Final report

MLA Digital Farm: ICT International sensors providing better outcomes in environmental monitoring

Project code: V.DIG.2022

Prepared by: Sam Fisher

ICT International PTY LTD

Date published: 31st May 2021

PUBLISHED BY

Meat and Livestock Australia Limited

PO Box 1961

NORTH SYDNEY NSW 2059

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Abstract

MLA worked with Romani Pastoral Company to pilot various agtech solutions at the Windy and Warrah Stations. This included new and emerging technologies of remote sensing and low power wide area networks to transmit data to decision makers. In November 2019, ICT International installed a network of LoRaWAN enabled weather stations, soil moisture stations and tank and trough level sensors at Windy and Warrah Stations.

This project showed how the collection of this data can enhance operational efficiency and product quality of a farming enterprise; the monitoring of rainfall and soil moisture provides data which can inform pasture growth modelling for grazing management and pasture growth forecasts, whilst the data collected from weather and microclimate monitoring can be used to reduce the risk of heat stress in livestock. The introduction of remote monitoring for tank and trough levels has the potential to reduce both the labour and fuel costs associated with farm staff physically checking these assets.

Executive summary

Background

To drive the adoption of new technologies and solutions for monitoring of key resources on livestock properties, demonstration sites such as those used at the MLA/ Carwoola Pastoral Company trials have proven instrumental in this process. The introduction of a test site for the Romani Pastoral Company (RPC) holdings reflects this approach and aligns with the holding of the 2019 MLA AGM in Tamworth.

Drawing on the experience of the 2018 MLA Digital forum and open day at Carwoola Station, the use of demonstration sites provides the opportunity to address concerns around:

- Hardware availability
- Durability and suitability for commercial use
- Over promised and under-delivered 'solutions' that are not understanding of the producer's needs.
- Untied data: Allowing producers to be agnostic of providers, enabling all data to be reported to a common dashboard (web based) rather than tied into apps for each product offering.

In addition, demonstration sites provide opportunities for the MLA Membership to engage with Producer Digital Champions who have adopted these technologies and consider what the use of these technologies will enable now and into the future.

Objectives

ICT International supplied, installed, and made operational the following digital components:

1. 5no. Water trough sensors
2. 5no. Water tank sensors
3. 1no. Weather station
4. 1no. Rain gauge; and
5. 3no. Soil probes

Methodology

Each of the demonstration sites required instruments specified to suit the environment and infrastructure in place. Due to the nature of the test sites, the use of uniform tank installation methods was not possible.

Results/key findings

The demonstration site has been successful. MLA will continue to maintain connectivity to existing installed devices at the Romani properties for a period of three years. In addition to continuing data collection from installed devices and ongoing use case evaluations this will also allow for the development of follow on projects where all parties see mutual benefits and opportunities.

Benefits to industry

Clearly demonstrated applications of available technology, combined with accessible exemplar sites will enable further projects to be pursued.

The pursuit of these further projects will ensure an increasing awareness of the digital solutions available to the MLA membership and the industry as a whole. Demonstration sites such as Romani encompass a diverse range of agricultural operations, and as such provide the ability to transfer learning across the varied sectors (grains, fodder, beef and sheep) in Australian agriculture.

Future research and recommendations

Continuing these projects will ensure that the agricultural sector responds to both Federal and State policies surrounding water use. In the proposed strategy for New South Wales Water, there are clear intentions to continue to invest in water use management through R&D programmes (NSW Department of Planning, Industry and Environment, 2021, p105):

- NSW DPI Farms for the Future Pilots
- Improving the understanding of how changes in agricultural practices surrounding pasture and zero-till cropping increase rainfall capture.

Creating awareness to the value proposition will likely increase adoption of new and emerging technology that aims to support agriculture in this period of change.

Table of contents

1. Background

Digital farms are important for the longevity of Australian red meat supply chains, whether that be to inform consumers of our credentials such as the CN30 program or Beef Sustainability initiative or to improve production businesses. The Romani Pastoral Company project will demonstrate technology that was not available previously, or willing to be provided at the timeof a potential Carwoola Pastoral Company Phase 2 project.

In November 2018, Meat and Livestock Australia (MLA) hosted the inaugural Digital Forum, as a commercial testing ground for AgTech innovation. The Digital Forum was designed to push industry innovation providers to work together within networks and visualisation tools and to commercially test the robustness of their devices and services.

