Smarter Irrigation for Profit
PHASE II EVENT

Field day
Wednesday 10th February 2021
Keytah, Moree

GVIA Application of digital technologies for automated irrigation

Australian Government
Department of Agriculture, Water and the Environment

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Wednesday 10th February 2021
Keytah, Moree, NSW 2400
8am Start at W567 Bankless Channel development

Topic	**Presenters**
Welcome to GVIA Field Day	Zara Lowien
Sundown Pastoral Company	David Statham
Introduction to the GVIA and SIP2 projects at Keytah	Lou Gall
Discussion on experiences with irrigation of W567	Nathanial Phillis
New tech integrated smart sensing and automation in cotton	John Hornbuckle, Rodrigo FilevMaia (Deakin University)
PadmanStops Auto Winch	Grant Oswald (Padman Stops)
GoField – Canopy sensor and Soil probe	Tom Dowling (Goanna Ag)
Morning tea and site inspection	
10:15 Buses back to Bull Ring	
EnviroNode Farm Automation Control	Ric Otton, Michelle Quaglia (Dosec Design)
SISCOweb Irrigation Optimisation	Joe Foley, Malcolm Gillies (USQ)
Plant Based Sensing for Cotton Irrigation	Hiz Jamali, Chris Nunn (CSIRO)
Light weight surface drip technology	Gus De Notta, Jamie Zapp (Netafim)
Panel session: Adoption of automated irrigation	Drives for adoption, design, system choices, installation, performance, experiences and observations
Lunch and opportunity for growers to discuss with research representatives	

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The Smarter Irrigation for Profit Phase 1 enabled the completion of valuable research in areas including: irrigation system audits, irrigation scheduling research, investigation of new technology, evaluation of system design and water use efficiency assessments. It demonstrated that improved water productivity hinged on 'getting the basics right'. It found that irrigators could achieve a 10-20 percent improvement in farm profitability by adopting best practice and precision irrigation technologies. This initial project has now led to a second phase.

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. The objective of SIP2 is to improve the profit of over 4,000 irrigators. It has 14 sub-projects covering three main components:

- Development of new irrigation technologies including new sensors, advanced analytics to improve irrigation scheduling and strategies to reduce water storage evaporation.
- Cost effective, practical automated irrigation systems for cotton, rice, sugar and dairy.
- Closing the irrigation productivity yield gap for cotton, rice, dairy, sugar and grains irrigators through a network of 46 farmer led optimised irrigation sites and key learning sites located on commercial farms across Australia.

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Automated irrigation systems: Gwydir Valley demonstration of new digital irrigation technologies

1. What is the project about?

Automation of irrigation in the Australian cotton industry has the potential to improve water productivity, address challenges of labour resourcing and optimising irrigation efficiency.

This project will provide growers with commercially relevant information about how to best utilise irrigation monitoring tools and decision support systems to optimise irrigation. It will also provide advice on the installation and management of automated and autonomous irrigation systems.

2. What is happening in the 2020-2021 season?

The project builds on the previous five years of Keytah Irrigation System Comparisons, which assesses drip, lateral move, siphon and bankless channel for their water use efficiency and yield performance.

This year we have added an additional bankless channel field, a new 500ha automated field with three sets of five bays linked by automated gates. The new bankless development has been fitted with 30 Padman Stops Bankless Channel Bay Outlets incorporating Auto-winches enabling remote irrigation of the whole 500ha field.

This field is being used by the Deakin University team in their smart sensing and automation project and by CSIRO in their plant based sensing project.

There has been a complete upgrade of the system controlling the Smart Siphons. Smart Siphons are small pipe through bank (SPTB), fitted with a rotating elbow. Up to 150 siphons can be started at once remotely.

The remote siphon controller the EnviroNode Hub has been completely redesigned by Dosec Design, to provide a dashboard, mobile App and Bluetooth wireless control. The Hub provides wireless control of siphons and monitors, the channel level and water advance sensors in the field. The EnviroNode Farm Automation Controller (EFAC) enables the smart siphons to be started or stopped remotely via the EnviroDash from any web enabled mobile device.

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The subsurface drip tape has been replaced by a new surface drip tape. The automated system utilises the existing pump and filter set up, but instead of sub surface tape it utilises surface tape which is replaced each season. The tape is easily installed and fully recyclable. Irrigators who do not have an existing drip pumping and filter system will be able to hire one in a container to implement a drip system.

3. The project is providing value to irrigators through;

- Extention of key learnings from the Keytah Systems Comparison site incorporating design specifications and engineering considerations in the adoption of automated irrigation.
- Field testing of new sensors and systems including the infrastructure necessary to convert a typical siphon system into an automated system. It will identify the requirements for fitting a bankless system with automation.
- Reviewing measurement tools and decision support systems designed to enhance the efficiency of water use in irrigation, improve productivity and support more precise utilisation of limited resources.

For more information visit the GVIA and the Smarter Irrigation for Profit websites.
Contact: Lou Gall, Project Leader T: 0427 521 498 E: lou.gall@gvia.org.au

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Automated irrigation systems: integrated smart sensing and automation for cotton

1. What is the project about?

This project is developing and trialling low cost, integrated sensing and automation platforms that remove the requirement for manual irrigation checking and control. The irrigation platforms are being developed in partnership with growers and agriculture technology providers to ensure they are practical, reliable, and effective. The project is also building the capacity of research and commercial partners to offer 'fit for purpose' automated irrigation platforms.

