



FINAL REPORT

For Public Release

Part 1 - Summary Details

CRDC ID: AE1801

Project Title: Climate and energy for cotton farming businesses

Project Start Date: 3 July 2017

Project Completion Date: 9 June

2020

Research Program: Farmers

Part 2 – Contact Details

Administrator: Ms Janine Powell

Organisation: Ag Econ

Ph: 0427 961 332

E-mail: admin@agecon.com.au

Principal Researcher: Jon Welsh

Organisation: AgEcon

Ph: 0458 215 335

E-mail: jon@agecon.com.au

Supervisor: (Name & position of senior scientist overseeing the project).

Organisation:

Ph:

E-mail:

Researcher 2: (Name & position of additional researcher or supervisor).

Organisation:

Ph:

E-mail:

Signature of Research Provider Representative:

Date submitted: _____

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 farming game is full of risk with growers inadvertently making management decisions to minimise risk and maximise productivity every day. As farming systems become more complex and the administrative burden grows, cotton farmers are not spending the time (and sometimes do not have the skills) to undertake high level climate, investment or business analysis for their cotton enterprises. To make informed decisions, these analyses are essential.

Jon Welsh and Janine Powell (trading as Ag Econ) are experienced in conducting and presenting weather and economic analysis to cotton farmers. By clearly communicating the key variables of investment or gross margin analysis, results were extended in a way that ensured any cotton grower, in any location could consider the analysis for their own enterprise. Climate information was analysed and communications tailored to the cotton industry making it highly demanded and valued extension information.

Ag Econ completed all analysis and provide tailored extension packs in the areas of 'climate risk management', 'resource efficiencies' and 'business risk management' to deliver efficient solutions to these knowledge gaps.

Objectives

2. List the project objectives and the extent to which these have been achieved, with reference to the Milestones and Performance indicators.

MS No.	Milestone Description (what are the key steps in answering the question)	Performance Indicator (one Output per Milestone)	Expected science/industry outcome (one S/I Outcome per Milestone)	Status	Notes
1. Risk Management (Climate) analysis					
1.1	Grower extension on seasonal forecasting due diligence via fortnightly weather e-newsletter tailored to cotton and distributed via mail chimp. 2 workshops and 1x webinar to be delivered annually.	Distributed e-news. Analytics summarised in progress reports	Cotton growers are provided with targeted tools that enable them to improve climate risk management strategies	Achieved	Moisture Manager published fortnightly. Open rate between 34-40% with ~4000 total opens each week. Workshop KPIs were exceeded by around 400% for the project and climate webinars 150% with the addition of a podcast – 154 listens. Webinar viewing had a cumulative total of 350 live attendee and recording access twice annually.
1.2	Represent cotton in multi-sectoral RD&E projects as the CRDC lead for CCRSPI, MCV / R&D4P	Attend conferences, interstate forums, phone meetings, make submissions to internal/external stakeholders on behalf of CRDC	Cotton industry is represented at a national level to participate in the exchange of new weather knowledge	Achieved	Attended MCV and additional CCRSPI meetings. All attended. CRSPI conference cancelled due to Covid19
2. Resource efficiency analysis					
2.1	Conduct one @RISK or technology Benefit Cost Analysis (BCA) per annum.	One completed BCA annually, presented as; 1 x (either; a fact sheet (finished by graphic designer to CRDC specs) for CottonInfo.com.au,	Cotton growers are presented with information that assists them in improving resource	Achieved	2018. Energy case studies: Emerald 2019. Repair or Replace Pumps

