summer	Cotton	100	Cotton	150		
		Fallow	150	Fallow	100		
Year 3	Winter	Wheat	250	Wheat	250	2300	2050
	Summer	Soybeans	250	Soybeans	250		
Year 4	Winter	Fallow	250	Fallow	250	900	1050
	Summer	Cotton	100	Cotton	150		
		Fallow	150	Fallow	100		
Year 5	Winter	Wheat	150	Wheat	100	1080	1170
		Fallow	100	Fallow	150		
	Summer	Cotton	100	Cotton	150		
		Fallow	150	Fallow	100		

Table 4 shows the crop yield and water use outcomes. The winter crop water use and yields remained the same 'before' and 'after' the investment. Water use by cotton was reduced and cotton yields also improved. Water use by soybeans reduced slightly, while yields remained the same.

Table 4: Murrumbidgee 1 - Yield and water use changes

Murrumbidgee 1	**Yield (tonne or bales/ha)**			**Water Use (ML/ha)**		
Crops Grown	**'Before'**	**'After'**	**% Change**	**'Before'**	**'After'**	**% Change**
Wheat	4.00	4.00	0%	1.2	1.2	0%
Canola	3.44	3.44	0%	3.0	3.0	0%
Cotton	12.95	13.95	8%	9.0	7.0	-22%
Soybeans	3.00	3.00	0%	8.0	7.0	-13%

Economic Outcomes

The financial analysis showed that investing in more efficient irrigation technology had strong returns. The capital investment had a payback period of only 1 year (excluding borrowing and repayments that may have been required).

Both cotton and soybeans showed an improvement in gross margin per ha and per ML due to decreased water use and improved yield in the case of cotton. Winter crop water use and yields remained the same, so their gross margins also remained the same on a per hectare and per ML basis (Table 5). Winter fallow costs assumed were $46/ha and summer fallow costs $34/ha.

Table 5: 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	$ 454	$ 454	0%	$ 378	$ 378	0%
Canola	$ 802	$ 802	0%	$ 267	$ 267	0%
Cotton	$ 3,803	$ 4,293	13%	$ 423	$ 613	45%
Soybeans	$ 357	$ 417	17%	$ 45	$ 60	33%

Calculation of the return on capital investment after tax (Table 6) shows strong extra returns, expressed as a percentage return on the extra capital invested.

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

Item	
Average annual increase in total farm GM (Net benefit)	$ 195,429
Marginal tax (i.e. extra @ rate of 20%)	$ 39,086
Average annual net benefit after tax	**$ 156,343**
Capital cost of development	$ 237,500
Extra return on capital after tax	**66%**

On a total annual farm gross margin basis, the increase in area under cotton meant there were higher gains in some years compared to others. The replacement of cotton with soybeans once every five years results in variability in the total farm gross margin (Figure 1). The total farm gross margin is higher when cotton is grown, due to both improvements in cotton returns but also a larger area of cotton grown under the new layout.