Research and development activities are being conducted at the Irrigation Research and Extension Committee (IREC) demonstration farm at Whitton, and on commercial farms at Darling Point and Moree. The early results have been positive, and the owners of the 'Ringwood' commercial operation have expanded cotton irrigation automation across their multiple farms with approximately 800ha of irrigation layout converted across to automation technology systems for the 2020/2021 irrigation season.

2. Why automate irrigation systems?

Currently most irrigators manually check the status of fields and crops and irrigation controls. The process of checking status and controlling irrigation is both time consuming and inaccurate.

Early research results have confirmed that optimal sensing and forecasting systems linked to automated irrigation systems will enable irrigators to maximise productivity of their water whilst also reducing labour costs.

3. How will the research benefit irrigators?

The two key learning sites provide an opportunity for irrigators to assess, understand and use integrated, smart sensing irrigation technologies and automation platforms.

Commercial industry partners are offering systems developed in the project across the Australian cotton growing areas and networks to provide service support.

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4. Key results to date

Research activities demonstrated that the use of smart sensing and automation through a cloud-based platform can be achieved within an irrigation farming system. Linking across a range of sensing and hardware platforms and protocols for IoT based approaches.

Soil moisture tension has been identified as a key measurement which can be used for autonomous irrigation due to its 'absolute' measurement. This allows it to be used across multiple soil types without site specific calibration issues. This is an important consideration when using such data for autonomous irrigation. 'Calibration' and 'drift' in sensor data across an irrigation season are major issues when using soil moisture data for autonomous irrigation hardware control.

The project is developing a range of algorithms using machine learning. These are applied within irrigation seasons and across seasons to future predict soil moisture tension for triggering irrigation events. These will be further tested during the 2020/2021 irrigation season.

Additionally, to control irrigation during actual irrigation events (as opposed to scheduling timing of irrigation events). The use of water level data for triggering gate drops between irrigation bays has been refined. This is done by using both pressure transducer and ultrasonic water height sensors. The IRRISENS cloud-based app now controls watering events automatically using this data. This is particularly important on "difficult" soil types where infiltration is an issue.

The IRRISENS automation is used to control irrigation events to reach a water depth within bay and 'hold' the water at a level to promote infiltration without overtopping the hill or bed. This allows difficult soil types to be more effectively irrigated. The cloud based IRRISENS platform is run in a supervised or unsupervised fashion allowing full automation from the channel delivery outlet.

For further information or project progress updates, contact: John Hornbuckle, Project Leader; T: 0429 862 920 E: j.hornbuckle@deakin.edu.au

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Padman Stops infrastructure and automation

Infrastructure used at Keytah includes Padman Stops pipe end combo structure with:

- Pipe Ends (PE1000) modified for larger steps,
- 2 x MaxiFlow 1800 culverts
- 1000 Bubbler

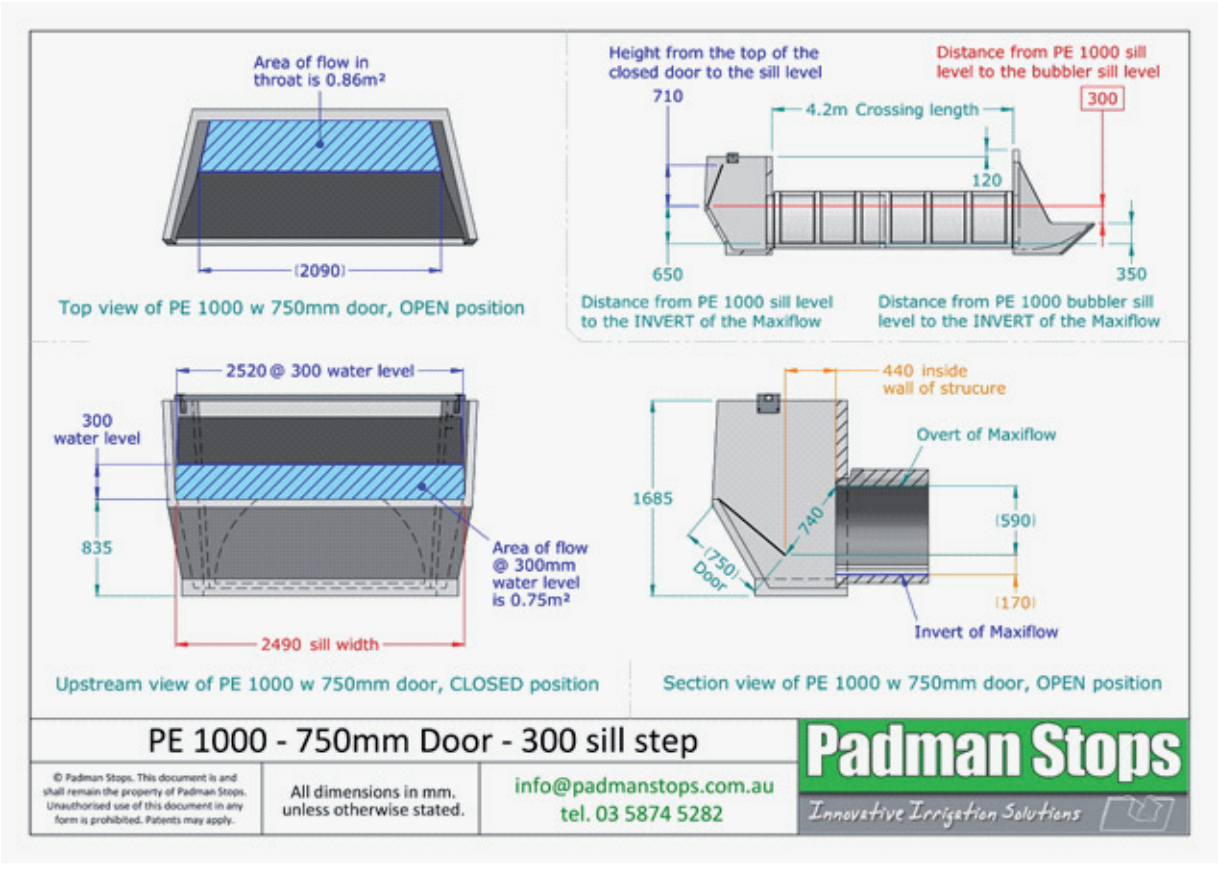
Structure can accommodate field steps of 150mm to 500mm. The overshot door has been designed to easily automate, self-clean and can be fully adjusted to set door height to overflow as a protection method or an erosion control method. The door points directly at invert of pipe for efficient flows

