Department of Primary Industries

primefact

Irrigation profitability case studies in southern NSW - Murray

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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 the Murray Valley. Both showed positive returns due to labour and water savings and improved crop gross margin returns.

One anonymous volunteer grower provided information on their irrigation development investment costs, cropping system changes and yield performance ‘before’ and ‘after’ the investment. The second case study was a representative farm focussed on rice production. Crop gross margin budgets were calculated from this information as well as rate of return (on capital investment) and projected cashflow.

The ‘Murray 1’ grower case study involved a partial change to a terraced bankless layout and showed positive returns due to labour savings and improved crop gross margin returns. The ‘Murray 2’ representative farm involved a full conversion from a side-ditch delivery contour layout to a terraced, bankless channel system with beds under rice.

Table 1: Summary

Case Study	Area (ha)	Capital cost	Annual increase in gross margin	Breakeven year
Murray 1	150 ha	$454,050 ($3,027/ha)	$ 138,097	Year 4
Murray 2	360 ha	$862,860 ($2,397/ha)	$ 204,717	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 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 grower 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	$340
Wheat (APW)	$232
Barley (feed)	$232
Maize	$278
Soybeans	$475
Canola	$513
Faba beans	$315

Water prices per megalitre (ML) were $125 for Murray 1 (as costed by the grower) and $65 (based on typical rice farm pumping costs) for Murray 2. This cost can vary from farm to farm due to 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:

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

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

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

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

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.

Murray 1 Case Study

Key Changes

The 'Murray 1' grower case study involved a partial change to a terraced bankless layout. The grower changed 150 ha of their 250 ha irrigation area from a contour bank system growing rice to a terraced bankless layout with row cropping of cotton, soybeans, maize and barley. There were 100 ha remaining under the contour layout which will continue under the rice rotation.

The largest changes were the landforming layout changes and additional permanent infrastructure including pumps. The grower makes extensive use of contractors, rather than having capital invested in machinery, so machinery purchase was not part of this case study. The terrace bankless layout was also split into two blocks (Block 1 is 60 ha and Block 2 is 90ha), running similar rotations in different phases. The capital cost was $454,050.

Practical Outcomes

Table 3 shows the rotations 'before' and 'after' the development, where the colours highlight the different crops and fallow periods.

The rotation under the 'before' layout was based around a rice production system with 200 ha grown in most years and rotated around the farm with either wheat or canola in winter. The 'after' also takes into account a low water allocation year (Year 3), where no summer and following winter crop is planted in the contour system as a result of water being traded temporarily.

The result of the development was that after the layout was changed, 150 ha under the new terrace bankless layout was changed to a soybean/cotton/maize summer cropping program, with intermittent barley crops in winter months.

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

		Crop 'before' (ha)		Crop 'after' (ha)					
		Contour		Contour		Terrace bankless Block 1		Terrace bankless Block 2	
Year 1	Winter	Canola	200	Canola	50	Barley	60	Barley	90
		Fallow	50	Fallow	50				
	Summer	Rice	200	Rice	50	Soybeans	60	Fallow	90
		Fallow	50	Fallow	50				
Year 2	Winter	Wheat	200	Wheat	50	Fallow	60	Barley	90
		Fallow	50	Fallow	50				
	Summer	Rice	200	Rice	50	Cotton	60	Soybeans	90
		Fallow	50	Fallow	50				
Year 3	Winter	Wheat	200	Wheat	50	Fallow	60	Fallow	90
		Fallow	50	Fallow	50				
	Summer	Fallow	200	Fallow	50	Maize	60	Cotton	90
		Fallow	50	Fallow	50				
Year 4	Winter	Fallow	200	Fallow	50	Fallow	60	Fallow	90
		Fallow	50	Fallow	50				
	Summer	Rice	200	Rice	50	Cotton	60	Maize	90
		Fallow	50	Fallow	50				
Year 5	Winter	Canola	200	Canola	50	Fallow	60	Fallow	90
		Fallow	50	Fallow	50				
	Summer	Rice	200	Rice	50	Maize	60	Cotton	90
		Fallow	50	Fallow	50				

Table 4 shows the changes is annual water use to efficiency gains per crop and the alteration in crop areas. Water use decreased in each year, except for Year 3, where water use increased due to maize and cotton crops replacing wheat. However, as a five year total, water use decreased overall from 10,920 ML to 7,890 ML, a decrease of 28%. However, assuming the farm allocation was 2,740 ML, as the maximum needed for the 'before' case in Years 1 and 5, the grower would not necessarily have to purchase extra water.