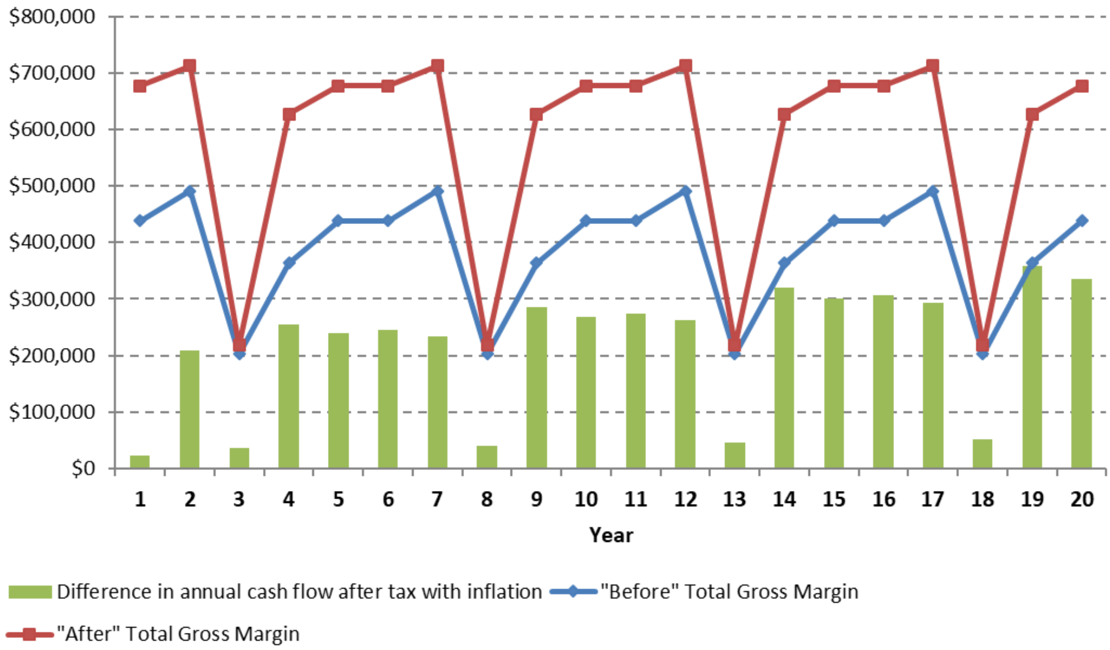

Figure 1: Murrumbidgee 1 - Annual farm gross margin and net cash flow after tax with inflation

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

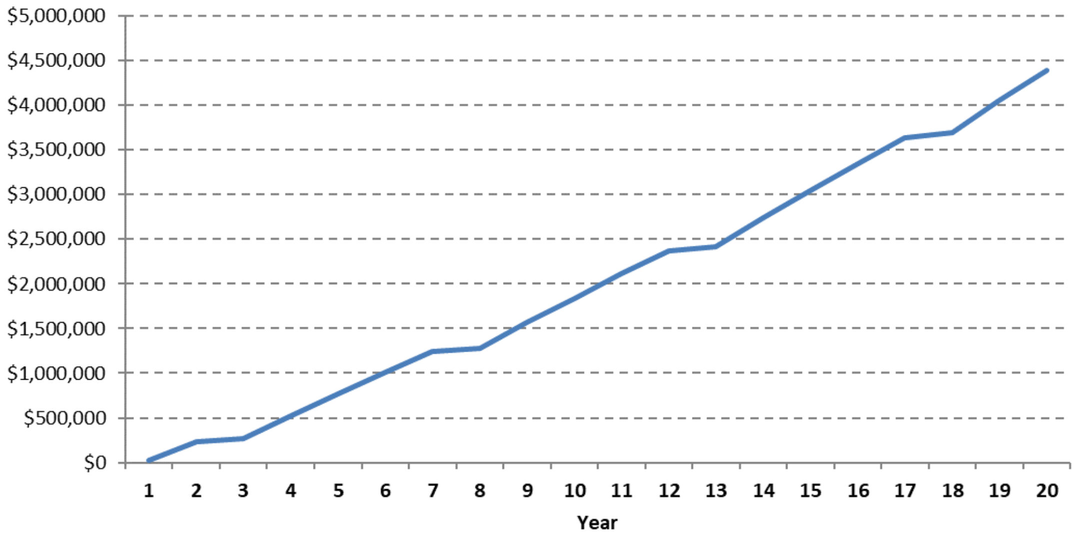

Figure 2: Murrumbidgee 1 - Cumulative net cash flow after tax with inflation

Murrumbidgee 2 Case Study

Key Changes

The ‘Murrumbidgee 2’ farm changed from a contour layout to a terraced bankless layout across the whole farm (1600 ha) and the crops grown from maize, rice, wheat and barley to exclusively cotton. Earthworks were conducted on the channels and automated water control gates were installed. The capital cost of the development was $1,400/ha for landforming and channel upgrading and $800/ha for new infrastructure. There was also a $100,000 investment in water storage and recycling. Given the change of focus to cotton, significant investment in suitable machinery was required, including a cotton picker, spray unit and tillage equipment (approximate purchase value $1.5 million). The total capital outlay for the layout change and associated machinery was $5,120,000.

Practical Outcomes

The result of the development was that irrigation efficiency was greatly improved, and an irrigation layout allowed a change in focus to cotton production with half the farm under cotton production each summer as shown in Table 7 below. Total annual water use was more than halved in most years.