		you tube video or conference paper) 1 x published report	efficiencies. Study on the BCA of broad acre robotics		2020. Autonomous spray robots 2 of 3 journal publications Energy Youtubes showing great engagements with ~1700 views for 2 clips
	Conduct 2 energy efficiency workshops p.a.	2x workshops completed and evaluation submitted in progress reports	Provide adoption pathways to improve energy efficiency and integrate renewable energy technology in irrigation pumps	Achieved	2018. Emerald 2019. ? 2020. Replaced with Spray drift focus group meetings
3. Business Management & Risk analysis					
3.1	Update Australian cotton industry gross margins for irrigated, semi-irrigated and rain-fed cotton to assist with International surveys and reporting obligations	Annually updated gross margins for irrigated, semi-irrigated and rain-fed cotton	A greater understanding of the production costs and margins for the Australian Cotton Industry	Achieved	Undertaken annually and uploaded to the CottonInfo website. 2018 analysis published in e-news Aug 2018 achieved the highest click-throughs of 400
3.2	General gross margin analysis and discussion including @RISK analysis and resilience/sensitivity testing of one key variable of production.	Annual analysis presented in either; a fact sheet, cotton grower article or extension package for CottonInfo	A greater understanding of the profit drivers and key variables of production so they can be appropriately managed	Achieved	2017 Dec Spotlight, electricity v diesel 2018 Dryland cotton upside v downside. 2019 e-news September, temporary water purchases and impact on crop GM
3.3	Cotton Production Manual - Review & update the 'Business of Growing Cotton' chapter, Energy and climate chapters			Achieved	Review accepted and chapters published annually
4. Industry networking and extension					

4.1	Attend CottonInfo 6-monthly meetings and teleconferences to extend findings	Attend fortnightly CottonInfo and AOP telecons	The CottonInfo team jointly understand industry priority areas, JVC reporting obligations and opportunities to collaborate	Achieved	Jon attending fortnightly and 3 annual AOP telecons
4.2	Attend cotton industry conferences and forums	Attend <i>Cotton Collective 2017 & 2019</i> Attend <i>Cotton Conference 2018</i>	Extension of the most up to date research to key industry stakeholders	Achieved	Presented at CC2018 and Cotton Collective 2017 & 2019
5. CRDC Reporting					
5.1	Document project activities, outputs and impacts	Bi-Annual progress reports Final Report		Achieved	All progress reports submitted consistently on time or before due dates

Methods

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

This project included a number of discreet research tasks. All methodologies used were routine approaches to analytical and economic problems: partial budgets, whole farm budget, and Discounted Cashflows were used. Every research task has been published in some form (see section 9) individual methodologies, results and outcomes are outlined in individual publications.

Results

4. Detail and discuss the results for each objective including the statistical analysis of results.

This project has over delivered, despite budget constraints in areas of climate risk management extension. Outputs generally across all KPIs has always exceeded milestones - with additional tasks undertaken. For example, outputs have featured in top ranking global and Australian scientific journals with 3 studies published and another climate journal in draft to be submitted in June. No budget allowances were allocated to the onerous review processes for journal publications. Additional rigor required by journals adds to quality of information to industry.

Areas of business management have always shown good engagement with high open rates. Gross margin analysis topics were selected with CottonInfo consultation and saw high click throughs indicating the mini analyses were highly sought after. Energy research is also gaining momentum with adoption of renewables occurring very slowly. However, more irrigators are calling and emailing to enquire about the economics and suitability under irrigation pumping scenarios.

Multi-sectoral collaboration through MCV and CRSPI has been a highlight with cotton always a willing voice to steer R&D direction and input into CRSPI Conferences, R&D review panels and boasts a full attendance to all activities including monthly MCV/FWFA telecons despite our industry being a small overall financial contributor. Multi-sectoral climate R&D outputs have enjoyed a seamless transition into grower climate extension: ACCESS-S model tools and research outputs feature in workshops, e-news, webinars and podcasts. The community of practice sessions with the BOM and BCG offer peer support to climate extension.

Outcomes

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

This project will help deliver CRDC's strategic research priority of *Lifting productivity and economic growth*.

Through the extension of high quality outputs in the key knowledge gap areas of 'climate risk management' 'resource efficiencies' and 'business risk management', growers have been provided tailored information to help them make business decisions that will ultimately improve productivity. Extension communications build knowledge and lead to adoption of management practices or investments that improve productivity efficiencies and build system resilience.

6. Please describe any:-

- a) technical advances achieved (e.g. commercially significant developments, patents applied for or granted licenses, etc.);**

The novel use of podcasts to add to extension mediums. An experiment was conducted to try a podcast with tremendous engagement.

b) other information developed from research (e.g discoveries in methodology, equipment design, etc.); and

None.

c) required changes to the Intellectual Property register.