Sensors are becoming more relevant to modern farming systems as agriculture, as an industry, becomes more data centric. The data from a collection of sensors can enhance the efficiency, safety and quality of a farming enterprise. This is achieved by gaining greater control and insight into the assets a herd or flock interacts with, allowing producers to make better management decisions in a shorter amount of time.

2. Objectives

ICT International supplied, installed, and made operational the following digital components:

6. 5no. Water trough sensors
7. 5no. Water tank sensors
8. 1no. Weather station
9. 1no. Rain gauge; and
10. 3no. Soil probes

ICT International has trained and acquired sign-off from Romani Pastoral Company's General Manager and MLA's innovation and Events Coordinator. These were all completed by the 5th December 2019.

3. Methodology

Each of the demonstration sites required instruments and support infrastructure specified to suit the environment and infrastructure in place.

3.1 Warrah Station

3.1.1 Warrah Network Overview

At Warrah Station the following sensing components were installed:

- 2 x ICT International SNiP-EP8-SL Multidepth Soil Moisture Probes
- 5 x ICT International LVL-NODE (Tank Water Level)
- 5 x ICT International LVL-NODE (Trough Water Level)
- 1 x ICT International Rain Gauge

Sensor	*Serial Number*	*Further details*
ICT Soil Moisture Probe 2	SNODEJA0D	SNiP-EP8-SL (EP100GL-08 sensor installed connected to an S-NODE with support power system)
ICT Soil Moisture Probe 3	SNODEJA0E	
ICT Tank 1	LVL1JA03	Ultrasonic water level sensor connected to a dedicated LVL-Node
ICT Tank 2	LVL1JA01	
ICT Tank 3	LVL1JA04	
ICT Tank 4	LVL1JA02	
ICT Tank 5	LVL1JA05	
ICT Trough 1	LVL1JA08	Ultrasonic water level sensor connected to a dedicated LVL-Node
ICT Trough 2	LVL1JA0A	
ICT Trough 3	LVL1JA06	
ICT Trough 4	LVL1JA09	
ICT Trough 5	LVL1JA07	
ICT Rain Gauge	ELSYSJB01	Rain gauge connected to an internal node

Table 3-1: Warrah Station Digital Components

Each ICT International sensor is connected to a Node, which reads sensor data and transmits this over LoRaWAN. At Warrah Station a NNNCo managed LoRaWAN gateway backhauls data to the NNN-DL LoRaWAN Server (over LTE).

From NNN-DL, ICT International transfers data (API) through to an AWS for long term data storage and posts data to Dataview Web (eagle.io) for near real time display. An overview of this data stream is provided in **Figure 3-1**.

