CRDC ANNUAL REPORT 2017–2018

Investing in RD&E for the world-leading Australian cotton industry

Australian Government
Cotton Research and Development Corporation

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If you are interested in learning more about CRDC and its investments visit the CRDC website www.crdc.com.au or subscribe to our quarterly magazine, *Spotlight*.

All photos and images in this report were sourced principally from CRDC, project researchers or research institutions.

Front cover photo by: Melanie Jenson

Front cover photo: Riverina-based cotton consultant Pat McGuinness and (then) Auscott Hay farm supervisor Alex Downes at the Gwydir Valley Irrigators Association field day at "Redmill" Moree in 2017, featuring CRDC-supported irrigation automation trials.

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Australian Government
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Introduction
ABOUT CRDC

The Cotton Research and Development Corporation (CRDC) has been delivering outcomes in cotton research, development and extension (RD&E) on behalf of Australia's cotton growers and the Australian Government for 28 years.

Established in October 1990 and operating under the *Primary Industries Research and Development Act 1989* (PIRD Act), CRDC exists to enhance the performance of the Australian cotton industry through investment in, and delivery of, cotton RD&E. CRDC is based in Narrabri, NSW: the heart of one of Australia's major cotton-growing regions and home to the Australian Cotton Research Institute.

CRDC's role is to invest in RD&E on behalf of cotton growers and the government, with the outcomes boosting the productivity and profitability of our industry. RD&E, and its resulting innovations, are a key driving force behind the cotton industry's continued success.

2017-18 marked a significant year for CRDC – the culmination of five years investment under the 2013-18 Strategic RD&E Plan, and its resulting impact. In this final year, CRDC invested $25.1 million into 318 RD&E projects in collaboration with 118 research partners and growers who conducted on-farm trials, across five key program areas: farmers, industry, customers, people and performance.

The findings from these research projects continue to be extended through a range of methods including the publication of information, extension of knowledge and commercialisation of new products and services. The industry's joint extension program, CottonInfo, is the key mechanism for supporting adoption of the results of research in combination with best management practices encouraged via the industry program *my*BMP. CRDC is a founding partner of both programs.

These investments achieved real impact for cotton growers, the industry and the wider community during 2017-18 – as detailed within this report.

Vision: **A globally competitive and responsible cotton industry.**

Mission: **To invest in RD&E for the world-leading Australian cotton industry.**

Purpose: **Enhancing the performance of the Australian cotton industry and community through investing in research and development, and its application.**

ABOUT THE AUSTRALIAN COTTON INDUSTRY

The Australian cotton industry is an Australian agricultural success story. A culture of innovation within the industry, supported by and embracing RD&E, has been a major contributor to this success.

Australian cotton aspires to be the highest yielding, finest, cleanest and greenest cotton in the world. On a global scale, Australia is not a large cotton producer: accounting for only around three per cent of the global crop. Yet Australia is one of the largest exporters of cotton, with nearly 100 per cent of the national crop exported. Cotton is Australia's fifth most valuable agricultural export commodity, generating an average of $1.9 billion in export revenue annually.

Cotton is a major contributor to the economic, environmental and social fabric of rural Australia. Predominately grown in New South Wales (NSW) and Queensland (QLD), with expansion into Victoria (VIC) and commercial trials in northern Australia, cotton is a major employer and contributor to the local, state and national economy. The industry generates significant wealth and provides an economic foundation to these regions and their communities, employing some 10,000 people.

New cotton varieties, new farming technologies, favourable weather and market conditions, and support from RD&E have facilitated recent growth in the cotton industry, with greater uptake in dryland cotton, an expansion in southern cotton-growing regions, and an extended season for northern growers.

RD&E plays a critical role in supporting the success of first-time cotton growers and industry growth. The impact of some RD&E for the Australian cotton industry is easy to see and measure: Australia's world-leading cotton yields and quality, efficiency gains in water use and reductions in pesticide use, for example. Yet arguably, cotton production would not have been possible for the last 20 years if it wasn't for RD&E and the industry's commitment to improving its practices for controlling insects, and managing diseases such as Fusarium wilt.

Cotton is, and long has been, an industry that recognises changing societal expectations and responds accordingly. The introduction of the industry's best management practice program *my*BMP, the uptake of biotechnology to help reduce pesticide use, and the implementation of the industry's environmental assessment and resulting commitment to ongoing sustainability reporting, are all examples of the cotton industry recognising the need for change, and working with the RD&E system to enact it.

With the culture of innovation, and a commitment to continuous improvement in on-farm practices, Australian cotton growers have become world-leaders in resource efficiency, working to optimise resources while reducing their environmental footprint.

LETTER OF TRANSMITTAL

Australian Government
Cotton Research and Development Corporation

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15 October 2018

The Hon. David Littleproud
Minister for Agriculture and Water Resources
Parliament House
Canberra ACT 2600

Dear Minister

It is with great pleasure that I submit the Corporation's Annual Report for 2017-18, prepared in accordance with the provisions of section 28 of the *Primary Industries Research and Development Act 1989,* section 46 of the *Public Governance, Performance and Accountability (PGPA) Act 2013,* and the *Funding Agreement 2015-2019.*

The activities of the Corporation are reported against the objectives, strategies, outputs and outcomes of the CRDC Strategic Research and Development Plan 2013-18, and are consistent with CRDC's 2017-18 Annual Operational Plan and Portfolio Budget Statement.

Under section 46 of the PGPA Act, CRDC Directors are responsible for the preparation and content of the Annual Report being made in accordance with the Public Governance, Performance and Accountability Rule 2014. The report of operations was approved by a resolution of the Directors on 9 October 2018.

Yours sincerely

Richard Haire
Chair
Cotton Research and Development Corporation

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Executive Summary

REPORT FROM THE CHAIR AND EXECUTIVE DIRECTOR

Under the 2013-18 Strategic RD&E Plan, CRDC strategically invested in RD&E in five core priority areas – farmers, industry, customers, people, and performance – to drive forward profitability, competitiveness and sustainability for the benefit of cotton growers and the wider community.

CRDC continued to deliver real impact for cotton growers through our RD&E investments in 2017-18 – bringing to a close the strategic investment priorities of the 2013-18 Strategic RD&E Plan.

Working closely with industry and government stakeholders, CRDC created gains for the industry through RD&E, delivering against the goals and objectives of this Plan and helping growers achieve 4.6 million bales of cotton this year, up from 4.2 million bales in 2016-17.

During this year, CRDC invested $25.1 million in collaboration with 118 research partners and growers into 318 RD&E projects and on-farm trials across the five key program areas. In this report, we highlight some of our significant research achievements during this year and provide an update on how key projects are progressing.

In last year's report, we outlined three impact assessment reports into CRDC's RD&E investments, which found benefit-cost ratios of 17.1 to 1 for our investment in the Central QLD early planting research; 8.29 to 1 for our investment in water-use efficiency research; and 5.4 to 1 for our nutrition investments. This year, we continued to conduct impact assessments, with the two latest reports finding our investment into the industry program *my*BMP on behalf of growers and the government delivered a benefit-cost of 9.1 to 1; and into industry sustainability a benefit-cost of 2.5 to 1. These reports highlight the contribution that RD&E makes to the industry at large.

This year, CRDC has continued to lead the three major collaborative projects under the Department of Agriculture and Water Resources' Rural R&D for Profit program: *Smarter Irrigation for Profit, More Profit from Nitrogen,* and *Accelerating Precision Agriculture to Decision Agriculture.* All three projects reached critical stages in 2017-18, with the finalisation of the Precision to Decision Agriculture project (the first collaborative project across all 15 of our fellow Rural Research and Development Corporations), and its official launch by the Minister for Agriculture and Water Resources, the Hon. David Littleproud MP at the ABARES Outlook national conference in Canberra in March 2018.

A major outcome of the Precision to Decision Agriculture project was the finding that the implementation of digital agriculture across all Australian production sectors could lift the gross value of agricultural production by $20.3 billion – a 25 per cent increase on 2014. This shows the enormous potential of digital agriculture, and the RDCs are now working together to drive stage two of this project forward.

The cotton industry has long embraced new technology, and CRDC continues to play a leading role in driving the application and adoption of new innovations and developments. This year, we have been investigating how working with the start-up community through accelerators, incubators and venture capitalists can help bring beneficial new technology products and services to the cotton industry. Agtech is already a part of the Australian cotton growing and processing landscape, with many CRDC projects – from canopy temperature sensors, to temperature inversion weather stations, weed sensing for robotics, and irrigation automation technology – playing a role.

Looking forward, we anticipate there will be a lot of change in our industry – from where we grow cotton to the technology we will use to grow it. In this regard, the development of a new five-year CRDC Strategic RD&E Plan, commencing 1 July 2018, has strongly informed the future direction for technology-based solutions and innovation as we support sustainable growth, responsible practices, profitability and the adaptive capacity of the Australian cotton industry. It has also challenged us to think about how CRDC can innovate within our business processes to ensure the organisation is fit for purpose, now and into the future. With these thoughts in mind, we expect to make some changes as we embark on the ambition to contribute to creating $2 billion in additional gross value of cotton production for the benefit of Australian cotton growers and the wider community by 2023.

On behalf of our fellow Directors, we invite you to read the CRDC Annual Report for 2017-18.

Richard Haire
CRDC Chair

Bruce Finney
CRDC Executive Director

Pictured at the official launch of the Accelerating Precision to Decision Agriculture project at ABARES in March 2018: Leanne Wiseman of the Australian Centre of Intellectual Property in Agriculture (ACIPA) at Griffith University; Bruce Finney, Executive Director, CRDC; the Hon. David Littleproud MP, Minister for Agriculture and Water Resources; Jane Trindall, R&D Manager, CRDC and Tim Lester, Executive Officer, Council of Rural RDCs.

Executive Summary

FINAL REPORT AGAINST CRDC STRATEGIC R&D PLAN 2013-18

CRDC's RD&E investments during 2017-18 were governed by the Strategic R&D Plan 2013-18, which outlined five key investment programs – farmers, industry, customers, people and performance. During the lifespan of the plan 2013-18, CRDC completed an analysis of performance against the Strategic Plan measures and reported outcomes annually.

2017-18 marked CRDC's final year of operation under this Strategic Plan. The table below shows CRDC achievements against the Strategic Plan programs ending 30 June 2018. Progress was measured through the CRDC monitoring and evaluation framework. Each of the measures of success outlined in the Strategic Plan had corresponding metrics, against which performance was measured through annual quantitative and qualitative surveys.

The red, amber and green traffic light system was used in CRDC's monitoring and evaluation to track overall performance against the CRDC Strategic Plan.

- ● The specific measure has been achieved.
- ● We did not fully achieve this target.
- ● Measure not delivered.

Strategic Plan Measures	Result	Comments
Farmers: Cotton is profitable and consistently farmers' crop of choice		
Farmers increase productivity by 3 per cent per hectare per year	●	Average annual increase in yield for the five years of the 2013-2018 strategic plan was maintained at 3 per cent per hectare per year despite reduced yields in 2016-17. The compounding annual growth remained at just above 2 per cent for the five-year period.
Industry: The Australian cotton industry is the global leader in sustainable agriculture		
Industry can report against recognised sustainability indicators	●	The Australian cotton industry was the first agricultural industry in Australia to develop and document its performance against specific environmental, economic and social sustainability indicators. The 2014 Australian Grown Cotton Sustainability Report developed and benchmarked 45 key sustainability indicators for the Australian cotton industry. The cotton industry is committed to ongoing sustainability reporting, and with significant CRDC support has developed a range of new sustainability targets. Benchmarks as at June 2018 for these targets are: ▪ 1.1 bales/ML (GPWI) ▪ 6 per cent of farm native vegetation managed for conservation ▪ 10 kg lint/kg of nitrogen ▪ 383 kg of CO_2e per bale of cotton produced
Customers: The Australian cotton industry captures the full value of its products		
Double the premium for Australian cotton	●	CRDC invested in a number of projects to investigate and improve the quality of Australian cotton, and while successful, environmental impacts such as rainfall at harvest can reduce the overall quality of Australian cotton resulting in Australia maintaining its premium rather than doubling the premium. While maintaining efforts to improve fibre quality and develop systems that alleviate risk to quality, CRDC has furthered its research efforts to develop novel high-value uses for Australian cotton. These approaches are longer term initiatives and will make Australian cotton more competitive with man-made fibres.
People: Capable and connected people driving the cotton industry		
A skilled, educated and progressive workforce	●	CRDC and Cotton Australia collaborated to deliver the industry's first Workforce Development Strategy in 2015-16, and in 2016-17, the strategy resulted in $14.7 million in vocational training funding from the NSW Government being made available through Cotton Australia for NSW cotton and grains industries. In addition, CRDC has continued support for 10 industry leadership and development programs. A study published by CRDC in 2017 to better understand and build the role of women's participation in the Australian cotton industry determined that 88 per cent of women in an industry role and 86 per cent of women on cotton farms have a diploma, degree or higher qualification, with 71 per cent involved in making major business decisions.
Performance: Measured performance of the Australian cotton industry and its RD&E drives continuous improvement		
Measured performance of the Australian cotton industry and its RD&E drives continuous improvement	●	CRDC's RD&E underpins the industry's best management practices program, *my*BMP, with industry participation in the program now at 78 per cent. In addition, CRDC's monitoring and evaluation (M&E) framework enables ongoing performance reporting. In 2017-18, CRDC continued to measure its performance and that of the industry through M&E, including a survey of growers, a survey of consultants, an economic analysis of the industry's performance, a longitudinal study of investments, and impact assessments of specific project clusters.

THE AUSTRALIAN COTTON INDUSTRY IN 2017-18:

4.6 million bales produced by the Australian cotton industry

500,000 hectares planted into irrigated and dryland cotton, just shy of the 2016-17 crop, which was the largest crop in five years.

$2.92 billion gross value of cotton production.

(Source: ABARES Ag Commodities Report, June 2018)

CRDC'S INVESTMENT IN 2017-18:

$25.1 million – CRDC's investment in cotton RD&E on behalf of cotton growers and the Australian Government

318 RD&E projects

118 research partners

5 key program areas

farmers, industry, customers, people and performance

CRDC'S IMPACT IN 2017-18:

3% average growth in yield per hectare over the five years from 2013: **achieving our Strategic Plan goal.**

130 The number of events the CottonInfo team attended or hosted in 2017-18, engaging with some 4200 industry personnel, including growers, consultants, agribusinesses, supply chain representatives, government and natural resource bodies.

3000

The number of copies published of the industry's flagship publications, the Australian Cotton Production Manual, and the Cotton Pest Management Guide, co-published by CRDC and CottonInfo.

$1.1 million

The investment by the National Landcare Program Smart Farming Partnerships in new technologies to improve natural resources and biodiversity on Australian cotton farms project, led by CRDC.

9.1 : 1

the benefit-cost ratio of CRDC's investment in the collaborative industry *my*BMP program: $9.10 in benefit to growers for every $1 invested by growers and the government through CRDC into this RD&E.

2.5 : 1

the benefit-cost ratio of CRDC's investment in the industry sustainability RD&E: $2.50 in benefit to growers for every $1 invested by growers and the government through CRDC into this RD&E.

33 innovative projects

– invested in by CRDC under the 'blue sky' Cotton Futures theme in 2017-18, including innovations in gin trash, polymers, new technologies to measure water stress and technologies enabled by robotics to improve weed control.

$20.3 BILLION

– the amount by which the gross value of all agricultural production could increase through the implementation of digital agriculture across all Australian production sectors – a 25 per cent increase on 2014 - a key finding of the Accelerating Precision to Decision Agriculture project.

3 NEW PRODUCTS

– successfully commercialised in 2017-18 with CSIRO: Cottonspec, cotton contamination detection sensors for gins, and algorithms for stress-time thresholds (for on-farm canopy temperature sensors).

3 MAJOR COLLABORATIVE PROJECTS

– driven by CRDC under the Rural R&D for Profit program: Smarter Irrigation for Profit, More Profit from Nitrogen, and Accelerating Precision Agriculture to Decision Agriculture.

78% the number of growers participating in *my*BMP.

58%

of presenters at the Association of Australian Cotton Scientists' Australian Cotton Research Conference in August 2017 represented CRDC's investments in RD&E.

40%

The percentage of CRDC research that is in cross-sectoral RD&E.

77%

The number of growers who noted opportunities to improve irrigation efficiency, nitrogen application or irrigation management to improve their nitrogen-use efficiency, as a result of attending the CottonInfo optimising irrigation and nitrogen researchers tour.

863,000

The number of collective views that the 152 CRDC-supported best practice videos have amassed on the CottonInfo YouTube channel as at June 2018.

One video, on starting a siphon pipe, has been viewed

781,000 times

Executive Summary
YEAR IN REVIEW: CRDC RD&E ACHIEVEMENTS

CRDC RD&E: continuing to deliver real impact for cotton growers

Following the first stage of impact assessments of CRDC's RD&E investments and impacts in 2016-17 (which found our water investments delivered a benefit-cost ratio of 8.29 to 1; our nutrition investments a benefit of 5.4 to 1; and our partnership with QDAF on the Central QLD early planting research 17.1 to 1) the second stage of impact assessments were conducted in 2017-18, focusing on CRDC's sustainability RD&E investments and the industry's *my*BMP program. The assessments found that CRDC's investment of $4.85 million on behalf of cotton growers and the Australian Government into six projects focusing on improving the sustainability of the Australian cotton industry provided a return of $12.26 million, and a benefit-cost ratio of 2.5 to 1. In addition, CRDC's investment of $6.39 million in six projects to support the industry's *my*BMP program from 2012 to 2017 returned a benefit of $58.15 million, a benefit-cost ratio of 9.1 to 1.

Completion of current, and development of new, Strategic RD&E Plan

2017-18 marked the final year for CRDC under the 2013-18 Strategic Plan. This Plan outlined five core goals that the corporation aimed to achieve through investment in RD&E for the benefit of the Australian cotton industry – helping cotton growers to achieve an increase in productivity of three per cent per hectare per year; enabling the industry to report against recognised sustainability indicators; doubling the premium for Australian cotton; developing a skilled, educated and progressive workforce; and ensuring the measured performance of the Australian cotton industry and its RD&E drives continuous improvement. 2017-18 saw the completion of four of the five measures, with work well underway on the fifth: doubling the premium for Australian cotton.

During 2017-18, CRDC also finalised the development of CRDC's new Strategic RD&E Plan 2018-23. This Plan sets an ambitious direction for the future of the Australian cotton industry, with CRDC's goal to contribute to creating $2 billion in additional gross value of cotton production for the benefit of growers and the wider community by 2023. The new Plan commenced on 1 July 2018.

Delivery of three major CRDC-led collaborative grant projects

CRDC has been leading three major collaborative grants under the Rural R&D for Profit program: *Smarter Irrigation for Profit, More Profit from Nitrogen,* and *Accelerating Precision Agriculture to Decision Agriculture*. All three projects reached critical stages in 2017-18, with the finalisation of the Precision to Decision Agriculture project, and its official launch by the Minister for Agriculture and Water Resources, the Hon. David Littleproud MP at the ABARES Outlook national conference in Canberra; and the final years of Smarter Irrigation and More Profit from Nitrogen. A major outcome of the Precision to Decision Agriculture project is the release of the final report, which has found that the implementation of digital agriculture across all Australian production sectors – represented by the 15 Research and Development Corporations who partnered in the program – could lift the gross value of agricultural production by $20.3 billion – a 25 per cent increase on 2014.

In addition to the Rural R&D for Profit program grants, an additional new CRDC-led collaborative project was announced in June 2018 under the National Landcare Program Smart Farming Partnership, focused on developing new technologies to improve natural resources (biodiversity) on Australian cotton farms.

CRDC-supported innovation commercialised in 2017-18

CRDC successfully commercialised three new products during 2017-18 with its research partner CSIRO. These included Cottonspec, cotton contamination detection sensors for gins, and algorithms for stress-time thresholds. These three technologies have the potential to greatly benefit growers and the industry. Cottonspec is a yarn-quality prediction program, that enables spinners to accurately predict the yarn that will be produced from the cotton growths utilised. The cotton contamination detection sensors detect and record contamination events at the gin, helping to prevent contamination issues in ginning, spinning, weaving and knitting. And the stress-time threshold algorithms are designed to support the use of canopy temperature sensors on-farm, helping growers to make decisions regarding the timing of irrigations. Using the canopy temperature sensors with the optimisation algorithms could result in a 5-10 per cent benefit in water-use efficiency in climatically challenging seasons. Through CRDC's commercialisation program, these project outputs are now being commercialised with industry partners to accelerate the scale and rate of adoption of these technologies.

Investing in critical core research: pests, weeds and diseases

During this year, CRDC continued to invest in critical areas of cotton industry R&D: integrated pest, weed and disease management. These three areas are core priority areas for growers and the industry: ensuring we can continue to grow high-quality cotton with minimal disruption from pests, weeds and diseases. Our integrated pest management investments were in direct response to high pest pressure experienced by the industry, and included R&D focused on silverleaf whitefly, pest-suppressive landscapes, resistance monitoring, helicoverpa egg lays, real-time broad scale insect monitoring, and extension via the CottonInfo pest management short course.

Integrated weed management investments focused on guarding against resistance and spray drift, ensuring the industry can stay ahead of the weed evolution. This included a CRDC-supported study tour for growers to the US, membership of WeedSmart, new tools in the industry's arsenal for drift management, and continued research into temperature inversions. From an integrated disease management perspective, two new pathologists were appointed at the Australian Cotton Research Institute during this year, focusing on two CRDC-supported projects to conduct the national disease survey, and find innovative solutions to cotton diseases.

Biosecurity in focus: Be a good mate, stop it at the gate

A new biosecurity extension campaign, *Be a good mate, stop it at the gate*, commenced in 2017-18, driven by the CottonInfo biosecurity technical lead and underpinned by CRDC's R&D in biosecurity and the resulting best practice. The campaign recognises that growers play a key role in protecting Australia's agricultural industries from pests and diseases, and on-farm biosecurity and hygiene measures can help stop the introduction and spread of endemic and exotic insects, weeds and diseases. The campaign is a central component of CottonInfo's activity at the 2018 Australian Cotton Conference.

Tracking our water productivity over time: the cotton water benchmarking study

CRDC invested in a NSW DPI water productivity study during the 2017-18 season: following on from similar surveys in the 2006-07, 2008-09 and 2012-13 years. This is an important piece of research for the industry, providing crucial metrics for the industry to understand its current performance, and continuously improve. The results of the previous surveys have found that the industry has achieved a 40 per cent increase in water productivity since 2003. The data from the study is due to be released in 2018-19.

Cotton Futures: innovation on the agenda

Under the 2013-18 Strategic Plan, CRDC has been investing in Cotton Futures, a blue-sky investment program designed to determine the feasibility of novel tools and technologies for the industry. In 2017-18, CRDC invested in 33 innovative blue-sky projects under Cotton Futures themes, 12 of which began during this year. These projects include innovations in gin trash, polymers, new technologies to measure water stress, and technologies enabled by robotics to improve weed control.

Building capacity: CRDC's 'people' program

The cotton industry recognises that people are its most important resource, and as such, CRDC's 'people' program invests in capacity building projects to enhance capability and connection. During 2017-18, this investment included support for four leadership programs: the Australian Rural Leadership Program, in partnership with Cotton Australia and Auscott Limited; Nuffield Scholarships, in partnership with Cotton Australia; Peter Cullen Trust; and the ABARES Science and Innovation Award for Young People in Agriculture. CRDC also supports development programs, including the AgriFutures Australia Horizon Scholarship and Cotton Australia and CRDC's Cotton Future Leaders Program; and runs the CRDC PhD, summer and honours scholarship program. We also support the AgriFutures Rural Women's Award, designed to recognise the contribution of outstanding women in agriculture.

From the ground up: CRDC's Grassroots Grants program

CRDC's Grassroots Grants program encourages Cotton Grower Associations to apply for funding to support capacity-building projects in their regions. Up to $10,000 in funding is available for CGAs to help fund a project aimed at increasing the engagement of growers in the industry, solving specific regional issues, and improving their skills, knowledge base and networks. Since the Grassroots Grants program commenced in 2011, CRDC has invested over $548,600 into 62 projects across the cotton-growing valleys, including 10 in 2017-18.

Incubating startups: new investment approach for CRDC

In 2016-17, CRDC began working in the entrepreneurial space with start-up science company Pollenizer, and its successor, X-Lab. CRDC's work to incubate potential cotton start-ups and entrepreneurs gained strength in 2017-18, with the continuation of the X-Lab partnership. In this year, CRDC invested in an incubator program, provided support to Startup Catalyst, sponsored the MIT-QUT bootcamp, solidified a partnership with X-Lab to provide a more innovation-driven approach to RD&E investments, and formed a strategic partnership with NSW DPI's The Gate. Work also began in this year on Startup Alley – a new initiative at the Australian Cotton Conference designed to showcase cotton-specific entrepreneurs and innovations. One major RD&E outcome has already been delivered through this new investment approach, with CRDC investing in a new technology, Flurosat, which uses data analytics from drone and satellite imagery to assess plant health, diagnose problems and direct fertiliser application.

RD&E supporting continued industry expansion

The Australian cotton industry continues to expand, with the industry extending both to the south and north. In 2016-17, a research role was created, with support from CRDC, to address issues faced by southern growers, particularly germination and emergence. In 2017-18, CRDC has continued its investment in cotton research for northern Australia, particularly cotton developments in northern Western Australia. The CRDC and Cotton Australia Nuffield Scholar for 2018, Luke McKay, is a cotton grower from Kununurra, who is investigating tropical cotton-growing systems and considerations, including double cropping, rotation crops, irrigation methods, staff requirements, machinery requirements and environmental management.

CRDC-supported researchers recognised for cotton contributions

In 2017-18, a number of CRDC-supported researchers have been recognised for their major contributions to cotton RD&E. Professor Peter Gregg, Dr Lewis Wilson, Dr Mary Whitehouse and Dr Grant Herron have proven themselves as leading experts in the entomology field, having been published in the pinnacle scientific publication, the *Annual Review of Entomology*. Dr Paul Grundy and Dr Stephen Yeates were recognised for their work on the CRDC-supported QDAF-led early planting research in Central QLD by being awarded the 2017 CSD Researcher of the Year Award. A team of researchers from Deakin University, led by Professor Xungai Wang, was awarded an H&M Foundation Global Change Award in 2017 for their innovative work on reducing the environmental impact of denim production. The team had been supported by CRDC on an initial project in this area. In addition, UQ PhD student Rhys Pirie received the CRDC-supported ABARES Science and Innovation Award in 2018, and a grant from the Minister for Agriculture and Water Resources by winning the overall 2018 Minister's Science and Innovation Award. As part of his research, Rhys will develop a low-energy methodology to transform organic wastes into high-efficiency fertiliser.

Extension of R&D outcomes to growers: CottonInfo connecting growers with research

CottonInfo's extension of cotton R&D to growers had three major focuses in 2017-18: managing irrigation to improve nitrogen-use efficiency; tackling the increased threat of pests, diseases and resistant weeds in cotton-growing regions; and identifying and managing soil constraints and optimising the efficient use of inputs. A major project for the team during the year was the delivery of the optimising irrigation and nitrogen researchers' tour, which saw 12 CRDC-supported researchers go on-farm with over 400 growers and consultants across the cotton-growing valleys.

