Final report

Farmo sensors trial to improve efficiency, safety and quality at Romani Pastoral Co

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Abstract

There is scope to improve workplace safety, animal welfare, efficiency and profitability on farms through the use of digital technology. The Romani Pastoral Company Project is demonstrating a range of devices that enable remote monitoring and collection of data for action or analysis.

Farmo sensor devices have been installed on both Windy and Warrah Stations. Low power, long range communication modules are used to transmit data collected in the field to a cloud-based server for analytics and final presentation on the end user dashboard.

Data is collected on the state of water levels in troughs and tanks, real-time gate status and rainfall. The data populates graphs and charts on the dashboard accessed via mobile phone and PC. When trigger levels are reached, email or text message alerts are automatically forwarded to nominated persons. These are repeated again if required by the user, once the normal state is resumed.

Executive summary

Background

The project sought to demonstrate the use of digital technology on a commercial cattle property in order to better understand the benefits and challenges involved with emerging technologies in the agriculture sector. Results will promote increased adoption and uptake of digital technology that can help improve productivity, animal welfare and profitability.

Objectives

The objective was to demonstrate the capacity of digital technology on a working farm and show how the property owner can benefit from accessing and analysing data collected remotely.

Methodology

The methodology employed was a co-ordinated installation by multiple device providers at locations identified by the host property. During the trial period the methodology was improved to include signal strength mapping prior to confirming suitable locations for installation.

Results/key findings

Key findings from the project were that digital technology can provide real-time and long-term data that improves the performance and productivity of a primary producer operation.

Improvements to installation methodology to include signal strength mapping.

Benefits to industry

The benefit to industry of this project includes an improved understanding of the benefits of digital technology to primary producers in the red meat industry.

Future research and recommendations

Farmo believes that a key recommendation is to provide more incentives to the industry to enable rapid uptake of the most recent and productive digital technologies. This could be achieved with a straight rebate on the purchase of digital technology from commercial providers.

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1. Background

1.1 Overview

1.1.1 Overview of issues project sought to address

The project has sought to improve workplace safety, animal welfare, efficiency and profitability on farms through the use of technology.

Checking stock waters is a time consuming and inefficient activity on most farms. The consequences of undetected or late-detected water supply issues can have a major negative effect.

Monitoring the access of personnel on and off the property has become more important as biosecurity has become a bigger issue. Farms can cover thousands of hectares and it is impossible to keep watch over all areas all the time, or even on a daily basis. Further to this, knowing that a staff member or solo contractor has safely left the property after a day (or nights) work is of high importance to all farm managers.

Rainfall is distributed unevenly in any given rain event. The typical rain gauge at the homestead does not give an accurate picture of rainfall across the entire property.

1.1.2 How the outcomes were intended to act as a solution

Checking waters can be done remotely at more frequent intervals than physical on-site inspections. Alerts can be set to automatically email nominated parties when trigger levels are reached meaning the technology itself does not require constant monitoring.

Gate Sensors designed specifically for farm gates will send alerts whenever a gate is opened or closed. Confirming the safe exit of a solo contractor at the end of the day can be done quickly and efficiently on a remote PC. Unexpected entries can be followed up with further investigation.

Rain Gauges placed in different locations will give a much more complete picture of rainfall received across the property. Over time, data from these and other environmental sensors can be used to more accurately estimate fodder growth potential.

1.1.3 How the project is unique to others that address the same issue

Some devices used in the project have been designed specifically for Australian agricultural user cases. The Farmo Gate Sensor is an original design, developed in Australia with patent applications filed.

2. Objectives

2.1. Supply, install and make operational the digital components

2.1.1. Water Trough Sensor (10x)

10x Farmo Water Level sensors have been installed on water troughs and are operational. The robust fixing of the sensor to the trough is the biggest challenge for this type of device due to the large variety of stock water trough designs in Australia.

Figure 1. Water Trough Sensor metal lid

Figure 2. Water Trough sensor round cement

2.1.2. Water Tank Sensors (5x)

Water Tank Depth Sensors have been installed at all sites.

Figure 3. Water Tank at Windy Station

Figure 4. Hydrostatic pressure sensor installation.

2.1.3. Gate Sensors (5x)

Farmo Gate sensors have been installed on both properties. The installation has covered single gate, double gate and storage shed user cases.

