Staged automation of irrigation in rice systems

Key points:

- Implementation of a smart irrigation system can be staged over time
- Developing your farm layout so automation can be added later is crucial to reduce costs
- Automation can generate a positive return from labour savings alone (IRR of 9%).
- Water savings of up to 20% through reduced run-off and deep drainage are achievable
- Equipment can be easily moved each season to increase flexibility around water availability
- Automation allows a transition to aerobic rice 'dry rice' or 'flush irrigation' cropping to minimise water use

Benefits of automated irrigation systems

- **Labour savings**
  - Labour costs can be decreased by 85%, for a typical bankless channel layout with 8ha bays. It also reduces reliance on casual staff and helps to achieve a better work-life-balance.
- **Water savings**
  - Smart automation can enable improved scheduling achieving water savings through reduced surface and deep drainage losses. Water management is a key factor for nitrogen use efficiency (NUE). Smart irrigation practices have the potential to reduce nitrogen losses.
- **Energy savings**
  - Automating a bankless channel system improves the energy productivity of the system by up to 11% because of less need to pump tailwater.
- **Enhanced irrigation flexibility**
  - Recent research has demonstrated that smart automation allows irrigators to easily implement delayed permanent water or "dry rice systems".

More detailed information on the benefits of automated irrigation for rice is available from the Smarter Irrigation for Profit website. Go to https://smarterirrigation.com.au > topics> automated irrigation.

Growing 'dry rice' commercially with smart automation

Darrell Fiddler, Farm Manager at De Bortoli Wines near Griffith worked with Deakin University to improve his return per ML of water by trialing automation to produce 'dry rice". The trial linked sensing, forecasting and automation systems to produce the first commercial dry rice crop in Australia. The first year trials yielded 1.1 t/ML and the move to dry rice produced water savings of up to 3ML/ha and reduced tailwater pumping costs.

"Integration of soil moisture sensors and forecasting extreme weather events with automation systems allowed water to be applied when the crop needed it to optimise production and minimise losses."

"Automation has allowed me to irrigate 1000 ha and still maintain a sleep so I can continue to function through the day. It is definitely a more affordable option now and I know some irrigators who only have the supply door and drain door automated and that is still beneficial automation." Nick Ronfeldt, Whitton

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A staged approach to automation

Step 1: Layout and design of the irrigation system

Upfront costs for automation are flexible depending on how it integrates with your current system. **Plan to automate when developing your farm to reduce the cost.** Layout of an irrigation enterprise and the in-field structures are the biggest cost in terms of automation. The more structures needing to be controlled the more automation hardware needed.

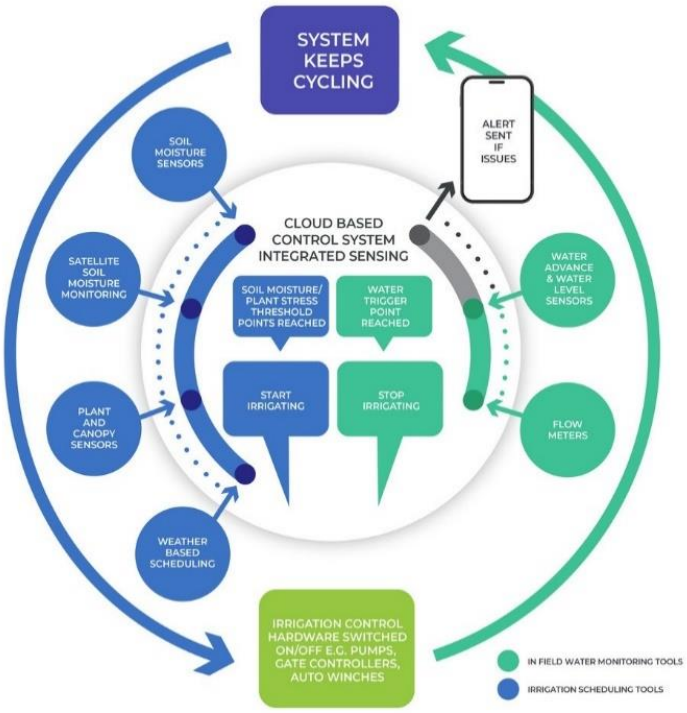
Step 2: Install structures that can be automated

Automation can be as simple as supply gates and drainage gates, which can be progressively converted to a smart irrigation system by including a range of sensors to schedule irrigations to meet crop needs.