MELANIE JENSON

Executive Summary
YEAR IN REVIEW: ORGANISATIONAL HIGHLIGHTS

New CRDC Directors appointed: providing strategic direction for cotton industry RD&E

In November 2017, CRDC welcomed the appointment of three new Board Directors: Ms Rosemary Richards, Professor Les Copeland, and Dr Jeremy Burdon. The Directors join the existing CRDC Board: Chair Mr Richard Haire, Executive Director Mr Bruce Finney, and Non-Executive Directors Ms Kathryn Adams, Mrs Elizabeth (Liz) Alexander and Mr Greg Kauter. Two Directors completed their tenures with the Board in September 2017, and CRDC recognised their contribution to the cotton industry: Deputy Chair and St George cotton grower, Mr Cleave Rogan, and Director and Plant Biosecurity CRC CEO, Dr Michael Robinson. Ms Kathryn Adams has subsequently been elected as CRDC's Deputy Chair. In February 2018, the CRDC Directors went on-farm at Brookstead for the CottonInfo researchers' tour, providing an opportunity to meet with local growers, view the implementation of CRDC-supported research and discuss research priorities in response to local needs.

Fourth annual Research Priority Forum identifies cotton RD&E priorities

CRDC's fourth annual research priority setting forum was held in Sydney in June 2018, bringing together cotton growers and industry supply chain members on Cotton Australia's research advisory panels to help determine the industry's future research priorities. The Forum is part of CRDC's procurement process, which was revised in 2015-16 to improve efficiency, streamline the RD&E investment process and provide greater clarity to researchers.

Collaboration: a key to cotton RD&E

CRDC works in partnership with other industry bodies and other rural research and development corporations (RDCs) to achieve strategic outcomes for the industry, and to leverage higher returns for our investments. This underpins our investment strategy, with CRDC partnering in over 80 per cent of RD&E projects conducted in the cotton sector. In 2017-18, 40 per cent of CRDC investments are in cross-sectoral RD&E. The collaboration extends from national to cotton industry-specific and local initiatives – from national cross-sectoral partnerships on water and soils; to the industry-specific extension joint venture, CottonInfo with Cotton Australia and Cotton Seed Distributors; and at the local level, partnerships with Cotton Grower Associations on CRDC Grassroots Grants. CRDC also plays a strong leadership role in the cotton industry and the wider agricultural sector, with active involvement in the Council of Rural Research and Development Corporations (CRRDC); the Research and Innovation Sub-Committee of the Agriculture Senior Officials Committee (AgSOC); the National Primary Industries Research, Development and Extension Framework; and the Cotton Innovation Network, where CRDC collaborated with partners on the development of a vision for cotton RD&E capability.

International research collaboration

Australia is well recognised as a global leader in cotton RD&E and, in addition to building strong partnerships and collaborations with Australian research partners, CRDC also builds mutually beneficial relationships abroad. In 2017-18, this has included partnering with our US counterpart, CottonInc, on seven RD&E projects; and attending the International Cotton Advisory Committee (ICAC) Social Environmental and Economic Performance of Cotton (SEEP) Conference; the Better Cotton Initiative Conference; the Sustainable Apparel Coalition Annual General Meeting; the Bremen Cotton Conference; the Forum for the Future (Cotton 2040) Conference; and the International Society of Precision Agriculture Conference. CRDC also built relationships with the International Wool Textile Organisation, the German Sustainable Textile Initiative, and the DO School, and supported Australian cotton growers on a weed resistance management study tour to the US.

CRDC RD&E showcased at industry events

CRDC-supported RD&E projects were showcased at the major research event, the Association of Australian Cotton Scientists' Australian Cotton Research Conference in August 2017, with 58 per cent of speakers on the conference agenda supported by CRDC. RD&E also featured at the Cotton Australia Cotton Collective, held in Griffith in July 2017. CRDC is continuing its support for the major industry event, the 19th Australian Cotton Conference, in August 2018, the planning for which began in 2017-18.

Strong demand for flagship RD&E publications

CRDC's latest research outcomes were published in two key publications during the year in conjunction with the CottonInfo extension team. The *Cotton Pest Management Guide* was published in September 2017, and the *Australian Cotton Production Manual* in May 2018. The flagship publications feature the latest RD&E and best practice information, are compiled by a team of authors who are each leading researchers and experts in their respective fields, and are key reference tools for the industry, with annual subscriptions of 3000 copies. These publications consistently rank as the most preferred method of receiving R&D information among consultants. During this year, CRDC established a partnership with Crop Consultants Australia (CCA) on the development of the *2018-19 Cotton Pest Management Guide*, released in September 2018, with the CCA forming a technical review panel to ensure the publication remains as useful as possible for both growers and consultants.

Interactive digital dashboard for CRDC grower survey

The 2017-18 year marked 21 years of the CRDC Cotton Grower Survey, which gathers valuable information about cotton farming practices to give a greater understanding of the industry's performance. The survey provides important information to CRDC and Cotton Australia about the industry, on-farm practices, and priority areas for future research. For the first time in 2018, the results of the survey were published via a new online interactive digital dashboard, allowing growers to explore the data in more depth and to compare results across regions.

Section 2
CRDC Business

CRDC role

CRDC operations

Setting the research priorities

Cooperation and collaboration

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CRDC ROLE

CRDC's role is to invest in and manage a portfolio of RD&E projects on behalf of cotton growers and the Australian Government. These investments are designed to enhance the environmental, social and economic contribution of cotton, for the benefit of cotton growers, the wider cotton industry, regional communities and the Australian public.

CRDC is co-funded through an industry levy and matching Commonwealth contributions. In 2017-18, CRDC invested $25.1 million in RD&E into 318 projects on behalf of Australia's cotton growers and the Government.

CRDC's corporate outcome is the adoption of innovation that leads to increased productivity, competitiveness and environmental sustainability through investment in research and development that benefits the Australian cotton industry and the wider community.

CRDC has four key stakeholders: the Australian Government, through the Minister for Agriculture and Water Resources; the Department of Agriculture and Water Resources; the cotton industry's representative organisation, Cotton Australia; and cotton growers, including Cotton Grower Associations.

CRDC recognises that collaboration is essential to the delivery of RD&E outcomes. As such, CRDC partners with researchers, research organisations and growers to deliver RD&E projects, and most importantly, outcomes.

In 2017-18, CRDC partnered with 118 research partners, including the following:

- Department of Agriculture and Water Resources
- Department of Agriculture and Fisheries (QLD)
- Department of Primary Industries (NSW)
- Other state government departments
- CSIRO
- Cooperative Research Centres (CRCs)
- Cotton Grower Associations
- Cotton Innovation Network
- Cotton Seed Distributors Ltd
- Crop Consultants Australia
- Australian Association of Cotton Scientists
- Australian Farm Institute
- Australian Rural Leadership Foundation
- Other Rural Research and Development Corporations
- Universities
- Agribusinesses
- Supply chain and trade partners
- International partners, including Cotton Incorporated
- Specialised consultants.

Cotton growers across all valleys directly contribute to RD&E through conducting on-farm trials, a critical component of the RD&E process. In addition to their financial contribution through direct on-farm costs and opportunity costs, growers also provide their time, knowledge and expertise to research trials.

CRDC Business
CRDC OPERATIONS

Investing in cotton RD&E

CRDC's investment in cotton RD&E is guided by a five-year Strategic Plan: the CRDC Strategic R&D Plan 2013-2018. This plan is designed to help the industry achieve its long-term vision, and to meet the industry and Australian Government's rural research and development (R&D) priorities.

The plan has a strong focus on improving the industry's profitability, sustainability and competitiveness. It recognises the critical importance of knowledge sharing and strong relationships between cotton growers, the wider industry and its customers. The 2017-18 year marked the last year of operation under the 2013-18 Strategic Plan.

Core programs

CRDC established five strategic outcomes to be achieved under the 2013-18 Strategic R&D Plan that informed the key focus areas for RD&E investment in 2017-18:

- Farmers: Cotton is profitable and consistently farmers' crop of choice.
- Industry: The Australian cotton industry is the global leader in sustainable agriculture.
- Customers: The Australian cotton industry captures the full value of its products.
- People: Capable and connected people driving the cotton industry.
- Performance: Measured performance of the Australian cotton industry and its RD&E drives continuous improvement.

The Strategic Plan investment priorities

VISION: *A globally competitive and responsible cotton industry*				
MISSION: *To invest in RD&E for the world-leading Australian cotton industry*				
OUTCOMES				
Farmers Cotton is profitable and consistently farmers' crop of choice	**Industry** The Australian cotton industry is the global leader in sustainable agriculture	**Customers** The Australian cotton industry captures the full values of its products	**People** Capable and connected people driving the cotton industry	**Performance** Measured performance of the Australian cotton industry and its RD&E drives continuous improvement
STRATEGIES				
Successful Crop Protection Cotton crops protected from pest, weed and disease threats	**Respected Stewardship** Industry protects its production technologies and its biosecurity	**Assured Cotton** The integrity and qualities of Australian cotton set global benchmarks for customers	**Workforce Capacity** A skilled, educated and progressive industry workforce	**Best Practice** World's best practice underpins the performance of the cotton industry
Productive Resource Efficiencies Inputs for cotton production are optimised	**Responsible Landscape Management** Industry leads in managing natural assets	**Differentiated Products** Customers recognise the differentiated value of Australian cotton products	**Networks** An industry connected by dynamic networks	**Monitoring and Evaluation** Industry and RD&E performance is captured
Profitable Futures Innovation in cotton production	**Sustainable Futures** An industry achieving its vision	**Competitive Futures** The demand for Australian cotton product is positively transformed	**Communication** Stakeholder information needs are met	**Reviews** Continuous improvement in industry and RD&E performance

By focusing on these five strategic priorities, CRDC will achieve its outcome of *adoption of innovation that leads to increased productivity, competitiveness and environmental sustainability through investment in research and development that benefits the Australian cotton industry and the wider community.*

Cotton Futures

The plan includes three futures themes: Profitable futures (farmers program), Sustainable futures (industry program), and Competitive futures (customers program). These themes provide a clear framework through which CRDC can invest in long-term innovations to address the industry's goal to remain profitable, sustainable and competitive in 20 years' time and beyond.

The futures themes ambitiously seek to transform the industry through blue-sky research. Following extensive engagement with the cotton industry, the wider supply chain and the industry's customers to identify priority areas for blue-sky R&D investment, CRDC published the *Designing a Future for Australian Cotton* report in late 2014.

This report prioritised the top 18 transformational research concepts, five of which were then further explored through feasibility studies within the Competitive futures program area: investigating supply chain optimisation, dissolving cotton, using cotton as a substrate for carbon fibre, using cotton for 3D printing, and developing renewable chemicals from cotton biomass.

In 2017-18, CRDC invested in 33 innovative blue-sky projects under the three Cotton Futures themes, 12 of which commenced during this year. The majority of these projects are delivered in collaboration with other Rural R&D Corporations (RDCs) as part of the Australian Government's Rural R&D for Profit program, such as the CRDC-led *Accelerating precision agriculture to decision agriculture* project.

For the five-year period from 2013-18, CRDC invested $4.4 million in Cotton Futures research projects across the three program areas. For more on the Cotton Futures investments, see Section 4: RD&E Portfolio.

Our investment process

The process of deciding where to invest CRDC's annual RD&E funding is a collaborative one, involving all major stakeholders. Each year, CRDC works closely with Cotton Australia and the Australian Government to identify and evaluate the cotton industry's requirements for RD&E. Cotton Australia provides ongoing advice to the CRDC on research projects and where research dollars should be invested, guided by the priorities established in the 2013-18 Strategic Plan.

In line with this plan, CRDC holds an annual research priority forum, bringing together the Cotton Australia research advisory panels to identify the gaps in the existing research portfolio and opportunities for new research. CRDC also holds a series of discipline forums with research partners, to identify any emerging research priorities.

From here, CRDC issues a targeted annual call for research proposals against these identified priorities. In determining which proposals are successful, CRDC again undertakes a process of consultation with growers, via the Cotton Australia panels. The final decision-making authority lies with the CRDC Board.

Successful proposals become contracted projects with CRDC, and are delivered by our research partners. Critically, CRDC's success in delivering RD&E outcomes to growers and the industry is contingent upon strong relationships with our research partners, who deliver projects on our behalf.

Communicating research outcomes and achieving practice change

CRDC is actively involved in the dissemination of R&D results, working through a range of mechanisms to promote research outcomes, principally supported by the industry's joint extension program, CottonInfo.

CottonInfo aims to ensure the effective communication of, and support for, the adoption of research results through engagement and collaboration. CRDC established the CottonInfo joint venture with partners Cotton Australia and Cotton Seed Distributors (CSD) Ltd in 2012.

The CottonInfo team aims to improve industry practice, improve R&D communication, and improve industry responsiveness. The team consists of regional extension officers (on-ground support, based in the cotton-growing valleys), technical leads (specialists in specific research areas who provide a conduit to the wider cotton research community) and experts in the industry's best management practice program, *my*BMP (who can assist growers to sign up for, and participate in, *my*BMP, providing a critical link between research extension and best practice).

Within this venture, CRDC is responsible for resourcing program management, communication and technical leads, whose role is to translate research findings and outcomes into best practice for industry uptake.

During 2017-18, CottonInfo engaged with growers, consultants and the wider industry at 130 events, with 4200 cotton industry personnel in attendance: 1700 growers and farm workers; 700 consultants; 300 agribusiness personnel; and 1500 people representing the wider industry, including supply chain, government, and natural resource management bodies. To date, CRDC-supported studies have found that 90 per cent of growers and 98 per cent of consultants are aware of CottonInfo; and that 86 per cent of growers and 100 per cent of consultants believe CottonInfo has helped to improve practices.

Measuring performance and ensuring efficiency

One of CRDC's formal principles of operation is to strive to maximise the return on investment for all industry and public funds invested through CRDC into RD&E. A variety of monitoring and evaluation projects are funded under CRDC's performance program, designed to ensure the impact of investment in RD&E can be captured and demonstrated.

One such evaluation – an analysis of investment in the stewardship of Bollgard® II Cotton during the period 2010 to 2018 – showed that the benefits for these investments were valued at in excess of $100 million with a benefit-cost of 8.5 to 1. More importantly, the Australian cotton industry was recognised globally as the leader in the stewardship of Bt traits, which has resulted in scientific exchanges between the US and Australia.

As this evaluation shows, in order to achieve industry efficiency, CRDC works in collaboration with other cotton industry bodies both nationally and internationally to achieve strategic outcomes for the industry and to leverage higher returns for our investments. For more, see the Cooperation and Collaboration section of this report.

CRDC is also committed to continuous improvement in the efficiency of its operations. CRDC has invested in improved systems and infrastructure to ensure improvement in the organisation's productivity.

Developing the new CRDC Strategic RD&E Plan

CRDC's 2013-18 Strategic R&D Plan ended on 30 June 2018, and as such, work commenced in 2016 on the development of a new five-year Strategic RD&E Plan. The Minister for Agriculture and Water Resources approved CRDC's 2018-2023 Strategic RD&E Plan in May 2018 to commence from 1 July 2018.

This plan will guide CRDC's investments from 2018 to 2023 and become CRDC's key planning document. The plan sets the direction for the organisation's operation and investments in cotton RD&E over the five years, enabling the industry to achieve its long-term vision, and the Australian Government to achieve its strategic RD&E priorities. As such, the plan was developed in close consultation with key stakeholders, including cotton growers, Cotton Australia, the Minister for Agriculture and Water Resources, and the Department of Agriculture and Water Resources.

COTTON AUSTRALIA

Adam Kay, Chief Executive Officer of Cotton Australia and Bruce Finney, Executive Director of CRDC, at the Monsanto Cotton Grower of the Year field day at Darlington Point in southern NSW, recognising the achievements of the Toscan family of Cavaso Farming, the 2017 Monsanto Cotton Growers of the Year.

CRDC Business
SETTING THE RESEARCH PRIORITIES

CRDC works with the Australian cotton industry to determine the sector's key RD&E priorities, with the Australian Government to determine its overarching agricultural RD&E priorities, and with both the industry and Government to determine the Cotton Sector RD&E Strategy.

Industry accountability

CRDC is accountable to the cotton industry through its representative organisation, Cotton Australia. As the industry peak body, Cotton Australia is responsible for providing advice on industry research priorities.

CRDC engages with Cotton Australia in a formal process of consultation in the development and implementation of the Strategic RD&E Plan, including RD&E investments. This engagement ensures industry research priorities are regularly reviewed; emerging issues are actively considered; and facilitates the uptake of research in the form of best practices and the overall performance of the Australian industry.

Overarching cotton industry priorities for RD&E:

- Invest in the skills, strengths and occupational health and safety of the human resources in the cotton industry and its communities.
- Improve the sustainability of the cotton industry and its catchments.
- Improve the profitability of the cotton industry.
- Create and support a strong, focused and committed research program.

In addition, at CRDC's June 2018 research priority forum, the Cotton Australia research advisory panels identified key areas of focus for future RD&E investment, including:

- Managing spray drift
- Minimising fruit shedding
- Developing industry-wide traceability solutions
- Developing nitrogen-fixing cotton varieties
- Evolving farming systems for northern Australia
- Non-chemical control of weeds
- Improved management of cotton in hot seasons
- Developing succession plans for researchers
- Improving management of cotton diseases
- Defining best management practice for dicamba-tolerant cotton
- Increasing the accuracy and reliability of local weather forecasting
- Manipulating planting date and growth stages for increased yield and disease management.

Government accountability

CRDC is accountable to the Australian Government through the Minister for Agriculture and Water Resources. Government communicates its expectations of CRDC through Ministerial direction, enunciation of policy, administration of the PIRD Act, and priorities (Science and Research Priorities and Rural RD&E Priorities). CRDC responds to government expectations through regular communication; compliance with the Funding Agreement, policy and legislated requirements; and the development of Strategic RD&E Plans, Annual Operational Plans and Annual Reports.

Australian Government research priorities

The PIRD Act makes provision for funding and administration of primary industry research and development with a view to:

- increasing the economic, environmental and social benefits to members of primary industries and to the community in general by improving the production, processing, storage, transport or marketing of the products of primary industries;
- achieving the sustainable use and sustainable management of natural resources;
- making more effective use of the resources and skills of the community in general and the scientific community in particular;
- supporting the development of scientific and technical capacity;
- developing the adoptive capacity of primary producers; and
- improving accountability for expenditure on research and development activities in relation to primary industries.

The Australian Government Science and Research Priorities and Rural RD&E Priorities are:

The Science and Research Priorities	Rural RD&E Priorities
Food*	Advanced technology
Soil and water	Biosecurity
Transport	Soil, water and managing natural resources
Cybersecurity	Adoption of R&D
Energy	
Resources	
Advanced manufacturing	
Environmental change	
Health	

** The Food Science and Research Priority also includes fibre.*

National Primary Industries RD&E Framework and the Cotton Sector RD&E Strategy

The Australian, state and territory governments, Rural R&D Corporations (RDCs), CSIRO, and universities have jointly developed the National Primary Industries Research, Development and Extension Framework to encourage greater collaboration and promote continuous improvement in the investment of RD&E resources nationally.

National research, development and extension strategies have been developed for the following primary industry and cross-industry sectors:

- cotton, beef, dairy, fisheries and aquaculture, forests, grains, horticulture, pork, poultry, sheep meat, sugar, wine, wool, and new and emerging industries;
- animal biosecurity, animal welfare, biofuels and bioenergy, climate change and variability, food and nutrition, soils, plant biosecurity, and water use in agriculture.

CRDC, research organisations, industry and government are committed to the implementation of the Cotton Sector RD&E Strategy and its five research priorities:

- Better plant varieties;
- Improved farming systems;
- People, business and community;
- Product and market development;
- Development and delivery.

CRDC provides the secretariat for the Cotton Innovation Network, which is responsible for implementing the Cotton Sector RD&E Strategy. CRDC is also committed to supporting the implementation of the cross-sectoral strategies, including climate change, soils, plant biosecurity, and water use.

Vision 2029: the industry's vision for a sustainable future

In addition to the above, the industry has also developed its own 20-year vision for the future that encompasses industry priorities around improved industry performance, collaboration and capacity. Developed in 2009, this Vision uses a 20-year timeframe to ensure a long-term focus. The Vision 2029 elements were central to the development of the CRDC Strategic RD&E Plan, and continue to play a key role in guiding CRDC's investments each year, to ensure CRDC is contributing to their achievement.

Vision 2029: Australian cotton, carefully grown, naturally world's best

By 2029, the Australian cotton industry will be:

- **Differentiated** – world-leading supplier of an elite-quality cotton that is highly sought in premium market segments.
- **Responsible** – producer and supplier of the most environmentally and socially responsible cotton on the globe.
- **Tough** – resilient and equipped for future challenges.
- **Successful** – exciting new levels of performance that transform productivity and profitability of every sector of the industry.
- **Respected** – an industry recognised and valued by the wider community for its contribution to fibre and food needs of the world.
- **Capable** – an industry that retains, attracts and develops highly capable people.


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COOPERATION AND COLLABORATION

Cooperation and collaboration are fundamental to CRDC's operations. CRDC works in partnership with other industry bodies and other RDCs to achieve strategic outcomes for the industry, and to leverage higher returns for our investments.

This collaborative approach underpins CRDC's investment strategy. CRDC partners in over 80 per cent of RD&E projects conducted in the cotton sector, and approximately 40 per cent of CRDC investments are in cross-sectoral RD&E.

CRDC's cooperation extends from national and international initiatives to cotton industry-specific and local initiatives – from participating in national cross-sectoral collaborations on water and soils; to the industry-specific extension joint venture, CottonInfo; and at the local level, partnerships with Cotton Grower Associations on CRDC Grassroots Grants.

Cotton Australia

Cotton Australia and its members provide advice to CRDC on research strategy and investments from the perspective of cotton growers. This is achieved through research advisory panels aligned with CRDC's programs.

Research partners

All CRDC projects are delivered in partnership with key research partners. In 2017-18, CRDC partnered with 118 research partners to deliver RD&E projects and outcomes to cotton growers and the wider industry. The full list of partners can be found in Appendix 4 of this report: the RD&E portfolio.

Growers

In addition to the Cotton Australia research advisory panels, cotton growers also contribute to RD&E through participation in other industry committees, such as the Cotton Australia Transgenic and Insect Management Strategy (TIMS) Committee and Technical Panels to provide practical guidance on the implementation of stewardship practices for GM traits. Growers are also actively involved in RD&E by conducting on-farm trials – a critical component of the RD&E process. This involves a financial contribution through direct on-farm trial costs and opportunity costs, and the provision of growers' time, knowledge and expertise. Thirty-five per cent of growers host research trials on their farms, with growers contributing an average of 19 hours and $5500 towards their on-farm trials.

Cotton industry programs: CottonInfo and *my*BMP

CottonInfo

CottonInfo, the cotton industry's joint extension program, is a collaboration between joint venture partners CRDC, Cotton Australia and CSD Ltd. CottonInfo is the conduit between researchers and growers, communicating research results and encouraging their adoption.

*my*BMP

Similarly, *my*BMP, the industry's best management practices program, is a collaboration between CRDC and Cotton Australia. This program links RD&E outcomes to best management practice, and provides self-assessment mechanisms, practical tools and resources to help growers grow cotton using best practice. It is an integral part of the CottonInfo program.

Rural Research and Development Corporations

CRDC is one of 15 Rural RDCs that come together under the banner of the Council of Rural RDCs (CRRDC) to coordinate efforts, collaborate and co-invest in projects and achieve consistency in communication. The focus is on improving efficiencies, maximising the impact of research outcomes and avoiding duplication in research.

The scale of this collaboration extends from large national research programs to small local projects and administration, to bring a national focus in dealing with climate variability, soil health, irrigation, plant biosecurity, crop protection, farm safety and human capacity. CRDC continues to work with the CRRDC to investigate administrative efficiency gains within the RDCs and the rural R&D system as a whole.

CRDC also partners with fellow RDCs on grants under the Australian Government's Rural R&D for Profit program.

The Minister for Agriculture and Water Resources, the Hon. David Littleproud MP, launched the Accelerating Precision to Decision Agriculture project final report at the ABARES Conference in March 2018.

Australian Government grants

CRDC works in partnership with the Australian Government and fellow RDCs on a number of grants projects.

Ongoing projects during 2017-18

CRDC managed three programs in 2017-18 under Government's grants, contributing a combined $19.7 million into RD&E funding across the life of the programs, for the benefit of the Australian cotton industry, the community and other industries.

These projects, all administered by the Department of Agriculture and Water Resources, are as follows:

- **Smarter irrigation for profit** *(funded 2015-18, with up to $4 million from the Rural R&D for Profit program - round one).* Involves fellow RDCs Dairy Australia, RIRDC and Sugar Research Australia (SRA), and other research partners.
- **More profit from nitrogen: enhancing the nutrient-use efficiency of intensive cropping and pasture systems** *(funded 2016-20, with $5.9 million from the Rural R&D for Profit program - round two).* Involves fellow RDCs Dairy Australia, SRA, and Horticulture Innovation Australia (HIA) and other research partners.
- **Accelerating precision agriculture to decision agriculture** *(funded 2016-18, with $1.4 million from the Rural R&D for Profit program - round two).* Involves all 14 of CRDC's fellow RDCs and other research partners.

CRDC is also involved in seven other programs through Rural R&D for Profit program grants led by other RDCs:

- **Stimulating private sector extension in Australian agriculture to increase returns from R&D** *(funded 2015-18, led by Dairy Australia; $1.6 million from the Rural R&D for Profit program - round one).*
- **Improved use of seasonal forecasting to increase farmer profitability** *(funded 2015-18, led by RIRDC; $1.8 million from the Rural R&D for Profit program - round one).*
- **A profitable future for Australian agriculture: Biorefineries for higher value animal feeds, chemicals, and fuels** *(funded 2015-18, led by SRA; $3 million from the Rural R&D for Profit program - round one).*
- **Digital technologies for more dynamic management of disease, stress and yield** *(funded 2016-20, led by AGWA; $3 million from the Rural R&D for Profit program - round two).*
- **Forewarned is forearmed: managing the impacts of extreme climate events** *(funded 2017-20, led by Meat & Livestock Australia Limited in partnership with CRDC through the Managing Climate Variability program; $6.2 million in funding from the Rural R&D for Profit program - round three).*
- **Improving plant pest management through cross-industry deployment of smart sensors, diagnostics and forecasting** *(funded 2017-20, led by Horticulture Innovation Australia in partnership with CRDC; $6.8 million in funding from the Rural R&D for Profit program - round three).*
- **Increasing farmgate profits, the role of natural capital accounts** *(funded 2017-20, led by Forest and Wood Products Australia in partnership with CRDC; $900,000 in funding from the Rural R&D for Profit program - round three).*

CRDC is also involved in one program through the Control Tools and Technologies for Established Pest Animals and Weeds grant led by the NSW Department of Primary Industries:

- **Biological control and taxonomic advancement for management in the Noogoora burr complex** *(funded 2017-2019, led by NSW DPI in partnership with CRDC; $559,700 from the Control Tools and Technologies for Established Pest Animals and Weeds program).*

New project commencing 2018-19

In 2017-18 new projects commencing under the *National Landcare Program; Smart Farming Partnerships initiative - round one* and administered by the Department of Social Services Community Grants Hub were announced. CRDC is the leading agency for one of these grants:

- **New technologies to improve natural resources (biodiversity) on Australian cotton farms** *(funded 2018-2022, led by CRDC up to $1,131,022 through the National Landcare Program; Smart Farming Partnerships initiative - round one).*

Section 3
Corporate Operations

Business financials

Our investments in RD&E

Investments against Government priorities

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CRDC's investment in RD&E is funded through an industry levy and matching Commonwealth contributions.