Table 4: Annual water use changes

Year	Annual water use 'before'(ML)	Annual water use 'after' (ML)
Year 1	2,740	1,345
Year 2	2,600	1,790

Year 3	240	1,170
Year 4	2,600	1,790
Year 5	2,740	1,795

Table 5 shows the crop yield and water use outcomes. Rice and canola yields increased, while rice water use per ha reduced slightly. Water use in canola increased in order to improve canola yields.

The landforming and infrastructure meant that water can be moved around the farm more efficiently, including on and off paddocks faster. As a result, rice yield improved by 0.5tonne/ha, despite using 0.5 ML/ha less water.

Table 5: Murray 1 - Yield and water use changes

Murray 1	**Yield (tonne or bales/ha)**			**Water Use (ML/ha)**		
Crops Grown	**'Before'**	**'After'**	**% Change**	**'Before'**	**'After'**	**% Change**
Maize	not grown	15.00	N/A	not grown	8.00	N/A
Cotton	not grown	11.00	N/A	not grown	7.00	N/A
Rice	9.50	10.00	5%	13.00	12.50	-4%
Wheat	4.00	4.00	0%	1.20	1.20	0%
Barley	not grown	4.19	N/A	not grown	2.00	N/A
Canola	2.80	3.44	23%	0.70	3.00	329%
Soybeans	not grown	3.50	N/A	not grown	6.00	N/A

Economic Outcomes

The financial analysis showed strong returns from investing in a more efficient irrigation layout and changing to more profitable crops. The capital investment had a payback period of 4 years (excluding borrowing and repayments that may have been required).

On a per hectare basis, the gross margin outcomes shown in Table 6 indicate an improved gross margin return for rice and canola. The gross margin per ML for canola decreased as a result of increasing the water applied from 0.7 ML/ha to 3 ML/ha. Rice returned an improved gross margin per ML. Permanent labour costs were reduced from $70,000 per annum to $35,000.

Table 6: Murray 1 - Gross margin per ha and per ML changes

Murray 1	**Gross Margin ($/ha)**			**Gross Margin ($/ML)**		
Crops Grown	**'Before' Change**	**'After' Change**	**% Change**	**'Before' Change**	**'After' Change**	**% Change**
Maize	not grown	$1,895	0%	not grown	$237	0%
Cotton	not grown	$2,580	0%	not grown	$369	0%
Rice	$ 565	$777	38%	$43	$62	44%
Wheat	$ 378	$378	0%	$ 315	$315	0%
Barley	not grown	$258	0%	not grown	$129	0%
Canola	$ 570	$607	7%	$ 814	$202	-75%
Soybeans	not grown	$322	0%	not grown	$ 54	0%

Table 7 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 rice gross margin, the addition of maize and cotton, and a reduction in labour costs.

Table 7: Murray 1 - Rate of Return on capital investment

Item	Amount
Average increase in total farm GM (Net benefit)	$138,097
Marginal tax (i.e. extra @ rate of 20%)	$27,619
Net benefit after tax	**$110,477**
Capital cost of development	$454,050
Extra return on capital after tax	**24%**

On a total annual farm gross margin basis, the incorporation of cotton into the rotation significantly boosts overall returns, despite the total summer and winter crop area being the same or less in any given season.

Figure 1 shows the total farm gross margin returns 'before' and 'after' and the difference in annual net cash flow. For simplicity, it is assumed the gains in gross margin returns (such as water savings and yield improvements) are immediate. Variation in the post-change crop rotation areas causes the gross margin returns to fluctuate. This is due to the comparable rotation mix in the first and sixth year where the rice area is significantly reduced, and only substituted with a small area of soybeans, which have a lower gross margin.

