Investing in satellite technology to save irrigation water on a large-scale farm in northern Victoria

KEY MESSAGES

- Increased precision for irrigation duration and scheduling by using satellite technology and sensors was tested on perennial pasture for dairy production on case study farms in northern Victoria.
- The profitability of this technology depends on the capital cost, the amount and value of irrigation water saved, and any associated increases in pasture consumption.
- If irrigation water is valued at $120/ML it is likely to be a profitable investment with 'low end' capital cost. If irrigation water is valued at $300/ML, then the 'high end' investment in improved satellite technology and sensors would be an attractive investment if the saved irrigation water was 0.45 ML/ha (IRR 29%).
- The use of this technology on the scale analysed for this farm business has not been tested as yet. *This technology may provide different benefits and challenges when implemented on farms with less developed infrastructure.*

ABOUT THE RESEARCH

As part of the ***Smarter Irrigation for Profit Phase 2*** (SIP2) project, Amjed Hussain, Andy McAllister and Des Whitfield of Agriculture Victoria set up the satellite-based irrigation management approach on sites on three farms in northern Victoria. Using the satellite-based irrigation management approach irrigators in the trial were able to reduce their irrigation durations by up to 30 minutes which can represent a reduction in water application of 10-20mm per irrigation. The approach was used to manage over 150 irrigation events in the 2020/21 irrigation season.

The results of the experiments showed that satellited-based irrigation management approach could be adopted to manage irrigations for different soil types, bay sizes, flow rates, soil deficits, and for open channel as well as pipe and riser irrigation systems.

The case study used in this analysis is located at near Tatura in northern Victoria and consists of 3 dairy farms located in close proximity and owned by the one family. There is a large area of perennial pasture (approximately 450 ha over the 3 farms). The precision with which the technology can be used to predicted the required irrigation duration to minimize runoff has impressed the farmers. They are interested in investigating whether the technology can be scaled up from the 18ha trial site to the 450 ha of perennial pasture.

The pasture is irrigated with a laser graded border-check layout. Most irrigation runoff is captured by a re-use system and they have some automation. The farmers see benefits in this technology regardless of whether there is automation or not.

ANALYSIS OF FARM LEVEL COSTS AND BENEFITS

The estimated benefits and costs of incorporating satellite technology and sensors into the irrigation management of 450 ha of perennial pasture irrigated with an automated pipe and riser system were analysed. The analysis applied discounted cashflows over 10 years.

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Capital Expenditure/Setup Costs. A 'high end' cost of $292,500 ($650/ha) was assumed to purchase, install and commission the communication technology and the water depth meters at the end of the bays and in the supply channel. A 'low end' cost of $87,300 ($194/ha) to purchase, install and commission the communication technology and the water depth meters was also analysed.

It was assumed that the technology would have a useful life of 10 years.

Quantity of irrigation water saved. It was assumed that the total amount of irrigation water running off the end of the bays was reduced by 3 ML/ha/year with this technology. This runoff was previously captured by a re-use dam and recycled but, it was assumed that 30% was lost to evaporation and deep drainage through the recycling process, hence it was assumed that the savings were 0.9 ML/ha/year. This meant that there would also be a reduction in pumping 2.1 ML/ha/year from the recycle dam at a cost of $10/ML (this cost may currently be higher). The quantity of irrigation water saved could be higher on a farm without an irrigation re-use system. Savings of 0.45 and 1.35 ML/ha/year were analysed in addition to 0.9 ML/ha/year.

Value of saved irrigation water. A value of $120/ML was assumed for the saved irrigation water (high availability period). A value of $300/ML was also analysed to reflect periods of lower irrigation water availability.

Amount of extra pasture consumed. Pasture growth rates were not measured in this trial. It is possible that this technology could lead to increased pasture consumption but it will most likely require integration with related grazing management programs to realise a substantial increase. The farmers visual observation was that the pastures on the trial site were as good as any on the farm but it is difficult to predict that there will be an increase without pasture measurements. In this analysis we tested the sensitivity of economic performance of an additional amount of pasture consumed of 0.5 t dry matter per ha.

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.

Other changes in operating costs. It was assumed that there were savings in labour of 80? hours/year with reduced checking for water to reach the end of bays. The farmers see a benefit for labour in that a reduced reliance on the re-use system can reduce the duration of irrigation on each bay which could add up to a substantial reduction in the number of days taken to irrigate 450 ha. This would allow more time to be focussed on other aspects of the business when not irrigating. There will be an increased requirement to collate and interpret data but this shouldn't require much more time than if the technology was used on a small area of pasture.