In 2017-18, CRDC invested $25.1 million in cotton RD&E throughout the industry supply chain. In 2018-19, CRDC estimates cotton RD&E expenditure will be $24.3 million.

Revenue

Cotton levy revenue is collected either on cotton lint bales at the point of ginning or on export of seed cotton. Cotton farmers pay a levy of $2.25 for each 227-kilogram bale of cotton lint, or for seed cotton a levy of $4.06 per tonne of exported seed cotton. Australian ginning and export of seed cotton occurs from March to September of each calendar year. Therefore, cotton levy revenue in any financial year is drawn from two consecutive cotton crops.

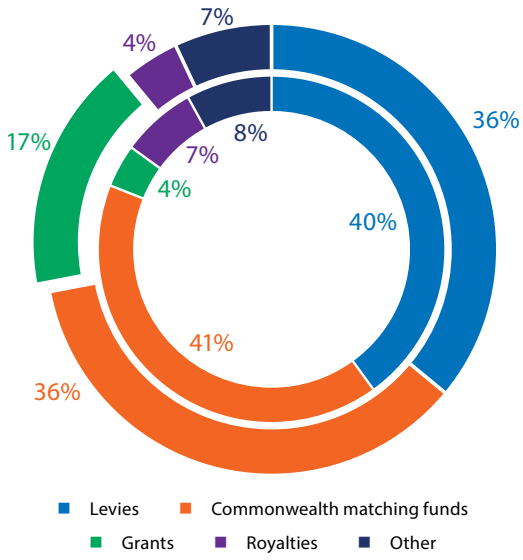
The Australian Government provides a contribution of up to 50 per cent of the cumulative total eligible expenditure on RD&E. The maximum contribution is generally capped at 0.5 per cent of a three-year rolling average of gross value of production for the cotton industry.

The setting and collection of the industry levy is enabled by the *Primary Industries (Excise) Levies Act 1999* and the P*rimary Industries Levies and Charges Collection Act 1991* respectively. The Australian Government matching contributions in 2017-18 were capped at the value of levies collected, as it was lower than the 0.5 per cent of the three-year average gross value of production.

Revenue (Actuals)	2017–18 ($m)
Industry levies	9.093
Australian Government	9.089
Royalties	1.080
Interest	0.896
Research Grants	4.273
Other	0.816
TOTAL	25.247

The following graph demonstrates the change in sources of revenue from 2013-14 to 2017-18. The proportion of grant revenue generated by partnerships with the Australian Government, RDCs and commercial enterprises has increased from 5 per cent of total revenue to 17 per cent of total revenue. In 2017-18 the Australian Government's Rural R&D for Profit program grants, administered by the Department of Agriculture and Water Resources, contributed a total of $2.1 million in revenue to CRDC, and have also attracted additional grant revenue of $1.2 million from program partners. Other grant revenue from industry and cross-sectors was $1.0 million.

Change in CRDC revenue mix over five years: 2012-13 (inner circle) to 2017-18 (outer circle).



Total revenue for 2017-18 of $25.247 million was $1.181 million (4 per cent) below budget of $26.428 million. Total 2017-18 revenue comprised of:

- Industry levy revenue of $9.093 million, which includes $5.527 million (66 per cent) of the 2016-17 crop and $3.566 million (34 per cent) of the 2017-18 estimated crop.
- Australian Government matching contribution of $9.089 million was capped at the value of levies collected.
- $1.080 million in royalties from the sale of CRDC-funded CSIRO seed varieties.
- Interest revenue of $0.896 million was 38 per cent above budget, due to the higher level of cash reserves under CRDC management generated by above-budget revenues in the prior years.
- External grants of $4.273 million included Rural R&D for Profit and co-investments from program partners.
- Other revenue of $0.816 million, which includes project refunds.

Expenditure and investment

Actual expenditure for 2017-18 was $25.062 million, an increase of $2.542 million over the budgeted expenditure of $22.520 million.

Actual ($m)	2013-14	2014-15	2015-16	2016-17	2017-18
Cotton Crop Size (millions of bales)	3.90	2.31	2.77	3.75	4.60*
Total Revenue	27.479	20.073	18.935	21.600	25.247
Industry levies	10.977	7.298	6.054	6.131	9.093
Australian Government	11.239	7.295	6.053	6.129	9.089
Royalties	1.830	1.707	0.745	0.585	1.080
Interest	1.779	1.596	1.282	1.078	0.896
Research Grants	1.243	0.925	4.127	6.719	4.273
Other**	0.411	1.252	0.674	0.958	0.816
Expenditure total	21.293	22.826	20.555	24.089	25.062
Cotton RD&E activities	18.203	19.244	17.052	20.318	20.908
Total equity position	**44.488**	**41.645**	**40.025**	**37.536**	**37.717**

** ABARES estimate, Agricultural Commodities June 2018.*
*** Includes project refunds.*

Cost Allocation Policy

CRDC has a Cost Allocation Policy for allocating direct and indirect costs to activities across its program. Expenditure in 2017-18 was allocated to the following activities:

Cost Allocation Activity	2017-18
Direct R&D Expenditure (project costs)	$16,980,631
Indirect R&D Expenditure (administration costs)	$3,506,466
Grant-funded expenditure (R&D not eligible for Commonwealth Matching)	$4,574,882
Total Expenditure	**$25,061,979**

Portfolio Budget Statement

The CRDC Portfolio Budget Statement released in May 2018 provided an estimate of CRDC's outcomes, outputs, performance and financial position for 2018-19 to 2021-22. The statement was consistent with the CRDC Strategic R&D Plan 2018-23 and the Annual Operational Plan 2018-19.

Outcomes and outputs 2017-18

CRDC has one Australian Government outcome: *Adoption of innovation that leads to increased productivity, competitiveness and environmental sustainability through investment in research and development that benefits the Australian cotton industry and the wider community.*

Outcome	2017-18
TOTAL Budgeted Revenue	$26,428,090
TOTAL Actual Revenue	$25,247,488
TOTAL Budgeted Cost of Outputs	$22,520,460
TOTAL Actual Cost of Outputs*	$25,061,979

* Total cost is shown rather than total price because CRDC is primarily funded through industry levies rather than on the basis of the price of its outputs. Each research project and its funding contributes to the outcome. Total research expenditure for the outcome is calculated, with the remaining expenditure attributed to the outcome on a pro rata basis.

The variation between the budgeted and the actual revenue of $1.181 million is a result of the 2017-18 crop being below budget, partly offset by increases in interest received, grants received and project refunds. The smaller crop has reduced levies, Commonwealth contributions and royalties by $2.906 million.

Forecast revenue

Future revenue from levies, Commonwealth-matching contributions and royalties are directly impacted by cotton production. Water availability and commodity prices are significant factors in forthcoming cropping decisions. ABARES June 2018 Agricultural Commodities report estimated the average storage level of public irrigation dams serving the Australian cotton-growing region was 44 per cent of capacity as at 16 May 2018, down from 66 per cent at the same time in 2017. Some seasonal inflows into the main cotton irrigation dams can be expected before November 2018.

CRDC has budgeted for a $1.401 million operating deficit for 2018-19. This reflects revenue of $22.931 million and expenditure of $24.332 million. Industry levy revenue and Commonwealth contributions will continue to be drawn from two crop seasons, 2017-18 and 2018-19.

The size of industry levies and Commonwealth contributions is heavily reliant upon crop production, which was budgeted to be 3.9 million bales for 2018-19. CRDC expects that the Australian Government matching contributions will be based on matching industry levy revenue in 2018-19.

Forecast expenditure

Budgeted expenditure for 2018-19 is $24.332 million, a decrease of $0.730 million below the 2017-18 actual expenditure. The forecast expenditure for the next two years for RD&E is budgeted at $24.604 million in 2019-20 and $25.159 million in 2020-21.

Forecast deficits

CRDC is a statutory body enabled by the PIRD Act with the rights of a body corporate and has the right to retain surplus funds. However, as a corporate Commonwealth entity, CRDC must seek approval from the Minister of Finance for a deficit in any year. CRDC has sought and received approval for deficits of $1.461 million in 2018-19, $3.402 million in 2019-20, $3.991 million in 2020-21 and $4.432 million in 2021-22, to be funded from contingency reserves.

Corporate Operations
OUR INVESTMENTS IN RD&E

CRDC used the Strategic R&D Plan 2013-18 to guide its program investments in 2017-18. The plan was developed with extensive industry, government and stakeholder consultation and was evaluated in the preparation of the Annual Operational Plan 2017-18.

CRDC's investments addressed the Australian Government priorities (the Science and Research Priorities and the Rural RD&E Priorities), the cotton industry priorities and the collective Cotton Sector RD&E Strategy.

As established in the Strategic R&D Plan, the CRDC actively seeks to achieve a balanced RD&E portfolio that considers the distribution of investment across:

- The RD&E strategies
- The type of research, including basic, applied, blue-sky, development and delivery
- In-project risks
- Researcher experience and capacity
- Research providers
- Timeframe to outcomes
- The likely return on investment for projects and programs
- R&D management.

The portfolio includes RD&E that seeks to 'protect and defend' the production base from pest threats; increase productivity while ensuring resource-use efficiency; enhance product value through the supply chain; build a capable industry; and create an element of research discovery.

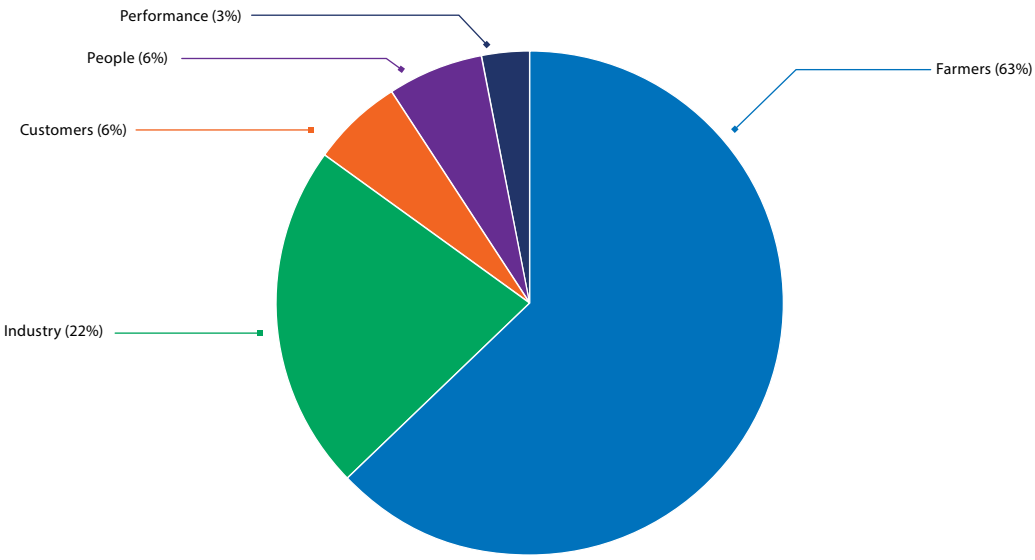
CRDC invests in applied RD&E that improves productivity, biosecurity, and natural resource management, and manages climate variability concurrently given the interrelationships between the issues.

Projects by CRDC program area

CRDC program	Farmers	Industry	Customers	People	Performance	TOTAL*
Number of projects	121	48	25	104	20	**318**
Program expenditure ($m)*	$13.1	$4.6	$1.2	$1.3	$0.7	**$20.9**
Program percentage (of expenditure)	63%	22%	6%	6%	3%	**100%**

* Excludes budgeted employee and supplier expenditure and corporate research activities that support R&D planning and adoption. Some percentages have been rounded up or down.

Investment by program



Total number of CRDC projects

CRDC projects	2013-14	2014-15	2015-16	2016-17	2017-18
Active projects	61	118	150	155	**167**
New projects funded	142	162	141	205	**151**
Projects completed	85	130	136	193	**188**
Continuing projects	118	150	155	167	**130**

Further detail on CRDC's projects can be found in Section 4: RD&E Portfolio, and in Appendix 4: RD&E Portfolio.

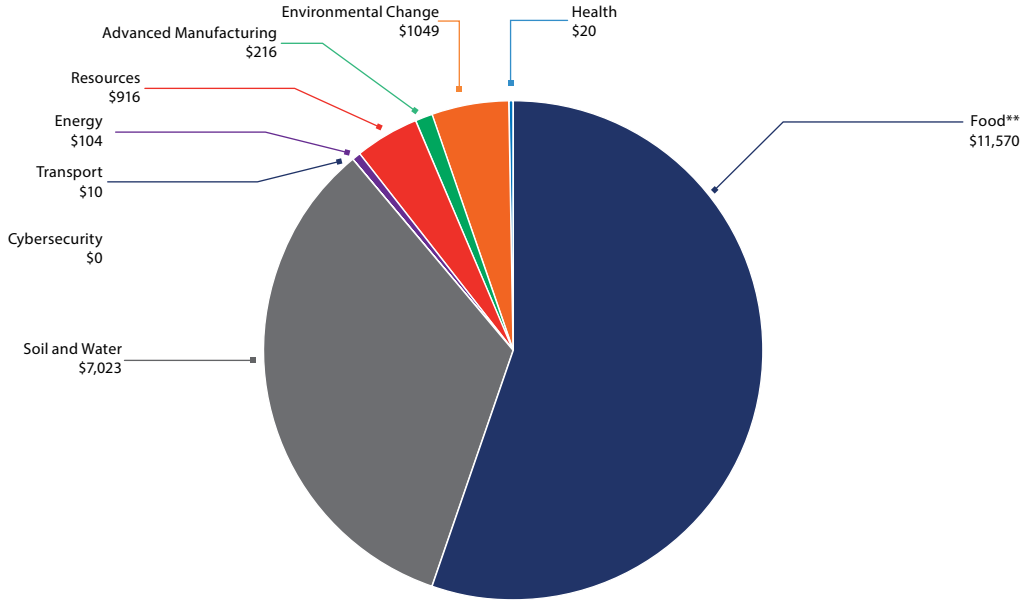
Corporate Operations
INVESTMENTS AGAINST GOVERNMENT PRIORITIES

CRDC's investments in RD&E support the achievement of the Australian Government's Science and Research Priorities and Rural RD&E Priorities.

CRDC investment by Science and Research Priorities

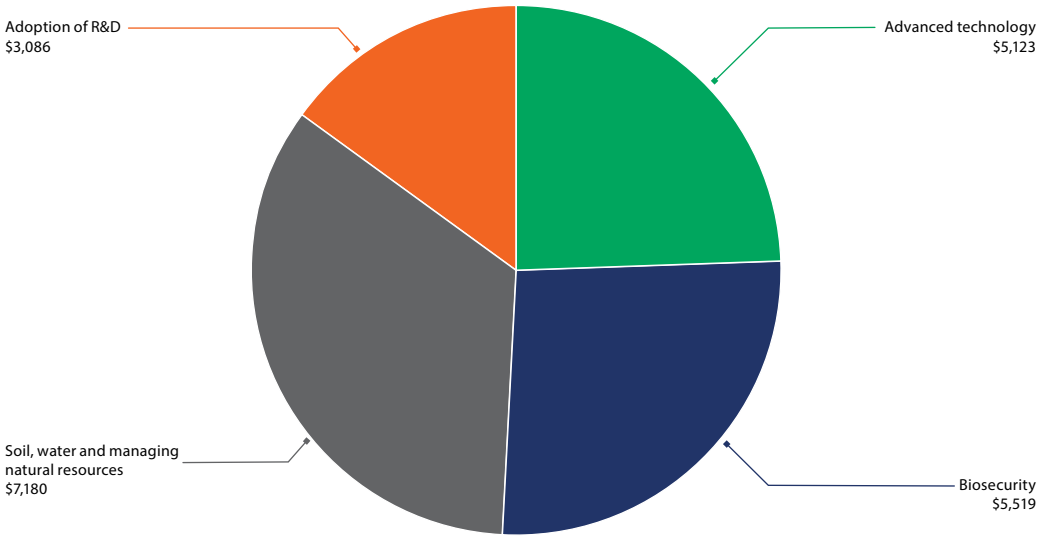
Science and Research Priorities (SRP)	CRDC investment ($'000)
Food**	$11,570
Soil and Water	$7,023
Transport	$10
Cybersecurity	$0
Energy	$104
Resources	$916
Advanced Manufacturing	$216
Environmental Change	$1,049
Health	$20
TOTAL	**$20,908**

* Some figures have been rounded up or down.
** The Food Science and Research Priority also includes fibre.



CRDC investment by Rural RD&E Priorities

Rural RD&E Priorities	CRDC investment ($'000)
Advanced technology	$5,123
Biosecurity	$5,519
Soil, water and managing natural resources	$7,180
Adoption of R&D	$3,086
TOTAL	**$20,908**



Further detail on how CRDC's RD&E investments align with these priorities can be found in Appendix 2: Australian Government priorities.

Section 4
RD&E Portfolio

Program 1: Farmers

Program 2: Industry

Program 3: Customers

Program 4: People

Program 5: Performance

JOHNELLE ROGAN

Program 1: Farmers			
Program	**Farmers**		
Outcome	Cotton is profitable and consistently farmers' crop of choice.		
Measure	Farmers increase productivity by three per cent per hectare per year.		
Theme	**1.1 Successful Crop Protection**	**1.2 Productive Resource Efficiencies**	**1.3 Profitable Futures**
Strategy Outcomes	Cotton crops protected from pest, weed and disease threats.	Inputs for cotton production are optimised.	Innovations in cotton production.
Will be achieved by	1.1.1 Monitoring and investigating the ecological behaviours and responses of cotton pest, weeds and diseases. 1.1.2 Testing practices that deliver improved management of insect pests, weeds and diseases. 1.1.3 Improving capacity, knowledge and adoption of techniques to successfully protect the cotton crop.	1.2.1 Delivering benchmarks of on-farm resource-use efficiencies. 1.2.2 Developing and proving decision systems and practices that deliver optimal resource efficiencies on cotton farms. 1.2.3 Developing new systems and tools to support farm decision-making processes. 1.2.4 Improving capacity, knowledge and adoption of techniques to optimise resource uses.	1.3.1 Investigating the application of new technologies and different scientific approaches which have the potential to deliver significant improvements and economic returns to the cotton farming system.
Measures of success	Farmers are able to improve their crop management practices based on sound science. ▪ 85 per cent of farmers adopting improved practices that reduce the reliance on pesticide inputs. ▪ 50 per cent of farmers adopting improved practices that reduce the incidence of insect pests, weeds and diseases affecting cotton on their farm. ▪ World-class science foundations for managing ecological adaptations in cotton insect pests, weeds and diseases.	Farmers are able to increase their productivity: ▪ per hectare of land. ▪ per unit of nitrogen fertiliser. ▪ per ML water. ▪ per unit of CO_2 equivalent emitted.	Farmers are profitable: ▪ Improving gross margins for Australian cotton production systems. ▪ On-farm innovations and partnerships established to drive profitability.

Key program investments

This section provides a snapshot of some of CRDC's investments during 2017-18 in this program area. The full list of CRDC's investments for this period can be found at Appendix 4: the RD&E portfolio. Reports from all completed projects can be found at CRDC's online library, Inside Cotton (www.insidecotton.com).

Successful Crop Protection: Monitoring and investigating the ecological behaviours and responses of cotton pest, weeds and diseases; Testing practices that deliver improved management of insect pests, weeds and diseases; Improving capacity, knowledge and adoption of techniques to successfully protect the cotton crop.

Significant advancements have been made in protecting cotton from insect pests, weeds and diseases, but new threats and challenges continue to emerge. The RD&E focus is on developing strategies and practices that support farmers in addressing these challenges.

CRDC's 2017-18 investment in this area included the following key projects:

- *Enhancing Integrated Pest Management in cotton systems;* with CSIRO
- *Staying ahead of weed evolution in changing cotton systems;* with UQ
- *Digital technologies for dynamic management of disease, stress and yield;* with AGWA
- *Managing verticillium risk for cotton;* with NSW DPI
- *Improving the management of cotton diseases in Australian cotton farming systems;* with QDAF
- *Innovative solutions to diseases;* with NSW DPI.

Silverleaf whitefly (SLW) is a major pest in cotton. Besides having a large host range, SLW can contaminate cotton lint with honeydew, rapidly reproduce, and also develop resistance to many insecticides. The *Enhancing Integrated Pest Management in cotton systems* project has continued to strengthen integrated pest management (IPM), with sharper focus on SLW in response to industry concerns. Working with Dr Richard Sequeira, the project team updated the industry recommendation for SLW monitoring to include nymphs, and modified the threshold matrix before the 2017-18 season.

Other work includes the following: DNA detection of SLW in predator guts to identify the main predators; a study of effects of different insecticides on SLW; field monitoring of SLW movement trends down the plant throughout the day; and better monitoring strategies. This project also ensures that industry information to support IPM decisions remains current and accurate. This includes the impact of insecticide on beneficials, and thrip trials to provide independent data on new products.

To combat the impact of glyphosate-resistant weeds on the cotton industry and to reduce the risk of multiple resistant weeds, researchers from the University of Queensland, the QLD Department of Agriculture and Fisheries, and Innokas Intellectual Services are studying the drivers for weed resistance in cotton farming systems and evaluating new tactics for weed control. In the *Staying ahead of weed evolution in changing cotton systems* project, the research team used the Diversity Model. They devised a multi-species, multi-herbicide modelling scenario comparing triple stack (TS) herbicides only, plus one double knock (glyphosate followed by paraquat) before planting, against a best practice strategy with several residual herbicides and variations of the TS strategy. This work is important to understand the impact of the introduction of Monsanto's new triple herbicide stack technology which is likely to be commercially released in 2020.

The comparison found that using the TS herbicides with one extra tactic is predicted to be insufficient to control glyphosate-resistant barnyard grass. The best practice system controlled glyphosate-resistant barnyard grass well. If there is substantial background of resistance to dicamba and/or glufosinate when the TS is introduced, the TS strategy is predicted to gradually fail to control glyphosate-resistant fleabane. The best practice strategy is predicted to slow this process, but still fail eventually. New tactics for assessing weed control include cover cropping and pre-harvest weed seed control. Early results suggest both tactics could help with managing invasive weeds.

The *Digital technologies for dynamic management of disease, stress and yield* project is a cross-sectoral project under the Australian Government's Rural R&D for Profit program, administered by the Department of Agriculture and Water Resources. The project, which commenced in 2016-17, is led by the Australian Grape and Wine Authority, with CRDC and Horticulture Innovation Australia as project partners. The project aims to integrate systems capable of simultaneously measuring and providing data to help cross-sectoral holistic decision making for the management of yield, disease and stress in cotton, grapes and horticulture. Under the grant, two projects focus on cotton.

In the *Managing verticillium risk for cotton* project, NSW DPI Research Pathologist Dr Karen Kirkby is making headway developing a molecular diagnostic tool for growers and agronomists to quantify *Verticillium dahliae* inoculum levels in soil, and to better manage risks. Growers could use the tool to guide their decision to either return to cotton or plant a non-host crop based on Verticillium wilt risk. Initially, the test was also going to assess strains based on vegetative compatibility groups (VCGs), but the research has found that VCG is not always correlated with severity in Australia. PhD candidate at the University of Sydney, Pearl Dadd-Daigle, has been characterising different Australian strains, and early results would suggest that the VCG2A strain in Australia occurs as either a non-virulent strain or a virulent strain. This finding is significant because if a molecular marker associated with virulence can be found, it will be linked to the test.

Historically, the cotton industry has monitored disease severity and spread from separate disease surveys in NSW and QLD. The *Improving the management of cotton diseases in Australian cotton farming systems* project brings industry data together. It uses digital approaches to make better use of the survey data for industry outcomes, and partners with CottonInfo to better focus on responding to emerging issues. In this study, all regions were surveyed in late and early season. Crop rotation with either a non-host or bare fallow is recommended for managing Verticillium wilt of cotton. Integrating microbial diversity studies from the survey have highlighted that while fallow reduces disease inoculum, it also reduces diversity. This means that while disease risk is initially lower, it might result in soil that is less resilient to diseases in the longer term.

In a related project, *Innovative solutions to diseases* project, NSW DPI's Dr Duy Le is assessing the efficacy of novel and currently unregistered products in controlling major soil-borne pathogens in cotton. After an initial review, 'Disease-related constraints to Australian cotton production', this project focuses on seed treatments with unregistered and novel compounds, and on potential biocontrol agents to control cotton seedling disease, especially black root rot. It will test biodisinfestations of soil to suppress black root rot, Fusarium wilt and Verticillium wilt, and study whether plant activators induce resistance against Verticillium wilt. The project aims to support registration and/or commercialisation of any potentially effective products.

Following unusually severe *Alternaria* recently, this project has also tried to isolate and identify the species involved, and is screening fungicides to determine the best fit for industry for permits and/or registration.

Case study: Cotton industry fighting back against weed resistance

The 2017 cotton industry weed survey, commissioned by CRDC annually, has shown glyphosate resistance remains high in problematic weeds in cotton farming systems.

CottonInfo's Weed Management Technical Lead Eric Koetz has undertaken recent surveys and says the resistance levels coming out of screening remain at high levels between surveys. The weeds of most concern are sowthistle, fleabane, feathertop Rhodes grass, windmill, and barnyard grass.

'These five weeds have been identified as some of the most problematic in the cotton farming system,' Eric said.

'The big message for growers is that if we continue down this path, we will lose this chemistry for weed control in all farming systems.

'We need diversity in our weed control, which includes herbicide and non-herbicide control tactics.'

The random nature of surveys and sampling of different cotton fields between years explains in part what would appear to be a decline in resistance levels. While the 2017 survey was a smaller sample size than previous years, there are still alarming levels of resistance.

The five weeds showing high levels of resistance are all prolific seeders, thrive in no-till systems, produce mobile seeds and all have capacity to develop resistance.

CRDC R&D Manager Susan Maas explained that while concerning, these results certainly weren't a surprise.

'The industry continues to identify these weeds as being particularly challenging due to their shared characteristics.

'The herbicide tech panel annually review industry practices as part of providing recommendations for Herbicide Resistance Management Strategy.

'While there have been some increases in use of residuals, particularly in crop, the 2016-17 Crop Consultants Australia survey found that about a third (22 per cent fully irrigated, 33 per cent dryland) of the cotton crop relied on glyphosate as the only option.

'While the reliance on glyphosate in cotton is concerning, it was good to see that the majority of growers are using more than two non-glyphosate tactics in their fallow, as outlined in the Herbicide Resistance Management Strategy.'

The annual weeds survey is conducted with support from CRDC.

For more, see the Autumn 2018 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

WARWICK WATERS

CottonInfo REO for the Darling Downs, Annabel Twine, with CottonInfo Weed Management Technical Lead, Eric Koetz of NSW DPI.