Figure 5. Farmo Gate sensor on double gates at Windy Station

Figure 6. Farmo Gate sensor on chemical shed at Windy Station

Figure 7. Farmo Gate sensor on single gate at Warrah Station.

2.1.4. Rain gauges (2x)

Rain Gauges have been installed at 2 sites. One of these sites appears to be out of the LoRaWAN coverage area.

Figure 8. Rain Gauge at cattle yards on Windy Station

2.1.5. Water flow monitoring sensors (2x)

Water Flow monitoring has not been installed. The Water Flow sensors were purchased and configured as instructed for flow under pressure. However subsequent inspection and communication with the farm manager confirmed the sites are not under pressure and therefore the devices are not fit for prupose and could not be installed.

3. Methodology

3.1. Installation

3.1.1. Water trough sensors

Heavy duty angle brackets are fixed with masonry bolts to cement surfaces, or self drilling metal Tek screws to metal troughs. Sensor equipment is attached to brackets via 60mm u-bolts.

3.1.2. Water tank sensors

The hydrostatic pressure sensor is suspended via cable into the void with the communication module secured to the top surface via masonry screws, or self drilling Tek screws depending on the tank construction.

3.1.3. Gate and door sensors

The non-ferrous gate latch receiver is fixed permanently to the post or frame and the gate chain with D-latch is fixed permanently with security screws to the swinging element (gate or door).

3.1.4. Rain gauges

Rain gauges are fixed in locations out of reach of cattle, and away from trees or buildings that would interfere with the collection of rain. Spirit levels are used to confirm the positioning is level for correct functioning of the tipping mechanism within the rain gauge.