Aims for automation at the Keytah irrigation system site

- Soil moisture and scheduling data provide triggers on when to irrigate.
- In irrigation event triggering of water change over via both water advance and water depth sensors.
- Collaboration of different 3rd party system platforms via API's between GoannaAg, Deakin University etc.

Keytah automation has installed

- Autowinch Sense (with water level kit) attached to Padman PE1000 and Padman rubber inserts at drainage pits.
- Autowinch Screw drive attached to screw gates such as the Rodney industry gates at supply channel.
- Sensor Pro for monitoring of water heights in channel and water advance sensors to trigger automated outlets.
- Radio gateway to communicate between devices and Apps.
- The irrigation manager uses an IPAD to monitor and control status of devices via the Padman Webapp Portal and can also receive critical alerts via Padman Mobile App.



Cost of Keytah system at today's retail price

$180/ha capital cost

$10/ha ongoing per year cost for connectivity, apps and maintenance of devices.

- Costs does not include earthworks or water infrastructure for the Bankless layout.
- Costs represent a system that has the potential to be fully autonomous and are of the higher end of the cost range for this part of the world. Expect range of $150-$200/ha depending on system selection and irrigation layout such as size of bays.

Drivers for return on investment (ROI) for automation

1. Water use efficiency (WUE). Automation enables the irrigation manager the opportunity to execute critical events with timeliness for optimised precision irrigation with the following potential benefits:
   - Lower deep drainage losses, which research has shown to average 12% water loss. Which could be the equivalent of an extra irrigation = Less whole of system water used per hectare.
   - Reduce leaching of nutrients from soils – More nutrient available to plants = more yield per hectare and more yield per ML.
   - Roots underwater for less time means more growing time = more yield per hectare and more yield from less water.
2. Labour and Human Resources gains.
   - Reduction in required labour in paddock of approx. 85% - Live examples of irrigators spending 20 hours in travel and labour to perform change overs per irrigation event and reducing that to three hours.
   - Automation allows smart irrigation managers to be making more of the critical decisions which leverage's smart labour on farms better.
   - Reduction in human resource risk and overheads.
   - Reduction in safety risk with less staff hours being performed during the night and during rain events.

How much is your water worth per ML? How many ML would your farm need to save per hectare to achieve a high ROI from a $180/ha capital investment in automation?

Key points to consider when looking at automation

- Be wary about installing/designing full blown automation in new bankless layouts before doing a manual irrigation. Economical portable time-based automation available to assist initial irrigation are available whilst assessing full automation design.
- Understand what optimised irrigation is for your layout, soil types etc when considering designing a new automation system.
- Ensure thorough consultation with automation company in design process when considering full autonomous automation systems.
- Assess the automation companies' ability to understand the design requirements for your system, flexibility to implement system and then provide support and back up for the system ongoing.

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GoannaAg GoField Plus

GoField®

As an irrigator, you know that converting water into production drives the success of your business. But you also know that irrigation scheduling can be challenging…and that even a small mistiming will cost you money. And whilst the industry has made significant water use efficiency gains over the past 20 years, you have not had any new tools to drive further efficiencies.

But that just changed.

In conjunction with CSIRO and CRDC, Goanna Ag introduce you to the next generation of precise irrigation scheduling to optimise your water use efficiency. In an increasingly volatile environment where access to irrigation water has never been more challenging – you now have a solution that helps you make these critical decisions with greater confidence and precision.

Introducing GoField

GoField delivers you a fully integrated approach to better understanding how your crop is performing, the optimal time for next irrigation, how much water has been used and how efficiently it is using that precious water.

The insights generated from GoField enable you to make smarter irrigation decisions than ever before.