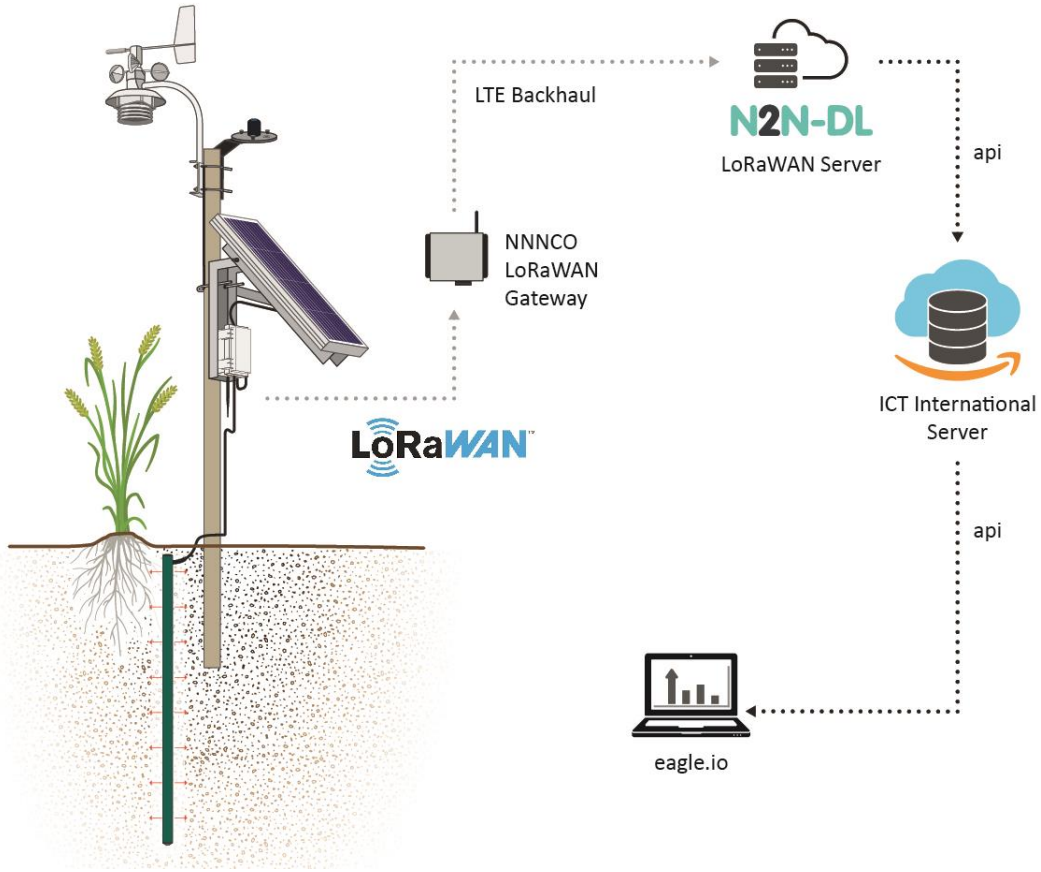

Figure 3-1: Data Stream from sensor to dashboard

3.1.2 Installation Details: Soil Moisture Probes

The SNiP-EP8-SL base sensor, the EP100GL-08 EnviroPro Multidepth Soil Moisture Probes provide an 8-point soil moisture measurement 10 – 80cm depth. Technicians augured a 50mm hole to 1m, installed the probe into the hole and backfilled with a slurry made from the excavated soil.

The top of the EP100GL-08 were buried to a depth of 50mm below the surrounding surface; a protective sleeve (200mm PVC pipe) was installed around the sensor and star picket mounting pole to protects cabling from birds, rodents, and native mammals, refer to figure 3-2.

Further guarding by way of cattle yard panels was installed to protect installation from livestock.

Figure 3-2: Soil Moisture Probes

3.1.3 Installation Details: Tank Sensor

On Warrah Station there are three types of tanks: galvanised steel, poly, and a fibre composite. The ICT Tank sensor has been installed on each of these three types of tanks found on Warrah Station. Examples of each of these installation types are provides in figures 3-3 to 3.6. The LVL-NODE is mounting within a 100mm PVC pipe to protect the cable and antenna from birds.

Figure 3-3: Tank Level Installation

Figure 3-4: Tank Level Installation

Figure 3-5: Tank Level Installation

Figure 3-6: Tank Level Installation

3.1.4 Installation Details: Trough

The Trough sensor is installed at a pre-set level above the tank; using a galvanised arm, the sensor is situated to prevent damage from livestock using the water trough whilst still providing an accurate reading. The arm is concreted in place whilst the Node is easy to access for maintenance (such as changing the battery), refer to figure 3-7.

Figure 3-7: Trough Sensor Installation

3.1.5 Installation Details: Rain Gauge

Comprising a PRP-02 tipping bucket rain gauge and ELT-2 node mounted to a 40NB galvanised pipe, refer to figure 3-8.

Figure 3-8: Rain Gauge Installation

3.2 Windy Station

3.2.1 Windy Station Network Overview

At Windy Station, the following components were installed:

- ICT International Weather Station
- ICT International Soil Probe

Sensor	Identifier	Further Details
ICT Weather Station	SNODEJA0F	Multi-parameter MSO-SDI weather station and SRG0 tipping bucket rain gauge connected to an S-NODE for IoT connection
ICT Soil Probe 1	SNODEJA0C	SNiP-EP8-SL (EP100GL-08 sensor installed connected to an S-NODE with support power system)

Table 3-2: Windy Station Digital Components

As at Warrah Station, data was transmitted through a NNNCo operated LoRaWAN network in the same data stream identified in 3-1.

3.2.2 Installation Details: Weather Station

A multi-parameter MSO-SDI weather station (air temperature, relative humidity, barometric pressure, wind speed and wind direction) and SRG0 tipping bucket (rainfall) was installed on a pump shed roof, refer to figure 3-9.

Figure 3-9: Weather Station Installation

3.2.3 Installation Details: Soil Moisture Probes

Soil moisture probe installed as in section 3.1.1.

