Staged automation of irrigation in cotton systems

Key points:

- Automation can achieve up to 20% improvement in water productivity and an 85% reduction in labour.
- Upfront costs of automation are flexible depending on your irrigation layout.
- Automation can be staged: 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.
- Most important elements are soil moisture monitoring, water control and crop stress monitoring coupled with the automated irrigation control structures and weather forecasting.

Benefits of automated irrigation systems

- **Labour savings**
  - Economic analysis reports an 85% saving to a baseline labour use of 0.4 hr/ha/year for a cotton bankless channel layout with 20 ha bays with labour valued at $40/hr (including on-costs).
  - 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.

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

Rob Houghton, Whitton NSW

Rob Houghton moved to automating his bankless irrigation system because of the constant labour requirements of siphons and roto bucks and the flexibility needed to grow late season cotton in the southern cotton growing area to overcome any setbacks like waterlogging. Rob believes the greatest benefits of automation comes from more accurately managing the cotton planting window, in-season growing conditions and reducing the incidence of either water stress or water deficits.

“When I started with soil pressure sensors and capacitance probes, I was surprised how my ‘gut feel’ for when the plant needed water was out by three days on some occasions… using sensors reduced the need to be tearing around the farm checking things,” says Rob.

Rob found that the installation was easy but placing probes with varying soil types can be tricky. The telemetry could be seamlessly integrated into existing farm PC and i-phone technology which was easy to navigate and control.

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A staged approach to automation

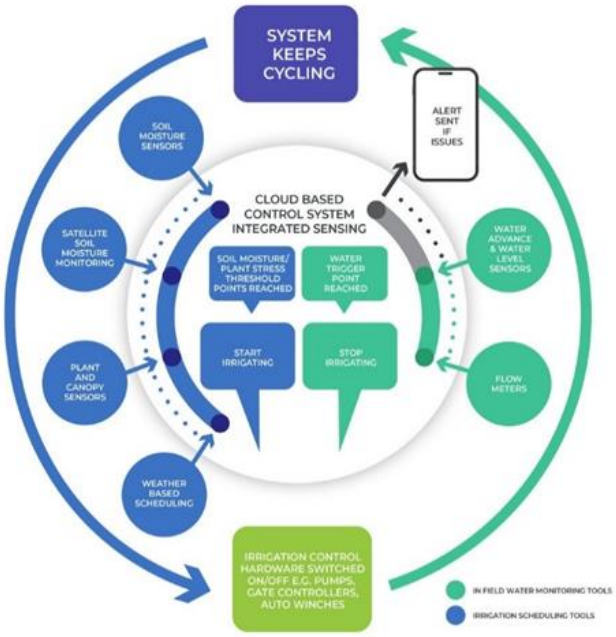
Step 1: Layout and design of the irrigation system

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, in both fully and partially irrigated crops. 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 cotton bankless channel

Costs are based on a 100ha bankless channel site in southern NSW with Padman rubber flap gates and integrated smart sensing and automation installed. Capital costs are based on 2021 estimates.

Upfront cost	$155/ha (30 ha bays) to $328/ha (10 ha bays)	• Larger bays have less structures to automate
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

Economic modelling found over 10 years; the case study 100 ha investment generated benefits greater than costs for all bay sizes. Labour savings were equal to between 45% to 60% of the upfront cost per ha. **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-Sensing-and-Automation-in-Cotton_Case-Study_Aug-2021-.pdf

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

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