GoField combines existing moisture probe technology with our GoSat analytics as a base layer. We then add local weather observations, regular satellite imagery along with point specific short term forecasting.

This all helps understand what's going on in the soil and how the next 7 days weather will impact on your scheduling.

What makes GoField more powerful than ever, is the addition of a brand new sensor solution. CSIRO & CRDC have invested significant research efforts over the past 10 years to develop a sensor that focusses on the health of the growing plant. The result is the Canopy Temperature Sensor which, supported by unique and powerful analytics, takes irrigation management a quantum step forward.

For the first time, you now know precisely how your crop is performing and how you should best manage it's irrigation.

This data and decision support is displayed on the Goanna Ag app, putting this valuable information right into your hands.

The Outcome

GoField helps you make relatively complex and dynamic irrigation scheduling simpler and more precise – at a price that returns you significant value. In fact, trial work demonstrates a consistent ROI of tenfold, but of course that varies from field to field.

GoField is offered as an annual, all inclusive subscription service. There are no lock in contracts, which means you only need use the solution when you have a crop in the ground. It also means that Goanna Ag are always responsible for the performance of the sensor devices and that you do not need to commit to technology that will inevitably become superseded in the future.

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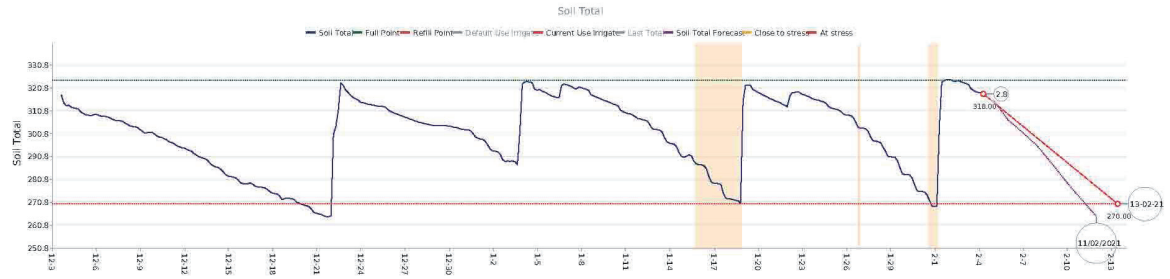
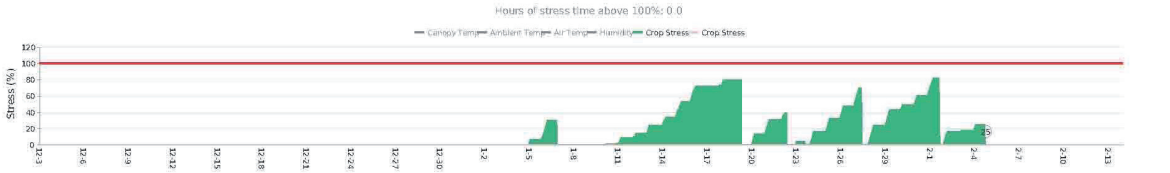
Location Details
Name : SPC W7A
Owner : Sundown Pastoral Co-Keytah
Start Date : 03-12-20 00:00:00
Last Reading : 04-02-21 07:41:47
Current Crop : Cotton
Active : true

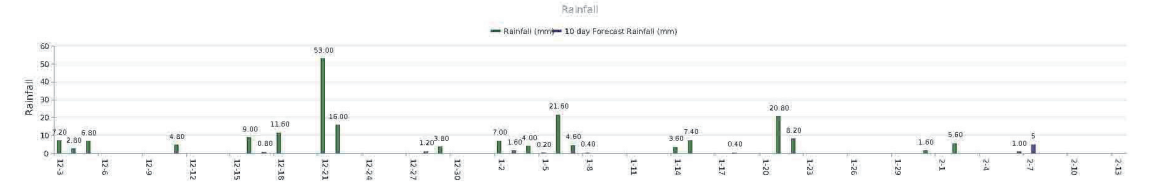
Rainfall
0 mm Last Hour
0 mm 6 Hours
0 mm 24 Hours
3 mm 48 Hours
7.2 mm 7 Days
74.2 mm 30 Days
519.8 mm 365 Days

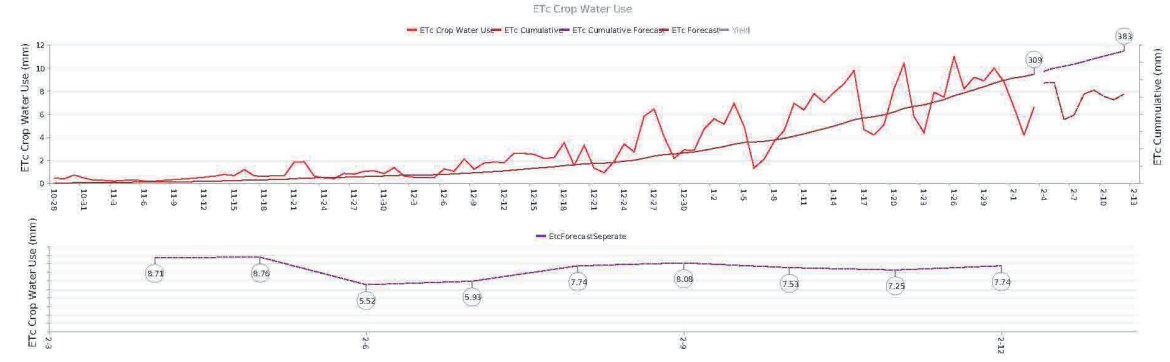
Irrigation Details
Default Usage(mm/day) : 8
Current Usage(mm/day) : 2.8
Irrigation Date (default) :10-02-21 06:12:59
Irrigation Date (current) :13-02-21 06:41:47