Filled out

Conclusion

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

Climate risk management: a key area that continues to grow in demand due to improving climate literacy. Farming to the 'cycles' instead of the 'average' is a key mantra. Climate science can help identify sequences and assist in management decisions – gearing inputs with water and moisture availability is critical for the financial health of businesses.

Business risk management: pricing and assumptions in a cotton crop can change from year to year. For example, round-bale pickers changed from \$800k to \$1.05m in one year due to exchange rate fluctuations. Pesticide requirements have been changing due to later cut-out in some regions and energy costs continue to impact Queensland growers. Keeping abreast of changing costs with detailed industry surveys of chemical suppliers, agronomists, machinery salesmen and technology providers such as irrigation engineers can inform growers to alter costs and improve returns.

Energy technologies and advances in robotics have shown a certain fit in some areas. However, while payback may prove attractive, the complexity of these systems constrains communication and adoption.

Extension Opportunities

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

(a) to further develop or to exploit the project technology.

Podcasts are a popular addition to extension campaigns. More refined analysis needs to be undertaken on duration and target audience to achieve maximum impact.

(b) for the future presentation and dissemination of the project outcomes.

(c) for future research.

Hydrogen technology application to the cotton system. These can be potentially included in FRP004.

9. A. List the publications arising from the research project during the project period.

During the project period all efforts were made to ensure research and findings were published in peer review journals, this ensures relevant research at the highest standards. All research findings were extended through traditional CottonInfo channels, Spotlight, e-news, reported to the CottonInfo team, workshops and conference presentations. To increase the audience that was reached, novel avenues such as youtube videos, podcasts, webinars and social media were also utilised. The list below outlines the publications for the three-year project.

Book chapters

Farquharson, R., & Welsh, J. M. (Eds.). (2017). *The Economics and Perspectives of Site Specific Irrigation Management*. Gewerbestrasse, Switzerland: Springer.
https://link.springer.com/chapter/10.1007/978-3-319-68715-5_5

Peer reviewed journals

Welsh, J. M., Powell, J. W., & Revell, G. (2020). Economic potential of autonomous tractor technology in Australian cotton production systems. *Australian Business Farm Management*, Under review.

Powell, J. W., Welsh, J. M., & Farquharson, R. (2019). Investment analysis of solar energy in a hybrid diesel irrigation pumping system in New South Wales, Australia. *Journal of Cleaner Production*, 244(Accepted, in print.), 444-454.
<https://www.sciencedirect.com/science/article/pii/S0959652619307620?via%3Dihub>

Powell, J. W., & Welsh, J. M. (2019). The Economics of Integrating Alternative Energy. *Australian Farm Business Management Journal*, 16(1).

Powell, J. W., Welsh, J. M., & Eckard, R. J. (2017). An irrigated cotton farm emissions case study in NSW, Australia. *Agricultural Systems*, 61. doi:10.1016/j.agsy.2017.09.005.
<https://www.cottoninfo.com.au/sites/default/files/img/Powell%2C%20Welsh%2C%20Eckard%202017.pdf>

Welsh, J. M., Smith, J., Dickinson, S., Devlin, A., Hunter, G., Thomas, A., & O'Keeffe, K. (2017). *CottonInfo on-farm Nitrogen trials and N-use practices*.
<http://cottoninfo.com.au/sites/default/files/documents/CottonInfo%20On-Farm%20Nitrogen%20Trials%202017.pdf>

Conference presentations

Welsh, J. M. (2018). *Which climate models can you use?* PENERAY speaker 2018 Australian Cotton Conference, Gold Coast, QLD. Presentation here:
<https://www.youtube.com/watch?v=GSpJ4RWaE0>

Powell, J. W. (2018). *Incorporating solar into cotton farms*. Speaker 2018 Australian Cotton Conference, Gold Coast, QLD. Presentation here:
<https://australiancottonconference.com.au/wp-content/uploads/01-Janine-Powell.pdf>