Case study: Shedding light on compaction

Darling Downs farmer Ian Hayllor hosted a CRDC and CottonInfo-supported compaction workshop on his farm in 2017. The workshop involved digging a soil pit in an irrigated field to investigate the effect compaction has on water and nutrient infiltration and efficiency, and how it could be avoided and repaired.

Ian always had concerns about compaction and the impact of round module cotton pickers, but digging the pit on his farm confirmed his suspicions. The results were both instructive and concerning.

Compaction on his farm was potentially costing Ian 10 to 20 per cent yield loss, equating to 'a lot of money' and potential soil health issues.

'To actually see what soil compaction looks like and the effects on the soil and, correspondingly, our crops was enlightening,' Ian said.

'You could see the effect the compacted soil would have on root growth, water infiltration and water-holding capacity.

'Down through the profile, under wheel tracks and following the root channels, soil moisture was low, yet in adjacent uncompacted regions it was the opposite, so the effect on water-holding capacity was crystal clear.

'This was an eye-opener into how much we are affecting the soil in this way, and leads me to believe that we have been masking the compaction problem through our management strategies, particularly in irrigation by continually reducing irrigation scheduling deficits.'

Ian's experience is supported by the fact that participants in the 2016-17 Crop Consultants Australia survey – covering nearly 200,000 hectares – reported that over 80 per cent of that area was affected by compaction, with 27 per cent of the area surveyed having a reported yield reduction of more than one bale per hectare.

The compaction workshop was part of research undertaken through CRDC and CottonInfo with CSIRO's Dr Michael Braunack and USQ's John McLean Bennett.

'Talking with growers and crop consultants helps us determine the full extent of the industry's compaction issues. This is used to develop research priorities to help guard against and manage compaction,' the researchers said.

'By giving growers a look inside their soil, we're bringing awareness to this issue and we can then work with growers to find solutions.'

Ian was so amazed by what he saw in his irrigated fields that he dug another pit in unfarmed country to compare soil structure, which he said was 'like chalk and cheese'. Ian has also begun moving his irrigated fields to controlled traffic farming (CTF), already in use in his dryland fields.

For more, see the Autumn 2018 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

MELANIE JENSON

Soil health and compaction are issues for both dryland growers and irrigators.

Case study: Dealing daily with Vert

Dealing with Verticillium wilt affects everyday management decisions at 'Strathguyle' near Mungindi in North-West NSW. Finding a way to successfully manage the disease is now ongoing through several research trials on the farm, one of which is being supported by CRDC into soil solarisation.

The path to serious Verticillium infection was not a usual one at 'Strathguyle'. Up until five seasons ago, the farm grew only conventional cotton, a rare sight in today's Bollgard landscape.

Farm manager Andrew O'Connor saw the decline of Fusarium, and the development and subsequent widespread effect of Verticillium.

'Before moving to Bollgard varieties we were growing conventional (Sicot 730) to help manage Fusarium, as we could pretty much go zero till and it helped our rotation program,' Andrew said.

'During this time we hadn't seen Verticillium impact our fields, but little did we know we'd been building up inoculum in the soil through our management practices.'

Verticillium was found at 'Strathguyle' around four seasons ago, after having plants tested.

'Since then, it's been years for the disease. Dry winters meant no rotation crop, so we started to push higher nitrogen and shorter irrigation intervals, which all combined to create the perfect storm,' Andrew said.

'In the 2014-15 season, the crop looked great to peak flower, then just fell over as a result of Vert.

'Now we're still struggling to grow a five-bale-per-acre crop (farm average) while the rest of the industry are growing six bales.'

Andrew has seen so much Verticillium that he can now visually distinguish it from Fusarium.

'Vert presents differently to Fusarium. We tend to notice Fusarium earlier in the season, and the Vert around the second irrigation, around flowering,' Andrew said.

Andrew's advice for other growers, based on his experience, starts with getting plants tested the moment any symptoms are seen.

'I think everyone's got it, just eventually the inoculum levels build till it starts to show in the plant,' he says.

'For us, Verticillium management is an everyday response. In all our management, we think about the effect on Vert.'

For more, see the Autumn 2018 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

MELANIE JENSON

'Strathguyle' farm manager Andrew O'Connor has worked with CottonInfo Gwydir Valley REO Janelle Montgomery to establish many Verticillium trials on the farm after suffering severe impacts from the disease.

Productive Resource Efficiencies: Developing and proving decision systems and practices that deliver optimal resource efficiencies on cotton farms; Developing new systems and tools to support farm decision-making processes; Improving capacity, knowledge and adoption of techniques to optimise resource uses.

Ensuring growers can achieve optimal efficiencies of input resources is a key focus for the cotton industry's R&D. CRDC's investment focuses on developing, identifying, testing and extending decision systems and practices to help growers improve their efficiencies.

CRDC's 2017-18 investment in this area included the following key projects:

- *Irrigation agronomy for tailored and responsive management with limited water;* with CSIRO
- *Smarter Irrigation – 2018 CottonInfo Researchers Tour: Optimising irrigation and nitrogen;* with NSW DPI & CottonInfo
- *Smarter Irrigation: Develop precise and automated control systems for a range of irrigation systems;* with NCEA
- *Smarter Irrigation: Grower-led cotton automation integration trial;* with GVIA
- *Increasing profitability through improved NUE and reducing gaseous losses of nitrogen;* with QUT
- *Quantifying the effectiveness of cover crops as a means of increased water infiltration and reduced evaporation in the northern region;* with QDAF & GRDC.

Cotton production in Australia is limited by the lack of water availability in most years. The *Irrigation agronomy for tailored and responsive management with limited water* project aimed to enable growers to adapt and tailor their irrigations from definitive data. With an uncertain future climate and water availability, the project also helps them manage risk.

Earlier research supported by CRDC enabled the development of an irrigation scheduling method for furrow-irrigated cotton based on canopy temperature monitoring. Because they strongly relate to soil-water availability, canopy temperature measurements enable continuous monitoring of a crop's need for irrigation using a plant-based method that is practical on commercial farms.

Through this project, the canopy temperature method was further refined for fully irrigated systems, and was tested in partially irrigated situations. The project outputs are now being commercialised with an industry partner to accelerate the scale and rate of adoption of this precision irrigation technology. Future research will further refine the methodology in fully irrigated systems and help progress the adoption of canopy temperature approach of irrigation within the cotton industry.

Following the success of CottonInfo researcher tours over recent years, the *Smarter Irrigation – 2018 CottonInfo Researchers Tour: Optimising irrigation and nitrogen* aimed to bring together researchers, industry, advisors and growers to raise awareness of industry-funded research programs, and promote the latest best practice management.

At the seven events, tour themes covered topical industry-wide management issues, including optimising different irrigation systems, practices to maximise performance of irrigation systems, practices to increase nitrogen-use efficiency (NUE) where nitrogen (N) losses occur, and the impact of irrigation.

The tour drew a total of 447 growers and consultants, who heard from 12 researchers/industry presenters. In the evaluation survey, 77 per cent of attendees noted opportunities to improve their irrigation efficiency, and a similar number noted opportunities to change their N application or irrigation management to improve NUE.

The broad aim of the *Smarter Irrigation: Develop precise and automated control systems* for a range of irrigation systems project is to develop a broad-acre precision irrigation control system that is automated and adaptive. Built for the Australian cotton, dairy and sugarcane industries, it will operate on the large field areas across furrow irrigation systems in cotton and sugarcane, and under centre-pivot irrigation on cotton and dairy pastures. The project provides the opportunity for substantial labour savings in irrigation, for better irrigation management and performance, and for better water productivity in these industries.

With these autonomous broad-acre irrigation systems, commercial farms have the capacity to manage individual irrigations. The project used the VARIwise system's assessment and predictive feedback to determine crop yield potential, which allows it to alter control with changes in water availability. The next stage of this project has three parts: research to refine yield-based irrigation decision support tools; expand field trials to validate relationships; and develop low-cost water sensors for assessing on-farm water.

The suitability of flood irrigation automation concepts in commercial irrigation systems is of interest to growers. The *Smarter Irrigation: Grower-led cotton automation integration trial* project included commercial comparisons between lateral, drip, automated siphon and bankless systems. It sought to maintain or improve water-use efficiency, to reduce labour and energy requirements, and to identify a system that is cost effective for broad-scale adoption. The project provided an extra set of comparison data, affirming previous findings that irrigation efficiency is influenced more by seasonal conditions than by the system. It showed that on-farm broadband systems will significantly improve reliability and speed of internet connectivity, which becomes more important as irrigators adopt automation.

Of the initial challenges in automated flood irrigation, selection of equipment is important. Installing smart siphons could be achieved cost effectively, but different approaches are possible. The project demonstrated that irrigators could gradually progress towards automation by using smart siphons and associated management system. To meet the interest in these systems, more research is needed into mechanisms that accurately and confidently schedule and manage irrigations more efficiently.

Nitrous oxide is a potent greenhouse gas. Reducing its emission will both improve the environmental performance of cotton growing, and increase the productivity of fertiliser use. The *Increasing profitability through improved NUE and reducing gaseous losses of nitrogen* project is trialling and demonstrating nitrogen fertiliser management strategies — including variable-rate fertiliser applications, rotational cropping with legumes, and matching fertiliser rates to crop demands — to reduce nitrous oxide emissions from irrigated cotton systems in Central QLD and north-west NSW.

The project is also trialling different irrigation practices, such as siphon size, number and time of irrigation, and reducing run-off. This is to determine and demonstrate the potential to reduce nitrogen losses through reducing erosion and sediment movement. When nitrogen (N) and carbon (C) move from the cotton field into tail-water drains, the N is converted to nitrous oxide, and the C is lost from the field. If nitrous oxide emissions and soil carbon loss are reduced, irrigated cotton farming systems can be more productive and profitable.

The project results demonstrate the critical importance of soil N mineralisation in supplying the cotton crop's N requirements, and the potential to reduce fertiliser N applications. Results also suggest that nitrification inhibitors can effectively reduce overall losses of N from the system. The project also showed that currently available methods for predicting the amount of N that soil mineralisation will provide over the growing season are highly uncertain. When this uncertainty is overcome, growers can have confidence in the predicted levels of N from the soil, and thus the amount of fertiliser N they need to apply.

Typically, cover crops offer several main uses: protect the soil from erosion and increase infiltration in low-stubble situations; return biomass to maintain soil organic matter and

biological activity; and an alternative source of nitrogen if legumes are used. However, cover crops also offer an opportunity to increase fallow moisture storage and, thus, to grow better and more profitable grain and cotton crops in NSW and QLD. Recent research suggests that cover crops and higher stubble loads can cut evaporation, raise infiltration, and provide net gains in plant-available water (PAW) over the traditional fallow periods.

For grain and cotton growers in the northern region, more effective capture and storage of rainfall are major challenges: only 20–40 per cent of rainfall is typically transpired by dryland crops; 60% of rainfall is lost to evaporation; and a further 5–20 per cent is lost in run-off and deep drainage. The *Quantifying the effectiveness of cover crops as a means of increased water infiltration and reduced evaporation in the northern region* project is assessing and quantifying the effectiveness of cover crops to increase rainfall infiltration, reduce evaporation, and increase the PAW for dryland grain and irrigated cotton production systems. With water relations a focus of the project, grain and cotton growers are interested in the outcomes.

While the project is in its early days, the data shows that these treatments are having the expected benefits on PAW in the fallows. The variable recharge (especially at Goondiwindi) will provide a good basis for assessing and understanding the ultimate effects on fallow efficiencies, on PAW at planting, and on subsequent crops, of the various cover crops being trialled. There is widespread interest in the use of cover crops, and in their underlying biological effects for many growers, especially cotton growers. Some limited sampling and assessment of key biological measures will be undertaken to compare some key cover crop treatments at the end of the longer fallows in both systems.


MELANIE JENSON

Case study: Nitrogen and irrigation management go hand in hand

A CottonInfo nitrogen-water trial, conducted at Garry Houston's property at Weemelah in the Border Rivers region during the 2017-18 season, highlighted the transient nature of nitrogen (N) in cotton fields.

The trial was designed to quantify the runoff component of the N loss pathway and highlight the relationship between irrigation and N management.

Nitrogen is the most difficult nutrient to manage in irrigated cotton production; it has more impact on yields, crop maturity and lint quality than any other primary plant nutrient.

The irrigation evaluation was conducted as part of a CottonInfo Nitrogen and Irrigation trial undertaken by Regional Extension Officer Janelle Montgomery, with NCEA's Dr Joe Foley and Malcolm Gillies. They confirmed the soil had a high infiltration rate, which can result in the movement of N out of the root zone, particularly at the head ditch where the opportunity time for infiltration is greatest.

'This lines up with low N near the head ditch and high N at the tail drain end, which showed up in soil tests and was also evident in yellowing of plants at the head ditch near the end of the season,' Janelle said.

'Infiltration will drive irrigation performance and, hence, the N movement within the field.'

Cotton consultant Rob Holmes of HMAg believes there are significant implications for their nutrient management given the infiltration associated with this soil type.

'The irrigation evaluation provides an insight into how water moves through this soil,' Rob said.

'We did not expect these results at all, but it all makes sense now to what we're seeing in the field.'

As a result of the evaluation and information, Rob is working with Garry to improve the way they manage their N application by implementing variable rate and a possible change to water-run N for more timely application. They are also looking to optimise their irrigation application.

CottonInfo on-farm trials are conducted across the cotton-growing valleys each season to try new ideas and test new technology.

For more, see the Winter 2018 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

JANELLE MONTGOMERY

Alex Trinder and Robert Holmes from HMAg, Moree.

Case study: Pooling nitrogen resources

The CRDC-led national More Profit from Nitrogen Program (MPfN) is a four-year partnership between Australia's four major intensive users of nitrogenous fertilisers: dairy, cotton, sugar and horticulture.

Supported by $5.8 million from the Australian Government's Department of Agriculture and Water Resources Rural R&D for Profit program, MPfN is in its second year of delivering the research findings of 10 industry-based projects from a partnership of 23 organisations. Combined contributions have seen a commitment of $15 million to nitrogen-use efficiency (NUE) research.

'By bringing the four industries together, the result is increased cross-sector collaboration to reduce duplication of effort and more progressive and expedited outcomes for the investment than research undertaken in isolation,' said Marguerite White, Science Coordinator for the program.

MPfN is working towards improving farm profitability while decreasing environmental impacts, by reducing the amount of N required to produce a unit of product for each industry sector. Producers know there are many contributing factors when deciding on how, when and where to use N. Too little may reduce yield potential, while too much can affect profitability and increase greenhouse gas emissions.

Ensuring it delivers outcomes from research and practical solutions, MPfN has been designed to engage with growers from the beginning. The project involves 33 study sites from Darwin to Hobart. These sites host local field days, and are further supported by laboratory analysis, experiments, simulation and modelling.

Program research is being undertaken under three focus areas for improving productivity and profitability through improved NUE. A particular focus is developing a better ability to predict in-season soil mineralisation so that more precise N fertiliser budgets can be developed.

CRDC is supporting two cotton projects under the MPfN Program: one with the University of Southern Queensland, Optimising nitrogen and water interactions in cotton, and the other with the NSW DPI, Enhancing nitrogen-use efficiency in cotton.

'Both these projects are building on previous research supported by CRDC, and include a focus on improving our understanding of the impacts of different water and nitrogen application strategies on NUE – and especially the interactions between the two,' said Allan Williams, CRDC's R&D Manager for the program.

For more, see the Summer 2017-18 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

The More Profit from Nitrogen team at the first annual partners forum held August 2017 in Coolangatta.

Case study: Reducing labour and optimising irrigation

With the help of automated irrigation and a move away from traditional siphons, it now takes just one person to irrigate cotton at Steve Carolan's property 'Waverley' near Wee Waa in North West NSW, where seven people were once needed.

After seeing CRDC-supported research into automation in action at a CottonInfo field day and demonstration site at Moree in 2016, Steve and farm manager Andrew Greste initially converted 100 hectares from traditional siphons to a fully automated system. The Small Pipe Through the Bank (sPTB) has now been implemented across 2200 hectares at 'Waverley'.

The sPTB system consists of small pipes through the bank and a series of gates in the channel delivery system that can be remotely monitored, opened and closed by mobile phone. Gates are opened remotely in a 300-metre blind channel, starting 150 pipes per set.

Before implementing the new system, Steve and Andrew needed seven staff to manually start siphons for four hours each day, for every day of a seven-day irrigation cycle. Four utes were also in operation during irrigation to transport staff for siphon work and to monitor water levels across the farm's channel network.

'Full automation is not cheap to set up, but we can justify some of the expense over time in terms of savings in labour and improved water-use efficiency,' Andrew said.

Fully automated sPTB furrow irrigation is commercially available and viable at around $1200 per hectare.

Supported by funding from the Australian Government's Rural R&D for Profit program's Smarter Irrigation for Profit project (SIFP), the system has been expanded and refined. The advantages are significant labour savings, improved uniformity and better water-use efficiency.

For more, see the Spring 2018 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

MELANIE JENSON

David Robson of FarmConnect and Rubicon Water, with Dr Joseph Foley of USQ, and Steve Carolan and Andrew Greste from Waverley Ag at Wee Waa.

Profitable futures:
Investigating the application of new technologies and different scientific approaches which have the potential to deliver significant improvements and economic returns to the cotton farming system.

Cotton growing will continue to evolve. Whether change is driven by productivity constraints, environmental, economic or regulatory factors, the long-term profitability of farmers relies on finding innovation and strategies that allow the cotton farming system to adapt. This theme looks to initiate RD&E efforts to deliver these innovations and build the longer-term profitability of cotton production.

In 2017-18, CRDC's support for this important research area included the following key projects:

- *Agri-intelligence in cotton production systems – Stage 1;* with QUT
- *Precision to Decision – Data communications;* with UNE
- *Precision to Decision – Overall program;* with AgriKnowHow
- *Precision to Decision – Producer survey to identify needs and issues;* with CSIRO
- *Precision to Decision – Travel: International Precision Ag Conference, Canada & Interest Group and Agricultural Data, Germany;* with Griffith University
- *Precision to Decision – Analysis of the economic benefit and strategies for delivery of decision agriculture;* with AFI.

With farming operations becoming more complex (more data, connectedness of decisions, tightly optimised systems), farmers need help with decision making. Agri-intelligence targets this increasing complexity at finer scales than ever before. The *Agri-intelligence in cotton production systems – Stage 1* project aims to develop situational awareness of the diversity and complexity of decisions in farming operations, as well as information use and use gaps within the industry.

The outcomes should influence agri-intelligence solutions in cotton production, and also help CRDC with research investment decisions.

The study provided key background on information, decisions, data usage, and state of knowledge of the value chain. It classified 61 decision areas according their perceived difficulty and impact on the enterprises. It also created an interactive graphic tool to show the interconnectedness of these decisions, and information about the network and subnetworks. This tool can help map the complexity of decision-making in cotton production.

Stage 2 of the project will select decision areas and specify key elements of associated problems. Some solutions may include data generation and capture methods, data analytics, information systems, communication strategies, and decision-support tools.

In the ever-evolving data communications field, the industry needs a bird's-eye view to understand how it all works. From this perspective, the *Precision to Decision – Data communications* project worked with producers, providers, and developers of technologies and data services. It looked at key telecommunications that producers use, and at factors limiting uptake or adoption of available technologies. It also investigated future needs and opportunities.

While the on-farm telecommunications market is rapidly changing, education remains one of the biggest challenges for all participants. Industry needs well-curated case studies to guide educational approaches. With this in mind, the project includes an introduction to the key telecommunications technologies and services on offer to Australian producers, as well as illustrative case studies of producers and service providers. The report discusses future opportunities, and offers recommendations aimed at helping producers understand a big-data future for their farming business. The recommendations also guide future research into enabling digital agriculture in all sectors.

The *Accelerating Precision to Decision Agriculture (P2D)* project is supported by funding from the Australian Government's Department of Agriculture and Water Resources as part of its Rural R&D for Profit program. Led by CRDC, the P2D project involves all Rural Research and Development Corporations, and is focused on three main aims:

- Facilitating the development of digital technology in Australian agriculture
- Fostering the establishment of appropriate legal frameworks, data systems, and access to critical datasets
- Identifying the data communications systems required to deliver the benefits of digital agriculture to the Australia farm and agribusiness sectors.

Digital agriculture in Australia was found to be in an immature state in many parts, including strategy, culture, governance, technology, data, analytics, and training. The economic modelling identified that, with maturity, the implementation of digital agriculture across all Australian production sectors (represented by the 15 RDCs) could lift the gross value of agricultural (including forestry, and fisheries and aquaculture) production by $20.3 billion (a 25 per cent increase on 2014).

The P2D project has delivered 13 key recommendations designed to catapult Australian agriculture into the digital age. If implemented, they will break down the current barriers to digital transition, including poor connectivity, a lack of confidence in returns from investment in digital agriculture, poor knowledge and support to assess options, and trust and legal issues around data ownership. The project has also delivered a series of web-based tools to increase data sharing across industries and data-informed business results. All RDCS are working together to implement the recommendations of the report.

The increasing use of big data in business has led to the need to understand its application in agriculture. The *Precision to Decision: Producer survey to identify needs and issues* project aimed to benchmark Australian producers' needs, perceived risks and benefits, and their expectations of digital agriculture and big data. Such understanding will guide strategies aimed at: (i) better use of agricultural data to raise productivity and profitability; and (ii) capitalising better on opportunities created by digital agriculture and big data.

The research highlighted issues around digital literacy, grower trust, and the availability of appropriate data and decision-support tools. It also confirmed that a lack of access to mobile and internet telecommunications infrastructure is a major barrier to adoption. This data will form the basis of a digital maturity index for Australian agriculture.

Currently, the legal and regulatory frameworks for agricultural data are immature. Around the world, many groups are uncertain about best practice for agricultural data governance that enables producers to capture data and encourage innovation. In the *Precision to Decision – Travel: International Precision Ag Conference, Canada & Interest Group and Agricultural Data, Germany* project, the lead researcher travelled to two international conferences and presented a paper at each:

- The 11th Plenary of Research Data Alliance (RDA): From Data to Knowledge, 21-23 March 2018, Berlin, Germany
- The 13th International Conference on Precision Agriculture (ICAP) in Montreal, Canada, 24-27 June 2018, Montreal, Canada.

The contacts made during this exchange will foster international collaboration as Australia seriously considers the governance of Australian agricultural data to guide policy and practice.

The advancement of decision agriculture plays an important role in the cotton industry's future. The research project *Precision to Decision: Analysis of the economic benefit and strategies for delivery of decision agriculture* aimed to identify areas where the wider agriculture sector, including cotton, could benefit from decision agriculture.

In addition to the findings that the value of production could rise by $20.3 billion if the full potential of digital agriculture in Australia is realised, the project also found that producers from all agricultural sectors would become more globally competitive and there would also be major flow-on effects to other parts of the economy.

The project identified some areas of cross-sector value in the value chain from producer to consumers – more automation, smarter use of inputs, accelerated genetic gains, and better market access and biosecurity. This economic analysis will help guide the development of a digital strategy for Australian agriculture. The resulting targeted investments and implementation by government and RDCs is expected to reduce current barriers to decision agriculture, and make it more profitable.

MELANIE JENSON

Case study: Growers support on-farm research

The Riverina is known for rice, grapes, horticulture and dryland broadacre cropping, however in recent years cotton has become a crop of choice for many.

Moving into different crops can be a challenge for irrigators, however farmer-led 'learning sites' are taking the guesswork out and improving outcomes.

In 2016, Mat Stott of 'Point Farms', Darlington Point, allowed fields on his farm for use as a key learning site and optimised irrigation farm. For growers new to cotton, the site gives them the opportunity to see first-hand how the crop is managed, while at the same time showing how water-use efficiencies can be realised.

'Point Farms' is one of a network of 19 farmer-managed learning sites in major irrigation regions in Australia. The sites provide practical demonstrations of research supported by funding from the Australian Government's Rural R&D for Profit program's Smarter Irrigation for Profit project (SIFP). SIFP is a collaboration between the cotton, sugar, rice and dairy research industries and research partners, including CRDC, the project leader.

For Mat, hosting the trial provided a first-hand look at research in the field, and for 'Point Farms' it wasn't a case of under, but over-watering.

'Coming from corn growing, we were using similar scheduling, and tended to water our cotton too often,' Mat said.

'What was surprising is that we found we were causing a yield penalty from overwatering.

'After working with researchers through the SIFP trials on our farm, we changed our irrigation scheduling, which has increased yield by roughly three-quarters of a bale per hectare.

'We schedule now on a seven-day cycle, while still tailoring watering to other factors such as the weather and climate.'

In the trials crops at 'Point Farms', researchers have been testing and validating scheduling technology to find a management strategy that suits the soil type, climate and water-delivery mechanisms of the Riverina.

'Every farm is different, so what we are trying to show at these sites is that you can adapt what you see here to make it work on your farm,' Mat said.

'I think the site has been beneficial for the region by giving interested growers and researchers access to the crop first-hand.

'By being involved we have had outside agronomists and other researchers come onto the farm at field days and many other times to look at the wider cropping area. They all bring information to us as well as taking it away.'

In February 2018, researchers and technical experts viewed trials at 'Point Farms' as part of an 'Optimising irrigation and nitrogen research' tour hosted by CRDC and CottonInfo.

For more, see the Spring 2018 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

MELANIE JENSON

Irrigators from the Riverina, Gavin DalBroi and Mat Stott, visiting optimised irrigation farms in the Gwydir Valley. Mat's farm at Darlington Point is also a key learning site, where he has implemented knowledge from travel to other regions.

Case study: Diagnosis for decision-making

Verticillium wilt poses a significant challenge to the Australian cotton industry. The 2016-17 CCA survey found consultants estimated that Verticillium had some impact on 64 per cent of cotton area profitability, with 20 per cent having losses of more than $100/ha.

CRDC supports several Verticillium wilt projects, including NSW DPI Research Pathologist Dr Karen Kirkby's research on the development of a molecular diagnostic tool for growers or agronomists to quantify *Verticillium dahliae* inoculum levels in soil.

The project aim is to develop a tool to identify levels of infection in the soil so that fields with high inoculum levels can be avoided, and instead identify fields (pre-plant) for cotton that will have less risk of causing disease in the following season. Karen is working with Dr Toni Chapman, a molecular specialist at Elizabeth Macarthur Agricultural Institute to develop the tool.

The research is a part of the Digital Technologies for Dynamic Management of Disease, Stress and Yield Program, which is supported by funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit Program.

'The tool will be similar to a fertiliser test,' Karen said.

'You would send in a soil sample from a particular field and we would identify how many propagules per gram in that soil, which is representative of the entire field.

'The sampling strategy in cotton fields will be important as pathogens are spatially variable.

'We hope to differentiate strains, and the test will be quick, accurate and reliable.

'Currently, to determine pathogen levels we use a common technique called dilution plating, which is very hands-on and time consuming. We don't get the answers very quickly, hence the need for this molecular tool.'

For more, see the Autumn 2018 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

MELANIE JENSON

NSW DPI's cotton pathology team: Sharlene Roser, Peter Lonergan and Dr Karen Kirkby.