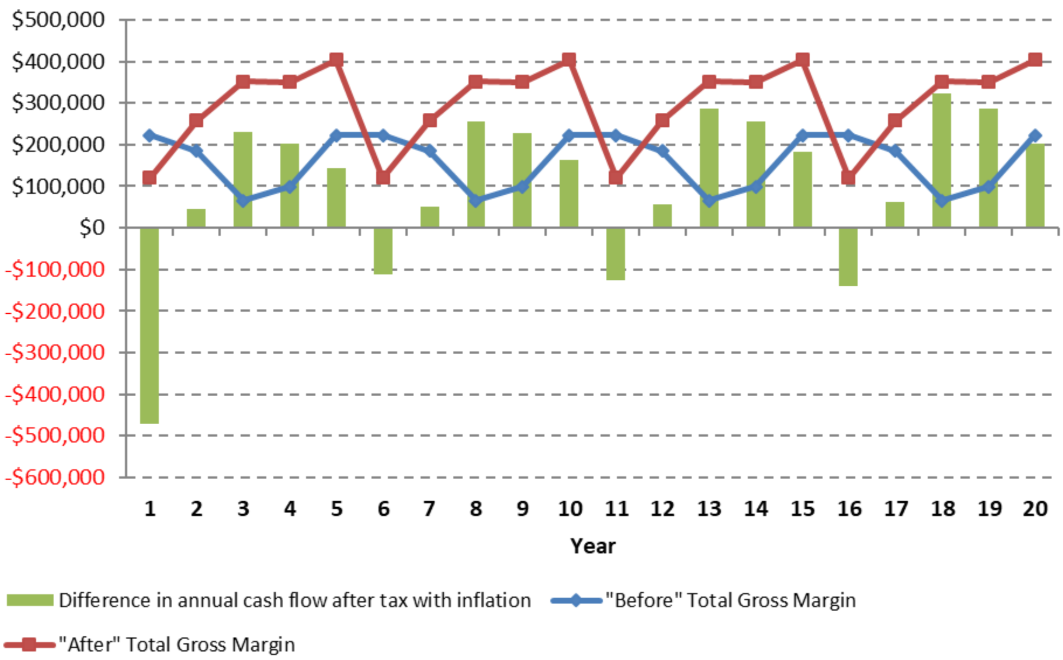

Figure 1: Murray 1 - Annual farm gross margin and net cash flow after tax with inflation

The net cumulative cash flow after tax and including inflation is shown in Figure 2. Breakeven occurs in year four. 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.