Table 7: Murrumbidgee 2 crop rotations ‘before’ and ‘after’ the development

		Crop ‘before’ (ha)		Crop ‘after’ (ha)		Annual water use ‘before’ (ML)	Annual water use ‘after’ (ML)
Year 1	Winter	Barley	1600	Fallow	1600	14,080	5,600
	Summer	Rice	800	Cotton	800		
		Fallow	800	Fallow	800		
Year 2	Winter	Wheat	1600	Fallow	1600	12,000	5,600
	Summer	Maize	800	Fallow	800		
		Fallow	800	Cotton	800		
Year 3	Winter	Wheat	800	Fallow	800	10,000	5,600
		Fallow	800	Fallow	800		
	Summer	Maize	800	Cotton	800		
		Fallow	800	Fallow	800		
Year 4	Winter	Barley	1600	Fallow	1600	14,080	5,600
	Summer	Rice	800	Fallow	800		
		Fallow	800	Cotton	800		

Table 8 shows the crop yields and water use resulting from a shift from cereal cropping to cotton. The grower recommended an allowance be made for a lower yielding cotton crop year every third year to account for yield variability.

Table 8: Murrumbidgee 2 - Yield and water use changes

	Yield (tonne or bales/ha)		Water Use (ML/ha)	
Crops Grown	**'Before' Change**	**'After' Change**	**'Before' Change**	**'After' Change**
Wheat	5.00	not grown	2.50	not grown
Barley	5.50	not grown	1.80	not grown
Maize	13.04	not grown	10.00	not grown
Rice	9.50	not grown	14.00	not grown
Cotton High Yield	not grown	13.95	not grown	7.00
Cotton Low Yield	not grown	12.95	not grown	7.00

Economic Outcomes

The financial analysis showed strong returns from investing in more efficient irrigation technology, machinery and changing to a more profitable crop. Due to the size of the investment, the capital investment had a payback period of 6 years (excluding borrowing and repayments that may have been required).

On a per ha and per ML basis, cotton gross margins per ha and per ML were considerably higher than for the other crops grown previously (Table 9).

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

	Gross Margin ($/ha)		Gross Margin ($/ML)	
Crops Grown	**'Before' Change**	**'After' Change**	**'Before' Change**	**'After' Change**
Wheat	$ 575	not grown	$ 230	not grown
Barley	$ 700	not grown	$ 389	not grown
Maize	$1,952	not grown	$ 195	not grown
Rice	$1,350	not grown	$ 96	not grown
Cotton High Yield	not grown	$ 4,293	not grown	$ 613
Cotton Low Yield	not grown	$ 3,923	not grown	$ 560

Calculation of the return on capital after tax (Table 10) shows reasonable extra profit from the development, expressed as a percentage return on the extra capital invested. The positive return is attributed to the addition of cotton to the rotation which returns higher gross margins than the cereal crops grown previously. The net benefit after tax was enough to offset the capital cost of the development, despite higher overhead costs.

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

Item	
Average increase in total farm GM (Net benefit)	$ 1,055,533
Marginal tax (i.e. extra @ rate of 20%)	$ 211,107
Net benefit after tax	**$ 844,426**
Capital cost of development	$ 5,120,000
Extra return on capital after tax	**16%**

On a total annual farm gross margin basis, Figure 3 shows the returns 'before' and 'after' and the difference in annual net cash flow. It is assumed the gains in gross margin returns are immediate. The net cash flow also includes an estimated $230,000 annual increase in overhead and maintenance costs.