RD&E Portfolio
PROGRAM 2: INDUSTRY

Program 2: Industry			
Program	**Industry**		
Outcome	The Australian cotton industry is the global leader in sustainable agriculture.		
Measure	Industry can report against recognised sustainability indicators.		
Theme	**2.1 Respected Stewardship**	**2.2 Responsible Landscape Management**	**2.3 Sustainable Futures**
Strategy Outcomes	Industry protects its production technologies and its biosecurity.	Industry leads in managing natural assets.	An industry achieving its vision.
Will be achieved by	2.1.1 Monitoring for and investigating changes in pest and weed susceptibility to biotechnologies and crop-protection products used by the cotton industry. 2.1.2 Exploring tactics and strategies that lower the risks of pesticides to the environment and resistance evolution in populations of key insect pests and weeds. 2.1.3 Developing and supporting the industry's capacity to effectively steward key technologies and products. 2.1.4 Supporting the industry's preparedness and ability to deal with biosecurity threats.	2.2.1 Defining the values and drivers relating to the management of natural landscapes and systems in cotton-growing regions. 2.2.2 Recording and demonstrating improved environmental performance of the cotton industry. 2.2.3 Identifying and proving integrated management strategies which deliver environmental and productivity gains. 2.2.4 Researching the connectivity between cotton farms and natural systems in the landscape. 2.2.5 Supporting initiatives and partnerships to improve the knowledge and capacity to manage natural landscapes and systems in cotton regions.	2.3.1 Scoping and investigating critical threats and opportunities which may influence the long-term sustainability of the Australian cotton industry. 2.3.2 Supporting innovative approaches to solve traditional industry issues and drive future sustainability.

Program 2: Industry			
Measures of success	Industry is able to maintain its access to, and the effectiveness of, biotechnologies and crop protection products. ▪ 100 per cent of cotton farmers are aware of the underlying risks of trait and agricultural chemical resistance. ▪ 100 per cent of insecticide use decisions are consistent with the Insecticide Resistance Management Strategy (IRMS). ▪ The cotton industry has the necessary science to provide informed input into the development of resistance management plans for biotech traits. ▪ The cotton industry demonstrates pesticide management practices that lower the risks posed to the environment and the evolution of resistance in target insect pest and weed populations. Industry is capable of managing its biosecurity responsibilities. ▪ The cotton industry is able to meets its biosecurity obligations. ▪ The cotton industry is prepared to effectively respond to biosecurity incursions.	Industry participation in the collective management of natural landscapes. ▪ Regional delivery partnerships for every major cotton-growing region. Industry recognised for its leadership in environmental performance. ▪ Recognition by national and global initiatives for biodiversity management. ▪ 1000 km of riparian lands managed under best practice. ▪ One million hectares of floodplain vegetation managed under best practice. Industry contributes to the improvement of landscape systems knowledge and science. ▪ A comprehensive database documenting the extent and condition of the natural assets the industry utilises and manages. ▪ Two national science-based collaborations for the industry to inform surface and groundwater management.	Industry is capable of leading and adapting to change. ▪ Innovations and partnerships established to drive cotton industry sustainability.

Key program investments

This section provides a snapshot of some of CRDC's investments during 2017-18 in this program area. The full list of CRDC's investments for this period can be found at Appendix 4: the RD&E portfolio. Reports from all completed projects can be found at CRDC's online library, Inside Cotton (www.insidecotton.com).

Respected stewardship:
Monitoring for and investigating changes in pest and weed susceptibility to biotechnologies and crop-protection products used by the cotton industry; Exploring tactics and strategies that lower the risks of pesticides to the environment and resistance evolution in populations of key insect pests and weeds; Supporting the industry's preparedness and ability to deal with biosecurity threats.

Stewardship refers to supporting the responsible use of crop protection products and protecting their long-term effectiveness in the Australian cotton industry. Ensuring that key insect pests and weeds do not become resistant to biotechnology or crop-protection products is of critical importance to the industry. Biosecurity preparedness is also included in the stewardship program, with research and extension aimed to ensure industry is well positioned to deal with biosecurity threats.

In 2017-18, CRDC continued its support of this important research area through key projects, including:

- *Conventional insecticide resistance in Helicoverpa;* with NSW DPI
- *Development of a spray drift hazard prediction system;* with MRES
- *Improving plant pest management through cross-industry deployment of smart sensors, diagnostics and forecasting;* with HIA
- *Monitoring silverleaf whitefly (SLW) insecticide resistance;* with QDAF
- *Plant Biosecurity Research Initiative (PBRI);* with HIA
- *Resistance research and monitoring to enhance stewardship of Bt cotton and management of Helicoverpa spp.;* with CSIRO.

Even in this Bollgard 3 era, growers still need to protect yield and quality from insect and mite pests. But resistance to chemicals used on pests remains a threat. In response, the cotton industry has implemented an Insecticide Resistance Management Strategy (IRMS) to manage risk in key pests. CRDC supported three monitoring programs to guide changes in field resistance levels and to support management recommendations. Because *Helicoverpa armigera* is also grains pest, the project *Conventional insecticide resistance in Helicoverpa* collaborated with the Grains Research and Development Corporation (GRDC). Over the last two years, this project has identified increasing Indoxacarb resistance, driven particularly by higher resistance frequency in Central QLD. Early research suggests this regionally higher level may be due to resistance having a fitness cost associated with diapause.

In 2016, project leader Lisa Bird joined the National Insecticide Resistance Management (NIRM) working group as a permanent panel member to coordinate the development of a strategy for *H. armigera* resistance management in the Australian grains industry. In April 2018, GRDC released the strategy and other supporting documents that will complement cotton industry Resistance Management Plan efforts.

Unintended herbicide damage is an issue affecting a number of broad-acre and intensive agricultural industries in all cotton-growing regions. Off-target spray drift has been identified as a key RD&E priority by growers across a number of regions. CRDC has collaborated with GRDC on the *Development of a spray drift hazard prediction system* project to focus on improving understanding of surface temperature inversion, with the ultimate aim to improve identification and forecasting of safe spray conditions.

Over two seasons, Graeme Tepper, MicroMeteorology Research and Educational Services, and CottonInfo Climate Technical Lead Jon Welsh have overseen the establishment and collection of data from monitoring towers in the Lower Namoi Valley, Gwydir Valley, Border Rivers and Darling Downs regions. These observations

are being compared and calibrated with a high-resolution meteorological/air pollution model to identify algorithms that could be used to provide timely advice and warning of site-specific hazardous conditions. CRDC and GRDC are now investigating the roll-out of this network more broadly.

As part of the Australian Government's Rural Research and Development for Profit program, the *Improving plant pest management through cross-industry deployment of smart sensors, diagnostics and forecasting* project will develop a mobile, plant-pest surveillance network to monitor and report the presence of pests that threaten the cotton, grain, sugar, horticulture, wine, and forestry industries. Led by Horticulture Innovation Australia (HIA), the project will involve all plant RDCs (including CRDC).

The surveillance network has four main strands:

(i) advanced surveillance technologies, such as automated trapping and sampling, to detect and monitor a wide range of endemic and exotic plant pests. The project will also produce flexible surveillance hubs with trapping technologies that can be mobilised in response to incursions

(ii) better pest forecasting, by linking pest detection with weather forecasting and modelling systems

(iii) fast, reliable and cost-effective means to identify pests, such as high-volume data collation and distribution, and advanced molecular diagnostics

(iv) a cloud-based virtual coordination centre (AUSPestCheck) to improve information exchange on pests to producers, industry and government. Producers will receive timely and accurate updates.


CSIRO

The *Monitoring silverleaf whitefly (SLW) insecticide resistance* project seasonally tests silverleaf whitefly, *Bemisia tabaci* MEAM1, for insecticide resistance to registered chemistry. The data from these tests is essential to making informed decisions about insecticide resistance management. The project is part of a program that includes monitoring cotton aphid, two-spotted mite (TSM) and mirid resistance, and monitoring *Helicoverpa armigera* resistance to conventional insecticides.

In the 2016-17 season, resistance in SLW to pyriproxyfen, the cornerstone control product, had become widespread in the central region. Collections from St George, Macintyre, Gwydir and Namoi valleys tested positive, which prompted an industry response. To reduce the risk of SLW becoming widely resistant to pyriproxyfen (and causing the product to fail), the IRMS insecticide technical panel recommended a 30-day period for each region in which pyriproxyfen could be applied. CottonInfo extension supported the process by including SLW management workshops in Macquarie and Gwydir, and running an IPM short course. In another response, researchers revised the SLW threshold matrix in the *2017-18 Cotton Pest Management Guide*. Despite adherence to the IRMS being voluntary for growers, they readily complied and adopted the amended IPM.

In the 2017-18 cotton season, the project team collected SLW from 16 regional sites, covering most of the NSW and QLD cotton valleys. Early results indicate the industry response has slowed the increased rate of resistance. Tiny parasitoid wasps are important natural enemies of whitefly. The project also monitored levels of parasitism in field samples and looked at the impact of several insecticides used for management of cotton pests, supporting improved IPM decision making.

To address plant biosecurity issues affecting Australia's cropping industries, the *Plant Biosecurity Research Initiative (PBRI)* was established. It is a partnership between the nation's plant Research and Development Corporations (RDCs), working collaboratively with Plant Health Australia (PHA), the Department of Agriculture and Water Resources (DAWR), and industry, state and federal biosecurity stakeholders.

PBRI enables Australian cropping industries to collaborate on cross-sectoral R&D projects, and to develop the long-term capacity of biosecurity programs. Investments support surveillance of Australia's near neighbours to identify possible pest and disease threats to Australian industries, and to prepare better for biosecurity incursions. PBRI's long-term agreement will be reviewed and re-executed every five years to ensure a coordinated and sustainable cross-sectoral RD&E initiative into the future.

The continued availability and efficacy of Bollgard 3 cotton is threatened by resistance to the *Helicoverpa* spp. The industry relies on a pre-emptive strategy to slow the development of Bt resistance in *Helicoverpa* spp. This work is underpinned by monitoring of background levels of resistance frequencies provided in part by research from the *Resistance research and monitoring to enhance stewardship of Bt cotton and management of* Helicoverpa *spp.* project.

This project continues a program begun in 1994 to monitor resistance to Bt toxins produced in transgenic cotton. The significant new change is to conduct F1 screening in alternate years, and F2 screening every fifth year. (F1 involves screening the offspring from crossing field-collected individuals with known resistant individuals. In F2, the grandchildren of cross-field-collected samples are tested.)

During the 2017-18 season, F1 results did not suggest any obvious increases in frequencies of resistance to any toxin for either species of *Helicoverpa*. Using F2, the project isolated a type of resistance in *H. armigera* that does not appear to be the same as previously identified. In controlled studies, the project was also able to select for *H. punctigera* that is simultaneously resistant to three toxins, and is testing to see if there is a fitness cost.

Case study: Resistance monitoring leads to industry response

The Silverleaf whitefly (SLW) Resistance Monitoring project, undertaken by Dr Jamie Hopkinson of QDAF and supported by CRDC, collects whitefly from farms across cotton-growing areas for testing.

Results from testing of insects collected during the 2016-17 season revealed a steep increase in resistance frequency to the cornerstone control product – pyriproxyfen. This led to urgent calls from industry and researchers through the IRMS tech panel for changes to the IRMS.

Following advice, Cotton Growers' Associations nominated a voluntary 30-day window for each region in which pyriproxyfen could be applied. The aim of narrowing the pyriproxyfen window is to minimise consecutive generations of SLW being exposed to resistance selection and to ensure the product is being applied once per season when most effective.

In addition, for SLW control, preserving beneficial insects is key, along with correctly using industry pest thresholds to mitigate unnecessary sprays, which may disrupt beneficials and promote resistance. In response to this emerging resistance threat, researchers revised the SLW threshold matrix in the *2017-18 Cotton Pest Management Guide*. CottonInfo supported the IPM and resistance messaging through area-wide groups and IPM short course.

The tiny parasitoid wasps *Eretmocerus* spp. and *Encarsia* spp. are important natural enemies of SLW, and contribute to natural biological control throughout the season. Parasitoids occur in almost all regions that grow cotton, but due to their small size often go unnoticed. Like all natural enemies, they are susceptible to insecticides applied to control pest species.

Dr Jamie Hopkinson of QDAF looked at the impact of several insecticides on *Eretmocerus hayati*.

'It's important to remember some natural enemies, such as *Eretmocerus*, are basically invisible to the naked eye so can go unnoticed, but are still important,' Jamie said.

'Therefore it is dangerous to work on the pretext that because you can't see them, they're not there.'

For the 2017-18 cotton season, the project team collected SLW from 16 regional sites, covering the majority of the cotton production valleys in NSW and QLD. Early results indicate the industry response has been successful in slowing the increased rate of resistance.

For more, see the Spring 2017 edition of CRDC's Spotlight *magazine: www.crdc.com.au/spotlight.*

NEIL FORRESTER

Responsible landscape management: Defining the values and drivers relating to the management of natural landscapes and systems in cotton-growing regions; Identifying and proving integrated management strategies which deliver environmental and productivity gains; Researching the connectivity between cotton farms and natural systems in the landscape; Supporting initiatives and partnerships to improve the knowledge and capacity to manage natural landscapes and systems in cotton regions.

The Australian cotton industry recognises the need for sustainable and responsible landscape management, and over the past decade has made significant gains in improving its environmental management. Industry research has shown the mutual benefits that can be gained from managing natural assets for both production and environmental outcomes.

In 2017-18, CRDC's investment in this area included the following key projects:

- *Developing the groundwater health index (GHI) as an industry-wide monitoring tool;* with Macquarie University
- *Improving the ability of the Australian cotton industry to report its sustainability performance;* with QUT
- *Managing riparian corridors on cotton farms for multiple benefits;* with UNE
- *Effects of climatic fluctuation and land use change on soil condition in the lower Lachlan;* with the University of Sydney.

The *Groundwater Health Index* project, building on previous Cotton Catchment Communities CRC research, enhanced the industry's knowledge of groundwater ecosystems and provided baseline data on groundwater health. This was achieved by benchmarking groundwater health in four catchments and developing a tool that improved the assessment methodology of groundwater health.

A database documenting the extent and condition of subterranean groundwater-dependent ecosystems was established for four cotton catchments: Condamine, Gwydir, Namoi, and Macquarie. From this work, the weighted Groundwater Health Index (GHI) was developed. The new refined methodology allows groundwater health to be assessed and monitored on-farm using a combination of biological and water chemistry variables. The GHI and monitoring framework is being developed by the project lead and CottonInfo's NRM Technical Lead into tools for inclusion in the industry's *my*BMP program.

Agriculture provides many benefits, including economic, environmental, and social. But when these benefits are at risk, especially environmental and social, public concern increases. There are higher expectations for sustainable production, including the cotton industry's performance. The industry has to effectively and cost-efficiently demonstrate sustainability so that it can rapidly respond to emerging issues. The *Improving the ability of the Australian cotton industry to report its sustainability performance* project helps to meet that challenge.

The results of the study formed the basis for draft Australian cotton industry sustainability targets. The project reviewed social sustainability measures, identified gaps in reporting, and suggested steps to resolve issues. Indicators for individual and community wellbeing have now been incorporated into the industry's proposed sustainability targets. With researchers from UNE, Griffith University, and CSIRO, the project also reviewed biodiversity targets, and recommended ways to more effectively and efficiently report on industry efforts to improve biodiversity. As a result, an alternative biodiversity target representing insectivorous bird and bat guilds was included in the proposed targets. The next phase of the project will develop a sustainability database to form the basis of the cotton industry's Sustainability Reporting in 2019.

The *Managing riparian corridors on cotton farms for multiple benefits* project recognises the concern cotton growers have about the noticeable decline in the health of river red gums (*Eucalyptus camaldulensis Dehnh*) in agricultural regions across Australia, and the need to identify the causes and possible management solutions to mitigate tree dieback. Many factors contribute towards tree dieback – natural causes and land practices, or a combination of both. The six key factors identified are drought/water deficit, spray drift, insect attack, salinity, cockatoos, and grazing and its impact on groundcover. The research indicated that dieback affects not only extant trees, but also decreases the quantity and quality of seed produced, as well as the growth rates of offspring. Restoration of dieback-affected areas may therefore require active revegetation measures, such as tree planting or direct seeding to restore canopy cover and improve ecosystem condition.

In collaboration with CottonInfo's NRM Technical Lead Stacey Vogel and the North-West Local Land Services, the lead researcher developed a *Eucalyptus* dieback identification and management guide for cotton growers. The lead researcher will be building on this research in a new project looking at developing better and cost-effective techniques for restoring native vegetation on cotton farms.

Because soil is an invaluable finite resource, it is important to understand the long-term impacts of irrigated cotton farming on it. This PhD project, *Effects of climatic fluctuation and land use change on soil condition in the lower Lachlan*, monitored the change in soil condition in the semi-arid irrigated cotton-growing district of Hillston in the lower Lachlan River valley catchment in south-west NSW between 2002 and 2015. From two soil surveys taken in those two years, data from soil cores extracted to 1.5 m depth were used to monitor the change in five important soil properties – pH, electrical conductivity, exchangeable sodium percentage (ESP), organic carbon, and inorganic carbon. The research concluded that there have been changes in several aspects of that soil.

From an agricultural production viewpoint, some soil properties had improved, such as the highly alkaline soils moving towards neutral, and the increase in soil organic carbon content. On the other hand, some soil properties had worsened, such as an increasing ESP. It was clear that irrigated cotton production changed different soil properties from 2002 to 2015, although these changes were not necessarily negative. It was also apparent that the significant shifts in rainfall patterns during the study period also affected many aspects of soil condition, suggesting that appreciable changes in soil condition can occur at the decadal scale as a result of changes in climatic conditions. The project highlighted that farming can both improve and impair soil quality, and emphasised the importance of monitoring soil condition changes over long periods.

Case study: Biofuel from waste explored

Cotton production, like other agricultural industries, can generate thousands of tonnes of waste each year, typically representing a burden to the industry due to the need to dispose of it safely. However, there is potential to convert this trash into treasure.

Cotton gin trash is one renewable biomass feedstock that regional biorefineries could convert into value-added bioproducts, such as fuels, chemicals, feeds, fibre and energy. A recent CRDC-commissioned study highlighted that under Life Cycle Assessment modelling, using gin trash to produce ethanol should reduce total CO_2 emissions.

In an ongoing CRDC-funded project, NSW DPI scientists, and phytochemists and pharmacologist from Southern Cross University and Western Sydney University are working to develop scalable, innovative and integrated processes to fractionate, refine and convert gin trash into novel biochemicals and biofuels.

'Gin trash is an ideal low-cost feedstock because unlike other biomass, it is concentrated at processing sites,' says NSW DPI's Dr Shane McIntosh.

'The study has been designed to evaluate and develop processing methods to exploit the high levels of carbohydrates in gin trash specifically to produce bioethanol.

'Moreover, the cotton plant is known to contain many important chemical compounds, some of which are highly valued particularly in pharmaceuticals, nutraceuticals, pesticides and fragrances industries.

'The project will explore the full spectrum and potential product application of compounds that can be extracted.

'By developing a consolidated processing configuration, and combining different processes into one or maybe a few sequential steps that simplifies the overall processing, significant reductions in production costs can be realised.'

The project has generated promising results at the lab scale, with the next steps being to optimise pretreatment of trash, and to start investigating scaling-up requirements.

CRDC is investigating the techno-economic feasibility of establishing biorefineries, and business model options, as a key component of *A profitable future for Australian agriculture: Biorefineries for higher value animal feeds, chemicals, and fuels* project. This is a major collaboration under the Department of Agriculture and Water Resources Rural R&D for Profit program.

For more, see the Winter 2017 edition of CRDC's Spotlight magazine: www.crdc.com.au/spotlight.

SHANE MACINTOSH

The stages in processing cotton gin trash to ethanol: raw trash; 'pretreated' or cooked trash; extracted sugars; and the fermentation beer (sugars to ethanol).

Sustainable futures:
Scoping and investigating critical threats and opportunities that may influence the long-term sustainability of the Australian cotton industry; Supporting innovative approaches to solve traditional industry issues and drive future sustainability.

Agricultural production, including cotton production, is becoming an increasingly complex business. Major uncertainties about global economics and international markets, shifting national policies and social values, demographic changes, competition for key resources, rapid technological change and the impact of an increasingly variable climate dominated by extreme events mean agricultural industries must continually adapt to changing circumstances.

In 2017-18, CRDC invested in the following key projects to help scope and investigate critical threats and opportunities:

- *Australian cotton industry sustainability strategy and sustainability targets;* with Sustenance Asia Pty Ltd
- *Bio-degradation of dyed cotton fabrics;* with NCSU
- *Microparticles generated from laundering of cotton and other fabrics;* with NCSU.

The Australian cotton industry has been managing on-farm sustainability for many years, underpinned by investments in R&D and the Best Management Practices program (*my*BMP). Now, we are more actively managing and communicating about sustainability to reduce risk, raise productivity, and grow our markets. After technical review, industry input and external stakeholder consultation, the *Australian cotton industry sustainability strategy and sustainability targets* project narrowed the 45 indicators of ongoing sustainability work into targets and indicators for eight sustainability topics. The targets cover a mix of environmental, social and economic topics. They broadly represent the largest benefits and disadvantages of cotton production likely to be most important to stakeholders and industry.

The Australian Cotton Industry Sustainability Strategy provides a framework to better coordinate the industry's broad body of existing sustainability work, to achieve ambitious sustainability targets, and to guide further change. After incorporating industry and stakeholder feedback, the industry hopes to launch the Strategy and the Targets towards the end of 2018.


JOHNELLE ROGAN

Wastewater Treatment Plants (WWTPs) are a source of microplastics, with the composition (polyester, acrylic, etc.) and morphology (fibres instead of particles) of these microplastics suggesting that they are derived from sewage via the washing of clothes. According to a study by the International Union for Conservation of Nature (IUCN), synthetic textiles are the second biggest source of primary microplastics in the world after plastic pellets. The potential utility and environmental impact of all fibres, including cotton, at the end of their intended use is of growing interest in a society with increased interest in recycling and environmental stewardship.

While research shows that cotton in its raw state readily biodegrades in the natural environment, indicating that the biodegradability of cotton could provide a reason to choose cotton over synthetic fibres, it is important to account for the impact of the dyes and finishes generally applied to cotton fabrics. Few comprehensive studies have considered how dyed cotton products degrade at the end of their product life cycle, and how degraded dyed cotton might affect the environment. The *Bio-degradation of dyed cotton fabrics* project aims to answer those questions.

Microplastics in water bodies have been established as a significant environmental pollutant. They can originate from the laundering of clothing, with a recent study finding that 700,000 fibres could be released from washing 6 kg of acrylic fabric. The non-biodegradability and, thus, long exposure periods of synthetic fibres make them especially problematic, so the biodegradability of cotton could provide a reason to choose cotton over synthetic fibres. The purpose of the *Microparticles generated from laundering of cotton and other fabrics* project is to quantify the microfibres generated from the laundering of cotton, polyester, rayon, and polyester-cotton blended knitted fabrics, and to understand how cotton and rayon-spun filaments perform during laundering relative to synthetic polymer filaments.

Cotton and rayon fabrics released more microfibres during laundering than polyester, influenced mainly by the presence of detergent solution. Phase 2 of the work will investigate the relative biodegradability of cotton vs. cotton/polyester blend vs. polyester vs. rayon in a range of environments to determine whether cotton does indeed have an advantage over synthetic fibres for its biodegradability.

Case study: The price of plastic

A single piece of contamination can lead to the downgrading of Australian cotton bales, yarn, fabric and garments or the rejection of an entire batch. It can significantly harm Australian cotton's reputation as contamination-free, and damage the relationship between growers, ginners, merchants and our customers.

While the round-module picker and stripper has reduced the risk of some types of contaminant associated with conventional modules, it has introduced a new risk – polyethylene (plastic) wrap on the round module.

There are many ways to manage the risk of the wrap entering the gin; one is a sensor placed in the module feeder hood that detects and alerts the gin operator to plastic caught on the beaters.

Developed by CSIRO with Australian Cotton Ginners Association and CRDC support, contamination sensors were first installed in the 2012 season. The technology is now used in 10 Australian cotton gins. The system captures contamination events, allowing ginners to respond promptly to remove contaminants before they fragment into the bale.

'Contamination is not just an issue for Australia. The need to invest in managing contamination is often cited by spinners as a reason to not use cotton at all,' CRDC R&D Manager Allan Williams said.

'So while Australia benefits from being contamination-free, it is also important that the cotton industry as a whole reduces its contamination levels to better compete with man-made fibres, which do not require managing for contamination.'

In April 2018, a workshop between fibre quality and ginning researchers from Australia and the USA included a focus on managing plastic contamination. Organised by CRDC and US upland cotton research and marketing group Cotton Incorporated, the workshop discussed many issues to identify collaboration opportunities for researchers from both countries.

Other topics included trash management and improving fibre maturity measurement. Researchers from CSIRO, the University of Southern Queensland, the US Department of Agriculture, and Cotton Inc. attended the event.

'We all felt that there was a need to look at short-term and long-term solutions,' Allan said.

'In the short term, stopping plastic getting into the modules, and removing plastic before it enters the gin were seen as critical.

'Enhancing the ability to detect plastic, for example, through a change in colour or the use of additives was also discussed.'

Long-term solutions included a system that didn't require plastic at all.

For more, see the Winter 2018 edition of CRDC's Spotlight magazine: www.crdc.com.au/spotlight.

MELANIE JENSON

Plastic contamination can shut down a cotton gin and harm Australia's reputation globally. CSIRO's Andrew Krajewski (pictured) helped to develop gin sensors to detect plastic contamination in gins. More still needs to be done by operators to avoid the issue.

Program 3: Customers			
Program	**Customers**		
Outcome	The Australian cotton industry captures the full value of its products.		
Measure	Double the premium for Australian cotton.		
Theme	**3.1 Assured Cotton**	**3.2 Differential Products**	**3.3 Competitive Futures**
Strategy Outcomes	The integrity and qualities of Australian cotton set global benchmarks for customers.	Customers recognise the differentiated value of Australian cotton products.	The demand for Australian cotton products is positively transformed.
Will be achieved by	3.1.1 Improving Australian fibre quality testing standards and procedures and the capacity to measure and manage contamination. 3.1.2 Supporting the development and implementation of post-farmgate BMPs. 3.1.3 Developing and implementing a standardised reporting system for Australian cotton product quality and traceability. 3.1.4 Benchmarking Australian cotton against key international programs for product stewardship and sustainability.	3.2.1 Identifying opportunities for improvements in fibre quality and cotton products. 3.2.2 Demonstrating the value of different fibre classes and defining fibre quality parameters that secure a premium market. 3.2.3 Developing customer-based partnerships for the development of higher value and novel products, which differentiate Australian cotton.	3.3.1 Investigating existing and future markets for Australian cotton and communicating these findings to the Australian cotton industry. 3.3.2 Facilitating the development of new technologies and systems to improve the competitiveness of Australian cotton.
Measures of success	Customers have confidence in the integrity of Australian cotton: ▪ Australia has the best ranking for non-contamination in the International Textile Manufacturers Federation (ITMF) survey. ▪ Customers recognise and use Australia's BMP standards as their guarantee of quality assurance. ▪ Australia uses standardised reporting systems for product quality and traceability for farmers, industry and customers. ▪ Australia can respond to customer needs for reporting sustainability indicators.	Customers value the qualities of Australian cotton: ▪ New fibre classification systems established. ▪ Partnerships established to demonstrate the potential for differentiating Australian cotton.	Customers continue to demand Australian cotton products: ▪ Provide the Australian cotton industry with knowledge of fabric innovations and future market opportunities. ▪ Development of alternative and high-value cotton products.