A software subscription of $7,200 per year was assumed for the 'high end' capital cost system but, not for the 'low end' system. An increase in repairs and maintenance of $4,500 per year was assumed.

Investing in improved satellite technology and sensors at the 'low end' capital cost would be a very attractive investment if the saved irrigation water was 0.45 ML/ha and irrigation water was valued at $120/ML.

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The results indicate that the 'high end' investment in improved satellite technology and sensors would not be an attractive investment if the saved irrigation water was valued at $120/ML and there was less than 0.8 ML/ha of saved irrigation water (Table 1). The 'low end' investment in improved satellite technology and sensors would be an attractive investment even if the saved irrigation water was 0.45 ML/ha and irrigation water was valued at $120/ML (with no additional pasture consumed). Savings of this magnitude appear possible on this soil type.

Table 1. Summary of results. Discounted cashflows of benefits from investment in improved satellite technology and sensors compared to the baseline scenario (saved water valued at $120/ML).

Saved irrigation water (ML/ha)	**0.45**	**0.9**	**1.35**
('High end' capital cost)			
Internal Rate of Return (nominal)	4%	19%	34%
Years to pay back (after interest)	10 or more	6	4
('Low end' capital cost)			
Internal Rate of Return (nominal)	70%	Over 100%	Over 100%
Years to pay back (after interest)	2 or less	2 or less	2 or less

The results are sensitive to the value of the saved irrigation water (Table 2). If irrigation water was valued at $300/ML, then it appears the 'high end' improved satellite technology and sensors could be an attractive investment if the saved water was 0.5 ML/ha (14%). The 'low end' investment in improved satellite technology and sensors would be an attractive investment if the saved irrigation water was 0.1 ML/ha (IRR 39%). A value of $300/ML is not uncommon in this region during periods of low irrigation water availability.

Table 2. Summary of results. Discounted cashflows of benefits from investment in improved satellite technology and sensors compared to the baseline scenario (saved water valued at $300/ML).

Saved irrigation water (ML/ha)	**0.45**	**0.9**	**1.35**
('High end' capital cost)			
Internal Rate of Return (nominal)	11%	52%	Over 100%
Years to pay back (after interest)	8	3	2 or less
('Low end' capital cost)			
Internal Rate of Return (nominal)	Over 100%	Over 100%	Over 100%
Years to pay back (after interest)	2 or less	2 or less	2 or less

The results are sensitive to increases in pasture consumption. If the 'high end' technology enabled an increase of 0.5 t DM/ha of pasture consumed, then it would be an attractive investment with water savings of 0.45 ML/ha (IRR 43%) and with water valued at $120/ML (Table 3). At the 'low end' capital cost the technology would be a very attractive investment with less than 0.45 ML/ha of saved irrigation water, if pasture consumption increased by 0.5 t DM/ha.

A 0.5 t DM/ha increase in pasture consumption just from the satellite technology and sensors is unlikely but, it may contribute to benefits if integrated with related grazing management programs. On a large farm business such as this there may be benefits from ensuring more uniform irrigation practices and making it easier to have standard operating procedures for people involved in irrigating. It could also help fast-track the learning of new managers with less 'trial and error' required.

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Table 3. Summary of results with a 0.5 t DM/ha increase in pasture consumed. Discounted cashflows of benefits from investment in improved satellite technology and sensors compared to the baseline scenario (saved water valued at $120/ML).

Saved irrigation water (ML/ha)	**0.45**	**0.9**	**1.35**
('High end' capital cost)			
Internal Rate of Return (nominal)	43%	60%	83%
Years to pay back (after interest)	3	2	2 or less
('Low end' capital cost)			
Internal Rate of Return (nominal)	Over 100%	Over 100%	Over 100%
Years to pay back (after interest)	2 or less	2 or less	2 or less

Concluding remarks

The profitability of the satellite and sensor technology depends on: the capital cost, the amount and value of irrigation water saved, and any associated increases in pasture consumption. If irrigation water is valued at $120/ML it is likely to be a profitable investment with 'low end' capital cost. If irrigation water is valued at $300/ML, then both the 'low end' and 'high end' capital investment in improved satellite technology and sensors would be an attractive investment if the saved irrigation water was over 0.45 ML/ha.

The application of this technology to an area as large as 450 ha of perennial pasture over 3 farms is yet to be tested but, the analysis indicates that there could be substantial benefits if it is successful.

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