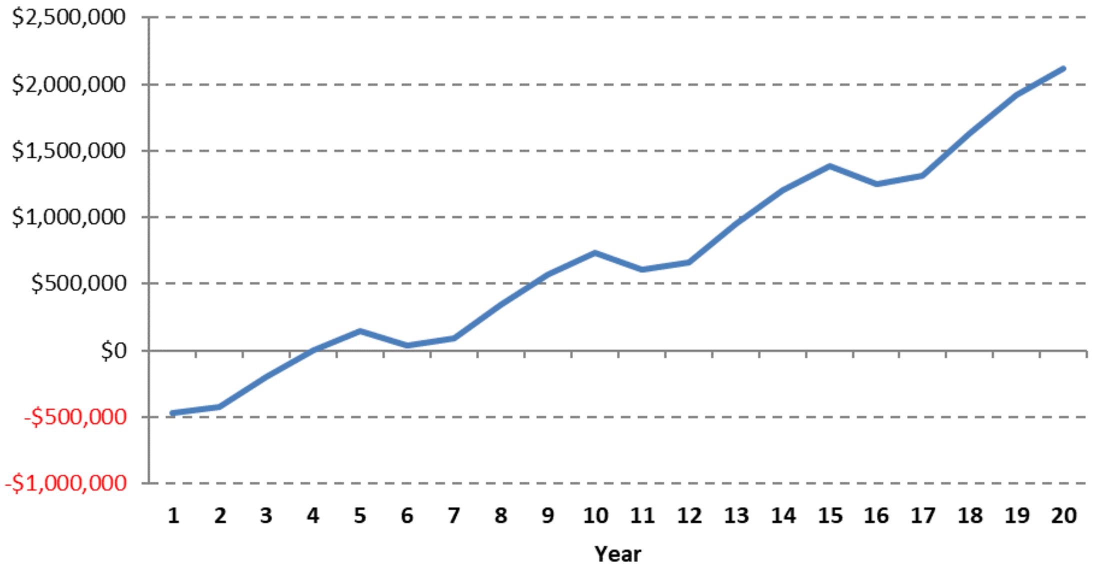

Figure 2: Murray 1 - Cumulative net cash flow after tax with inflation

Murray 2 Representative Farm Case Study

Key Changes

The 'Murray 2' representative farm case study involved a full conversion to a terraced bankless layout. The farm is a 360 ha representative farm, focussed on growing rice before and after the layout change, in rotation with wheat and canola. The farm has an assumed water allocation of 1,800 ML. The assumed change is from a side-ditch delivery contour layout to a terraced, bankless channel system with beds, aimed to reduce the risk of waterlogging. The capital cost of the development was based on commercial rates and assumed to be $1,300/ha for landforming and $733/ha for permanent infrastructure, totalling $732,000. A machinery upgrade was also assumed, this included $45,000 to buy a larger boom spray and convert an existing narrow point tyned 12 m planter to single disc units. Commercial rates were sought for this conversion for 48 units for a 12 metre setup, this was costed at $85,860 ex-GST. The total capital outlay assumed for the layout change and machinery was $862,860.

Practical Outcomes

This layout change is expected to enable a change from 120 ha of aerially sown rice every year (based on a 3 year rotation) to 180 ha of direct drill sown rice every year (based on a 2-year rotation). The new layout is assumed to save 3 ML/ha over 120 ha, so the area cropped to rice can be increased to 180 ha in every year (Table 8).

Table 8: Murray 2 crop rotations 'before' and 'after' development

		Crop 'before' (ha)						
		Contour						
		Block 1		Block 2		Block 3		
Year 1	Winter	Canola	120	Fallow	120	Wheat	120
	Summer	Rice	120	Fallow	120	Fallow	120
Year 2	Winter	Fallow	120	Wheat	120	Canola	120
	Summer	Fallow	120	Rice	120	Fallow	120
Year 3	Winter	Wheat	120	Canola	120	Fallow	120
	Summer	Fallow	120	Fallow	120	Rice	120

Crop 'after' (ha)			
Terrace bankless			
Block 1		Block 2	
Canola	180	Wheat	180
Rice	180	Fallow	180
Wheat	180	Canola	180
Fallow	180	Rice	180
Rotation repeats after 2 years			

As a result the total farm water allocation is used for rice, so it is assumed the rotation crops (wheat and canola) are grown as dryland (Table 9). Yields were expected to be slightly lower for wheat and rice under the new layout, however this would be offset by the increased area under rice and wheat. Total annual water use remained the same (1,800 ML).

Table 9: Murray 2 - Yield and water use changes

Murray 1	Yield (tonne or bales/ha)			Water Use (ML/ha)		
Crops Grown	**'Before'**	**'After'**	**% Change**	**'Before'**	**'After'**	**% Change**
Wheat	5.00	4.00	-20%	2.00	-	-100%
Canola	1.80	1.80	0%	n/a	n/a	n/a
Rice	12.00	11.50	-4%	13.00	10.00	-23%

Economic Outcomes

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

Despite a slight yield reduction in both wheat and rice, the reduction in water use and resultant cost savings result in an increase in gross margin per ha for both crops. Wheat will become a dryland crop under the new layout reducing water use by 2 ML/ha, which resulted in a 23% increase in gross margin per ha (Table 10).

Table 10: Murray 2 - Gross margin per ha and per ML changes

	Gross Margin ($/ha)			Gross Margin ($/ML)		
Crop	**'Before'**	**'After'**	**% Change**	**'Before'**	**"After"**	**% Change**
Wheat	$294	$363	23%	$181	n/a	n/a
Canola	$555	$555	0%	n/a	n/a	n/a

Rice	$1,850	$1,915	3%	$ 142	$200	57%

Table 11 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 rice and wheat gross margins and an increase in the relative area under crop (i.e. increased cropping intensity).

Table 11: Murray 2 - Rate of Return on capital investment

Item	
Average increase in total farm GM (Net benefit)	$204,717
Marginal tax (i.e. extra @ rate of 20%)	$40,943
Net benefit after tax	**$163,774**
Capital cost of development	$862,860
Extra return on capital after tax	**19%**

Figure 3 shows the annual total farm gross margin before and after the development. It is assumed the gains in gross margin returns are immediate.