Key program investments

This section provides a snapshot of some of CRDC's investments during 2017-18 in this program area. The full list of CRDC's investments for this period can be found at Appendix 4: the RD&E portfolio. Reports from all completed projects can be found at CRDC's online library, Inside Cotton (www.insidecotton.com).

Assured cotton:
Improving Australian fibre quality testing standards and procedures and the capacity to measure and manage contamination;
Benchmarking Australian cotton against key international programs for product stewardship and sustainability.

CRDC's investment in this area aims to ensure that Australia maintains its global reputation for high-quality cotton, so as to help the industry capture the full value of its products. Programs that help to maintain and improve Australian cotton's fibre quality, and demonstrate the sustainability, transparency and traceability of the Australian cotton industry, are part of this investment program.

In 2017-18, CRDC continued its support of assured cotton through key projects, including:

- *Investigating the relative contributions of weathering, insect honeydew and fungal agents to cotton colour grade changes and discounts;* with CSIRO
- *Managing cotton quality to maintain Australia's premium status;* with CSIRO.

Along with the length, strength, micronaire and leaf content, the colour grade of cotton is a critical component of the set of characteristics used to assess the overall quality of a sample of cotton, and thereby to determine its value. The current 'base grade' colour for Australian cotton is Middling (Colour 31). If the colour grade falls to even the next lower grade of Strict Low Middling (Colour 41), then the value of the cotton will be significantly discounted.

Wet, cloudy weather at harvest (a factor beyond a grower's control) is one of the main causes of deterioration in the colour grade. The extent of the impact of wet weather on colour grade may also be influenced by a range of factors, including presence of honeydew, the type/source of the honeydew, crop architecture, crop stage (degree of boll opening), amount of sunshine following the wet and cloudy weather that the crop is exposed to, trash levels in the seed cotton, the moisture of the lint when harvested, and the length of time between harvest and ginning. The *Investigating the relative contributions of weathering, insect honeydew and fungal agents to cotton colour grade changes and discounts* project therefore aims to improve our understanding of how these different factors actually affect the colour grade of the cotton, and options for mitigating, to the greatest possible extent, the impact of wet and cloudy weather on colour grade. A range of sooty moulds that cause colour downgrades has been identified, with the next step being to test potential control measures (e.g. fungicides) and the most effective delivery mechanisms.

Australian cotton is highly sought after by international spinners. It attracts a premium because of its excellent fibre characteristics and reputation for low contamination. The *Managing cotton quality to maintain Australia's premium status* project has a number of research and extension objectives aimed at preserving this status. They include the following: (i) investigating the effects, in terms of gin turnout and fibre quality, of nitrogen fertilisation on plant regrowth after defoliation and the associated excessive green leaf and plant trash in picked seed cotton; (ii) establishing the impact of stripper harvesting on the quality of dryland cotton production, which is expected to increase over the next few years; and (iii) conducting a controlled study of the dyeing ability of Australian cotton against competitive growth in new export markets (such as Bangladesh and Vietnam).

Differentiated products:
Identifying opportunities for improvements in fibre quality and cotton products;
Demonstrating the value of different fibre classes and defining fibre quality parameters that secure a premium market;
Developing customer-based partnerships for the development of higher value and novel products, which differentiate Australian cotton.

Australian cotton growers are competing in a complex global market, with challenges coming from both within the global cotton industry (with Australian growers competing against subsidised overseas growers) and the wider global textile industry (where cotton's market share is diminishing against the ever-growing man-made fibre industry).

As a result, investments in this area look to fully exploit current advantages of Australian cotton, open up other opportunities for Australian cotton to be differentiated on the world market, and help cotton better compete with man-made fibres.

In 2017-18, CRDC continued its support of the differentiated products theme through key projects, including:

- *Breathable cotton for compression athletic wear;* with Deakin University
- *Improved thermal management performance of bedding systems;* with RMIT
- *Novel anti-wetting and self-sterilising cotton fabrics;* with Deakin University.

Compression athletic wear (CAW) has become increasingly popular for delivering better fit and enhanced performance. However, CAW is usually made from synthetic fibres because there are no current methods for creating CAW containing high levels of cotton. Consumer research has shown that consumers would prefer a cotton alternative, provided it offered the same performance levels as synthetic CAW. The *Breathable cotton for compression athletic wear* project therefore sought to develop a fabric suitable for compression garments from Australian Long Staple cotton to compete with currently available synthetic CAW.

Now recently finished, this project successfully developed a cotton-rich CAW fabric that demonstrated excellent stretch and recovery properties. The next stage is to create garments made from the cotton CAW, and compare and test them against the current synthetic options.

For active people, such as athletes or fitness enthusiasts, the restorative effects of sleep are commonly acknowledged as important for preparation (physiological and psychological) and recovery from participation in their sport. However, in human sleep research, little research appears to have been done about changes in skin temperature, sweat rates, and the sleep microclimate during sleep, and especially into the influence of the type of sleepwear materials and bedding systems. The *Improved thermal management performance of bedding systems* project is investigating the influence of sleepwear materials and bedding systems on skin temperature, sweat rates and the sleep microclimate. Ultimately, it is hoped that it can highlight the unique thermal, humidity and moisture-management benefits of cotton products used in next-to-skin sleeping environments when compared with competitive non-cotton synthetics products and treatments.

The *Novel anti-wetting and self-sterilising cotton fabrics* project successfully developed a treatment to apply to cotton fabric that provides the fabric with both antimicrobial and anti-wetting properties. Antimicrobial performance is an important aspect for improving the serviceability of apparel, upholstery and outdoor textiles. Outdoor textiles are especially susceptible to moulds and mildews and the subsequent degradation in colour and strength, as they bear the brunt of the wet and humid weather conditions. Current techniques have a range of drawbacks, including a tendency to discolour the treated fabric, which this new finish overcomes. Treated fabrics will now be commercially evaluated with an industry partner, focusing on the outdoor canvas market. Other market opportunities will also be explored, for example, in medical settings.

Case study: In-jean-ious research takes global award

Australian cotton industry researchers scooped an international prize and 150,000 Euros for their innovative work on reducing the environmental impact of denim production.

The researchers from Deakin University's Institute for Frontier Materials (IFM) were one of five winners out of nearly 3000 entries worldwide in the H&M Foundation Global Change Award 2017, which funds projects that promote sustainable fashion.

'We are absolutely delighted with the award as it reinforces the need for the work we've been doing and highlights its significance for not only the cotton industry but also the environment,' lead researcher Professor Xungai Wang said.

'We are also very grateful for the initial support from CRDC for our work in this area, as it supported a small desktop project at Deakin on New Developments and Opportunities for Cotton Yarn and Fabric, back in 2013.

'Through the project we did some literature study on the issues with denim products, and this study has been quite helpful, providing useful background information for us.'

Professor Wang, Dr Rangam Rajkhowa, Dr Nolene Byrne, Dr Christopher Hurren and Dr Rebecca Van Amber developed their idea because denim is one of the most widely used textiles in the fashion industry. However, the traditional denim-dyeing process needs large amounts of water and energy, and produces a lot of dye waste.

After grinding used denim into an ultrafine powder, the researchers used the powder to coat or print undyed new denim to create the typical denim appearance.

With a successful prototype now developed, the Global Change Award funding will allow scale-up of the idea, and work with denim producers and fashion brands to explore its potential, and reduce the environmental footprint of denim production.

The process is unique in that it not only recycles the fibres, but also the dye. This approach will also have major implications for other textiles and applications.

Xungai, Ragnam and Nolene have current textile-related projects with CRDC. Xungai's project is looking at improving the quality of cotton yarns, which he says may have 'significant implications for the cotton-spinning sector'.

'We are currently in the process of preparing a patent to protect the IP generated from the project,' he said.

For more, see the Spring 2017 edition of CRDC's Spotlight magazine: www.crdc.com.au/spotlight.

Professor Xungai Wang, Dr Nolene Byrne, Dr Rebecca Van Amber, Dr Rangam Rajkhowa and Dr Christopher Hurren have won a global award for their ground-breaking research into denim production.

Competitive futures:
Investigating existing and future markets for Australian cotton and communicating these findings to the Australian cotton industry; Facilitating the development of new technologies and systems to improve the competitiveness of Australian cotton.

Continued innovation is necessary to maintain the competitiveness of Australian cotton in traditional markets, and to open up new market opportunities. Investments in this area, under the CRDC Cotton Futures banner, are designed to transform the way in which consumers demand Australian cotton products in order to continue to ensure cotton's competitiveness.

In 2017-18, CRDC supported the Competitive futures theme through key projects, including:

- *Developing renewable fine chemicals from cotton biomass;* with QUT
- *New value opportunities through supply chain innovation in the cotton industry;* with Cambridge University.

The *Developing renewable fine chemicals from cotton biomass* project is part of a larger collaborative program funded by the Rural R&D for Profit program that is investigating profitable bioproduct opportunities in four industries: sugar, cotton, forestry, and animal feed. It is developing technologies to convert Australian agricultural and forestry feedstocks into new value-added animal feeds, chemicals, and advanced fuels. The cotton-specific project is looking at two opportunities for adding value to cotton gin trash (CGT), of which around 50 kg is produced per 227-kg bale of cotton lint. These are to use the CGT as a building block for fine chemical production, such as CMF (5-chloromethylfurfural), and converting the CGT into ethanol.

The project has demonstrated that CMF and ethanol can be produced from CGT at the lab scale. As well as more work to fine tune the processes, the major next step is to investigate the commercial requirements for using CGT as a feedstock for fine chemicals and/or ethanol production. Preliminary investigations highlight that there is sufficient embedded energy in CGT to supply the entire energy needs of the gin producing it, but practical and logistical challenges need to be addressed before it is commercially sensible for a gin to use CGT for its energy needs. These needs will be a focus of the recently commenced CRDC Strategic Plan.

With the *New value opportunities through supply chain innovation in the cotton industry* project, the CRDC's first with Cambridge University, CRDC set out to look at sustainability in the cotton supply chain through a different lens, using the Cambridge Value Mapping Tool. While sustainability is an important issue for the industry, it is typically examined through how processes can be accomplished more efficiently, particularly at the farm level. The Cambridge Value Mapping Tool supports supply chain innovation by taking a broader view of sustainability. It looks into the current accepted way that the entire supply chain is arranged, identifies problems that appear due to the accepted practice, and identifies opportunities for a more sustainable supply chain, such as by correcting underlying systemic problems, or developing new partnerships or business models.

The study was conducted over a relatively short period of time, so the findings from the report were based on a relatively small set of interviewees. To build on the initial findings, a longer and more extensive consultation would be needed to identify a more comprehensive set of value opportunities, and ascertain those that resonate the most with industry.

RD&E Portfolio
PROGRAM 4: PEOPLE

Program 4: People			
Program	**People**		
Outcome	Capable and connected people driving the cotton industry.		
Theme	**4.1 Workforce Capacity**	**4.2 Networks**	**4.3 Communication**
Strategy Outcomes	A skilled, educated and progressive industry workforce.	An industry connected by dynamic networks.	Stakeholder information needs are met.
Will be achieved by	4.1.1 Investigating effective strategies for attracting, developing and retaining people in the cotton industry. 4.1.2 Supporting initiatives which lead to the continuous improvement of human resource management, including on-farm Workplace Health and Safety. 4.1.3 Understanding opportunities for greater Aboriginal participation in cotton and partnering with organisations to support the development of a culturally aware cotton workforce. 4.1.4 Supporting educational opportunities which increase the skills and knowledge of current workforces and will meet the needs of future workforces. 4.1.5 Creating opportunities for, and supporting the development of, leadership skills.	4.2.1 Establishing and empowering creative forums and initiatives which build relationships. 4.2.2 Supporting and participating in collaborative cross-sectoral RD&E initiatives. 4.2.3 Creating and facilitating opportunities for national and international RD&E exchange. 4.2.4 Facilitating engagement with stakeholders for prioritising and capturing advice on RD&E issues. 4.2.5 Honing research expertise and the application of science from core research disciplines.	4.3.1 Providing information for demand-driven communication strategies and performance reporting. 4.3.2 Applying innovative communication methods.

Program 4: People			
Measures of success	Opportunities for learning are demanded by industry: ▪ A 10-fold increase in school visits to promote careers in cotton by 2018. ▪ A student gap year internship program. ▪ 50 Horizon students by 2018. ▪ 30 completed summer scholarships by 2018. ▪ 300 students having completed the UNE Cotton Course by 2018. ▪ Opportunities for workforce development are demanded by industry. ▪ 60 ginners trained. ▪ 25 industry representatives having completed the Field to Fabric Course. ▪ 50 cotton farmers awarded a new Diploma in Human Resources by 2018. ▪ A 10 per cent reduction in cotton farm-related injuries by 2018. ▪ On-farm skill development. ▪ Participation in leadership programs.	People and industry are connected through effective networks: ▪ 10 conferences and forums are coordinated which promote industry, cross-sectoral and community knowledge sharing. ▪ CRDC is an active member of key industry and government initiatives. ▪ Primary Industry Standing Committee (PISC) cotton and cross-sectoral RD&E strategies. ▪ 50 travel scholarships are supported. ▪ The cotton industry has effective collaborative structures for prioritising RD&E.	People have ready access to industry information: ▪ Communication systems for all CRDC stakeholders are meeting their communication needs. ▪ The information and services derived from CRDC investments are in demand and the technologies are adopted.

MELANIE JENSON

Key program investments

This section provides a snapshot of some of CRDC's investments during 2016-17 in this program area. The full list of CRDC's investments for this period can be found at Appendix 4: the RD&E portfolio. Reports from all completed projects can be found at CRDC's online library, Inside Cotton (www.insidecotton.com).

Workforce capacity: Investigating effective strategies for attracting, developing and retaining people in the cotton industry.

People are the cotton industry's most important resource, and ensuring the industry continues to have a network of capable and connected people is a key priority. CRDC's investments in this area aim to provide critical supporting information for the industry, helping to inform the industry's wider workforce development strategy.

In 2017-18, CRDC continued its investment into workforce development through a number of key projects:

- *Post-doc: Understanding and planning for the future workforce;* with USQ
- *PhD: Career motivational factors of cotton growers' attraction and retention;* with USQ
- *PhD: Human capacity needs and management on cotton farms;* with UNE.

The *Understanding and planning for the future workforce* project will ensure the cotton industry has a thorough understanding of future workforce issues to proactively drive change and innovation to ensure the industry remains at a competitive advantage in the future. The Australian cotton industry must be ready to capitalise on new technologies and have the workforce to drive innovation and change based on the adoption of new technology. The research will provide an understanding of the drivers of change that will affect the demand and supply of future skills and training, identify the future skills required within the industry to facilitate innovative farming practices, and develop practical tools to assist workforce planning in cotton businesses.

The *Career motivational factors of cotton growers' attraction and retention* PhD project looked at the psychological drivers and characteristics that affect cotton grower motivation and work/life satisfaction. Earlier research, focusing on single-factor influencers, had resulted in a broad scientific understanding of cotton. However, this project explored influencers of individual growers and the pivotal role of decision-making processes in career and crop choices. Whether in large corporations or small family operations, individual growers are producers who are solely responsible for decisions and motivation of the business. But as consumers, they are influenced by consumer behaviours associated with inputs needed for primary production and crop choices. These choices can drive desirable and, sometimes, undesirable outcomes. This research highlights the need to better understand adoption and application, development and delivery of scientific research to cotton by using crop choice as a starting point. Research on the influence of decision making offers insight into more effective behavioural change.

The aim of the *Human capacity needs and management on cotton farms* project was to determine current and future labour needs on cotton farms, and assess them against the supply of labour, identifying gaps and recommending strategies to address these gaps. Position descriptions for key farm roles were developed to help growers recruit for these positions. Strategies that growers use to retain core employees were assessed against industry trends to identify areas for improvement. Three main positions on cotton farms were identified: farm hands, supervisors, and managers. The research indicated that farm hand positions were generally covered by employing backpackers and employees on temporary contracts, while permanent positions were sourced locally. The research identified that although growers were seeking experienced workers, very few applicants had the required skills. Training successive cohorts of seasonal workers is expensive for growers, hence they are reluctant to invest time and money on it, and prefer work-ready employees.

The research identified a significant gap in expectations of farm supervisors. Candidates with relevant qualifications were being supplied by recruiting agencies, but they did not have the technical and management experience for the roles. Additionally, candidates were seeking permanent positions that didn't necessarily align with growing cycles on farms. By contrast, farm manager positions were seemingly well filled either by the owner of the family farm, or through recruitment of well-qualified people. These mostly permanent positions were highly attractive to employees.

Workforce capacity:
Supporting initiatives which lead to the continuous improvement of human resource management, including on-farm Workplace Health and Safety.

Health and safety continues to be a major priority for cotton growers and cotton industry employers. CRDC contributes to this priority by investing in on-farm safety and in monitoring and evaluation projects.

In 2017-18, CRDC continued its investment into workplace health and safety through key projects:

- *Primary Industries Health and Safety Partnership;* with AgriFutures
- *People in farming – employment starter kit (ESKi) website;* with Dairy Australia.

CRDC has had significant involvement with the *Primary Industries Health and Safety Partnership* over its 20-year history of tackling farm health and safety issues. During 2017-18, an extensive review of this program aimed for a more proactive approach to deliver farm safety. It led to the Health and Safety Farm Alliance being formed, with broad consultation around the principles for engagement with RDCs. The alliance will seek to further understand the risk factors that exist in each industry, including the causes of death and injury, and to deliver innovative solutions to identified risk areas, including engineering controls.

The *People in farming* project is an initiative of Dairy Australia, delivered in partnership with six other RDCs. It aims to develop an online resource for the agricultural sector to help employers and employees with human resource management needs. Inspired by the People in Dairy website, the project offers compliance support for employers, promoting agriculture as a career choice, and providing a platform for sharing employment information. It provides an overarching agriculture perspective as well as sector-specific content, with resources for employers and employees on one centralised hub. With an Employment Starter Kit to be developed in 2018-19, the project will continue to deliver coordinated human resource information for the agricultural sector.

Case study: Bringing knowledge together

With its focus on innovation and start-up science, CRDC supported participants at the MIT Innovation and Entrepreneurship Bootcamp held at QUT in February 2018.

The bootcamp was a week-long intensive program that brought together 140 of the best and brightest innovators from 39 countries to focus on the theme Future of Sustainability.

The program challenged participants to build technology-driven ventures that provided innovative and scalable solutions to issues in the environment, agriculture and mining resource sectors.

CRDC supported three cotton change-makers to attend the bootcamp: Douglas Oliver, a civil engineering and physics student at QUT; Caitlin Connellan, an integrated renewable energy and agricultural solutions specialist with Akuo Energy; and David Guinane, a civil engineer and analyst/developer at CQ University.

CRDC also provided two 'challenges' in line with the theme. Jane Trindall, CRDC R&D Manager, developed the challenges and also attended the event.

'The first CRDC challenge was to find a cost-effective technical solution to meter water at irrigation pump sites and provide valuable real-time data to water managers, regulators and users, such as signalling faulty water meters, automate pump sites, monitor pump sites, and real-time assessment of water allocation,' Jane said.

'One of the groups taking up the real-time water metering team found technology that could be suitable for Australian systems already in operation. This technology is now being looked at by commercial companies for use from a logistics viewpoint.'

Subra Ananthram, who was a part of this team, had not been involved in agriculture or cotton previously. His academic research focuses on international business. Subra says the bootcamp highlighted the opportunity for his skills to be used in agriculture and, in particular, cotton.

'The bootcamp provided an excellent platform to have business professionals, engineers, legal experts and others from various disciplines come together to identify real solutions (which require technology as well as a viable business model) to the problems that contemporary industries and business face,' he said.

'The experience showcased the importance of cross-disciplinary diversity in solving problems that industries and businesses face globally.'

MIT Bootcamps, an initiative of the Massachusetts Institute of Technology, condense curriculum taught in several MIT courses into a concentrated active learning experience delivered by internationally renowned speakers and senior educators.

For more, see the Winter 2018 edition of CRDC's Spotlight magazine: www.crdc.com.au/spotlight.

MIT's Prof. Brian Subirana, CRDC's Jane Trindall, CRDC scholarship recipient Caitlin Connellan, and CRDC's Bruce Finney.

Workforce capacity:
Supporting educational opportunities which increase the skills and knowledge of current workforces and will meet the needs of future workforces.

The cotton industry recognises the need for passionate, skilled and innovative people to shape its future in a rapidly changing and growing world. To ensure the industry is able to attract talented young people, CRDC continues to invest in initiatives focused on developing students at the school, undergraduate and postgraduate levels.

In 2017-18, CRDC continued its investment into educational opportunities for current and future workforces through a number of key projects:

- *Aboriginal Employment Strategy student scholarships;* with the Aboriginal Employment Strategy
- *Cotton Production Course;* with UNE
- *Cotton Young Farming Champions;* with Picture You in Agriculture
- *CRDC Summer and Honours Scholarships program;* funded by CRDC
- *CRDC PhD Scholarship program;* funded by CRDC
- *Developing education capacity in the Australian cotton industry (CottonInfo technical lead);* with CSIRO
- *Horizon Scholarship program;* with AgriFutures
- *Primary Industries Education Foundation program;* co-funded with Cotton Australia.

The *Aboriginal Employment Strategy* program is a school-based traineeship for Indigenous students. Running for 14 years, the program provides an opportunity for local Indigenous students enrolled in Years 11 and 12 at Wee Waa and Narrabri High Schools to gain paid work experience, a nationally recognised qualification, credit towards their Higher School Certificate, and exposure to the different career opportunities available in the cotton industry. The program has numerous benefits. It increases the skills, experience and capacity of the young Indigenous students; presents a possible source of future employment; and breaks down the barriers between non-Indigenous employees and Indigenous students. In 2017-18, CRDC supported a single student who was given paid work experience on a local cotton farm. The placement was so successful that the farm has retained the student in a full-time position after she completes her studies.

The ongoing *Cotton Production Course* provides a tertiary-level course on cotton production for those interested in and working in cotton. It also provides the wider benefit of mentoring prospective industry researchers and conducting applied systems research. A record 57 students participated in the course in 2017-18. The course delivered a high satisfaction rating from students, with evaluation scores averaging four out of five for overall satisfaction, course content and clear learning outcomes.

The *Cotton Young Farming Champions* program aims to identify youth ambassadors and future influencers working within cotton. The Young Farming Champions program promotes positive images and perceptions of farming and engages in activities such as The Archibull Prize. CRDC collaborates with Young Farming Champions and Picture You in Agriculture organisers to coordinate this project. These programs form part of Cotton Australia's focus on education, and the combined CRDC and Cotton Australia focus on workforce development.

The *CRDC Summer and Honours Scholarships* are available to university students completing the senior years of an undergraduate degree or enrolled in an honours program. The scholarships provide them with the opportunity to work on real research, extension or industry projects in a working environment as part of their professional development. In 2017-18, CRDC supported seven scholarships for students to work with existing researchers or research organisations.

The *CRDC PhD Scholarship* program funds researchers undertaking their PhDs. In 2017-18, CRDC helped fund 16 new or ongoing PhD scholars across all five of the CRDC's program areas.

The *Developing education capacity in the Australian cotton industry* project provided a fulltime education officer based at the Australian Cotton Research Institute. The officer implemented a range of activities and programs in schools and provided career guidance for students to boost their knowledge of the industry and its varied career options. This project contributed to the development and running of a revised integrated pest management short course for the industry. The course was delivered across four cotton-growing areas to more than 70 participants. There were 29 school visits as part of this project. Other activities included the Rotary Science and Engineering Challenge, six tours of the Australian Cotton Research Institute, an Ag Cap Enrichment tour, and work with Tocal Certificate in Agriculture students. About 6200 participants were exposed to the cotton industry and they actively engaged with more than 3090 people.

The *Horizon Scholarship* program is an initiative of AgriFutures that, in partnership with other RDCs and industry sponsors, supports undergraduates studying agriculture at university by providing a bursary, professional development workshop and work experience. Overall, CRDC has supported seven Horizon scholars. CRDC will continue its support for three existing Horizon scholars Scott Nevison, Holly Chandler and Sam Knight with a CRDC bursary until they complete study by December 2019.

The *Primary Industries Education Foundation* program focuses on encouraging primary industries education in schools by providing national leadership and coordination of activities, as well as resources for students and teachers, and encouraging interest in primary industry careers. CRDC and Cotton Australia jointly contribute to the Foundation on behalf of the cotton industry.

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Workforce capacity:
Creating opportunities for, and supporting the development of, leadership skills.

The cotton industry, like many other industries, is facing a period of change and uncertainty. Faced with climate variability, competition for skilled labour, changes in land use, and access to water, the industry needs a network of informed and experienced leaders who can work together to develop resilient and sustainable farming systems and communities.

In 2017-18, CRDC continued its investment into leadership through a number of key projects:

- *Cotton industry leadership development strategy;* with the Australian Rural Leadership Foundation
- *Nuffield Farming Scholarships program;* with Nuffield Australia
- *Science and Innovation Award for Young People in Agriculture;* with ABARES and the Department of Agriculture and Water Resources.

The *Cotton industry leadership development strategy* includes funding of the Australian Rural Leadership Program, which is focused on producing a network of informed, capable and ethical leaders who can work collaboratively to advance the interests of their industries, communities and rural Australia. In 2017-18, CRDC co-sponsored two new participants with Auscott and Cotton Australia: Timothy Chaffey and Richard Malone. CRDC's support for the Australian Rural Leadership Program continues in 2018-19.

The *Nuffield Farming Scholarships* program is the leading agricultural study program for primary producers in Australia. It provides farmers with the opportunity to pursue an area of agricultural-related study overseas, to the benefit of both the individual grower and their wider industry. Daniel Kahl from Wee Waa in the Namoi Valley completed his Nuffield Scholarship in 2018 with the release of a report on attraction and retention strategies needed to create career pathways for the next generation of cotton farm managers. In 2017, Luke McKay from the Ord River Valley, Kununurra, received a Nuffield Scholarship to investigate tropical cotton-growing systems, such as double cropping, rotation crops, irrigation methods, staff requirements, machinery requirements and environmental management. CRDC and Cotton Australia will continue to support the Nuffield Farming Scholarships program in 2018-19.

The *Science and Innovation Award for Young People in Agriculture* program recognises big ideas from young rural innovators who contribute to the success of Australia's agricultural industries. For CRDC, the awards provide an opportunity to help develop the technical and leadership skills of young cotton researchers, and reward them for their commitment to innovation. University of Queensland PhD student Rhys Pirie received the CRDC-supported Science and Innovation Award in 2018. He also received a grant from the Minister by winning the overall 2018 Minister's Science and Innovation Award. As part of his research, Rhys will develop a low-energy methodology to transform organic wastes into high-efficiency fertilisers and soil ameliorants delivered from domestic waste streams. CRDC's support for the Science and Innovation Award continues in 2018-19.

