CGA FINAL REPORT

Part 1 - Summary Details

Please use your TAB key to complete Parts 1 & 2.

CRDC Project Number: **CGA 1910**

CGA: **Macquarie**

Project Title: **On farm evaluation of the IoT technologies**

Project Commencement Date: 1/1/2019 **Project Completion Date: 15/06/2019**

Part 2 – Contact Details

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Part 3 – Final Report

(The points below are to be used as a guideline when completing your final report.)

Background

1. Outline the background to the project.

The Macquarie valley is closely monitoring the smart farm and 'automation" space, there are currently two providers in the valley who are offering new technology that the Macquaire Cotton Grower Association (MCGA) would like to trial in an "on farm evaluation". The MCGA have been using and evaluating the Canopy Temperature Sensor (CTS) technology and would now like to trial the "LoRaWan" gateway to access the Internet of Things (IoT) technology. There are potential significant gains to be made that could lead to our overall objective of improving efficiency of our most limiting commodity - water.

The project will have a three-year life span. The sensors will be purchased outright by the MCGA and the cost includes access to the software for a three-year period. Past trial work has outlined the need to evaluate over more than one season. The sensors easily moved, and "Gateway" access exists across the valley, farm locations can changed after the first season to explore other irrigation systems such as drip or overhead in the subsequent seasons.

This project has massive scope and potential to be built upon, there is flexibility to be able to repeat it next season with very little capital inputs. It can be adaptive and will try to explore how the IoT can help all farmers to improve and become

Objectives

2. List the project objectives (from the application) and the extent to which these have been achieved.

The MCGA would like to set up an 'on farm' evaluation of the IoT using "LoRaWan" system by means of low-cost sensors and connectivity, to optimise water management across the farm and significantly improve on-farm efficiencies. Current irrigation systems can have losses that could be improved with the addition of improved monitoring and scheduling. By linking the current technology such as MACE monitor units enabling live feedback of the flow from pumping systems *or channels, growers can work towards making every drop of water on the farm count.*

This is the first step we need to take before we can move towards 'automation'. The MCGA can build on what we are evaluating for the next two seasons and we feel that this project will allow growers to get firsthand tangible knowledge of the IoT and how that can look and feel on their farms.

A grower with two geographically isolated farms is going to try a suite of tools that is offered on the LoRaWan Gateway by two commercial providers. One property will be located within 3km of a Gateway and the other will be 15km from the nearest Gateway. The grower will be able to use the technology for the 2018/2019 season across two properties. During the season the MCGA will host a field day that will allow both service providers to demonstrate how the technology is used, as well as hear from the grower on how he has been using the technology and discover what the limitations and benefits might be in a real farm situation. The project aligns with CRDC Strategic objectives of investigating and communicating the application of beneficial new on-farm technologies and scientific approaches and investing in real time monitoring, building adoption capacity and developing benchmarks, decision tools and practices to support on farm resource efficiency decisions.

In summary the project objectives are to;

- Select the technology that will enable real time on farm benefits,
- Install it on the two farms
- Host a field day that will showcase the technology and communicate the benefits the grower has seen on farm.
- Create a case study that will capture the key findings from the trial to extend to the cotton industry
- Create feedback for the providers on what how we found the tools and what we would like to see in the development pipeline.

The project has achieved all the objectives as mentioned above. The on-farm evaluations were implemented and used throughout the 2018/2019 season. The growers who used the technology provided a case study that outlined the benefits and limitations of the systems we evaluated (Appendix 4). During the season the MCGA hosted a 'smart farm showcase' that saw over 110 attendees come together to see, how the technology looks and feels in both hardware and software components (Appendix 2).

Methods

3. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related projects.