Research reports

Powell, J. W. & Welsh, J. M. (2019). "Integrating alternative energy: A farm case study at Emerald, QLD." Cotton Research Development Corporation report. Ag Econ, Burren Junction, NSW, Australia <https://cottoninfo.com.au/publications/energy-integrating-alternative-energy-solutions-case-study-emerald-qld>

Welsh, J. M., & Powell, J. W. (2019). "Repair or replace? Line-shaft vs submersible pumps." Cotton Research Development Corporation report. Ag Econ, Burren Junction, NSW, Australia. <https://cottoninfo.com.au/publications/repair-or-replace-line-shaft-vs-submersible-pumps>

CottonInfo and industry publications

Annual chapters in the Australian Cotton Production Manual: Climate for Growing Cotton, Energy Use Efficiency and The business of growing cotton. Latest citations below. <https://cottoninfo.com.au/sites/default/files/documents/ACPM%202019%20final.pdf>

Welsh, J. M. (2019). Ch 3: Climate for cotton growing, *Australian Cotton Production Manual 2019*. CRDC, Narrabri, NSW, pg 12-15.

Welsh, J. M. (2019). Ch 9: Energy use efficiency, *Australian Cotton Production Manual 2019*. CRDC, Narrabri, NSW, pg 48-51.

Powell, J. W. (2019). Ch 24: The Business of Growing Cotton, *Australian Cotton Production Manual 2019*. CRDC, Narrabri, NSW, pg 140-144.

Annual update of cotton industry suite of gross margins. Latest citation below

Welsh, J. M. & Powell, J. W. (2019). Cotton Gross Margins Series: 2019-20. CRDC, Narrabri, NSW. <https://cottoninfo.com.au/publications/australian-cotton-industry-gross-margin-budgets>

Seventy six editions of the fortnightly climate e-news. Latest citation below

Welsh, J. M. (2020). The CottonInfo Moisture Manager. CRDC, Narrabri, NSW. <https://us9.campaign-archive.com/home/?u=48d1c0404d4f8dbd74944aba3&id=882f5f014e>

Regular contributor to Spotlight magazine

Welsh, J. M. & Powell, J. W. (2020). Bore pumps: is it time to repair or replace? *Spotlight*. Autumn 2020, CRDC, Narrabri, NSW, pg 33-34. <https://www.cottoninfo.com.au/publications/spotlight-magazine-autumn-2018>

Welsh, J. M. (2020). Bridging the gap: weekly and fortnightly climate outlooks. *Spotlight*. Autumn 2020, CRDC, Narrabri, NSW, pg 35. <https://www.cottoninfo.com.au/publications/spotlight-magazine-autumn-2018>

Welsh, J. M. (2018). Doing the figures: Automation is a good investment. *Spotlight*. Summer 2018/19, CRDC, Narrabri, NSW, pg 18. <https://www.crdc.com.au/sites/default/files/pdf/Spotlight%20Summer%202018-19.pdf>

Welsh, J. M. (2018). Wirelessly managing drift risks. *Spotlight*. Winter 2018, CRDC, Narrabri, NSW, pg 20. <https://www.crdc.com.au/sites/default/files/pdf/Spotlight%20Winter%202018.pdf>

Powell, J. W. & Welsh, J. M. (2018). Electricity or diesel: Which is best for you? *Spotlight*. Autumn 2018, CRDC, Narrabri, NSW, pg 33-35. <https://www.cottoninfo.com.au/publications/spotlight-magazine-autumn-2018>

Powell, J. W. & Welsh, J. M. (2018). Budget better with gross margin study. *Spotlight*. Summer 2018, CRDC, Narrabri, NSW, pg 9. <https://www.cottoninfo.com.au/publications/spotlight-magazine-autumn-2018>

Welsh, J. M. (2017). Avoiding spray drift? *Spotlight*. Autumn 2017, CRDC, Narrabri, NSW, pg 34-35. https://www.crdc.com.au/sites/default/files/pdf/Autumn17_SC.pdf