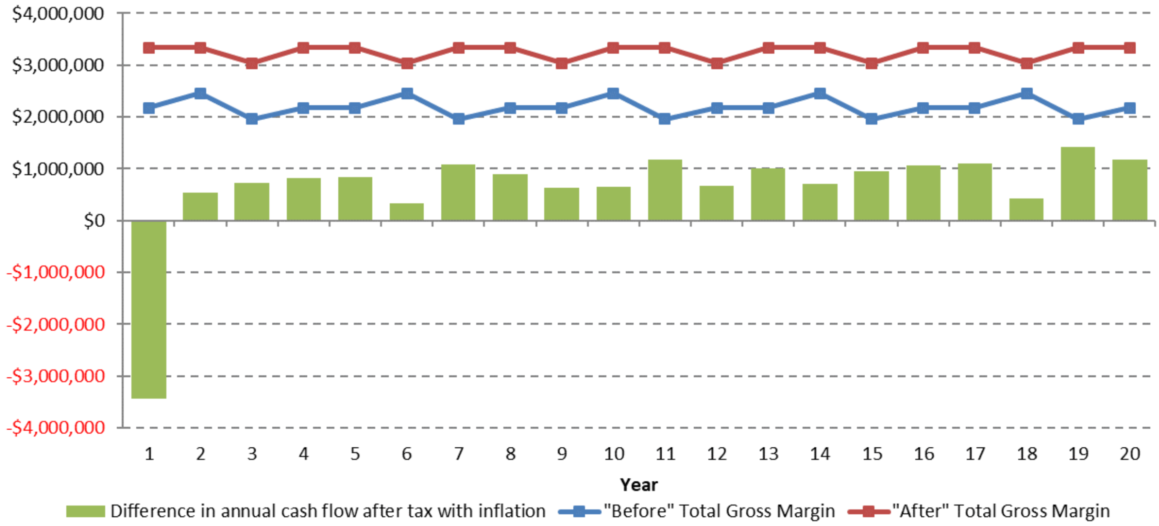

Figure 3: Murrumbidgee 2 - Annual farm gross margin and net cash flow after tax with inflation

The net cumulative cash flow is shown in Figure 4, where breakeven occurs between years six and seven. The estimates have assumed a cotton yield of 13.95 bales/ha beginning in year 1, with a lower yield of 12.95 bales/ha every third year. This 20-year projection assumes the average gross margins remain static and excludes the cost of borrowing (principal and interest repayments). The break-even point may be earlier if the grower had sufficient water allocation for the 'before' rotation, and was able to trade the water saved each year (or permanently sold a portion of or all the surplus water allocation at an early stage). Water sales would contribute extra income but these options were not part of the case study and would depend on the growers individual business goals.

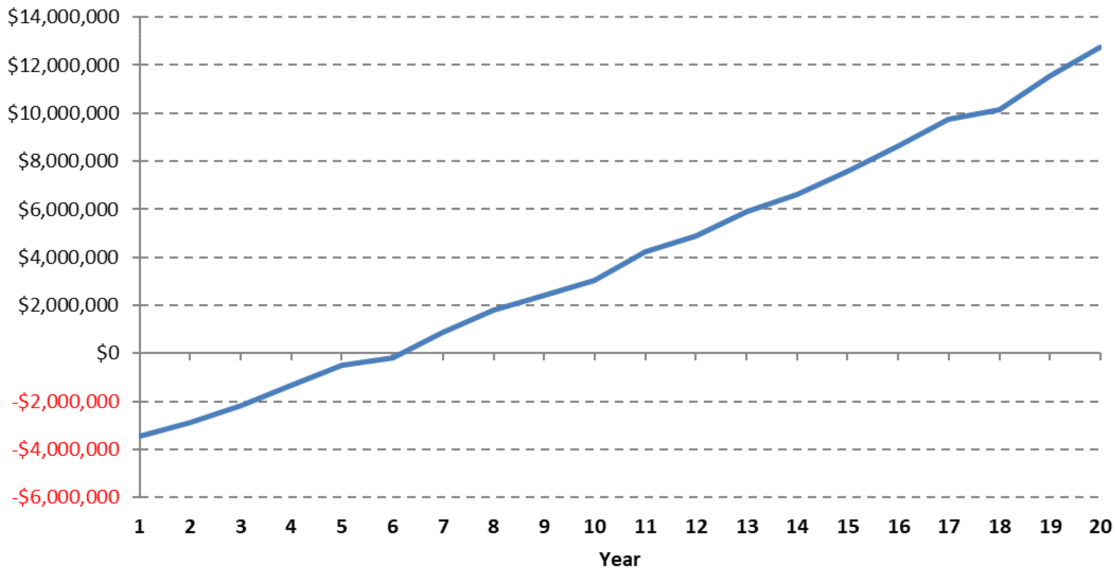

Figure 4: Murrumbidgee 2 - Cumulative cash flow after tax with inflation

Conclusion

These two case studies demonstrate the financial returns possible through upgrades in irrigation technology. The initial level of upfront costs significantly differ, but in both cases, the investment gave strong returns. This was due to the increased area of high value crops with improved water use efficiency.

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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