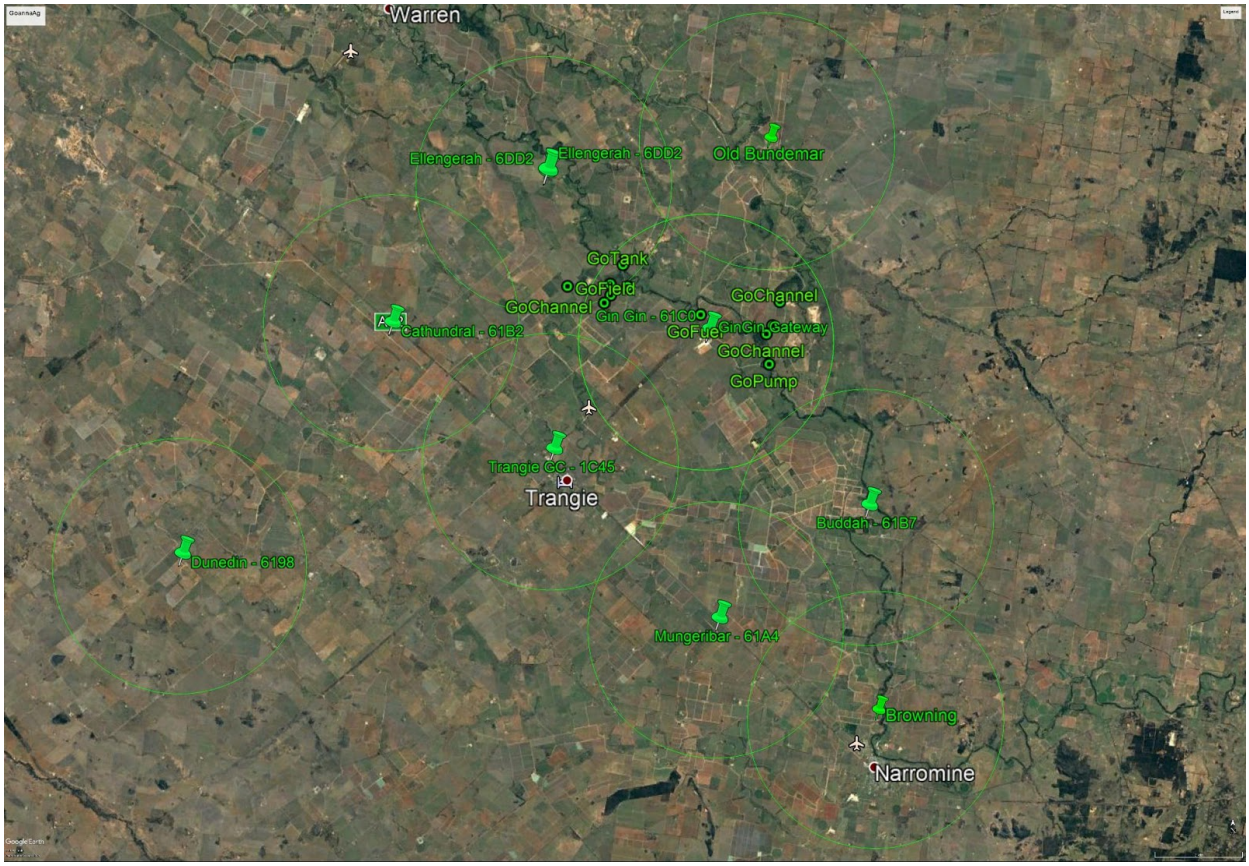

Figure 1. Green pins are the LoRawan Gateway locations (Source David Ward)

The farm was utilising the Gin Gin Gateway for most of the sensors (as marked on the map).

On farm evaluation technology used.

- Access to the LoRaWan gateway (3 years in advance)
- Go Fuel (3 years)
- Go Rain (3 years)
- Go Tank (3 years)
- Go Field LoraWan 80cm probe – seasonal hire
- Go Channel (3 years)
- Goanna Nimbus v2 Weather station
- Monitoring of fuel tanks, bore water tanks, water storages
- MACE meter Monitor
- Porosity, LoRaWAN Field Node
- Sensors: Water height for return channel, Pressure sensor (Pump ON/OFF),
- Rain gauge

On farm Goal: Initial goal was to save water by reducing wastage such as channel blow outs, and reducing irrigation run times. David Ward from Goanna Ag provided advice on which sensors and tools would be of benefit. We wanted to target specific sites to be able to view what was happening during irrigation remotely. The capacitance probe was installed in the field and the river pump mace meters installed with monitors as well as 2 rain gauges and an AWS, the grower reported “this gave us a good picture of where and water was on the farm”.