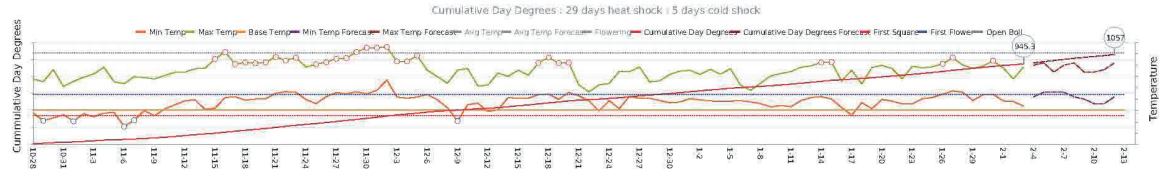
Crop Summary
Planting Date : 28-10-2020
End Date :
Refill Point : 270 mm
Full Point : 324 mm

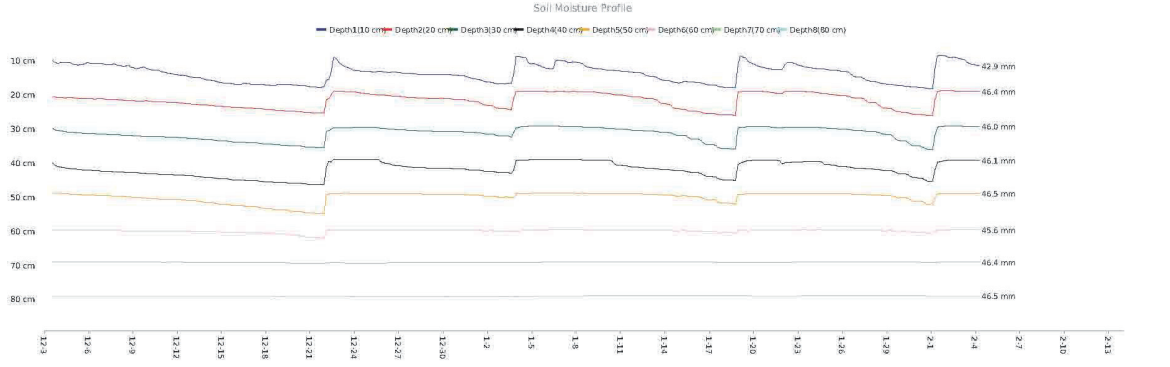










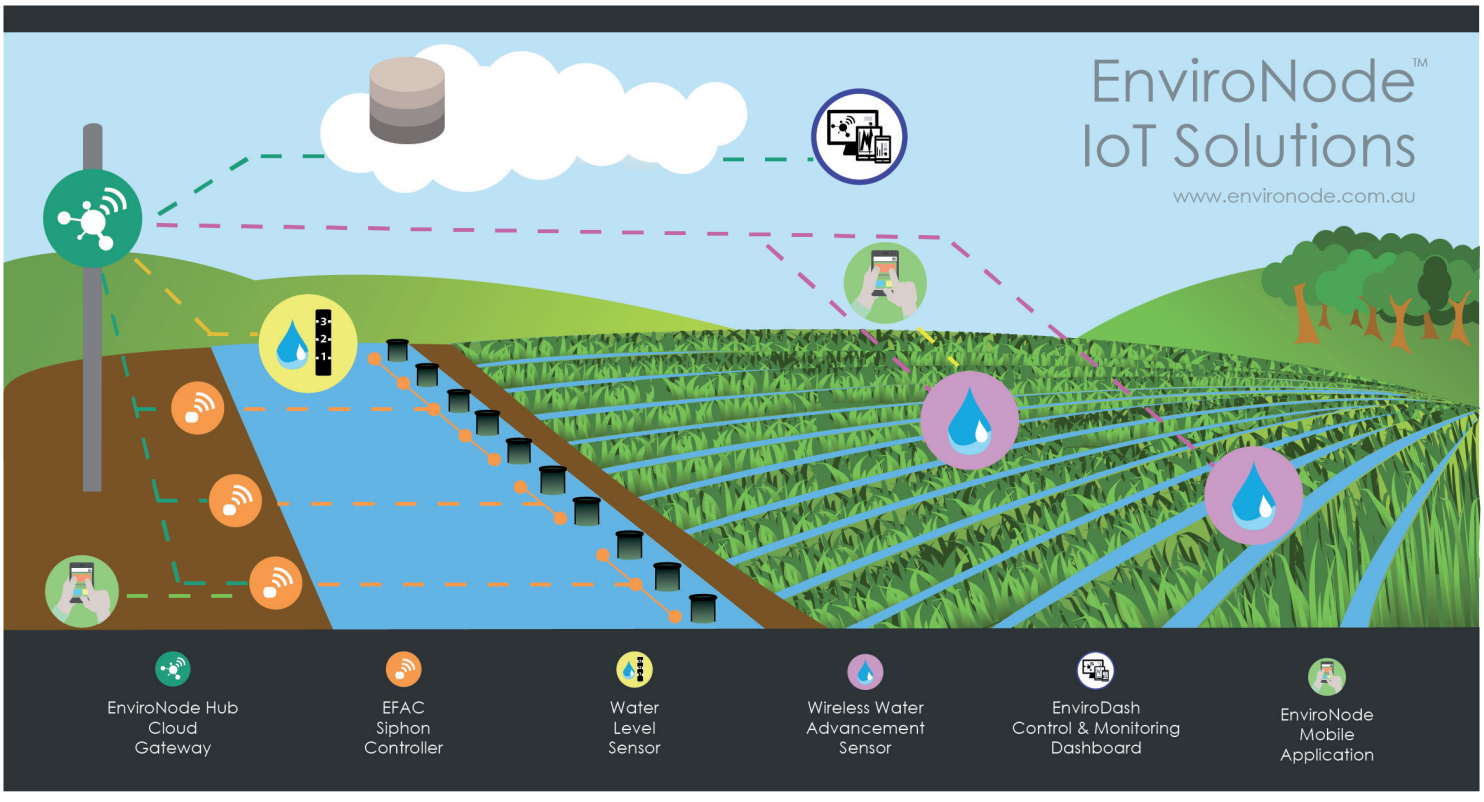


EnviroNode Hub and Farm Automation Control

The EnviroNode Hub, designed by EnviroNode IoT Solutions, is an autonomous controller for a whole farm irrigation system. It performs as a data logger, communication gateway, sensor interface and autonomous instrument controller.

At Keytah, the system has been set up to provide wireless control of siphons. Each siphon set has an EnviroNode Farm Automation Controller (EFAC). The EFACs are linked wirelessly to the Hub, enabling the smart siphons to be raised or lowered remotely via EnviroDash from any web enabled mobile device, or manually over Bluetooth with the EnviroNode mobile app.

There is a water level sensor directly wired to the Hub and a second level sensor connected via one of the EFACs. This EFAC is a weir controller, capable of opening and closing a weir whilst monitoring water level. The weir controller is managed and reported via EnviroDash, allowing remote weir management via the cloud.



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Water advance sensors have been installed in field and are linked by propriety LoRa to the Hub. They can be viewed and configured locally via the mobile app. Sensors such as weather stations can easily be linked to the Hub. All data is sent to the cloud, to enable ease of access.

System viewing and management, as well as complete system diagnostics are available via EnviroDash to support early detection and resolution of potential faults. The system includes email notifications and SMS alarms, and enables irrigators to remotely measure, monitor and control any parameters connected to it. It is also possible to set schedules to autonomously run irrigations.

The fit of the Environode IoT System is not limited to irrigation alone, other applications including fuel tank monitoring and pump management can be integrated into the system to enable whole farm remote management with local control.

For more information please contact:
Ric Otton or Michelle Quaglia at
Dosec Design Ph: (02) 9744 5766

EnviroNode™ IoT Solutions

Automated irrigation systems: precise real-time automated cotton and dairy irrigation for improved water productivity