Case study: Nuffield scholar behind development – Luke McKay

Luke McKay from Kununurra, Western Australia, is the cotton industry's most recent Nuffield Scholar. Luke's 2017-19 scholarship is supported by CRDC and Cotton Australia, and the young farmer has hopes of using the experience to help expand agriculture in Northern Australia.

Luke's Nuffield research will focus on issues relevant to tropical cotton-growing systems, such as double cropping, rotation crops, irrigation methods, staff requirements, machinery requirements, and resource and environmental management.

'I want to research the best systems from around the world for our region and climate to create a sustainable industry,' Luke said.

Luke is Farm Manager at Kimberley Agricultural Investment (KAI), where he oversees all KAI's cropping throughout the Ord River valley, north of Kununurra.

KAI were named as the preferred proponent for the Ord expansion in 2012, which inspired Luke's interest in further exploring the cropping and irrigation systems best suited to the area. This will focus on finding ways to adjust current systems to allow for cotton production.

'KAI and other Ord farmers are not alone in their ambitions to develop irrigated farming in Northern Australia. Outside the Ord Valley, there are currently operations being undertaken to develop and farm large areas in the Flinders and Gilbert catchments of North Queensland, with cotton in mind to be the base crop,' Luke says.

'We are confident the cotton industry will grow and be profitable in the north, but on my study tour I want to research the best systems to achieve this.'

Luke will travel to Brazil, Canada, China and USA, as well as locally to North Queensland, to learn from other growers in similar farming conditions.

Nuffield Australian Farming Scholarships is a unique program that awards primary producers with a life-changing scholarship to travel overseas and study an agricultural topic of choice. CRDC is a proud supporter of the Nuffield Scholarship program, supporting one cotton grower annually to undertake the program in partnership with Cotton Australia.

For more, information on the Nuffield Farming Scholarships visit www.nuffield.com.au

CRDC-supported Nuffield Scholar Luke McKay with QLD DAF's Dr Paul Grundy.

Case study: Rhys's research wins dual awards

Rhys Pirie, a PhD student at the University of Queensland, was awarded two prestigious ABARES Science and Innovation Awards for Young People in Agriculture for his focus on producing low-cost, high-efficiency fertilisers.

Rhys was selected for the first award – the CRDC-supported Science and Innovation Award – for his focus on re-purposing organic wastes (such as livestock manure, biosolids and cotton gin trash) as fertilisers and soil ameliorants, which help growers optimise resource efficiency and improve their environmental impact.

He was then selected from the field of awardees for the second award – the Minister's Science and Innovation Award – presented by the Minister.

Rhys is one of 11 young agricultural innovators, researchers and scientists who were awarded up to $22,000 each through the Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry. The joint industry and government funding aims to turn ideas for improving agricultural productivity into reality. Rhys received an additional $22,000 as part of the Minister's Award.

'High transport costs, lower nutrient density, higher moisture content, and determining the appropriate nutrient application rates make the adoption and use of organic wastes not as appealing to producers,' Rhys said.

'This is about trying to close nutrient loops and how to more efficiently fertilise crops.'

Rhys will work with a market-leading company with expertise in organic waste agglomeration and then test the resulting pelletised fertilisers on cotton plants in greenhouse trials. The next step will evaluate whether the trials can progress to a commercial stage and be economically viable.

'While my project is working with the cotton industry now, there's potential that my research results could be taken up by other agricultural industries, and lead to lower social and environmental impacts from farming systems.'

Rhys follows in the footsteps of the 2015 Minister's Award winner Alison McCarthy, who was also supported by CRDC. Alison has developed an integrated image-sensing system for soil-water and nitrogen levels in cotton crops that has now been put to use in the sugar and dairy industries.

The Science Awards were presented at a gala dinner as part of Australia's pre-eminent agricultural and economic forecasting event, ABARES Outlook 2018.

For more, visit the ABARES Science and Innovation Awards website: www.agriculture.gov.au/abares/conferences-events/scienceawards

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Secretary of the Department of Agriculture and Water Resources, Daryl Quinlivan; Awards recipient, Rhys Pirie; Agricultural Chief Scientist and Australian Chief Plant Protection Officer, Robyn Cleland; and CRDC Executive Director, Bruce Finney

Networks:
Establishing and empowering creative forums and initiatives which build relationships; Creating and facilitating opportunities for national and international RD&E exchange.

The cotton industry is well known for its collaborative and inclusive nature. CRDC's investment in this area is designed to ensure the industry continues to stay connected via dynamic networks.

In 2017-18, CRDC continued its investment into networks through a number of key projects:

- *Cotton industry people research forum;* funded by CRDC
- *CRDC Grassroots Grants program;* funded by CRDC.

CRDC hosted a *Cotton industry people research forum* in November 2017 to bring together social research scientists, growers, industry representatives, and staff from Cotton Australia and CRDC involved in the delivery of the industry's Workforce Strategy. The forum provided a strong foundation for social science research to be discussed at various levels, including research, policy, and future initiatives for the industry. At the forum, researchers presented project outcomes linked to the industry's workforce strategy on attracting, retaining and developing people who will drive industry competitiveness. The forum identified key social research themes to be considered during CRDC's annual research priority meeting and annual procurement round in 2018-19.

CRDC's *Grassroots Grants* program encourages Cotton Grower Associations (CGAs) to apply for funding to support capacity-building projects in their region. Up to $10,000 in funding is available for CGAs to help fund a project aimed at increasing the engagement of growers in the industry, solving specific regional issues, and improving their skills, knowledge base and networks. Since the Grassroots Grants program commenced in 2011, CRDC has supported 62 projects across the cotton-growing valleys, including 14 projects in 2017-18. These projects include infield research trials in Mungindi comparing dryland cotton to dryland sorghum across row configurations; a spreader configuration workshop; silverleaf whitefly and mealybug area-wide management meetings; and grower development programs to improve skills and capacity in Dawson Valley and Darling Downs.

Communication:
Providing information for demand-driven communication strategies and performance reporting; Applying innovative communication methods.

CRDC's investment in the area of communication aims to ensure that stakeholders' information needs are met. In 2017-18, CRDC continued its investment into communication through key projects:

- *Stimulating private-sector extension in Australian agriculture to increase returns from R&D;* with Dairy Australia
- *Videos: Documenting the production of best practice Australian cotton;* with QDAF.

The *Stimulating private-sector extension in Australian agriculture to increase returns from R&D* project developed and tested models to build the capacity of commercial and private-sector extension services in delivering R&D outputs on-farm. This project delivered eight modules for building the capacity of the private sector to deliver extension to Australian agriculture. Cotton and sugar consultants collaborated to build a framework to assess the value of digital agricultural services to their business. This is important to enable RDCs to embed research outcomes into digital agriculture tools. In June 2018, outcomes from the program and trials were shared during a webinar featuring RDC project managers and researchers from the Rural Innovation Research Group at the University of Melbourne.

The *Videos: Documenting the production of best practice Australian cotton* project communicated scientifically based crop production, protection and best practice principles to a diverse audience through a series of short, easily accessible videos. It builds upon the former *Australian cotton production and best practice documentaries* project. A total of 152 short videos have been produced over the course of the two projects, with collective views reaching more than 863,000 as at end June 2018. One video, on starting a siphon pipe, has been viewed 781,000 times. Videos include a range of cotton production issues: nutrition, soil health, pesticide-use efficiency, energy use, carbon, biosecurity, disease and insect management, natural resource management, stewardship, and weed control. The videos are accessible via the CottonInfo YouTube channel: www.youtube.com/CottonInfoAust.

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Program 5: Performance			
Program	**Performance**		
Outcome	Measured performance of the Australian cotton industry and its RD&E drives continuous improvement.		
Theme	**5.1 Best Practice**	**5.2 Monitoring and Evaluation**	**5.3 Reviews**
Strategy Outcomes	World's best practice underpins the performance of the cotton industry.	Industry and RD&E performance is captured.	Continuous improvement in industry and RD&E performance.
Will be achieved by	5.1.1 Supporting a best practice framework as the primary integrated planning, risk management, benchmarking, knowledge development and delivery system. 5.1.2 Promoting best practices through the development and delivery Joint Venture.	5.2.1 Developing and implementing an internal M&E framework for evaluating CRDC's investment portfolio balance and its RD&E performance. 5.2.2 Conducting annual industry surveys to capture practice change. 5.2.3 Establishing a framework through which industry performance can be nationally and internationally reported.	5.3.1 Undertaking scientific discipline reviews of the industry's RD&E. 5.3.2 Commissioning and participating in independent reviews of CRDC's RD&E and organisational performance. 5.3.3 Commissioning independent reviews of the social, environmental and economic performance of the industry. 5.3.4 Participating in cross-sectoral RD&E impact evaluations and reviews.
Measures of success	Industry is able to demonstrate best practice: ▪ The cotton industry's *my*BMP program is the primary resource for farmers accessing best practice knowledge and tools. ▪ The cotton industry's *my*BMP program is nationally recognised and integrated with other agricultural sector best management practice programs. ▪ An 80 per cent coverage of Best Management Practice systems across the Australian cotton industry.	Industry and CRDC are able to capture and demonstrate performance: ▪ A rigorous monitoring and evaluation platform which measures and reports on the performance of CRDC's research and development investments. ▪ An industry performance monitoring and evaluation framework that is consistent with national and international standards. ▪ Providing the industry with cotton sustainability indicators and supporting its capacity to report against these indicators.	Industry and CRDC are able to continually review and improve performance: ▪ Independent reviews of the social, environmental and economic performance of the industry's performance. ▪ Independent reviews.

Key program investments

This section provides a snapshot of some of CRDC's investments during 2017-18 in this program area. The full list of CRDC's investments for this period can be found at Appendix 4: the RD&E portfolio. Reports from all completed projects can be found at CRDC's online library, Inside Cotton (www.insidecotton.com).

Best practice:
Supporting a best practice framework as the primary integrated planning, risk management, benchmarking, knowledge development and delivery system; Promoting best practices through the development and delivery Joint Venture.

Ensuring world's best practice underpins the performance of the industry is a role for both the industry's best management practices framework, *my*BMP, and the industry's joint extension program, CottonInfo. CRDC is a founding partner of both *my*BMP and CottonInfo, and provides specific investment support to both programs.

In 2017-18, CRDC continued its support of the best practice theme through key projects, including:

- *my*BMP *support and program coordination;* with Rachel Holloway
- *'Science into best practice', linking research with CottonInfo;* with CSIRO.

The *my*BMP *support and program coordination* project reviewed all *my*BMP modules to ensure they contained the latest in RD&E outcomes from CRDC-invested research. The ten modules – biosecurity; energy and input efficiency; fibre quality; HR and WHS; IPM; pesticides management; petrochemical storage and handling; soil health; sustainable natural landscapes (natural assets); and water management – were reviewed and updated.

The *'Science into best practice', linking research with CottonInfo* project formed part of CRDC's support for the CottonInfo program. CRDC invests in key CottonInfo personnel, provides support for the *my*BMP program, and invests in the CottonInfo technical leads via research projects under their specific topic areas. This project was for one of the CottonInfo technical leads and, with the *my*BMP coordinator, ensured that all *my*BMP modules were updated with latest research outcomes. Further, this lead role rewrote the cotton pest management short course workbook, and coordinated a series of IPM short courses held in four different cotton-growing valleys during the 2017-18 cotton season that attracted more than 80 participants. The short courses raised confidence in best practice IPM and decreased the number of sprays being applied for thrip, mirid, and silverleaf whitefly control.

Monitoring and evaluation:
Conducting annual industry surveys to capture practice change; Establishing a framework through which industry performance can be nationally and internationally reported.

Measuring the performance of the Australian cotton industry over time is critically important in helping the industry: to continuously improve; to tell the story of the industry to customers; and to secure overseas markets by demonstrating the industry's social, economic and environmental sustainability.

In 2017-18, CRDC continued its commitment to industry monitoring and evaluation through five key projects:

- *Annual qualitative and quantitative surveys for the Australian cotton industry;* with Crop Consultants Australia
- *Australian Cotton Comparative Analysis;* with Boyce Chartered Accountants
- *Cotton Grower Survey;* with Intuitive Solutions
- *Measuring and reporting the value of capacity building on farms and in research;* with QualData
- *Longitudinal assessment of the cotton industry's People investment;* with Jennifer Moffatt.

The *Annual qualitative and quantitative surveys for the Australian cotton industry* project consists of two separate data sets/reports, collated by Crop Consultants Australia with the support of CRDC. The qualitative report is a survey of cotton consultants that provides information on the practices and attitudes of consultants and their cotton grower clients. The quantitative report provides hard data on practices on-farm, such as chemical use, and tracked how it has improved over time. The information from both surveys forms a critical data set for benchmarking, trending and research purposes. The final reports are available at the CRDC website: www.crdc.com.au/publications.

The *Australian Cotton Comparative Analysis Report* is compiled by Boyce Chartered Accountants with support from CRDC and provides the industry benchmark for the economics of cotton growing in Australia. The 2017 crop report, published in June 2018, focuses on the economics of the 2017 crop from growers across the different growing valleys. It is based on figures from growers who produced 498,000 bales, or 13 per cent, of total Australian cotton production. It found that the 'average' group of growers achieved profit per hectare of $1557 (compared with $1706 in 2016, and the five-year average of $1257) while the 'top 20 per cent' group achieved a profit of $2592 per hectare (down on last year's profit of $3159 but up compared with the five-year average of $2443). The 2017-18 report is available at the CRDC website: www.crdc.com.au/publications.

The *Cotton Grower Survey* gathers valuable information about cotton farming practices to give a greater understanding of the industry's performance. The survey provides important information to CRDC and Cotton Australia about the industry, on-farm practices, and priority areas for future research. The 2017 survey opened in mid-2017, with results published in February 2018. Questions focused on grower practices involving weeds, pest and disease control, pesticide management, irrigation technologies and on-farm automation, natural resource management, grower contribution to their local communities, on-farm training needs, and labour needs. For the first time, results were released via a report and an interactive online dashboard, both of which are available at the CRDC website: www.crdc.com.au/publications. The 2018 survey opened in June 2018, with results to be released in early 2019.

The *Measuring and reporting the value of capacity building on farms and in research* project is investigating how cotton businesses value investing in the capacity building of people on cotton farms. A skilled and capable workforce is known to contribute to industry profitability, sustainability and competitiveness. A key challenge for the project is to define key metrics to be used on cotton farms to assess the value derived from investing in upskilling staff. These metrics will help cotton businesses understand their workforce needs, the value of people to the enterprise, and help growers calculate the return on investment in building capacity in the cotton workforce. The project is due to report in 2018-19.

The *Longitudinal assessment of the cotton industry's People investments* project will assess the impact and cost benefit of CRDC's long-term investments (2008–18) in the People program. CRDC invests significant funds annually to provide opportunities for post-graduate scholarships, under-graduate scholarships, and professional development for individuals in the cotton industry through leadership programs. To date, the industry has incomplete knowledge and analysis of the long-term impacts of the participants, the cost of investment per individual, and the impact of their contributions to industry and communities, including national and international contributions. The first stage of the project surveyed 170 CRDC-funded participants from 2008 to 2018. The survey had a high response rate of 76 per cent for survey 1, and 87 per cent for survey 2. The project will inform future investments in the People program. It is due to report in 2018-19.

Case study: Cotton survey shines light on industry practices

Each year, Crop Consultants Australia (CCA), with support from CRDC, conducts a qualitative survey of cotton consultants of their practices and attitudes, as well as those of their cotton grower clients.

The resulting *Crop Consultants Australia Qualitative Report* provides valuable information to the Australian cotton industry about on-farm practices, helping to benchmark the industry's performance in a range of key areas over time. The latest report, looking at the 2016-17 cotton season, was released in November 2017.

The survey consisted of 65 qualitative questions that sought to draw out both the details of agronomic practices and consultants' views of those practices. The questions focused on such topics as management constraints, planting, crop protection, water management, soil management, and nutrition management. In addition, detailed information is provided on all product usage (seed, seed dressing, herbicides, insecticides, target pests, plant growth regulators, and harvest aids).

Sixty-five cotton consultants participated in the survey, representing 513 cotton growers and covering 318,000 hectares, or 55 per cent of the Australian cotton production area for the 2016-17 season.

CCA has been coordinating the collection of survey data of its practising members across the key cotton-growing regions of Australia since 1982. The surveys started in response to members wanting reliable product usage records to provide indicators of usage trends.

The annual qualitative and quantitative surveys continue to be coordinated by CCA, with CRDC funding. The survey data plays an important role in informing the cotton industry, wider supply chain, the community, and government of practice change within the sector, helping the industry to better tell its story.

Susan Maas, R&D Manager, said, 'CRDC commissions this survey each year to provide current and longitudinal knowledge of on-farm practices and attitudes, to aid the research, development and extension effort within the Australian cotton industry.'

CRDC publishes the report online. Additionally, the full set of quantitative survey data and historical data is available for researchers through CRDC, and is available for purchase from the CCA.

For more, see the Autumn 2018 edition of CRDC's Spotlight magazine: www.crdc.com.au/spotlight.

Consultant Stuart Doyle was the president of CCA during 2017-18.

Reviews:
Commissioning and participating in independent reviews of CRDC's RD&E and organisational performance.

To ensure continuous improvement as a key goal of the organisation, CRDC commissions independent reviews of RD&E investments and organisational performance, as required.

In 2017-18, CRDC continued its investment into reviews through the following key projects:

- *Enhancing private sector agricultural RD&E investment in Australia;* with Australian Farm Institute
- *Impact assessment of selected clusters of projects – Stage III;* with Agtrans Research and Consulting.

The *Enhancing private sector agricultural RD&E investment in Australia* project established the type of policy measures and resources Australian agriculture needs to boost private RD&E. The project included a review of available private RD&E data and of measures currently used in Australia and overseas, along with a series of interviews with heads of agribusinesses operating throughout the industry. Key findings of this project included:

1. Farmers rely on the private advisory sector, which has an important role in the Australian agricultural innovation system. Many advisory service providers are not sufficiently connected with industry RD&E, and farmers can feel uncertain about the type of advisors to use. Comparatively, the cotton industry has a higher level of private sector advisor use and greater connection with industry RD&E.
2. The advisory sector recognises their important role in extension, but their current engagement is ad hoc. Engagement strategies will require a level of sophistication to accommodate the range of advisor needs, expectations and business models. The project has trialled a range of approaches to use on specific technical innovation challenges.
3. The private sector sees value in cross-sector collaboration. Drivers for collaboration include the exchange of ideas and innovations, cross-sectoral regional collaboration, the ability to work with different RDCs, the opportunity to address problems, and professional development and capacity building opportunities.

The final report is available from the CRDC website www.crdc.com.au/publications.

During 2017, CRDC maintained its program of impact assessment through analyses of selected project clusters: sustainability and *my*BMP. The impact assessment of the sustainability investments found that CRDC's investment of $4.85 million on behalf of cotton growers and the Australian Government into six projects focusing on improving the sustainability of the Australian cotton industry provided a return of $12.26 million and a benefit-cost ratio of 2.5 to 1. In addition, CRDC's investment of $6.39 million in six projects to support the *my*BMP program in 2012-17 returned a benefit of $58.15 million, or 9.1 to 1. The reports are available at the CRDC website: www.crdc.com.au/publications.

Case study: CRDC's 2017 Grower Survey results shared via digital platform

CRDC conducts an annual Cotton Grower Survey, which opens in June each year. All growers and farm managers are invited to participate.

For the first time, CRDC published the results of the 2017 survey via a new interactive digital dashboard, as well as in a downloadable PDF format. The digital dashboard allows users to explore the data in more depth and to compare results across regions.

CRDC undertakes the annual survey of cotton growers to gather information about farming practices and growers' views on research, development and extension. This information helps to inform CRDC about the benefits of the research it invests in. Changes in industry practice can be quantified by comparing information from the surveys conducted over the past 20 years.

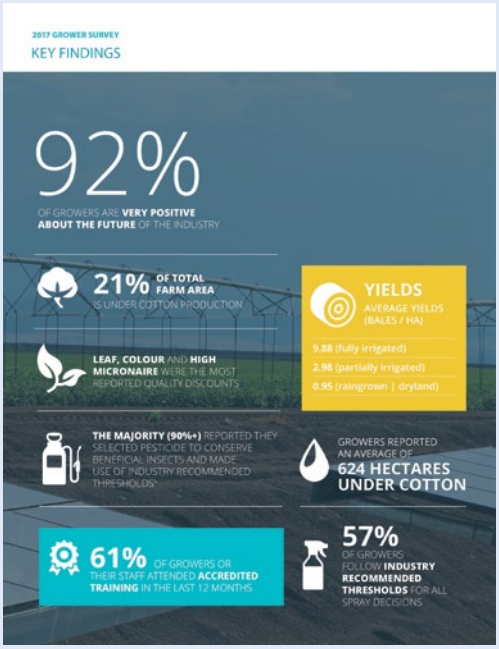
Previous surveys have included some core annual questions and then a number of focus areas to investigate specific aspects of the farming system. In 2017, CRDC undertook a review of the aims, purpose and design for the survey. The 2017 Grower Survey was developed by a working group including CRDC, Cotton Australia, researchers and others. It also gathered midterm assessment of growers' views of CRDC's performance against the Strategic R&D Plan 2013-18.

The overall survey program was guided by CRDC's Monitoring and Evaluation Framework and supplemented by research questions relevant to the seasonal conditions.

The survey is conducted by a professional researcher team, Intuitive Solutions, who have many years of experience in conducting surveys. Importantly, the information collected in the survey remains confidential. Only aggregated, anonymous information is passed on to CRDC.

The 2018 Cotton Grower Survey opened in June, and the results will be released in early 2019.

For more, see the Winter 2018 edition of CRDC's Spotlight magazine: www.crdc.com.au/spotlight or www.crdc.com.au/growersurvey.



Summary of results from 2017 Grower Survey.

Section 5
CRDC People and Governance

CRDC Board

CRDC employees

Governance and accountability

Selection Committee report

MELANIE JENSON

Mr Richard Haire (FAICD, FAIM)

Chair

Mr Haire has held many leadership positions within the cotton industry, most recently as Managing Director and regional head of Olam International, a global leader in the supply chain management of agricultural products and food ingredients. He was formerly the Chief Executive of Queensland Cotton Corporation Pty Ltd and a member of the Rabo Australia Food and Agribusiness Advisory Board. Mr Haire is a Fellow of the Australian Institute of Company Directors and the Australian Institute of Management. He formerly served as a Director on the CRDC board from 2011 to 2014.

Appointed: 29/08/2016 until 29/08/2019

Ms Kathryn Adams B.Sc.Agr (Hons), LLM, M.Bus, M.Env.Stud, Grad Dip Leg Pract, Prof Cert Arbitration, Practitioners Cert Mediation & Conciliation, FAICD.

Deputy Chair

Ms Adams is a microbiologist and lawyer who specialises in intellectual property management, commercial/industry application of R&D and corporate governance. She has had extensive experience in R&D investment from the perspective of a researcher, Director of a research institute and an investor. She has been a practising lawyer and was also the first Registrar of Plant Breeder's Rights in Australia.

Ms Adams was on the Board of the Cotton CRC and is currently on the Boards of a number of CRCs as well as Agriculture Victoria Services Pty Ltd, and PBIP Ltd. She is a member of the R&D Tax Incentives Committee of AusIndustry, an adjunct Senior Research Fellow with the Australian Centre for Intellectual Property in Agriculture (ACIPA, Griffith Law School) and is a Fellow of the Australian Institute of Company Directors.

Appointed: 20/10/2014 until 30/09/2017.
Reappointed 01/10/2017 until 30/09/2020.
Appointed Deputy Chair by the Minister from 19 December 2017.
Chair of the Intellectual Property Committee until 14 November 2017.
Member of the Audit Committee until 14 November 2017.
Member of Remuneration Committee and IP Committee from 15 November 2017.

Mr Bruce Finney BScAg (MAICD)
Executive Director

Mr Finney has extensive experience in agricultural research and corporate agriculture in management and agronomy roles in Australia and in an advisory role in Argentina.

Mr Finney is a member of the Cotton Innovation Network, the Agriculture Senior Officials Research and Innovation Committee, the Council of Rural RDCs Executive Committee and a board member of The Gate (Global Ag-Tech Ecosystem). He is a past member of the Advisory Board QLD DAF program on Agricultural Robotics at QUT, chair of the Australian Cotton Growers Research Association, and director of the Cotton Catchment Communities CRC and the Irrigation Association of Australia. Mr Finney is a graduate of the Australian Rural Leadership Program and of the Company Directors Course of the Australian Institute of Company Directors.

Appointed: 01/08/2004 by virtue of his appointment as Executive Director of CRDC. He attends the Audit, Intellectual Property and Remuneration Committees as an observer.

Mrs Elizabeth (Liz) Alexander BA, M Rur.Sys.Mgt, GAICD
Non-executive Director

Mrs Alexander specialises in finding collaborative and innovative solutions for regional challenges. She is the Agribusiness Development Coordinator for the Central Highlands Development Corporation (CHDC) and leads CHDC's Central Highlands Accelerate Agribusiness (CHAA) initiative, working with stakeholders to grow productivity and profitability for all agribusiness within the region. In her role, Liz developed and facilitates the AgTeCH events held annually in Emerald and Mungindi. She has extensive knowledge of dryland and irrigated cropping industries, and experience across natural resource management, agricultural extension and water policy.

Mrs Alexander is currently a director of Plant Health Australia. Previously, Liz was a Director of Cotton Australia and the Chair of Theodore Water, the Theodore Irrigation LMA Interim Board and Glencore's Clermont Open Cut Mine Groundwater and Environmental Reference Group. She obtained a Bachelor of Arts and a Masters of Rural Systems Management from the University of Queensland, is a member of the Australasia-Pacific Extension Network and a graduate member of the Australian Institute of Company Directors.

Appointed: 20/10/2014 until 30/09/2017.
Reappointed: 01/10/2017 until 30/09/2020.
Member of Remuneration Committee until 15 November 2017
Member of IP Committee and appointed Chair 15/11/2017

Mr Greg Kauter B.Ag.Ec. Grad.Cert Ru.Sc. GAICD

Non-executive Director

Mr Kauter is an agricultural consultant with more than 30 years of cotton industry experience. He has had extensive experience in cotton research administration and industry stewardship through roles in crop protection, farming systems, plant variety and biotechnology research programs. He has also planned and developed extension strategies to facilitate the adoption of new technology and knowledge. He has experience with industry representative bodies in developing strategic priorities with cotton growers and industry stakeholders, identifying emerging issues and developing evidence-based policy responses based on sound research and information.

Mr Kauter currently consults on cotton farm management and Best Management Practice implementation. He has been the industry representative for biosecurity through Plant Health Australia Ltd and Chair of the Cotton Industry Biosecurity Group. He is a former President of the Cotton Consultants Association Inc.

Appointed: 20/10/2014 until 30/09/2017.
Reappointed: 01/10/2017 until 30/09/2020.
Member of Audit Committee and appointed Chair from 15 November 2017

Dr Jeremy Burdon BSc (Hons.), PhD, Hon DSc (Umeå), FAA, FTSE, MAICD

Non-executive Director

Dr Burdon has an international reputation in evolutionary biology combining interests and expertise in ecology, epidemiology and genetics to contribute solutions to problems in a wide range of areas or agriculture, including disease control, pre-breeding, weed biology, and ecological sustainability. His research has been recognised through the award of a number of national and international awards and honours.

