Investing in Variable Rate Irrigation to improve pasture growth in WA

KEY MESSAGES

- Variable Rate Irrigation (VRI) was incorporated into a centre pivot that irrigated a 100ha area of pasture for dairy production at Boyanup in Western. Australia.
- The VRI provided a range of benefits which led to increased pasture consumption.
- It appears likely that investing in VRI was a very profitable option for this site, if an extra 1 t DM/ha of pasture was consumed.
- 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. The expenditure on the soil survey appears to be worthwhile before investing.

ABOUT THE RESEARCH

This work was initiated in 2014 but, the implementation was refined over the following 5 years as part of the ***Smarter Irrigation for Profit*** project co-ordinated by Sam Taylor. The site was a 100ha area of kikuyu / annual ryegrass pasture for dairy production at Boyanup in WA which was irrigated with a centre pivot. There was some variation in soil type and there were areas that were often boggy and led to a number of management challenges and inefficiencies. This suggested that there was potential for improvements in irrigation efficiency with the incorporation of Variable Rate Irrigation (VRI) for the centre pivot.

Given the high capital cost of VRI, it was considered sensible to conduct soil sampling and mapping to get an indication of potential benefits. Hence, the site was EM38 and Gamma Radiometric surveyed. That data was used to identify soil sample points, which were then extracted and soil attributes including water holding capacity were determined. That data showed that there was enough variation in soil water holding capacity, to suggest there could be substantial benefits from installing VRI.

The cost of the initial soil survey was around 10% of the cost of the VRI installation, which helps avoid needless capital expenditure if VRI is not found to be worthwhile. The farmer describes the investment in the soil survey as a "no brainer" and this approach saved them investing in VRI for a second pivot on the farm where the soil survey indicated minimal benefit was likely from incorporating VRI.

Once installed, the VRI began to show a range of benefits which led to increased pasture consumption. 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. This meant that in spring time the start up time could be earlier as there was much less risk of some areas being waterlogged. In autumn it became much easier to optimise the sowing of annual ryegrass without compromising irrigation scheduling. Overall, the total amount of water being applied to the pivot remained about the same but, it was used more productively.

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The VRI allowed the pivot to be switched off when travelling over the central laneway, gateways and around water troughs. This resulted in less boggy patches that made it easier for movement of machinery and cows which appeared to contribute to a range of benefits, such as better udder health, less mastitis and, improving milk quality.

ANALYSIS OF FARM LEVEL COSTS AND BENEFITS

The estimated benefits and costs of incorporating VRI into the 100ha pivot were analysed. The analysis applied discounted cashflows over 10 years, and applied a 5% discount rate.

Capital Expenditure/Setup Costs. A cost of $60,000 to retrofit VRI to the pivot (including software) was assumed. There was also an additional $25,000 for a variable speed drive (VSD) which the farmer found necessary to get the full benefit of the VRI. The cost for the soil survey (EM38 and Gamma Radiometric) was $6,000.

Amount of extra pasture consumed. The amount of extra pasture consumed as a result of implementing VRI was not measured. The farmer estimated there was 30% more pasture consumed (~3 – 4 t DM/ha) based on the reduction in the amount of supplementary feed required. 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. Values of $125 and $375 /t dry matter were also used to test the sensitivity. It was assumed that all the extra pasture could be consumed via grazing and no extra harvesting costs were incurred. The farmer indicated that this was what had occurred for their situation.

Value of water saved. It was assumed that the total amount of water being applied by the pivot did not change.

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 1 t DM/ha of pasture is consumed

The results indicate that the investment in VRI provides very attractive returns if an extra 1 t DM/ha of pasture is consumed, with and Internal Rate of Return (IRR) of 40% and 3 years to break-even (Table 1). The farmer estimates that the extra pasture consumed was substantially higher than this, making VRI a very profitable investment. If less than 0.5 t DM/ha of extra pasture was consumed, then it appears VRI would be unlikely to be an attractive investment for this site.

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)	13%	40%	75%	129%
Years to pay back (after interest)	7	3	2 or less	2 or less

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The results are sensitive to the value of the extra pasture consumed (Table 2). If less than 1 t DM/ha of extra pasture was consumed, then it appears VRI would be unlikely to be an 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.

If the extra pasture is valued at $375/t DM then VRI becomes an even more attractive investment. This value is likely to be a reasonable estimate for a drought period but is unlikely to remain at this level for the life of the investment.

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)	-2%	13%	26%	40%
Years to pay back (after interest)	10 or more	7	4	3
(Extra Pasture valued at $375/t DM)				
Internal Rate of Return (nominal)	26%	75%	170%	486%
Years to pay back (after interest)	4	2 or less	2 or less	2 or less

Concluding remarks

It appears likely that investing in VRI 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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