1. What is the project about?

This project is developing fully autonomous broad-acre irrigation control systems for cotton (furrow & pivot) and dairy pasture (pivot). Research is being conducted on large commercial-scale fields under real farming conditions to ensure the systems are robust, reliable, and practical. The aim is to maximise water productivity by using existing advanced bio-physical crop modelling in conjunction with the latest irrigation optimisation models under the VARIwise control system.

Activities include further development of; VARIwise cotton yield and dairy pasture biomass prediction capability based on fixed tower and UAV camera vision analysis of key plant attributes; and SISCOweb synchronous furrow irrigation optimisation measurement and modelling techniques. The project is also supporting the commercial development of irrigation automation technologies previously developed in Smarter Irrigation for Profit Phase 1. Project sites are located on farms near Burnie, Jondaryan and Wee Waa.

2. Is remote control of irrigation practical?

The autonomous irrigation technology developed through this project will support unassisted operation of autonomous broad-acre irrigation systems for cotton and dairy. The vision of operating a broadacre irrigation system remotely is now a reality.

While research to ensure these systems are robust is ongoing, some of the automation products representing interim steps toward fully autonomous optimised irrigation control systems are now under commercial development.

The SISCOweb server based system to optimise furrow irrigation events when triggered by advance sensors is fully operational and running on commercial servers through the USQ API.

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3. How will the research benefit irrigators?

Autonomous irrigation systems can increase water productivity and reduce labour costs improve measurement, and inform better water use.

Furrow irrigation optimisation leads to an average 10 to 15% water saving per irrigation event. Commercial scale deployment of remote-controlled furrow irrigation is now common for less than $800/ha.

VARIwise controlled cotton irrigation has led to a 6% yield improvement and 14% more efficient water use. The VARIwise Yield Predictor has regularly predicted final cotton yield to within 3% of actual yield six weeks prior to picking.