4. Results

As of May 2021, the monitoring network has been in the ground for 18 months. Results, summarised in terms of data quality and hardware performance over this period, is provided below in 4.1. and 4.2.

4.1 Data

4.1.1 Data Display

Data has been made available to specified Romani personnel and MLA project stakeholders over the project (to date) through the Eagle.io platform. Examples of the dashboarding for each of the data types is provided in the figures 4-1 to 4-4.

Figure 4-1: Trough water level dashboard

Figure 4-2: Tank water level dashboard

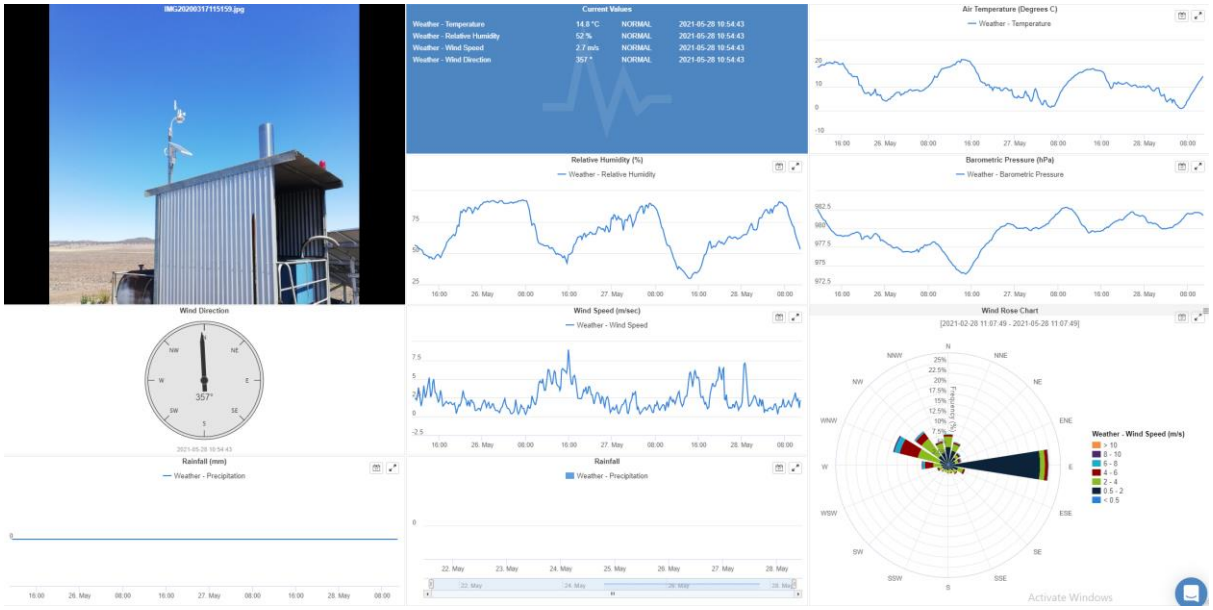

Figure 4-3: Weather Station dashboard

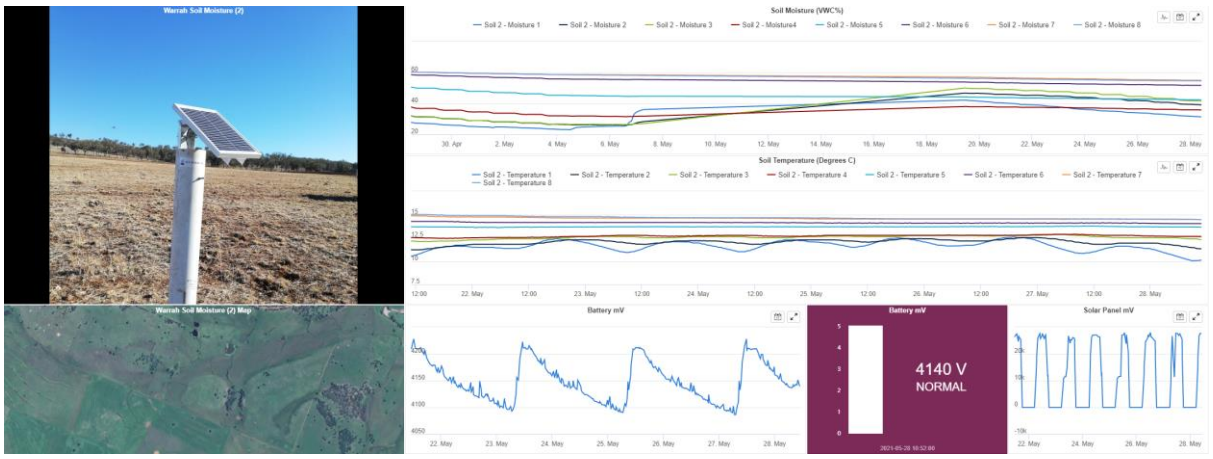

Figure 4-4: Soil Moisture dashboard

4.1.1 Data Uptime

Data uptime across the network of ICT International sensing, over the period Nov 19 – May 21 is currently 85%. Reasons for downtime:

1. ICT Rain Gauge never seen on network, suspected network range issue (constitutes 45% of total network downtime).
2. Network server decoding issue 7/5/21 to 25/5/21 due to NNN-DL migration from V2 to V3 which resulted in payload decoders being removed from devices (constitutes 25% of total network downtime).
3. Trough 1 installation damaged by livestock 21/07/20 (constitutes 20% of total network downtime).
4. Tank 2 offline since the 5/2/21, currently under investigation (constitutes 7.5% of total network downtime).
