



Final report

Smart Paddock deployment of sheep and cattle tracking tags at Romani Pastoral

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Abstract

Meat Livestock Australia, as part of their Digital Livestock 4.0 project, requested solution providers to deploy various products and services to the Romani Pastoral property, Redbankto demonstrate the current capability of the latest livestock relevant technology solutions. Smart Paddock was selected as one of the solution providers to deploy GPS tracking on different groups of cattle and sheep to identify the value that may be gained by tracking the livestock in real-time. Another goal was to test the integration of this type of technology between different solution providers and in this case the use of Smart Paddocks' GPS collars utilising NNNCo LoRaWAN network that was installed on the property.

Smart Paddock working with Romani Pastoral staff determined several use cases that GPS tracking could provide real benefit to the operation of the farm. Smart Paddock then provided up to 100 GPS tracking collars for cattle and sheep to be deployed for the identified scenarios.

Romani Pastoral staff were given access to an online web dashboard where they could securely monitor the current location and historic movements of their individual animals.

After several months of tracking livestock in each scenario the staff was interviewed to get their feedback on the value that they saw in the deployment and what additional value that could be obtained.

The interaction statistics with the NNNCo LoRaWAN network has also reviewed to determine if there was any substantial loss of data and lack of coverage was detected.

The deployment of Smart Paddock GPS tracking collars for this project identified key areas that Romani Pastoral staff could see value in GPS tracking their livestock. These areas included detection of downed ewes during lambing and monitoring bulls during joining.

Several issues were also raised with this deployment around the practicality of using collars on bulls and the need to have full coverage on the entire property to cover when animals were grazing in paddocks in lower topography and in more heavily treed areas.

With further large-scale trialling and the development of features specifically to address the identified use cases related to reproduction management there can be real value obtained when deploying GPS tracking and monitoring of livestock in the red meat industry.

Executive summary

Background

In 2019, Romani Pastoral Company was selected to host the 2019/20 Digital Livestock 4.0 pilot. Smart Paddock was chosen to participate as one of the digital solution providers.

Objectives

- Demonstrate the commercial availability of long-range GPS tracking for livestock.
- Gain insights and feedback on perceived benefits related to livestock tracking from a working cattle and sheep property.
- Allow a range of producers to view technology solutions in action on a working property.
- Validate that LoRaWAN technology solutions from different providers are compatible.
- Determine the practical coverage of a farm with LoRaWAN network infrastructure.

Methodology

Romani Pastoral deployed Smart Paddock GPS tracking collars on several groups of sheep and cattle across various paddocks on their Redbank property as part of the MLA Digital Livestock 4.0 project. Data was captured from these collars and access given to the Romani Staff through an online web dashboard to monitor their livestock in real-time and review the livestock historic movement. Interviews of staff was completed during the project to gain feedback on the use of such technology.

Results/key findings

It was demonstrated that it was technically viable and feasible to deploy LoRaWAN based GPS trackers on both cattle and sheep on a working property. Compatibility was also achieved with low effort between different solution providers. While collars are relatively easy to deploy on livestock it was determined that collars are not always practical for different categories of livestock (i.e., mature bulls).

Benefits to industry

Initial benefits of GPS tracking livestock will be the saving of time during mustering and receiving of geo-fence alerts to lower the occurrence of stray animals but there is greater value to be obtained by analysing their movements and behaviours to provide additional management insights. The ability for monitoring technology to alert producers to issues relating to lambing/calving and detection of lameness in bulls is where the greatest benefit to industry can be obtained.

Future research and recommendations

Further research is recommended to develop the technology to detect calving/lambing events and joining activity at an accuracy level sufficient to give the producer confidence to act on these issues. These more advanced behaviour detections will allow for a return of investment needed to deploy this technology at scale across Australia.

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1. Background

Meat and Livestock Australia (MLA), hosted a Digital Forum in 2018, showcasing the installation of digital solutions from 20 global solution providers, hosted at Carwoola Station. The event, which was held as an open day in which over 200 producers engaged in, had the goal to showcase the digital solutions in a real farm environment.

In 2019, Romani Pastoral Company was selected to host the 2019/20 Digital Livestock 4.0 pilot, and as one of the digital solution providers, Smart Paddock was chosen to participate. This is the first deployment of the Smart Paddock solution as an MLA sponsored demonstration project.

2. Objectives

We conclude that all the outlined objectives of this project were met successfully but with some key lessons learned on how to improve the overall outcomes in future trial projects and in commercial deployments.

It was shown that long-range GPS tracking hardware is available and functioned on both cattle and sheep on the Romani property with the network infrastructure that had been set up. There were certain paddocks where the pre-setup network coverage was not sufficient but by deploying temporary equipment that issue can be resolved, and this method could be used on any property to lower the initial infrastructure set up costs. Additionally, the Smart Paddock collars worked seamlessly with the NNNCo network equipment demonstrating the cross-compatibility of LoRaWAN based devices between different companies.