4. Key results to date

VARIwise Yield Predictor, and the SISCOweb synchronous surface irrigation automation systems have undergone further software and imagery analysis development. Proof-of-concept trials have been completed in commercial irrigation fields in cotton and dairy and further testing is currently being undertaken on commercial sites.

The SISCOweb software for autonomous synchronous optimisation of surface irrigation has undergone further sensor input upgrades and developments. Data transmission equipment has undergone rigorous and repeated testing and trials on farms and on-campus, for sensor to server interactions, including the SPOC data-checking and Tagglert SMS (grower advice) components of the autonomous surface irrigation optimisation process.

Anlysis of data from the 19/20 irrigation season found that while cotton canopy cover was accurately determined from both UAVs and satellites, open bolls could be best counted from UAVs overhead, or side monitoring cameras in morning.

For further information or project progress updates, contact: Joseph Foley, Project Leader T: 07 46 311 559 E: foley@usq.edu.au

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New technologies: Plant-based sensing for cotton irrigation

1. What is the project about?

Plant-based sensing techniques including canopy temperature (CTS) and UAV thermal imaging (Fig. 1) can increase cotton yields while reducing labour and water costs. These benefits are realized by matching the irrigations with crop water demand through continuous monitoring of plants. This project is testing and refining these technologies on commercial cotton farms to better understand how they can be most effectively used to improve water use efficiency and productivity for fully irrigated and partially irrigated cotton.

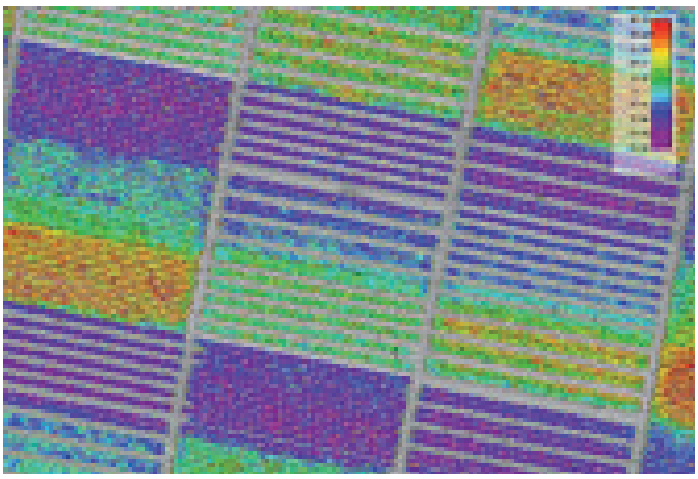

Fig 1: UAV thermal image showing spatial variability in crop water stress

2. How do canopy temperature sensors improve irrigation management?

Previous research monitored the canopy temperature on farms in different valleys. Growers used their own experience and/or fixed soil moisture deficits to make irrigation scheduling decisions. The continuous measurements of canopy temperature identified opportunities to optimize the timing of irrigations using the canopy temperature technology.

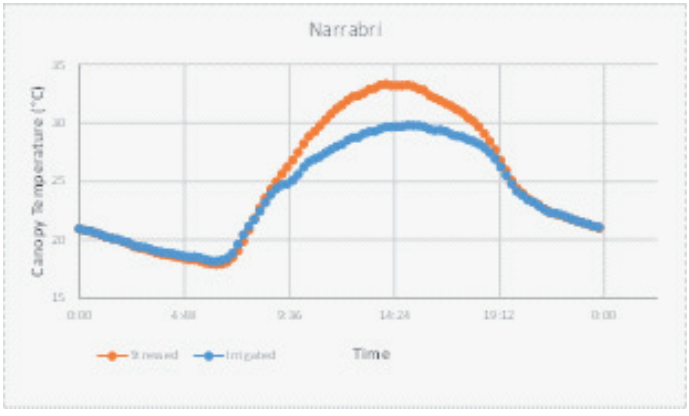

Fig2: Diurnal pattern of differences in canopy temperature caused by crop water status

As canopy temperature is a direct response of plant's access to (or lack of) soil water (Fig. 2), continuous monitoring of canopy temperature provides real time information on a crop's need for water that can be used to inform irrigation scheduling. Avoiding water stress and over watering improves farm profitability by increasing yield and water use efficiency. The canopy temperature infrared sensors being assessed in this project are affordable, easy to use and maintain, and can be a significant addition to the suite of tools available to growers for making important irrigation decisions.

3. How does this research benefit irrigators?

An economic assessment of incorporating CTS into irrigation management found it has the potential to improve farm profitability.

Researchers are working closely with commercial growers and technology providers to refine the methodology and ensure the technology is both practical and reliable at a commercial scale.

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Practical considerations include:

1. Utility of multipixel CTS for early season irrigation decision making when standard canopy temperature sensors with single field of view cannot be used because of smaller canopies.
2. Extending the utility of CTS for irrigation scheduling in limited water situations by developing new thresholds based on detailed research and on-farm trials.
3. Testing CSIRO's canopy temperature predictive algorithms platform for scheduling irrigations in advance.
4. Assessing spatial variability of canopy temperature on larger commercial farms to determine the minimum number of CTS required for effective and efficient irrigation scheduling.
5. Integrating canopy temperature technology with existing tools including soil moisture probes.

