New tech integrated smart sensing & automation for cotton

Application in bankless channel irrigation

KEY MESSAGES

- When labour savings are coupled with either small water savings or yield benefits from more efficient irrigation scheduling, the technology has the potential to generate a positive return on investment.
- Over an example 100 ha, the upfront cost of smart irrigation control in bankless channel cotton ranged from $155/ha (30 ha bays) to $328/ha (10 ha bays) and generated a positive return for all bay sizes.
- The equipment can be easily moved each season in line with crop rotations.
- Lifestyle factors such as reduced reliance on casual staff, reduced human error, and improved work-life-balance provide additional benefits.

ABOUT THE RESEARCH

As part of the ***Smarter Irrigation for Profit Phase 2*** (SIP2) project, Deakin University conducted field trials of smart sensing and automation systems in cotton production. The trials were conducted at two bankless channel irrigation systems in southern NSW near Whitton and Darlington Point.

The research demonstrated that smart sensing and automation can be achieved by linking a range of irrigation sensing and hardware platforms through cloud-based platforms.

These smart automation systems, developed by Deakin University and Padman Automation, use a range of sensors to measure soil and water parameters that automatically control irrigations.

ANALYSIS OF FARM LEVEL COSTS AND BENEFITS

This case study analysed the application of smart sensing and automation in example bankless channel cotton irrigation system. Costs and benefits were analysed over a 10-year period using discounted cashflows (5% discount rate).

Investment costs

The trials included Padman rubber flap gates with integrated smart sensing and automation platforms[1].

- Control hardware: Padman seasonal autowinches across irrigation outlets costing $1680 each and with a 10-year life, hardware can easily be moved each season in line with crop rotations, reducing farm level costs. Compatible gates are assumed to be already installed.
- Sensor network: Padman Sensor Pro sensors measuring water height and soil moisture in each bay and costing $800 per sensor. Watermark componentry is assumed to need replacing every 2 years for $60 per sensor. Sensors can be moved each season in line with crop rotations, reducing farm level costs.
- Communication network: Cloud-based infrastructure sensing and control. For this analysis, a solar powered LoRaWAN tower was installed for $3000, with connectivity fees of $350 per year per tower, and $10 per year per sensor. The range of the tower is up to 8km, allowing one tower to servicing multiple fields and decreasing farm level costs.

Cost sensitivity. The exact system requirements and costs may be dependent on the type of field layout and associated watering infrastructure (gates, etc), as well as bay sizes. With an example 100 ha of cotton grown per season, the upfront cost ranged from $155/ha (30 ha bays) to $328/ha (10 ha bays) (Figure 1).

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[1] Pers comm with John Hornbuckle (Deakin University), and Grant Oswald (Padman Stops).

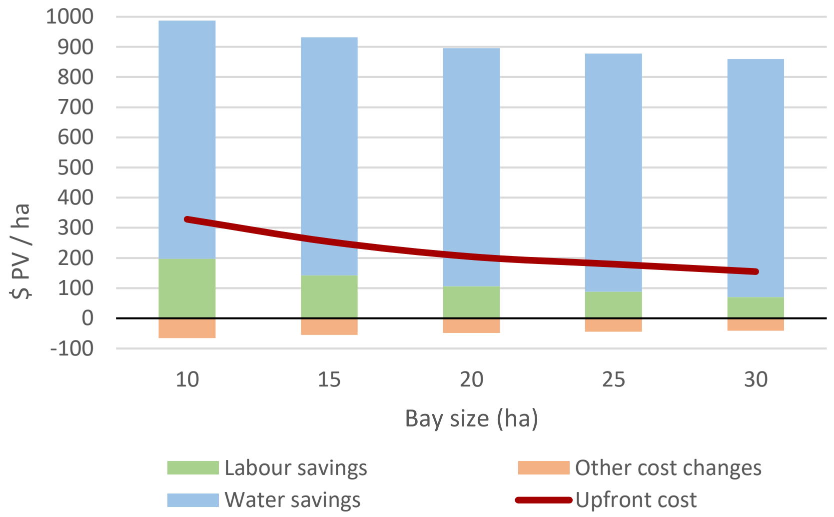

***Figure 1**. Investment costs and benefits (10 years, 5% discount) for 100 ha with different bay sizes*

Investment benefits

Figure 1 compares the upfront investment cost to net benefits including labour savings, water savings, and other irrigation cost changes. As the equipment can be moved each season in line with crop rotations, benefits can be generated each year pending water availability. Over 10 years, the example 100 ha investment generated benefits greater than costs for all bay sizes.