By trialling Smart Paddock's livestock collars and tracking platform key insights and feedback was received from the Romani Pastoral Company staff on potential additional benefits related to improving livestock management practices. While location tracking is a valuable feature on its own the new features suggested by the staff relating to calving/lambing detection and bull monitoring is key to widespread industry uptake. To implement new technology, you need buy in by both the operational and management staff and they must see the value and impact on their own day to day farm operations.

This deployment as part of the MLA Digital Livestock 4.0 forum allowed Smart Paddock to display our solution to all the attendees of the producer tour to make them aware of what is available in the market today and insight on where the industry is going with livestock tracking technology.

3. Methodology

3.1 Testing of Compatibility with NNNCo LoRaWAN Network On-farm Deployed Infrastructure

The Smart Paddock hardware utilises the LoRaWAN AS923 standards for communication, which is supported by the NNNCo network. The Smart Paddock collars were deployed using our default settings with no changes to the design or configuration of the components. Ninety-five Bluebell

collars were deployed on both cattle and sheep across the Romani Pastoral Redbank property, which is covered by several NNNCo network gateways installed across the property. Only the data sent through the NNNCo network system was received from the Bluebell collars into the Smart Paddock platform for analysis.

3.2 Collected GPS Data from the Deployment on the Sheep and Cattle

Forty-nine Smart Paddock Bluebell tracking collars (Fig. 1, Smart Paddock Collar) were deployed on sheep for ~5 months. Forty-six Bluebell tracking collars were deployed on cattle for ~3 months. The Bluebell tracking collars sent the GPS coordinates of the animals on a regular timed basis over the LoRaWAN network provided by NNNCo. The strength of the LoRaWAN signal was measured at the gateways and recorded with each message received.

The GPS location data was made available to Romani staff via a web-based dashboard with a paddock map view through the Smart Paddock platform, giving the Romani staff access to both the current location and the historic movement patterns of each animal. All collected data was also available to be downloaded in a csv file format for further analysis.

Smart Paddock Collar

Figure 1. Example of collar used both on sheep and cattle at Romani.



4. Results

4.1 Raw Data Collected

Collars Deployed	Animal	Days	Sensor Data Captured	Total <u>sets</u> of data for both animal types
49	Sheep	160	Location, temperature, activity level	181,068
46	Cattle	95	Location, temperature	

4.2 Collar Failures

One collar was damaged while the cow was in the crush and another two had buckles damaged while being attached to the cattle.

Approximately 10 sheep collars had come off the animals during the project either from broken buckles or from being too loose during fitting and slipping off the neck of the animal. Based on their

last known GPS location several of these collars were tracked down in the paddock to determine the cause of failure.

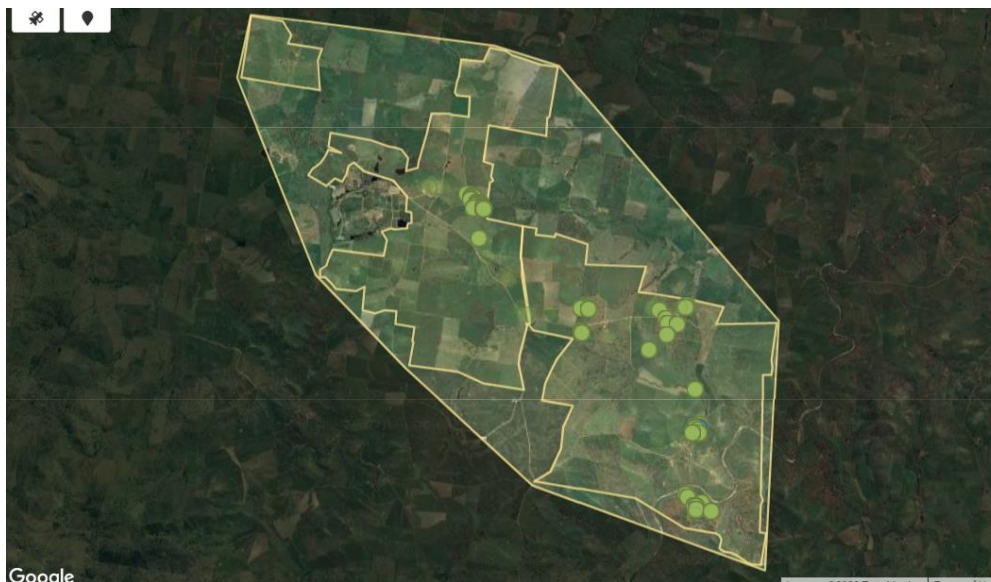
Three additional failures consisting of two collars (ID FEC23DFFFE0C183E and FEC23DFFFE0D5315) that had stopped reporting data while still on the animal and one collar (ID FEC23DFFFE0D5E02) that had been sending regular data updates but in an unreadable corrupted format.

4.3 Network Coverage of Romani Pastoral Redbank Property

Based on the paddock layout and maps provided by Romani Pastoral, the network gateway coverage for tracking the livestock was sufficient to cover the majority of the paddocks involved with the project. An example of the map view within the Smart Paddock platform can be seen below (Fig. 2, Paddock Coverage Map), with the green dots displaying the location of tracked livestock, including both cattle and sheep. The total area covered is approximately 22km by 9km.