4. Key results to date

- An assessment of sensing options for early-season irrigation scheduling identified a thermal sensing array MLX90640 (Melexis, Belgium) as most appropriate for broad scale capture of emergent cotton.
- Trials at CSIRO Narrabri using CTS showed peak flowering as the best time to apply an irrigation when water is available for a single irrigation only. Results are being validated through on-farm trials in different valleys with CottonInfo.
- Trial results montoring spatial variability in canopy temperature on cotton farms near Maules Creek (Namoi), Wee Waa (Namoi) and Moree (Gwydir) are being analysed. Each farm was equipped with nine or ten CTS with two farms also instrumented with capacitance probes to monitor soil water.
- CTS technology is available through GoannaAg as part of its irrigation management system. Researchers are working closely with Goanna Ag to streamline the process of providing growers the actionable data in real time and to resolve any technical issues that are expected in the first year of commercial roll out of GoFieldPlus.

For further information on the project, contact:

Dr Hiz Jamali, Project Leader T: 0477 366 618 E: Hiz.Jamali@csiro.au

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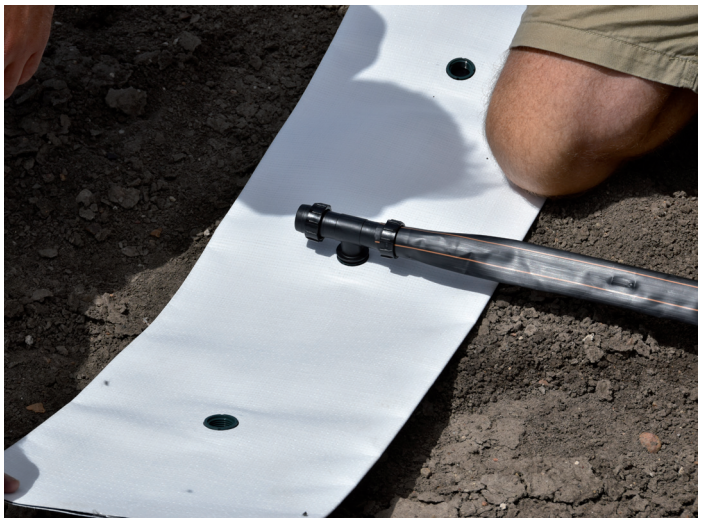
MODNET™ MODULAR, PORTABLE, ACCESSIBLE IRRIGATION SYSTEMS



Netafim have introduced ModNet™ an innovative, modular, portable system that makes drip irrigation accessible for all growers.
This modular, low-energy, non-permanent irrigation system is designed for use where and when you need it depending on your water availability from season to season.
ModNet is supplied as a fully working containerized system, fitted with pump, filters, sub mains and drip lines. It can be run using either diesel or electricity.
The submain is installed and connected to a robust thin wall drip line.

The primary benefits:

- no land development.
- low energy-low pressure-energy saving.
- recyclable material.
- fully transportable.
- fits well in the Netafim circular economy.
-

NETAFIM™
GROW MORE WITH LESS

For further information contact:
Gus De Notta: gus.denotta@netafim.com 0407 665 300 or
Jamie Zapp: jamie.zapp@netafim.com 0418 311 157

References and Links

Gwydir Valley Irrigators Association:

- https://www.gvia.org.au/community-and-industry-initiatives/irrigation-efficiency/keytah-system-comparison/
- https://www.gvia.org.au/community-and-industry-initiatives/irrigation-efficiency/

Smarter Irrigation for Profit:

- https://smarterirrigation.com.au/
- https://smarterirrigation.com.au/southern-nsw-cotton-research-update/
- https://smarterirrigation.com.au/dr-john-hornbuckle-associate-professor-from-deakin-university-talks-about-new-technologies-for-automation/
- https://smarterirrigation.com.au/ial-icid-webinar-addressing-the-global-water-challenge-through-autonomous-irrigation/
- https://smarterirrigation.com.au/andrew-greste-talks-about-precise-real-time-automated-cotton-and-dairy-irrigation-for-improved-water-productivity/
- https://smarterirrigation.com.au/joseph-foley-talks-about-automation-of-large-scale-irrigation/
- https://smarterirrigation.com.au/plant-based-sensing-optimising-irrigation-timing-in-limited-water/
- https://smarterirrigation.com.au/cottoninfo-webinar-canopy-temperature-sensors/

CRDC:

- https://www.crdc.com.au/smarter-irrigation-phase-2

CottonInfo:

- Variable rate irrigation using VARIwise; https://www.youtube.com/watch?v=fL1DG07Fge8&list=PLQy8KAPn-DyrR0kMHHeiZyCGcIWp_6hZf
- Yield prediction using remote images; https://www.youtube.com/watch?v=y7ns4AccRMc&list=PLQy8KAPn-DyrR0kMHHeiZyCGcIWp_6hZf&index=2
- Canopy temperature sensors as an irrigation tool: https://youtu.be/i2fPMCVG9dU
- Installing Canopy Temperature Sensors: https://youtu.be/pg1SxzOubHk

Australian Government
Department of Agriculture, Water and the Environment

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Smarter Irrigation for Profit
PHASE II EVENT

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making every drop count

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