When installing channel gates select drop in inserts and doors that are compatible with automation structures such as auto winches.

Step 3: Select hardware and sensors that can be integrated into irrigation decision support systems

Soil moisture, water level sensors and crop stress sensors together with automated irrigation control structures and weather forecasts are important components of a smart irrigation control system and are readily available.



A key barrier to the adoption of irrigation scheduling technologies is the diversity of tools available. Each irrigation scheduling tool has its own strengths and weaknesses and determining which tool is the best fit for a given farming system can be challenging. The use of sensors, however, ensures the water applied matches the crop water demand through the continuous monitoring of plants. Avoiding under and over watering improves farm profitability by increasing yield and water use efficiency.

Smarter Irrigation For Profit: Irrigation Tools and Technologies (2022) contains a summary of a range of irrigation tools and technologies that monitor, manage, sense and automate water movement or irrigation events.

Step 4: Choose a communication network.

Communication systems (telemetry) allow structures to 'talk' to each other so water can be applied and drained when it is needed by the crop rather than when the irrigator is able to do it manually. The ability to be able to provide connectivity for an automated system depends on the area to be covered and the access to electricity in the field.

These issues can be overcome through a number of ways including:

1. Wireless networks.
    - WLAN. A wireless computer network that links two or more devices using wireless communication to form a local area network (LAN) within a limited area. Through a gateway, a WLAN can also provide a connection to the wider Internet. Wi-Fi gateways can consist of a 24V/40W solar panel, a solar regulator, a 12V/9A battery, a 4G dongle, a router, and the Wi-Fi radio.
    - Low power wide area network (LPWAN). LPWAN can support a large number of devices over a large area, making them a great network choice for IoT and Machine Learning applications that utilise a lot of connected devices and sensors.
2. Satellites.
    - NBN Satellite access network
    - Low Earth Orbit Satellites, examples include Starlink Hubs and Myriota.

More detail is available from Smarter Irrigation For Profit: Irrigation Tools and Technologies (2022). Available at: https://smarterirrigation.com.au/irrigation-tools-and-technologies/

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Case study - integrated smart sensing & automation for rice bankless channel

This example is based on 100 ha of rice grown per season where smart sensing and automation was applied in a bankless channel rice irrigation system. Capital costs are based on 2022 estimates.

Control hardware *(Compatible gates are assumed to be already installed)*	Padman seasonal auto winches, $1680 each	• 10-year life • moved easily for each season
Sensor network	Padman Sensor Pro for water height and soil moisture, $800 per sensor Watermark componentry, $60 per sensor	• easily moved each season reducing farm level costs • Watermark componentry replaced every 2 years
Communication network	Solar powered LoRaWAN tower, $3000 Connectivity fees, $350 per year per tower $10 per year per sensor	• tower range up to 8km allowing one tower to servicing multiple fields and decreasing costs • ongoing system maintenance costs

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. 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.

Detailed economic case studies are available from the Smarter Irrigation for Profit website. www. smarterirrigation.com.au.

Smarter Irrigation Smarter Irrigation for Profit: Irrigation Tools and Technologies (2022).
https://smarterirrigation.com.au/irrigation-tools-and-technologies/

Economic case study.
https://smarterirrigation.com.au/wp-content/uploads/2021/08/Smart-Irrigation-control-in-rice-growing-systems_Case-Study_July-2021.pdf

Video-Irrigation Automation.
https://smarterirrigation.com.au/irrigation-automation/

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