Outcomes

4. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.

Planned outcomes:

- Investigating and communicating the application and potential benefits of new on-farm technologies,
- Growers sharing knowledge of new technologies via existing networks within the Macquarie Valley as well as with other valleys via the CottonInfo networks.
- Ground truthing technology in real farm situations, getting end user feedback in langue farmers understand.
- Creating a case study outlining the benefits and limitations of the technology used in the on-farm evaluation.
- The MCGA in conjunction with CottonInfo will host a 'smart farm' field day, to show end users what they have been trialling on farms in the Valley.

The Economic Benefits

- Using monitoring systems on farms with a geographical spread the grower can save inputs such as fuel and time by using the real time monitoring rather than driving in sometimes dangerous conditions to assess storm water or tail water.
- Improved monitoring of water when it comes on farm via remote sensors resulted in more efficient irrigation cycles and less tail water in the system.
- Monitoring of storage tanks such as fuel and water can prevent situations that could cause stock or productivity losses.
- Using Go Sat and the forecasting abilities to fine tune what the crop is using and what its likely to use in the future, there was a big benefit when it came to plan the subsequent irrigation intervals.
- A 40% reduction in visual checks was observed by the grower. This translates to less kilometres on vehicles and workers being more productive on farm. The flow of effects stated by the grower was being further ahead on ground prep and less reliance on contractors than in the past.
- Accurate monitoring of channel heights saw increased irrigation efficiencies and led to less pumping hours. The grower reported reduced irrigation times which on his heavy country can mean better yields.

The Environmental Benefits

Increase in on-farm use of digital technology can be of benefit the following ways:

- An increase in real time monitoring and the decision tools and practices to support on farm resource efficiency.
- Improved monitoring can lead to the reduction of valuable inputs such as fuel, electricity, water.
- Reduced disease risk via a big reduction of driving in muddy conditions to check channel heights, pumps, rain gauges.
- Reduced need for road repairs due to less traffic when its was wet.
- The insect and herbicide spray applications were improved by the addition of local weather stations that closely monitored applications; this had a direct impact in reducing off-target spraying. Effective spray applications can lead to less resistance issues. The use of the inversion towers was utilised to reduce the likely hood of spray drift going off farm.

The Social Benefits

- Improved lifestyle for the growers (less getting up at 3am in a storm to check on tail water situations, the monitoring will allow processes like fuel ordering to become more streamlined)
- Wellbeing of farm workers and managers due to better sleep patterns and improved productivity.

- Improved social licence due to more transparency around water extractions.
- The “peace of mind’ factor was a major benefit, in the past the grower has always had the need to go and do a physical check on channels that were filling and pump’s etc, this year he reported that he was “more efficient ’ as he was able to go off farm and do other tasks he normally could not do during irrigation cycles.
- Using this technology physically allows the grower to spend more time with his family than in the past. He was able to monitor on farm situations from home and do less “just checking” trips around the farms.

Achieved outputs:

- A field day that showcased the technology on farm, where both providers demonstrated software, sensors and the grower gave a ‘warts and all’ view of the technology. (Appendix 1)
- Field day evaluation (see appendix 1.a)
- Field day summary in the regional newsletter by CottonInfo (see appendix 2)
- Contribution to a spotlight article based on the benefits of Grass Roots Grants (see appendix 3)
- A case study from the grower based on the on-farm evaluations from the season. (see appendix 4)
- MCGA Facebook updates during the season
    - smart farm showcase invite
    - The king of foot baths

5. Feedback

a) Feedback forms were used at the field day (appendix 1a) overall the feedback was very positive. It was the biggest attendance at a field day that the MCGA has ever had. The MCGA was very grateful to the Denston and Richardson families who went above and beyond to make sure all the bases were covered to run a great day for what turned out to be record numbers. A summary of the day is outlined below.