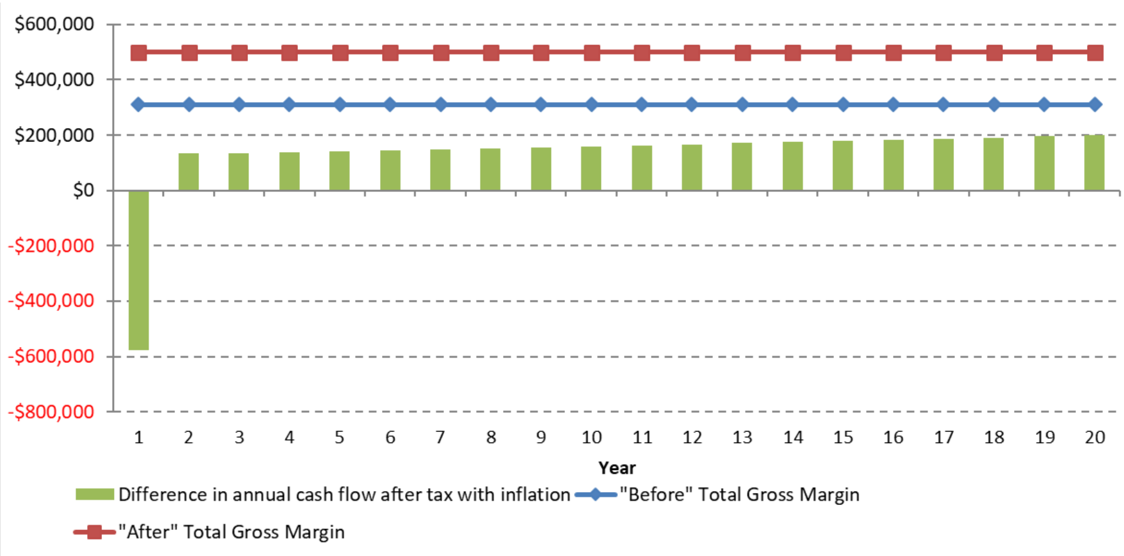

Figure 3: Murray 2 - Annual farm gross margin and net cash flow after tax with inflation

Figure 4 shows the cumulative cash flow after tax with inflation. Breakeven occurs in year five. This 20-year projection assumes the average gross margins used here remain static and excludes the cost of borrowing (principal and interest repayments).

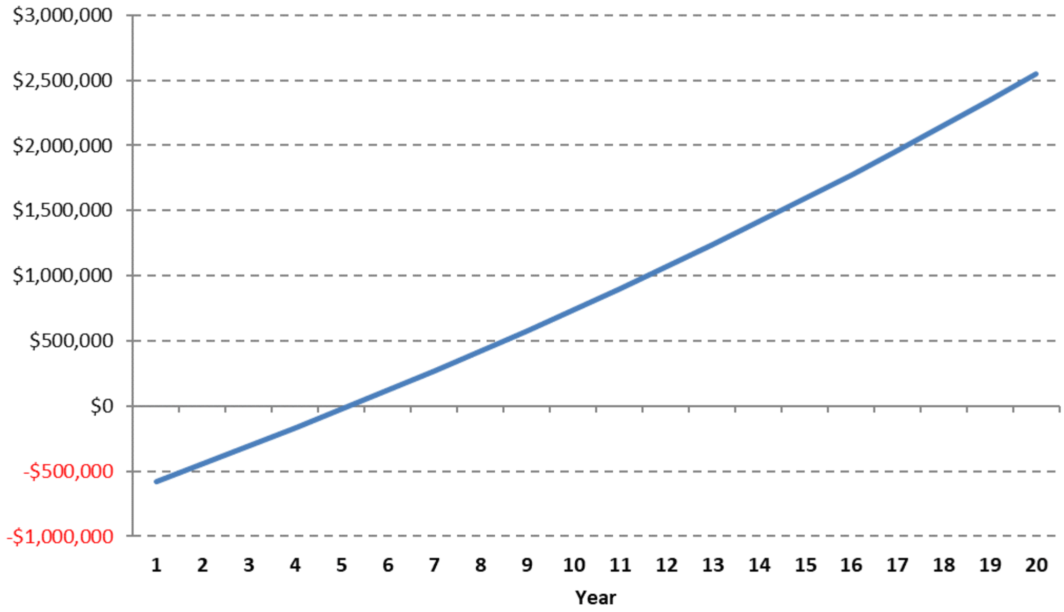

Figure 4: Murray 2 - Cumulative cash flow after tax with inflation

Conclusion

These two case studies demonstrate the financial returns possible through upgrades in irrigation technology. The initial level of upfront costs were similar per hectare, 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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