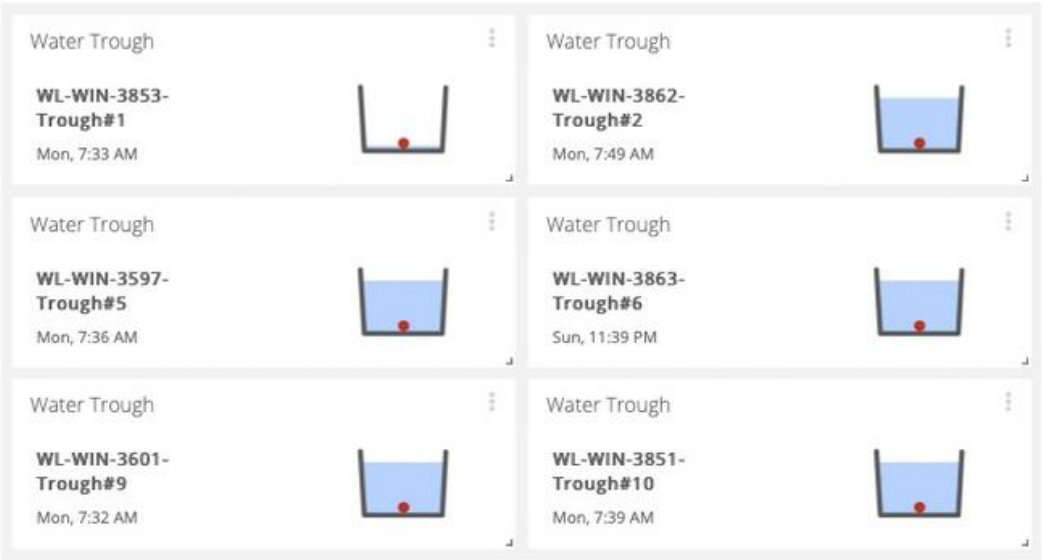
4. Results

4.1. Data reported from devices

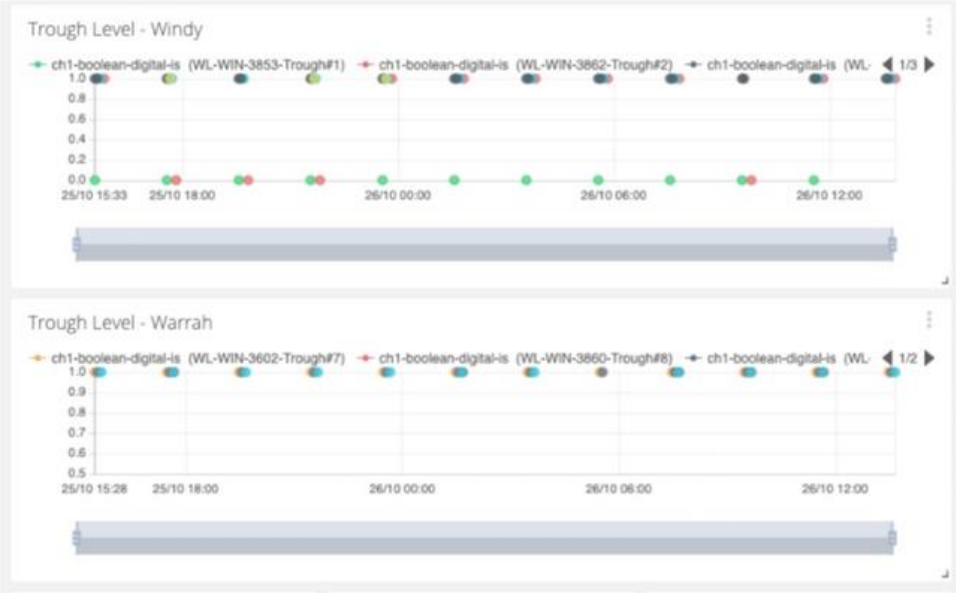
4.1.1. Water trough sensors

Data is sent every 2 hours from the sensor on each trough to the server via LoRaWAN protocol. The data is displayed graphically via simple icons for instant update on current conditions or they can be looked at longitudinally to understand water supply issues over time.

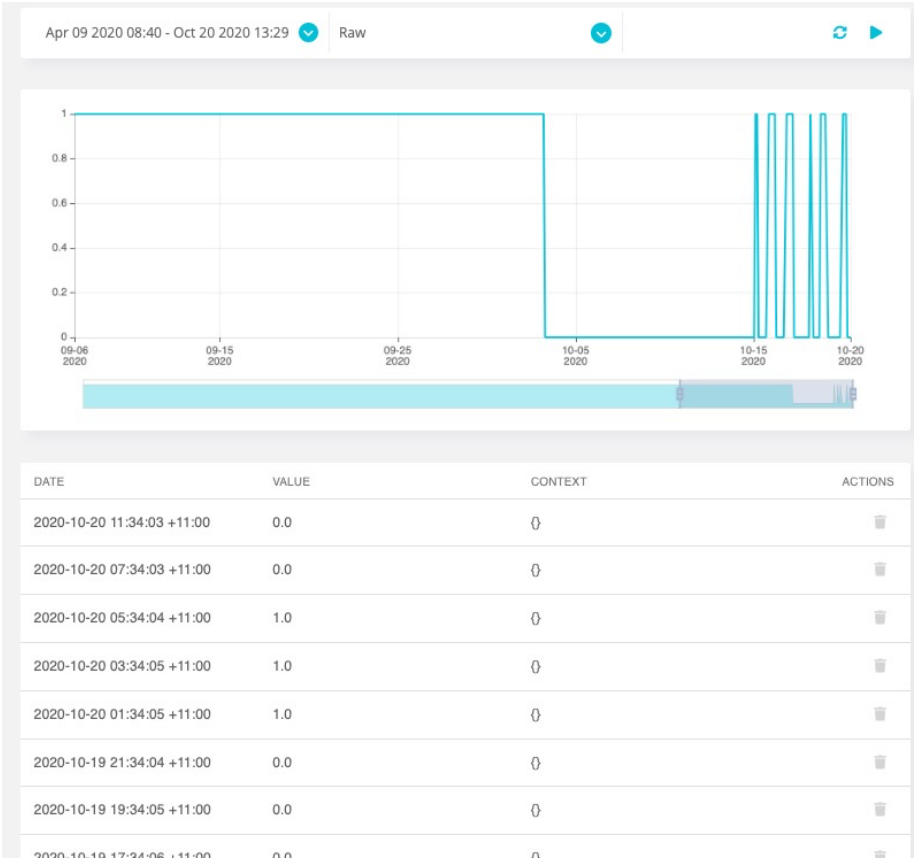
Figure 9. Screengrab from Farmo Dashboard showing trough sensor data



4.1.2. **Figure 10. Screengrab from Farmo Dashboard showing trough sensor data over time**



4.2. **Figure 11. Screengrab from Farmo Dashboard showing detail of device data timestamped**



Alerts can be enabled to email the farm manger when water levels have been low for more than 2 hours (or set to custom period lengths).