Field day

The smart farm field day was held on the 21-02-2019, 112 participants were in attendance, the focus was to showcase the technology and look at some Bankless fields that have been modified. A survey was conducted at the end of the field day to gain feedback and see how well we hit our targets on the day. The field day was a collaborative effort between CottonInfo and the Macquarie Cotton Growers Association.

The field day covered the following topics;

- Grant Tranter – MRFF Update – what the new requirements for metering irrigation water
- Brian Tompson – Porosity – Update on smart farm technology and CTS where is it now and what’s in the pipeline.
- Tom Dowling – Goanna Ag – Updates on the Mace Meters, overview of the Go field, Go sense, and quick chat about the LoRawan Gateways in the Macquarie
- Stew Denston – The remote management experience –
    - Stew talked about how the whole journey has been and what are some of the benefits he is seeing on farm
    - Stew touched on a ‘wish list’ of what he would like to see in future.
    - looked at the software on his laptop on the screen and showed everyone what the grower sees when using this technology.
- Get everyone on the buses and go and have a look at the sensors in the fields

- Buses to head down to the Bankless field and pull up and Pop Jenkins and Stu to talk about the Bankless at “Miegunyah”. Bankless 5 years “What we did we do wrong and how are we going to change and why”?

  Here are some of the survey results (for more information see appendix 1a)

Q. With regard to smart farm technology please rate your level of understanding (where 1 is very basic and 5 is very good)

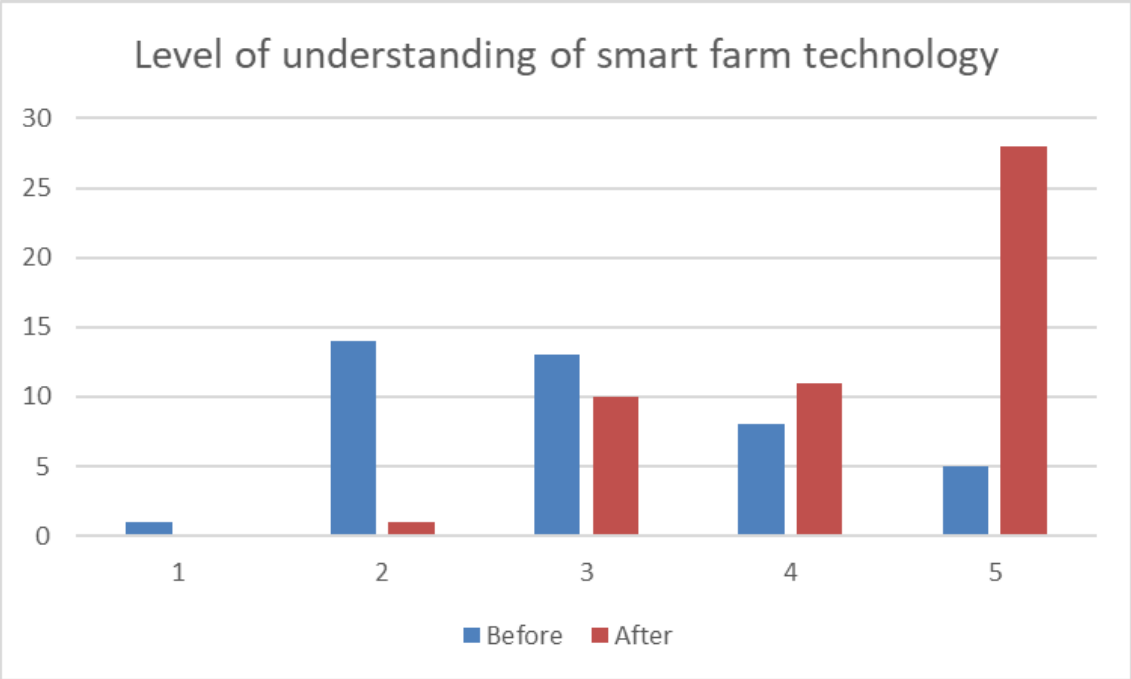

Figure 2: Blue is the response before the event and red is the response after the event.