With an example 100 ha of cotton grown per season, the upfront cost ranged from $155/ha (30 ha bays) to $328/ha (10 ha bays) and generated a positive return for all bay sizes.

Labour use changes. By automating irrigation checks and changes, smart irrigation technology can reduce irrigation labour costs by up to 90%[2]. This analysis applied a more conservative 85% saving to a baseline labour use of 0.4 hr/ha/year for a cotton bankless channel layout with 20 ha bays[3], and with labour valued at $40/hr (including on-costs). As labour use is linked to bay checks and changes, the labour requirement (and savings) for a given area decreases with larger bay sizes (see Figure 1).

Over 10 years, labour savings were equal to between 45% to 60% of the upfront cost per ha. This highlights the relatively high labour efficiency of the large bay sizes used in cotton. The use of the technology in crops other than cotton, such as winter crop rotations, was not included in this analysis and would provide additional benefit depending on the irrigation labour use intensity of the crop. In addition, other labour and lifestyle factors such as reduced reliance on casual staff, reduced human error, and improved work-life-balance may provide additional benefit.

When labour savings are coupled with either small water savings or yield benefits from more efficient irrigation scheduling, the technology has the potential to generate a positive return on investment.

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[2] Roth G et al. (2018) *Smarter Irrigation for Profit. A snapshot of research.* Cotton Research and Development Corporation, Australia.; and pers comm with Matt Champness (Deakin University), James Toskin (cotton trial site host), and Craig Saunders (early adopter) (June 2021).
[3] Pers comm with James Toskin (cotton trial site host), and Craig Saunders (early adopter) (June 2021).

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Water savings. By integrating the sensing and control elements, more efficient irrigation changes can provide water savings through avoided losses from deep drainage, conveyance losses and storage evaporation. Avoided losses will vary depending on soils, irrigation systems, rainfall, and management practices. Saved water can be valued at the temporary transfer price or the value of additional crop production, and generates benefits from reduced pumping energy and maintenance costs.

While not measured as part of this research, improved irrigation efficiency from smart automation in cotton has reportedly resulted in water savings of up to 20%[4]. Figure 1 (previous page) shows a conservative 5% water saving on the baseline 8.2 ML/ha of irrigation water[5], generating an IRR of between 34% and 66% depending on the bay size. Actual savings could be higher, with 20% water savings reported in other research indicating a large potential upside in the results. The use of the technology in crops other than cotton, such as winter wheat rotations, was not included in this analysis and could provide additional benefit depending on the water use intensity.

Other irrigation costs. Smart irrigation control includes ongoing system maintenance relating to replacing the watermark componentry on the sensors, and annual fees for network connectivity as outlined in the system costs. Net changes in other irrigation costs reduced total benefits by between 5% (30 ha bays) to 7% (10 ha bays).

Smarter Irrigation for Profit Phase 2 (SIP2) is a partnership between the irrigation industries of sugar, cotton, grains, dairy and rice, research organisations and farmer groups and is supported by funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program. For information on the SIP2 research, including the Deakin project underlying this analysis, visit https://smarterirrigation.com.au/.

For more information on this economic analysis, please contact George Revell, Principal Economist at Ag Econ, through george@agecon.com.au.

[4] Up to 20% from Roth G et al. (2018) *Smarter Irrigation for Profit. A snapshot of research.* Cotton Research and Development Corporation, Australia; and 10–15% from Craig Saunders (early adopter).
[5] Pumped from source, based on Powell et al. (2021) Australian Cotton Industry Gross Margin Budgets — Furrow Irrigated.

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