Paddock Coverage Map

Figure 2 Example screenshot map view within the Smart Paddock platform. The green dots refer to the current tracked location of livestock.



As part of the deployment a flock of sheep were collared and placed in a specific paddock during lambing. In that paddock the data reception from the collars to the LoRaWAN network towers was erratic and not consistent. Smart Paddock proceeded to borrow an additional NNNCo network gateway and temporarily set it up on a farm building across the road from the paddock see (Fig. 3 Additional Gateway Deployment and Fig. 4 Additional Gateway Deployment Position). This temporary gateway installation at an approximate height of 4 meters was sufficient to cover the paddock for the duration of the lambing and gave consistent radio and data reception from the sheep collars.

Additional Gateway Deployment Location

Figure 3 Location of temporary gateway install to cover lambing paddock.



Additional Gateway Deployment Position

Figure 4 Temporary gateway installed on side of local shed on Romani property.



4.4 Downed Animal Detection

At a meeting with Romani staff on June 15th, 2020 it was decided to do further research using the collars on their ewes during lambing in August/September timeframe. We re-deployed existing collars after a firmware update to see if we could detect downed animals during lambing. After deploying 20 collars on the ewes over several weeks we detected several instances (~ 6) of potential downed animals. Two of these incidents were collars that had come off the ewes while others were attributed to when the sheep were sleeping. The downed alert was triggered by the sheep but after a follow up review of their status (i.e., they were moving around the paddock after the alert) it was

determined the alert was triggered when they were sleeping. Utilising this data Smart Paddock has updated our algorithms to better detect the difference between sleeping and downed animals and is now a feature of our current commercial offering.

4.5 Ability to Download Collected Data

The Smart Paddock platform has the ability to download the raw data in a csv file format from the web dashboard. The animal data can be downloaded on a per farm basis for a specified date range. An example of the data is included below (T. 2).

Table 2: Example of raw data collected from the web dashboard

Ingress date	Collar ID	Latitude	Longitude	Temperature
3/31/2020 11:56:44 PM +00:00	FEC23DFFFE0C2C9F	-34.7689305	148.3955843	20.5
3/31/2020 11:54:35 PM +00:00	FEC23DFFFE0D2034	-34.7525186	148.3895449	25
3/31/2020 11:53:59 PM +00:00	FEC23DFFFE0CODDA	-34.7221999	148.3882898	24
3/31/2020 11:50:20 PM +00:00	FEC23DFFFE0C1728	-34.7266985	148.3727859	23
3/31/2020 11:50:11 PM +00:00	FEC23DFFFE0C1FAE	-34.7307472	148.3823189	17

5. Key findings

5.1 Discussion

The deployment of the Smart Paddock solution on both sheep and cattle has clearly demonstrated the ability to deploy the solution on a large property successfully, as highlighted in the project objectives. Utilising the LoRaWAN network to achieve coverage in all paddocks of the Romani Pastoral was successful by utilising the existing infrastructure and temporary installations when needed, proving the compatibility with Smart Paddock's solution and the NNNCo network. Valuable feedback has been received by Smart Paddock from Romani staff on the suitability of collars and their limitations for use on bulls and the additional features and device modifications that need to be further developed for commercial success of such products.

6. Conclusion and recommendations

6.1 Recommendations

Further research is recommended to develop the technology to detect calving/lambing events and joining activity at an accuracy level sufficient to give the producer confidence to act on these issues. These more advanced behaviour and animal status detections will allow for a return of investment needed to deploy this tracking and monitoring technology at scale at a benefit to the producers. Further trials are needed to develop the overall solution to accurately detect these events. Companies like Smart Paddock will need to work very closely with operational farms to gather the raw data, develop the algorithms and test the solutions. To encourage operational farms to participate in any such project to develop this technology they would need some form of financial support to compensate them for their extra time and effort. This support could take the form of

government or industry financial grants or a commercial agreement with the company developing the technology to share the company benefits gained from their new products and service offerings.

6.2 Key Messages

It is technically and practically possible to deploy LoRaWAN network infrastructure to properties to allow the live tracking of cattle and sheep.

While there are the more obvious benefits to knowing where your livestock currently are in the paddock with the Smart Paddock solution, there is a much greater value to be obtained by analysing their movements and behaviours to provide additional management insights, and further research will be able to fully realise the capability of these kinds of solutions. Farmers who embrace these kinds of new technologies will be the first to benefit from the additional value, but they will require extra effort on their parts to fully realise this value.

6.3 Further Research and Re-Deployments

At a meeting with Romani staff on June 15th, 2020 it was decided to do further research using the collars on their bulls in the September/October 2020 timeframe. We planned to re-deploy their existing cattle collars on their bulls to demonstrate the ability to show the activity levels of the individual bulls and compare the activity levels between bulls to determine any lame or underperforming animals. During deployment it was determined that placing collars on their mature bulls was considered too risky to the health and safety of Romani staff. Romani management still consider this use case as a key future benefit of this type of technology and committed to trialling on their bulls when available in another form factor (i.e., ear tags). Smart Paddock will approach Romani management in 2021 when their new ear tag version becomes available.