Q: Level of confidence in using smart farm technology (where 1 is basic and 5 is very good)

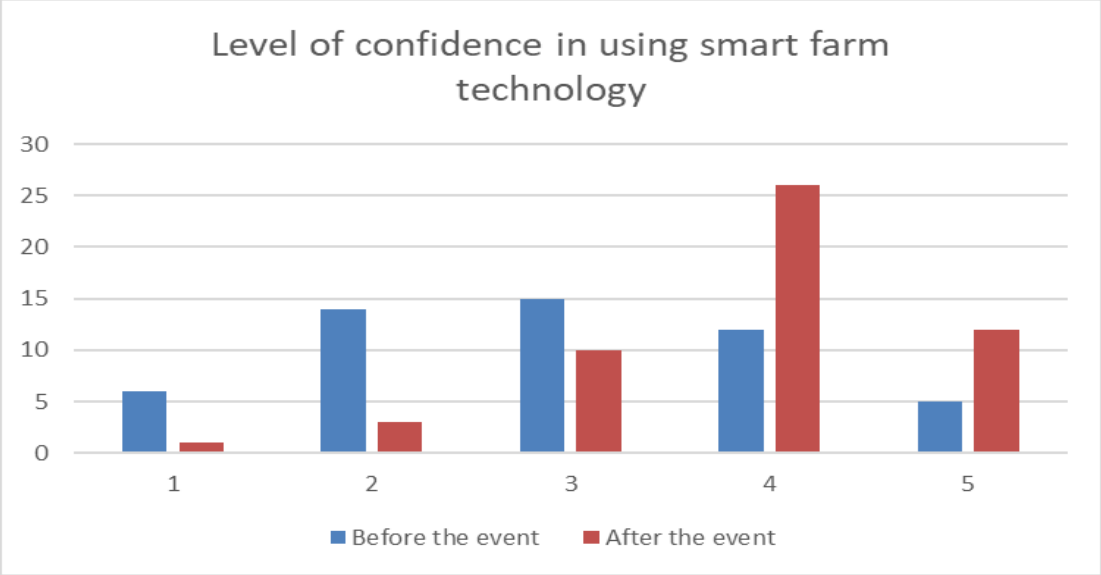

Figure 3: Blue is the response before the event and red is the response after the event.

Q: As a result of this event are you more likely to adopt the smart farm technology on your farm or in

your consultancy; or if you are already using it, to use it more effectively?

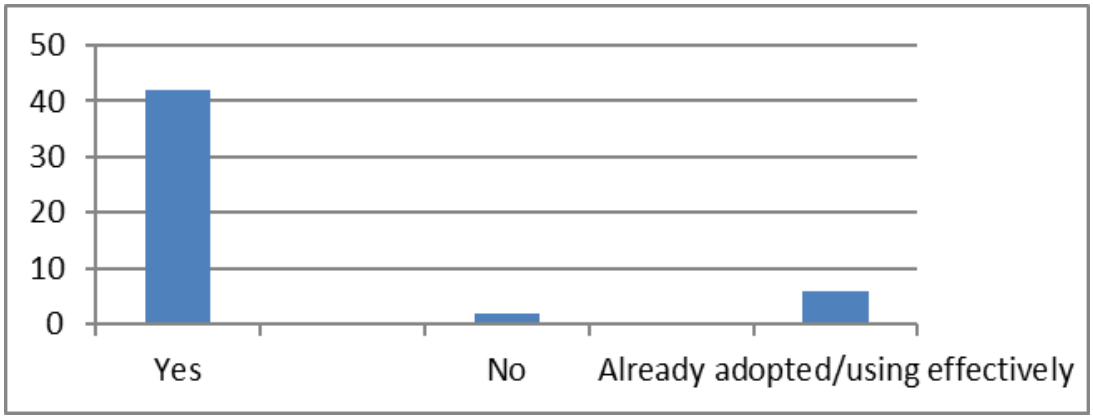

Figure 4. Are you more likely to adopt smart farm technology as a result of this field day?