Figure 12. Screengrab from Farmo Dashboard showing set up of alert system

Water tank sensors

The Water Tank sensors had some issues on installation which have not been resolved. At time of writing Farmo is waiting to go on site and determine if the issue is device related or network related and then fix the issue. Due to Covid 19 access has been limited.

4.1.3 Gate and door sensors

Two of the gate sensors are working as expected but it seems three of them are installed outside of the LoRaWAN coverage area. We have agreed with the network provider on a method to confirm on ground acceptable coverage to avoid this in future.
The Farmo gate sensors report both in real time when the gate is open or closed and every 12 hours when there is no change in the gate status.

Figure 13. Screengrab from Farmo Dashboard showing gate status

Figure 14. Screengrab from Farmo Dashboard showing gate status over time

4.1.4 Rain gauges

One of the Rain Gauges is installed in an area that seems outside of the LoRaWAN coverage area and this will be checked on the next visit. The second Rain Gauge is communicating normally but the reading is not correct and we suspect a loose wire in the device. This will be checked and repaired on the next visit.

5. Key findings

5.1. Digital Technology has the capability to provide real time and long term data sets for primary producers.

5.1.1. Data can be collected from remote sensors spread across large properties communicating under battery power. Individual devices can collect a wide range of environmental and situational data dependant on the sensor design.

5.1.2. Data can be sent via LoRaWAN as used in this project, or alternatively Cellular Narrow band and Satellite options are also available. LoRaWAN used in this project relies on gateways acting as a kind of repeater station, providing line of sight coverage across an area up to 10km in radius.

5.1.3. The end user can access the data in visible form via a dashboard where an internet connection is available. The packet data sent from each device is securely encoded and encrypted, until matched with unique keys on the server which enable decoding.

6. Conclusion and recommendations

6.1. Future R&D

Farmo believes there are opportunities for further R&D into sensors and IoT devices that address user cases and pain points experienced by primary producers. While battery and communication technologies are improving quickly, the practical device applications are not so the benefits to the red meat industry may be delayed by years and sometimes decades.

Digital technology and IoT is about the benefits that can be derived from interconnectivity across a network. In the red meat industry, the lack of an industry wide smart tag is a barrier to including the animals in the IoT network. Farmo believes the use of low frequency ear tags for the NLIS scheme is preventing the advancement of technology in this area.

Transparency, security and reliability of data can be further improved with the use of blockchain technology, especially where a large number of stakeholders from different sectors are involved. Work already done in this area should be further developed.

6.2. Practical application of insights and implications for the red meat industry

The insights into the capacity and capability of digital technology point towards significant practical applications for stakeholders. More frequent monitoring of water resources will allow for earlier detection of faults and deployment of corrective action, overcoming some of the problems caused by staff shortages.

Distribution of rainfall and environmental sensors will give a more granular picture of conditions on the ground and affect both current planning and management but also more accurately calibrate future land values to rainfall records.

Gate sensors will provide an extra level of security to areas of land that cannot be physically monitored for biosecurity breaches. Additionally, knowing that a staff member or subcontractor has started or finished work safely will help mitigate dangerous circumstances that occur when working alone remotely.

6.3. Development and adoption of activities

The development of the digital technology has continued across the duration of the trial as would be expected in this sector. Some of the devices originally tendered for the trial would have been superseded by the next iteration, by the time the trial has concluded.

Adoption of digital technology in the red meat industry has already shifted from “needing to be encouraged”, to “needing to be supplied” as the benefits are already seen from early adopters. The best schemes to encourage adoption are simple and fast, such as cash rebates paid directly to producers for purchase of a technology from a commercial provider. The validation is provided in the same manner the ATO applies to capital deductions, i.e. there are no lists of “preferred suppliers” or “approved devices” required, rather it is conformance to the device type definition.

The construction of “preferred suppliers” or “approved devices” lists adds years to the adoption process, delaying the benefits to industry, and increasing the cost to end users and ensuring they get out of date equipment. Enabling primary producers to make decisions about technology adoption for themselves is the better option.

The industry trials however are excellent for publicising and generating awareness of the potential and even existence of digital technology. These trials are often the first cautious look at digital technology for primary producers and other stakeholders. Recent work in quantifying the ROI of digital technology and producing tools accessible to end users prior to decision making are excellent passive encouragers to adoption.