Investing in Variable Rate Irrigation to increase pasture growth and save energy and water

KEY MESSAGES

- Variable Rate Irrigation (VRI) was incorporated into a centre pivot that irrigated a 111ha area of pasture for dairy production at Cressy in Tasmania.
- When combined with improved irrigation scheduling, the VRI provided a range of benefits including water savings, power savings, and increased pasture consumption.
- It appears likely that investing in VRI was a very profitable option for this site, even if the savings in irrigation water, electricity and increases in pasture consumption are less than half of what the monitoring suggested.
- This centre pivot covers a large area with significant variation in soil type. An investment in VRI may not be profitable for a smaller pivot with less variation in soil type. The expenditure on the soil survey appears to be worthwhile before investing.

ABOUT THE RESEARCH

This case study is focussed on the site at Cressy where a 111ha area of perennial ryegrass pasture for dairy production was irrigated with a centre pivot. Initial monitoring indicated that there was potential for some improvements in irrigation efficiency with the incorporation of Variable Rate Irrigation (VRI) and improved scheduling for the centre pivot.

Given the high capital cost of VRI, it was considered sensible to conduct a soil survey and mapping to get an indication of potential benefits. Hence, the site was EM38 surveyed. That data showed that there was enough variation in soil water holding capacity to suggest there could be substantial benefits from installing VRI.

Once installed and combined with good irrigation scheduling, the VRI began to show a range of benefits which included a reduction in irrigation water applied and subsequent reduction in electricity use for pumping, and increased pasture growth rates. Under the old flat rate application, there were areas that were often too wet and other areas too dry during the irrigation season. With VRI it became possible to keep soil moisture levels much closer to optimal across the whole area and pasture growth rates improved considerably in these areas.

The VRI allowed the pivot to be switched off when travelling over the laneways, gateways and around water troughs. This resulted in less boggy patches that made it easier for movement of machinery and cows.

In summing up the impact of the project on his farm, Rob Bradley stated "We're putting the water where it needs to go, we're using less power to do it, and we're growing more grass".

ANALYSIS OF FARM LEVEL COSTS AND BENEFITS

The estimated benefits and costs of incorporating VRI into the 111 ha pivot were analysed. The analysis applied discounted cashflows over 10 years and applied a 5% discount rate[1].

Capital Expenditure/Setup Costs. A cost of $95,000 to retrofit VRI to the pivot (including software and Variable Speed Drive) was assumed. There was also $4,000 for a new pump and $12,000 for a river screen to exclude sediment and debris which reduced problems with blockages dramatically. The cost for the soil survey and mapping (EM38) was about $6,330.

Amount of extra pasture consumed. The pasture growth rates were measured with a rising plate meter and this indicated that there was an extra 20 kg DM/ha/day for 90 days as a result of implementing the VRI and improved scheduling. This suggests an additional 1.8 t DM/ha/year could be consumed. However, it is possible that other changes in management practices may have also had an impact on this. In this analysis we tested a range of additional amounts of pasture consumed (0.5, 1.0, 1.5 and 2.0 t dry matter per ha) to estimate the 'break-even' amount required that would result in VRI being an attractive investment.

Value of extra pasture consumed. A value of $250/t dry matter for the additional pasture was used to represent a long-term typical value for supplementary feed of similar quality (assuming all the extra pasture could be consumed via grazing and no extra harvesting costs were incurred. A value of $125/t dry matter were also used to test the sensitivity and is likely to be a better reflection of the value if the extra pasture needed to be conserved and fed back.

Value of irrigation water saved. It was assumed that the total amount of water being applied by the pivot decreased from 700 ML to 490 ML per year (this equates to a reduction of 1.9 ML/ha/year). A value of $40/ML was assumed for the saved water. Savings of half this amount were also analysed.

Value of energy saved. It was assumed that the total amount of energy required for pumping reduced in proportion to the amount of irrigation water being applied (this equates to a reduction of $11,600/year in power costs). Savings of half this amount were also analysed.

Other changes in operating costs. It was assumed that any extra labour or repairs and maintenance costs were balanced out by benefits for labour and herd health associated with less waterlogging of laneways, gateways etc.

Investing in VRI for this site would provide very attractive returns if an extra 0.5 t DM/ha of pasture is consumed

The results indicate that the investment in VRI provides very attractive returns if an extra 0.5 t DM/ha of pasture is consumed, with and Internal Rate of Return (IRR) of 43% and 3 years to break-even (Table 1). The pasture growth rate measurements indicate that the extra pasture consumed was substantially higher than this, making VRI a very profitable investment. If no extra pasture was

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consumed, then it appears VRI and the other improvements would be attractive investment for this site (IRR 19%) due to the water and power savings.

Table 1. Summary of results. Discounted cashflows of benefits from VRI compared to the baseline scenario.

Extra pasture consumed (t DM/ha)	**0.5**	**1.0**	**1.5**	**2.0**
(Extra Pasture valued at $250/t DM)				
Internal Rate of Return (nominal)	43%	73%	117%	189%
Years to pay back (after interest)	3	2 or less	2 or less	2 or less

The results are sensitive to the value of the extra pasture consumed (Table 2). If 0.5 t DM/ha of extra pasture was consumed, then it appears VRI would still be a very attractive investment for this site if the value of the extra pasture was $125/t DM. This value for the extra pasture is likely to be a better estimate if the extra pasture needed to be conserved and fed back as was sometimes the case for this site.

Table 2. Sensitivity to the value of extra pasture. Discounted cashflows of benefits from VRI compared to the baseline scenario.

Extra pasture consumed (t DM/ha)	**0.5**	**1.0**	**1.5**	**2.0**
(Extra pasture valued at $125/t DM)				
Internal Rate of Return (nominal)	31%	43%	57%	73%
Years to pay back (after interest)	4	3	2 or less	2 or less

If the irrigation and power savings were only half of what was initially assumed, then the investment in VRI and improved scheduling would still be reasonable (IRR 14%) with 0.5 t DM/ha of extra pasture consumed at a value of $125/t DM (Table 3).

Table 3. Sensitivity to the amount of irrigation water and power saved. Discounted cashflows of benefits from VRI compared to the baseline scenario.

Extra pasture consumed (t DM/ha)	**0.5**	**1.0**	**1.5**	**2.0**
(Half the water and power savings and extra pasture valued at $125/t DM)				
Internal Rate of Return (nominal)	14%	25%	37%	50%
Years to pay back (after interest)	7	5	3	3

Concluding remarks

It appears likely that investing in VRI and improved irrigation scheduling was a very profitable option for this site. This centre pivot covers a large area with significant variation in soil type. An investment in VRI may not be profitable for a site with less variation in soil type.

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