Q: If you do you plan on making changes, in what time frame might it happen?

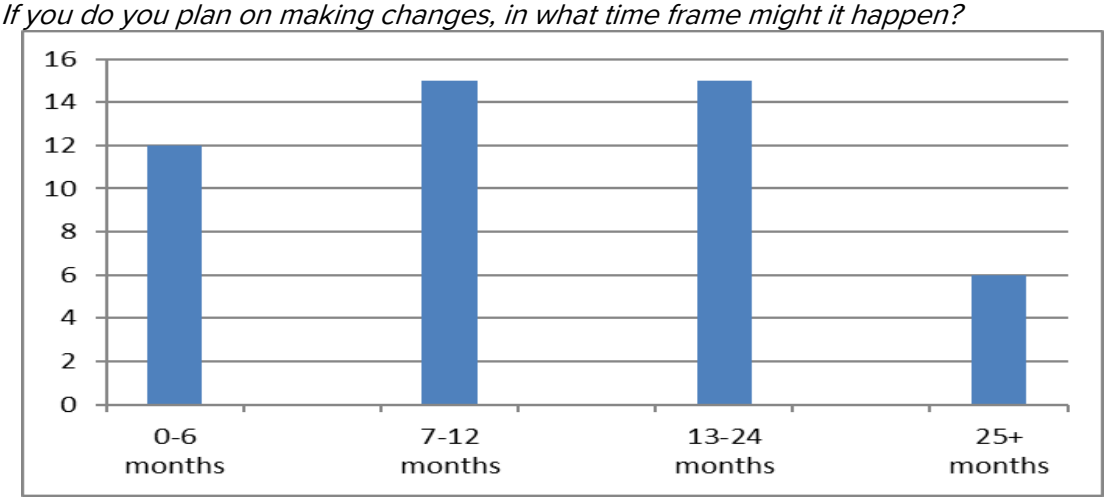

Figure 5: Timeframe for changes

Comments from the field day

Here is a summary of some of the comments from the field day that were captured in the survey sheets.

“Great to hear from the grower about how everything worked on his farm”
“The grower perspective was excellent and very practical”
“Very well-run event”
“Was looking for some more technical info on the telemetry”
“Well done, a new focus for field days, there is obviously lots of interest in it”
“On farm demos is the best way to showcase tech”
“Great timing as things were quiet on the farm”
“The balance was great - loved the strong farmer focused presenters”
“Great to come to a well-run farm and see what makes it tick”

When asked what is holding growers back from adoption this technology the most common answer was “lack of water security” along with ‘lack financial capability in the current climate” a close second. Growers also reported the following preventing them from using the technology.
“Capital investment as well as usage platforms, and training of older employees”
“Changing connectivity eg LoRa v CATMI”
“Maturity of technology”

"Access to lending and interest costs"
"Network coverage"

(See appendix 1a for full details)

Case Study (see appendix 4)

A draft case study is attached as appendix 4. An interview was conducted between Stew Denston and Amanda Thomas that forms the basis of the case study.

Conclusion

6. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What is the take home messages?

The impact of the 'on farm evaluation 'is significant in the Macquarie Valley growing region. The grower has reported seeing a payback on investment in 1 or 2 seasons (depending on the area of cotton grown). The Grass Roots Grant gave the MCGA the ability to trial the equipment "risk free on farm". A network of growers was developed who were able to communicate what was working well during the season. The grower who adopted the technology (Stew Denston) has reported the following;
"we started off trying to save water and we found so many more benefits on farm such as wellbeing for staff and managers, accuracy of water orders, labour saving, staff being more focused and getting more done every day".
He said overall "to sum it up in a few words we had better connectivity across the farming system".