5. Tank 1 offline since the 24/3/21, currently under investigation (constitutes 2.5% of total network downtime).

Reasons for sensor downtime are broadly categorised in **Figure 4-5**.

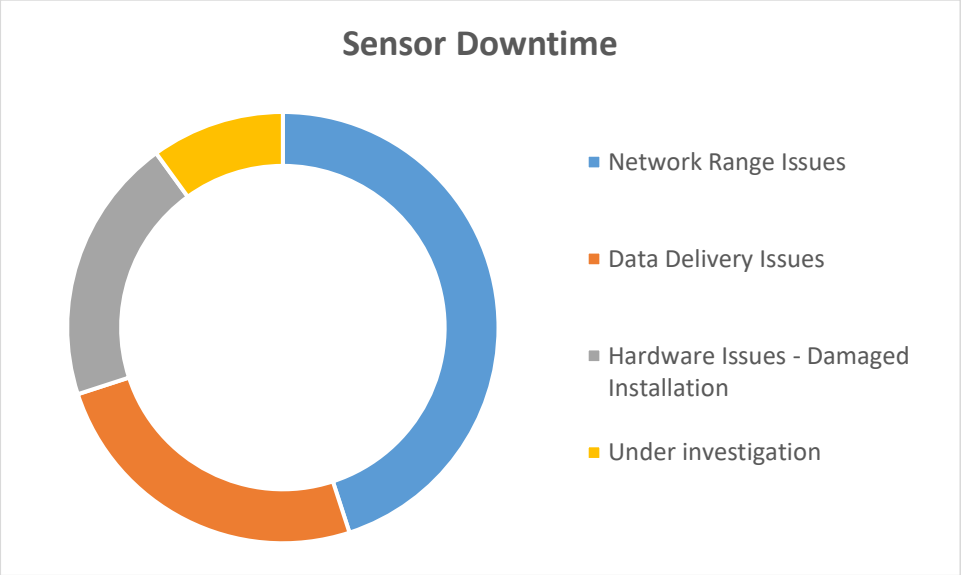

Figure 4-5: Reasons for Sensor Downtime

4.2 Hardware

4.2.1 Hardware Performance

Downtime due to direct hardware issues constituted 20% of total network downtime.

5. Key findings

- In day-to-day farm operations the most user value was gained from fixed asset monitoring of water levels in tanks and troughs.
- When monitoring systems go offline, an automatic notification is critical in proactively notifying the relevant site personnel that maintenance action is required.
- Hardware performance is largely hinged upon the support infrastructure being adapted to the site and considerate of any site-specific risks that may arise.
- For basic troubleshooting resource material needs to be adapted to incorporate consideration for support infrastructure.

6. Conclusion and recommendations

6.1 Future R &D

6.1.1 Industry Specific Measuring Metrics

ICT International will look at incorporating support for livestock specific metrics, such as heat load/stress into hardware and software packages.

7. References

NSW Department of Planning, Industry and Environment. (2021). *Draft NSW Water Strategy* (PUB20/882). NSW Department of Planning, Industry and Environment, Sydney. https://www.industry.nsw.gov.au/__data/assets/pdf_file/0010/351883/draft-nsw-water-strategy.pdf