Other extension materials

- Welsh, J. M. & Powell, J. W. (April 2020). *2020 Winter cropping climate outlook*, Webinar [video file]. Available; <https://www.youtube.com/watch?v=KgCvjZ2Sn3s>
- Powell, J. W. & Welsh, J. M. (Sept 2019). *CottonInfo e-news: Our gross margins – your bottom line*, E-news. Available; <https://mailchi.mp/crdc/cottoninfo-e-news-our-gross-margins-your-bottom-line?e=5d045cbcb6>
- Welsh, J. M. & Powell, J. W. (June 2019). *Climate drivers of the 2019 Winter crop*, Podcast [audio file]. Available; <https://cottoninfo.com.au/podcasts/podcast-3-weather-podcast-featuring-jon-welsh-and-janine-powell>
- Welsh, J. M. & Powell, J. W. (May 2019). *2019 Winter cropping climate outlook*, Webinar [video file]. Available; <https://www.youtube.com/watch?v=Ad1cBdnTvN8>
- Powell, J. W. & Welsh, J. M. (Sept 2018). *CottonInfo e-news: Our gross margins – your bottom line*, E-news. Available; <https://mailchi.mp/28f2e3d19cfe/our-gross-margins-your-bottom-line?e=5d045cbcb6>
- Welsh, J. M. & Powell, J. W. (July 2018). *Integrating alternative energy solutions into irrigation farms* [video file]. Available; <youtube.com/watch?v=y0wjOW-9RxM&t=2s>
- Welsh, J. M. & Powell, J. W. (June 2018). *Integrating alternative energy solutions: Comet, QLD*. CottonInfo fact sheet. <https://cottoninfo.com.au/sites/default/files/documents/FINAL%20Energy%20Fact%20Sheet%202018.pdf>
- Welsh, J. M. & Powell, J. W. (June 2018). *CottonInfo e-news: Thinking solar? Now's the time*, E-news. Available; <https://mailchi.mp/crdc/cottoninfo-e-news-thinking-solar-nows-the-time?e=5d045cbcb6>

B. Have you developed any online resources and what is the website address?

No. All resources have been published with CRDC approval as per above citations.

Part 4 – Final Report Executive Summary

As farming systems become more complex and the administrative burden grows, cotton farmers are not spending the time (and sometimes do not have the skills) to undertake high level climate, investment or business analysis for their cotton enterprises. Independent reviews and feasibility research are essential for growers and advisors considering practice change or capital investments in cotton farming businesses. Equipment suppliers often develop in-house feasibility with limited transparency on calculations / assumptions for a willing and sometimes unsuspecting consumer. Comprehensive peer review (including CottonInfo) of documentation and analysis underpins all outputs.

To make informed decisions, these analyses are essential. From 2017-2020, the following tasks were undertaken by CottonInfo's Jon Welsh, in partnership with economist Janine Powell:

- Regular climate risk analysis via CottonInfo e-news, webinars and workshops to improve climate literacy of growers and advisors – allowing better management decisions to reduce climate risk and build industry resilience;
- Improved climate literacy was achieved by regular climate e-news including feature editions at winter and summer cropping decision points as well as webinars, face-to-face extension, presentations to industry and CCA and other novel approaches to messaging such as podcasts;
- Gross margin analysis of dry-land and irrigated cotton was broadened to include contracted operations and overhead irrigation scenarios. Key input analysis within the gross margins was also reported and extended. Industry budgets and analysis give current and new cotton growers a starting point to create their own budgets which can potentially lead to more informed cropping and input choices and a more profitable enterprise, business and industry.
- Energy efficiency extension for irrigators to build knowledge in what works and when. Improved energy literacy results in informed decision making for cotton growers. 5 large solar investments have been installed as a direct result of project extension material. These investments have improved energy efficiency and farm profitability through lower cost of energy. And also improved farm sustainability through lowered emissions.
- Resource efficiency analysis; limited irrigation water scenarios, incorporating renewables and energy technologies into irrigation systems, robotics in agriculture and, measuring practice change scenarios through dynamic gross margin analysis. The in-depth and targeted analysis conducted within the project were extended to the industry to inform cotton growers of the feasibility drivers for various new technologies and practice changes. Building this business knowledge in our industry can improve the return on investment capital creating a more profitable and sustainable cotton industry.