Over the summer cropping period Stew reported that his confidence in the technology grew and he found more and more uses for it on farm. When asked does he think all farmers would be positively impacted by using the technology, he said the following;

- "Our farms are relatively close together, anyone who has a big distance in between farms or someone who uses casual labour should get onto this ASAP".
- "I see a payback on the investment in a season or two, your obvious things are fuel, time (labour) and water saving , but the big thing would be a major reduction in things like supply channel blowouts. These can have flow on effects throughout the irrigation cycle and could possibly cost you half a bale here and there".
- This on farm evaluation was able to see energy and fuel savings in the form of reduction in irrigation run times and I have no doubt this would flow onto yield benefits due to a reduction in 'stress hours' if you can get your water on and off in a timely manner.

Take Home messages:

- Installation was pain free and simple
- Results were better closer to the gateway, anything over 10 kilometres is pushing it if its not a clear line of sight.
- The software was adequate, easy to use and we would not change too much.
- All employees were able to install and use the software on their smartphones
- This is a great option where you don't have reliable phone signal
- The next step we need is the 'alert' system, setting some parameters you don't want to go below or above, getting a 'gentle ping' when it does would be valuable.
- There is a direct correlation to on farm savings when you can monitor you water and inputs remotely.
- The main benefit for a farm manager is the 'piece of mind factor' that using the technology can give you.
- Utilising this technology can allow you to multitask while irrigating and this leads to more productivity on farm, i.e. you can monitor channel heights while doing land prep

or sitting on the spray rig. Essentially have more freedom to do other things over the summer months.

The on-farm field day held last season, showed many are interested in adoption of this technology. The technology has been available for a while, but people have been in a wait and see holding pattern. MCGA and our growers are grateful that CRDC funded this project for us to go get out of the "wait and see" and into seeing what else can help us to save our two most precious resources, our people and our water.

Figure 6: Stew Denston talking to the crowd at the "smart farm showcase" 21st Feb 2019

The overall conclusion is that this technology has a beneficial fit on any cotton farm. There is potential for return on investment in a relatively short timeframe. It is a suite of tools that overcome the current connectivity issues that many areas have due to a lack of mobile coverage in some areas. Proximity to a LoRawan Gateway is key to getting the most of out the products we trialled.

Extension Opportunities

7. Detail a plan for the activities or other steps that may be taken:

(a) To tell other CGAs/growers/regions about your project.
(b) To keep in touch with participants.
(c) For future projects.

The case study that was created has been designed with a grower focus in mind. It aims to give a farmer account of what it was like using the technology in a real farm situation. It will be branded with MCGA and CottonInfo and distributed through our local networks as well as the CottonInfo networks.

The project contributed an article in the spotlight magazine (Appendix 3) based around our field day held in the Macquarie Valley.

The Warren Weekly and Narromine News ran stories on the field day Narromine news

The field day and case study have been reported in the "Macquarie Bale Up"

The MCGA has shared information on this project with 2 other CGA's and will be happy to share with others who are looking to benefit from a similar project. Sinclair Steele and Amanda Thomas are participating the Cotton Australia 2020 leadership course and as result have shared the success of the project with other members of CGA's across the growing regions.

The MCGA will keep using the products on farm for the next three seasons and do regular updates via the Macquarie Bale Up, written by Amanda Thomas and our Facebook page and website for more details go to Macquarie Cotton Growers Website

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Please email your completed report to research@crdc.com.au

ACKNOWLEDMGENTS:
The 2019 On farm evaluation of the IoT technologies was made possible by the ongoing support of CRDC. It was a collaborative effort organised by CottonInfo, MCGA, and thanks must go to the following people for making it all possible.

- Stew and Jenna Denston, John and Rhonda Richardson for putting their hand up to trial the technology, it seems like sweet deal but there is lots of work in hosting the field day and contributing to the reports and evaluations that we have done as a result of the project.
- Sinclair Steele, Amanda Thomas and Macquarie Cotton Growers Association for Hosting the field day and applying for the grants, and sponsoring the field day
- David Ward and Tom Dowling of Goanna Ag and Brian Thomson of Porosity Ag Services
- Goanna Ag, Porosity Ag Services , Cotton Seed Distributors for contributing towards the field day