Smart Irrigation control in rice growing systems

Application in bankless channel irrigation

KEY MESSAGES

- Over an example 100 ha of rice grown per season, the upfront cost ranged from $279/ha (12 ha bays) to $700/ha (3 ha bays) and generated a positive return for all bay sizes.
- The technology generated a positive return from labour savings alone (IRR of 9%).
- On top of labour savings, water savings provide a strong upside potential with an indicative water saving of 1% increasing the IRR to between 14% and 19% depending on the bay sizes.
- Longer term, smart irrigation control systems have been identified as a key supporting factor for the industry to move to a 'dry rice' or 'flush irrigation' cropping system, which aims to reduce water use even further.
- As the equipment can be easily moved each season in line with crop rotations, benefits can be generated each year pending water availability.

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 rice production. The trials were conducted at two sites in southern NSW at Widgelli in the Murrumbidgee Irrigation Area, and the Rice Research Australia (RRA) farm near Jerilderie on a bankless channel layouts.

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 irrigation events and water bay heights.

ANALYSIS OF FARM LEVEL COSTS AND BENEFITS

Drawing on the Deakin SIP2 outputs, this case study analysed the application of smart sensing and automation in example bankless channel rice 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 rice grown per season, the upfront cost ranged from $279/ha (12 ha bays) to $700/ha (3 ha bays) (Figure 1).

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

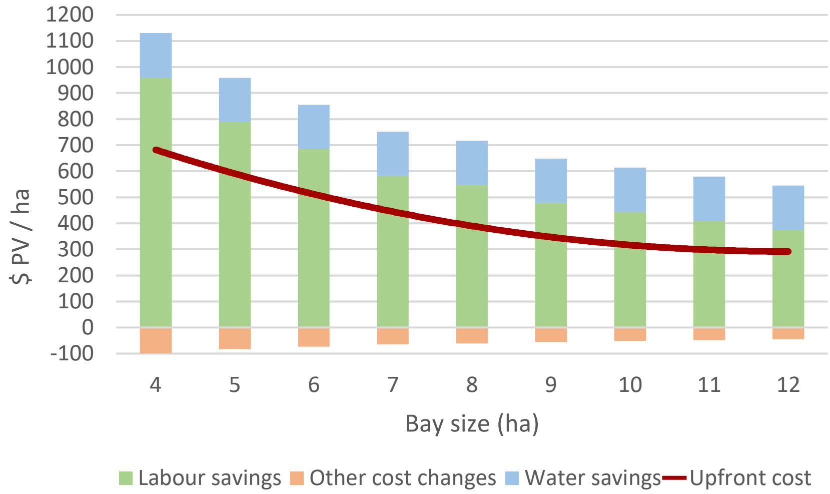

***Figure 1**. Investment costs and benefits (10 years, 5% discount) for 100 ha with different bay sizes*

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 in each of the 10 years pending water availability. Over 10 years, an example 100 ha investment generated benefits greater than costs for all bay sizes.

With an example 100 ha of rice grown per season, the upfront cost ranged from $279/ha (12 ha bays) to $700/ha (3 ha bays) and generated a positive return for all bay sizes.

Labour use changes. By automating irrigation checks and changes, the 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 2 hr/ha/year for a typical bankless channel layout with 8 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 for a given area decreases with larger bay sizes (see Figure 1). Over 10 years, the results showed that net benefits from labour and other operational cost changes (i.e. excluding water savings) were higher than the upfront cost, generating a 9% internal rate of return (IRR)[4], and showing that smart automation can be viable on labour savings alone. The use of the technology in crops other than rice, such as winter wheat rotations, was not included in this analysis and would provide additional benefit depending on the irrigation labour use intensity. 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.

The technology generated a positive return from labour savings alone, with additional water savings providing a potentially strong return on investment for all bay sizes.

[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), and Darryl Fiddler (rice trial site host).
[3] Groat M (SunRice) & Morger T (RGA) pers comm (February 2020)
[4] The internal rate of return (IRR) shows the annual rate of return that the investment earns and can be easily compared to the cost of capital, other investment options, or individual investor hurdle rates.

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Other costs. Other irrigation costs include energy use, and ongoing system 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. In this analysis, other irrigation costs reduced total benefits by an average 9%.

On top of labour savings, water savings provide a strong upside potential with an indicative water saving of 1% increasing the IRR to between 14% and 19% depending on the bay sizes. Actual savings could be significantly higher, with 20% water savings reported in other industries.

Water savings. By integrating the sensing and control elements, smart automation can enable improved scheduling and more efficiency changes, supporting water savings through reduced surface and deep drainage losses. Water losses will vary depending on soils, irrigation systems (including the use of on farm water recycling), rainfall, and management practices. Saved water can be valued at the temporary transfer price or the value of additional crop production. While not measured as part of this research, improved irrigation efficiency from smart automation in other crops has reportedly resulted in water savings of up to 20% through reduced run-off and deep-drainage[5]. Figure 1 (previous page) shows an indicative 1% water saving on the baseline 12.2 ML/ha of applied water[6], generating an IRR of between 14% and 19% depending on the bay size. Actual savings could be higher, with 20% water savings reported in other industries suggesting a large potential upside in the results. The use of the technology in crops other than rice, such as winter wheat rotations, was not included in this analysis and could provide additional benefit depending on the water use intensity.

Other potential benefits. The Deakin research also identified the potential for smart irrigation control systems to be a key supporting factor for the industry to move from a ponded anaerobic cropping to aerobic 'dry rice' or 'flush irrigation' cropping. Moving to an aerobic system, which aims to minimise water use, will be critical in ensuring the industries sustainability in a water constrained environment. In addition, water management is a key factor for the nitrogen cycle and nitrogen use efficiency (NUE) in irrigated agriculture, and changes in irrigation practices have the potential to impact nitrogen losses and environmental impact.

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.

[5] Roth G et al. (2018) *Smarter Irrigation for Profit. A snapshot of research.* Cotton Research and Development Corporation, Australia.
[6] ABS 4618.0 *Water use on Australian farms*.

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