He has had extensive experience in research management and commercialisation, leading CSIRO-Plant Industry for many years. This gave him exposure to a broad swathe of important Australian agricultural industries including cotton, grains, sugar, and various horticultural crops. Subsequently, he has served on the Board of Trustees of Bioversity International, as a director of the Grains Research & Development Corporation, a member of Sugar Research Australia's independent Research Funding Panel, and as Chair of the Australian Academy of Science's National Committee for Agriculture, Fisheries & Food. In that role he led the production of a Decadal Plan for Agricultural Science that was released in 2017.

Appointed: 01/10/2017 until 30/09/2020.
Member of the Remuneration and Audit Committees from 15 November 2017

Professor Les Copeland
Non-executive Director

Professor Copeland has been conducting research and teaching in agricultural and food science in the University of Sydney for over 40 years. His research on plant, grain and food chemistry, and the origins of the human diet, has resulted in over 150 publications and 34 PhD completions. He is a member of the Research Advisory Committee of the Australian Farm Institute, and Editor-in-Chief of the scientific journals *Cereal Chemistry* and *Agriculture*. Professor Copeland was Chair of the Cotton Catchment Communities Participants' Forum and a Director of the Australian Cotton and Value-Added Wheat CRCs. He is a former Dean of Agriculture, and he was the Foundation President of the Australian Council of Deans of Agriculture. He is the immediate past President of the University of Sydney Association of Professors.

Professor Copeland holds BSc and PhD degrees from the University of Sydney and a Graduate Diploma from the Australian Institute of Company Directors. He has held research positions at Yale University, the University of Buffalo, the University of California in Davis, and the Australian National University. He is a Fulbright Alumnus, the recipient of an Excellence in Teaching Award from the American Association of Cereal Chemists-International, and has had international experience in capacity building.

Appointed: 01/10/2017 until 30/09/2020.
Member of the IP Committee from 15 November 2017

Ms Rosemary Richards B.Ag.Ec, MBA
Non-executive Director

Ms Richards is an agribusiness consultant with extensive experience in broadacre cropping, in particular oilseeds and downstream processing sectors. Ms Richards is principal of Bowman Richards & Associates, which provides strategic planning, supply chain management and trade and market access services for private companies, industry and government organisations to support market and business growth.

She also has extensive experience in the biotechnology sector and was actively involved in the introduction of GM canola to Australia as CEO of the Australian Oilseeds Federation. Ms Richards continues to be involved in biotechnology policy and advocacy through work with Australian and international representative organisations.

Ms Richards currently consults on trade and market access, commercialisation of biotech crops and business strategy. She is a passionate advocate for the agricultural sector and maintains close linkages with a range of agribusiness industry organisations.

Appointed: 01/10/2017 until 30/09/2020.
Member of the IP and Audit Committees from 15 November 2017

Mr Cleave Rogan (MAICD)

Deputy Chair – until 30 September 2017

Mr Rogan has been farming and marketing cotton and grains for 30 years. He is currently the Chair of the Cotton Innovation Network. Previously, Mr Rogan had acted in an advisory role to CRDC, working on research projects related to biosecurity, insects, weeds, diseases, cotton fibre processing and quality enhancement. Mr Rogan was a director of Cotton Australia and has been an industry representative on various other cotton industry associations and research advisory committees.

Appointed: 01/10/2011 until 30/09/2014.
Reappointed: 20/10/2014 until 30/09/2017.
Deputy Chair until 30/09/2017.

Dr Michael Robinson BSc (Hons), PhD (FAIMS, GAICD)

Non-executive Director – until 30 September 2017

Dr Robinson is the CEO of Plant Biosecurity Cooperative Research Centre. Previously he was the CEO of FrOG Tech Pty Ltd, a private research company specialising in geological reconstructions and interpretations across a range of sectors, including oil and groundwater, and CEO of GeoSphere Ltd, a specialist geological consulting firm in New Zealand.

Dr Robinson has extensive experience in primary industries and natural resources research, development and extension. He was the Executive Director of Land & Water Australia, Centre Director of the Primary Industries Climate Challenges Centre (a joint venture between Department of Economic Development, Jobs, Transport and Resources (Victoria) and University of Melbourne), Chair of the National Climate Change Research Strategy for Primary Industries, CEO of the CRC for Greenhouse Accounting, and a member of the National Primary Industries Standing Committee RD&E Extension Subcommittee.

Appointed: 01/10/2011 until 30/09/2014.
Reappointed: 20/10/2014 until 30/09/2017.
Chair of Audit Committee until 30/09/2017.

Composition

CRDC has an eight-member Board, consisting of a Chair (appointed by the Minister for Agriculture and Water Resources), the Executive Director (selected by the Board) and six non-executive Directors nominated by an independent Selection Committee. Appointment of non-executive Directors is subject to Ministerial approval and Directors (other than the Executive Director) are appointed for three-year terms.

Board

CRDC Board at 30 June 2018:

1. Mr Richard Haire, Chair
2. Ms Kathryn Adams, Deputy Chair
3. Mr Bruce Finney, Executive Director
4. Mrs Elizabeth Alexander, Non-executive Director
5. Mr Greg Kauter, Non-executive Director
6. Dr Jeremy Burdon, Non-executive Director
7. Professor Les Copeland, Non-executive Director
8. Ms Rosemary Richards, Non-executive Director.

Responsibilities of Executive Director

The Executive Director is responsible for day-to-day management of the CRDC, implementation of CRDC's plans, and liaison between the Board and management. The Executive Director is also a member of the Board with the responsibilities of a Director.

Responsibilities of Non-executive Directors

The roles and responsibilities of Directors are set out in the Board Charter, which includes a governance statement, conduct and ethical standards provisions. Internal reviews of Board performance are conducted annually. The Board also obtains an external review of its performance periodically.

Expertise

The CRDC Board is a skilled-based board, with Directors collectively bringing expertise in cotton production, processing and marketing, conservation/management of natural resources, science and technology and technology transfer, environmental and ecological matters, economics, finance and business management, administration of research and development, sociology and public administration.

The PIRD Act requires the CRDC Selection Committee to specify how its Board nominations will ensure that CRDC collectively possesses experience in board affairs, adding to the existing requirement for an appropriate balance of expertise.

Directors may obtain independent legal and professional advice at CRDC's expense to enable them to discharge their duties effectively, subject to prior approval from the Chair, in consultation with the Board and Executive Director. This advice may relate to legislative and other obligations, technical research matters and general skill development to ensure there is a sufficient mix of financial, operational and compliance skills amongst Board members.

Induction

Following appointment to the Board, each Director is provided with an appropriate level of information about CRDC, its history and operations, and the rights, responsibilities and obligations of Directors. This information includes the Board Charter, Strategic RD&E Plan and relevant legislation.

The induction process is tailored to the needs of new Directors and may include an initial visit to CRDC office in Narrabri to meet with the Chair and staff for a comprehensive overview of corporate activities and practices, and a tour of key industry research facilities.

Training

Where necessary and appropriate, CRDC sources training for Directors, either individually or as a group. The Board generally establishes the need for such training during the first meeting of Directors.

Functions

- Establishing strategic directions and targets.
- Monitoring and evaluating the research and development needs of the industry and ensuring CRDC's research program is effective in meeting those needs.
- Approving policies, plans, performance information and budgets.
- Monitoring policies, procedures and internal controls to manage business and financial risk.
- Ensuring compliance with statutory and legal obligations and corporate governance standards.

Conflicts of interest

In accordance with section 131 of the PIRD Act, Directors are appointed based on their expertise and do not represent any particular organisation or interest group.

The Board follows section 29 of the PGPA Act regarding Directors' disclosures of interests. A Director who considers that he or she may have a direct or indirect pecuniary or non-pecuniary interest in a matter to be discussed by the Board must disclose the existence and nature of the interest before the discussion.

All disclosures are recorded in the minutes of the meeting and, depending on the nature and significance of the interest, Directors may be required to absent themselves from the Board's deliberations.

The Board is very aware of its responsibilities regarding conflict of interest and duty of care, and has adopted a very cautious approach. A Board Charter clearly outlines the roles and responsibilities of Directors in terms of potential conflicts of interest. Further, the Board has a standing notice of Director's interests that is tabled and reviewed at each meeting.

Board Charter of Corporate Governance

The CRDC Board Charter assists Directors in carrying out their duties and setting out roles and responsibilities of Directors and staff.

Indemnities and insurance premiums for Directors and officers

The Board has taken the necessary steps to ensure professional indemnity cover is in place for present and past officers of CRDC, including Directors of the CRDC, consistent with provisions of the PGPA Act. CRDC's insurance cover is provided through Comcover; however, the insurance contract prohibits CRDC from disclosing the nature or limit of liabilities covered. In 2017-18, Directors' and officers' liability insurance premiums were paid and no indemnity-related claims were made.

Board Committees

The Board operated the Audit, Intellectual Property and Remuneration Committees in 2017-18. In addition to face-to-face meetings, the Board and its Committees conduct much of their work via email and telephone, supported by a secure online information portal. CRDC finds this arrangement to be effective, productive and cost effective.

Board meeting	Date	Location
Meeting 4 – 2017	17 August 2017	Brisbane, Qld
Meeting 5 – 2017	26 September 2017	Teleconference
Meeting 6 – 2017	15 November 2017	Narrabri, NSW
Meeting 1 – 2018	15 February 2018	Dalby, Qld
Meeting 2 – 2018	18 April 2018	Canberra, ACT
Meeting 3 – 2018	20 June 2018	Narrabri, NSW

Attendances at Board meetings

Director	Board meeting attendance						
	Meeting 4 2017	Meeting 5 2017	Meeting 6 2017	Meeting 1 2018	Meeting 2 2018	Meeting 3 2018	TOTAL
Richard Haire	✓	✓	✓	✓	✓	✓	6 of 6
Kathryn Adams	✓	✓	✓	✓	✓	✓	6 of 6
Bruce Finney	✓	✓	✓	✓	✓	✓	6 of 6
Liz Alexander	✓	✓	✓	✓	✓	✓	6 of 6
Greg Kauter	✓	✓	✓	✓	✓	✓	6 of 6
Cleave Rogan	✓	✓					2 of 2
Michael Robinson	✓	✓					2 of 2
Jeremy Burdon			✓	✓	✓	✓	4 of 4
Les Copeland			✓	✓	✓	✓	4 of 4
Rosemary Richards			✓	✓	✓	✓	4 of 4

Audit Committee

Established under section 89 of the PIRD Act and section 45 of the *Public Governance, Performance and Accountability Act 2013* (PGPA Act), the Audit Committee's primary role is to ensure CRDC's financial reporting is a true and fair reflection of its financial transactions.

The Committee also provides a forum for communication between the Directors, the senior managers of CRDC and the internal and external auditors. It carries responsibility for identifying areas of significant business risk and stipulating the means of managing any such risk.

Michael Robinson was Chair of the Audit Committee until the new Board was appointed in October 2017. Michael Robinson was supported by members Greg Kauter, Kathryn Adams and Alex Keatinge, an additional skills-based appointee. At the first meeting of the new Board Greg Kauter was elected Chair of the Audit Committee supported by new Board members Rosemary Richards and Jeremy Burdon along with Alex Keatinge. CRDC Executive Director Bruce Finney attended meetings as an observer. They met three times during 2017-18, face to face and by teleconference.

Intellectual Property Committee

The role of the Intellectual Property (IP) Committee is to assist CRDC's Board in fulfilling its responsibilities and to monitor the adequacy and effectiveness of CRDC's policies and procedures relating to the management of IP.

The Committee's specific responsibilities are to review the operation of CRDC's IP policy and IP operating principles and to consider IP matters directed to it by the Board for consideration.

Kathryn Adams was Chair of the IP Committee, supported by members Greg Kauter and Liz Alexander until the first meeting of the new Board in November 2017. Liz Alexander was then elected Chair of the IP Committee, supported by Kathryn Adams and new members, Rosemary Richards and Les Copeland, with CRDC Executive Director Bruce Finney attending meetings as an observer. The IP Committee met three times during 2017-18, face to face and by video-conference.

Attendances at Audit Committee meetings

Member	Date of Audit Committee meetings			
	10/8/2017	23/1/2018	22/5/2018	TOTAL
Michael Robinson	✓			1 of 1
Greg Kauter	✓	✓	✓	3 of 3
Alex Keatinge	✓	✓	✓	3 of 3
Kathryn Adams	✓			1 of 1
Rosemary Richards		✓	✓	2 of 2
Jeremy Burdon		✓	✓	2 of 2

Attendances at Intellectual Property Committee meetings

Member	Date of IP Committee meetings				
	17/7/2017	1/9/2017	23/1/2018	21/5/2018	TOTAL
Kathryn Adams	✓	✓	✓	×	3 of 4
Liz Alexander	✓	✓	✓	✓	4 of 4
Greg Kauter	✓	✓			2 of 2
Rosemary Richards			✓	✓	2 of 2
Les Copeland			✓	✓	2 of 2

Remuneration Committee

The Remuneration Committee advises the Board on the Executive Director's remuneration and senior staff remuneration adjustments. Richard Haire was the Chair of the Remuneration Committee supported by members Cleave Rogan (until the end of his term) and Liz Alexander until the first meeting of the new Board in November 2017 when the support changed to Kathryn Adams and Jeremy Burdon. CRDC Executive Director Bruce Finney attended meetings as an observer. The Remuneration Committee met twice by teleconference during 2017-18.

Attendances at Remuneration Committee meetings

Member	Date of Remuneration Committee meetings		
	15/9/2017	16/04/2018	TOTAL
Richard Haire	✓	✓	2 of 2
Liz Alexander	✓		1 of 1
Cleave Rogan	✓		1 of 1
Kathryn Adams		✓	1 of 1
Jeremy Burdon		✓	1 of 1

Statement of principles

CRDC Directors and staff members are required to:

- Commit to excellence and productivity.
- Be accountable to stakeholders.
- Act legally, ethically, professionally and responsibly in the performance of duties.
- Strive to maximise return on investment of industry and public funds invested through CRDC.
- Strive to make a difference in improving the knowledge base for sustainable cotton production in Australia.
- Value strategic, collaborative partnerships with research providers, other research and development bodies, industry organisations, stakeholders and clients, for mutual industry and public benefits, including cooperation with kindred organisations to address matters of national priority.
- Value the contribution, knowledge and expertise of the people within our organisation and that of our contracted consultants, external program coordinators and research providers.
- Promote active, honest and effective communication.
- Commit to the future of rural and regional Australia.
- Comply with and promote best practice in corporate governance.
- Commit to meeting all statutory obligations and accountability requirements in a comprehensive and timely manner.

CRDC's small but dedicated team of skilled and experienced staff actively manage RD&E investment portfolios to achieve the cotton industry's strategic goals. Our internal capacity is an important element of the overall effectiveness of RD&E investment for the cotton industry.

CRDC Organisational Structure

As at 30 June 2018

CRDC Board of Directors

CRDC Chair Mr Richard Haire

CRDC Executive Director Mr Bruce Finney

R&D Investment	Business and Finance	CottonInfo	Communications
General Manager R&D Investment Dr Ian Taylor **R&D Managers** Allan Williams Jane Trindall Susan Maas	**General Manager Business and Finance** Graeme Tolson **IT Manager** Peter Harvey **Accountant** Emily Luff **Executive Assistant** Dianne Purcell **Project Administration Assistants** Megan Baker Amy Withington	**CottonInfo Program Manager** Warwick Waters	**Communication Manager** Ruth Redfern

Employment

Staff members are employed under section 87 of the PIRD Act, which provides that the terms and conditions of employment are to be determined by the Corporation. The terms and conditions of employment incorporate the Fair Work National Employment Standards and the Australian Government Industry Award 2016. CRDC complies with the Australian Government Bargaining Framework when exercising its power to engage employees in relation to sections 12 and 87 of the PIRD Act.

Including the Executive Director, there were 10 full-time employees and two part-time employees as at 30 June 2018.

CRDC employees

Employee type	2013-14	2014-15	2015-16	2016-17	2017-18
Full-time employees	10	11	11	11	11
Part-time employees	4	1	1	1	2
Parental leave	2	2	0	1	0
Casual	0	0	1	1	0
TOTAL CRDC staff	16	14	13	14	13

** The total number of CRDC staff employed by CRDC on 30 June 2018.*

Staff training and development

In 2017-18, CRDC spent $42,827 on training and $nil on recruitment. Areas of direct training activities were team values, management coaching, AICD, WHS, graphic design, and ICT.

Throughout the year, Directors and staff participated in a wide range of CRDC-related activities involving other organisations, providing valuable experience, as well as skills and knowledge upgrades for the personnel involved.

Equal employment opportunity

CRDC is committed to a merit-based, non-discriminatory recruitment and promotion policy, and staff members are chosen strictly according to their qualifications for the job.

CRDC's Equal Employment Opportunity, Discrimination and Harassment Policy defines prohibited discrimination and harassment, and sets out a complaints procedure to be followed if there is a breach of this policy, including details of what action can be taken once the complaint has been made. The policy applies to all employees, whether full-time, part-time, casual or temporary, to Directors, and to contractors and customers (clients).

Executive remuneration reporting

The Board reviews and approves the remuneration of senior executives annually in accordance with the PIRD Act. The *Privacy Act 1988* limits the right to publish an individual's personal information. The following tables provide the average remuneration.

Table A: Average annual reportable remuneration paid to substantive executives

No. of employees	3
Average reportable salary*	$218,938

**Average reportable salary includes gross salary, employer superannuation, and reportable fringe benefits. There were no allowances or bonuses paid in the period.*

Table B: Other highly paid staff

Nil.

CRDC was established in 1990 as a partnership between the Australian people (through the Australian Government) and the Australian cotton industry (through Cotton Australia, its legislated representative industry body).

Location

CRDC is based in one of Australia's major cotton-growing areas, Narrabri, in North West NSW. Being centrally located within the Australian cotton industry, CRDC benefits from developing and maintaining important relationships with cotton growers, researchers, processors, and members of regional cotton communities.

PIRD Act legislation

CRDC began operations in 1990 under the PIRD Act.

Charter

CRDC's charter under the PIRD Act is to invest in and manage a portfolio of research, development and extension projects and programs in order to secure economic, environmental and social benefits for the Australian cotton industry and the community. This is to be conducted in a framework of improved accountability for research and development spending in relation to the cotton industry.

PIRD objects

The objects of this PIRD Act are to:

(a) make provision for the funding and administration of research and development relating to primary industries with a view to:
  (i) increasing the economic, environmental and social benefits to members of primary industries and to the community in general by improving the production, processing, storage, transport or marketing of the products of primary industries; and
  (ii) achieving the sustainable use and sustainable management of natural resources; and
  (iii) making more effective use of the resources and skills of the community in general and the scientific community in particular; and
  (iv) supporting the development of scientific and technical capacity; and
  (v) developing the adoptive capacity of primary producers; and
  (vi) improving accountability for expenditure on research and development activities in relation to primary industries; and

(b) make provision for the funding and administration of marketing relating to products of primary industries.

Powers

Under section 12 of the PIRD Act, CRDC has the power to do all things necessary to carry out its functions, including but not restricted to:

- Entering into agreements for the carrying out of R&D or marketing activities;
- Applying for patents, either solely or jointly;
- Charging for work done, services rendered, and goods and information supplied;
- Acquiring, holding and disposing of real and personal property; and
- Anything incidental to any of its powers.

Functions

Function	Application
Investigating and evaluating the cotton industry's requirements for research and development, and the preparation, review and revision of an RD&E plan on that basis	This is achieved by continuing interaction with CRDC's legislated industry body, Cotton Australia, as well as the Australian cotton industry's wider peak body, the Australian Cotton Industry Council (ACIC). Cotton Australia undertakes a range of functions relating to CRDC, including an annual review to ensure the CRDC Strategic Plan remains current and relevant. The cotton industry and cotton researchers are closely involved in development of the CRDC Strategic R&D Plan, which incorporates Australian Government and cotton industry RD&E priorities, as well as advice from the Minister and the Department of Agriculture and Water Resources.
Preparing an Annual Operational Plan for each financial year	An Annual Operational Plan is submitted to the Australian Government and Cotton Australia prior to the commencement of each financial year.
Coordinating and funding RD&E activities consistent with current planning documents	RD&E projects are approved or commissioned in line with the Annual Operational Plan each year. The Annual Operational Plan is devised to address the objectives and strategies outlined in the current Strategic RD&E Plan.
Monitoring, evaluating and reporting to Parliament, the Minister for Agriculture, and to industry on RD&E activities coordinated or funded by the Corporation	The Corporation reports formally to the Australian Parliament through its Annual Report. In addition, CRDC informs the Minister for Agriculture and Water Resources of any matters of interest or concern in the current operating environment. This occurs in written and, where possible, face-to-face communication. CRDC is also in communication with the Department of Agriculture and Water Resources on a range of issues. Communication with the industry and Cotton Australia occurs continually on both a formal and informal basis, as outlined above. Communication with the broader community is a key focus of CRDC's communication activities. In order to ensure stringent evaluation of its RD&E activities, CRDC is committed to the ongoing Council of Rural Research and Development Corporation's Impact Evaluation process.
Facilitating the dissemination, adoption and commercialisation of research and development results in relation to the cotton industry	CRDC plays a pivotal role in facilitating fast and effective dissemination of cotton RD&E outcomes. CRDC undertakes detailed analysis and planning for determining the most appropriate adoption pathway for the results of research projects. While the majority of research results are extended as information, the CRDC actively works with its research partners to develop commercial adoption pathways where that is preferred. CRDC is a founding partner in the industry's joint extension program, CottonInfo, along with co-partners Cotton Australia and CSD Ltd. Formed in 2012, the CottonInfo team works to improve responsiveness to grower needs through improved communication and regional representation, focusing on delivering research directly to growers and consultants. The model recognises the importance of supporting adoption of RD&E through multiple delivery pathways and is underpinned by the industry's best management practices program, *my*BMP. In addition, CRDC hosts forums and on-farm events, participates in roadshows and the cotton trade show, produces publications, sponsors the biennial Australian Cotton Conference and Australian Cotton Research Conference, and has a communication strategy to extend and enhance the adoption of RD&E. CRDC also collaborates in the successful commercialisation of RD&E where possible.

The PGPA Act

CRDC has been subject to the *Public Governance, Performance and Accountability Act 2013* since 1 July 2013, which provides enhanced levels of accountability as well as a planning and reporting framework.

Other legislation

The setting and collection of levies on the cotton industry is enabled by the *Primary Industries (Excise) Levies Act 1999* and the *Primary Industries Levies and Charges Collection Act 1991*.

Cotton R&D levy

The Australian Government introduced an R&D levy at the request of industry. The cotton levy funds CRDC research and development programs and the subscription for industry membership of Plant Health Australia. The levy is payable on cotton produced in Australia, and the producer (the person who owns the cotton immediately after harvest) is liable to pay the levy.

The levy rate for cotton is $2.25 per 227-kilogram bale of cotton. The Australian Government contributes matching funds up to set limits.

There is also a separate levy for seed cotton exports of $4.06 per tonne of exported seed cotton.

Minister

During 2017-18, CRDC was accountable to the Australian Parliament through the then Deputy Prime Minister and Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP, until the Hon. David Littleproud MP was sworn in and appointed Minister for Agriculture and Water Resources in December 2017.

Minister's responsibilities

The Minister's powers and responsibilities, as outlined under various sections of the PIRD Act, include appointing CRDC's Chair and Directors and, under certain conditions, terminating these appointments; approving CRDC's Strategic R&D Plan and any variations to it; appointing a person as Presiding Member of CRDC's Selection Committee, as well as other members of that Committee; and transferring to CRDC any assets held by the Commonwealth that the Minister considers appropriate and that would assist its performance and function.

Ministerial directions

CRDC complies with all Ministerial directions, legislative and policy requirements of the Australian Government that it has been able to ascertain.

CRDC received no Ministerial directions during 2017-18.

CRDC role, responsibilities and accountabilities

- CRDC is formally accountable to the Australian people through the Australian Parliament and to the cotton industry through its industry representative body, Cotton Australia.
- CRDC's stakeholders set broad objectives, which the Corporation addresses through its Strategic R&D Plan and Annual Operational Plan.
- CRDC has used these objectives as a basis for the development of its planned outcomes and the identification of key outputs.
- CRDC's reporting processes include the presentation of a formal report to its industry stakeholder. Part of this presentation includes an opportunity for questioning and debating Board decisions.
- CRDC annually reports on investments, project outcomes, operation activities and financial statements every year via its Annual Report.
- CRDC publishes an Annual Operational Plan, Strategic R&D Plan and Annual Report on the outcomes of investments, projects, operations and financials.

Policies, procedures and charters

CRDC has policies, procedures and charters to assist with the effective governance of the organisation. These documents are available from CRDC's internal shared folders and are made available to all Directors and new staff during induction training. In addition, staff receive policy training on an annual rolling basis at monthly staff meetings.

Corporate reporting

In accordance with the PIRD Act and the PGPA Act, CRDC prepares a five-year Strategic RD&E Plan, as well as an Annual Operational Plan for each financial year.

CRDC submitted the Annual Operational Plan for 2017-18 to the then Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP, on 28 June 2017 with the plan commencing from 1 July 2017. The Annual Report 2016-17 was submitted to the Minister on 13 October 2017 and the Minister tabled the report in Parliament on 27 November 2017.

Fraud control

Active fraud control is a major responsibility of all staff, and clear standards and procedures have been established. All personnel engaged in the prevention, detection and investigation of fraud receive appropriate fraud control training, consistent with the Australian Government's Fraud Control Guidelines.

The Audit Committee endorse, monitor and review the fraud control plan, which is read in conjunction with the Risk Management Plan and the Board Charter for Directors and Statement of Principles for staff.

CRDC's Audit Committee, Executive Director, and General Manager Business and Finance (the nominated fraud control officer) carry out the functions of a fraud investigation unit collectively, as described in the Commonwealth Fraud Investigation Model. The support of the Australian Federal Police would be sought if CRDC felt there was a prima facie case of fraud and further investigation was required. No such action was necessary in 2017-18.

Service charter

CRDC does not provide services directly to the public and thus does not have a service charter; however, CRDC has a Board Charter that includes a Governance Statement and a Statement of Principles that embody the set of values underlying our decisions, actions and relationships.

National Disability Strategy

CRDC working conditions and procedures for employees and stakeholders align with the *Commonwealth Disability Discrimination Act 1992* in the broader context of the National Disability Strategy 2010-20. CRDC has ensured that any person with a disability could be properly accommodated and carry out all functions, as either a staff member or a visitor. Should a future staff member or visitor need more-specialised disability assistance, CRDC will assess and meet these needs.

Equal Employment Opportunity, Discrimination and Harassment Policy

CRDC's Equal Employment Opportunity, Discrimination and Harassment Policy defines prohibited discrimination and harassment and sets out a complaints procedure.

Significant events

CRDC had no significant events in 2017-18.

Significant changes in the state of affairs

CRDC had no significant changes in its state of affairs in 2017-18.

Judicial decisions and reviews by outside bodies

CRDC had no judicial decisions in 2017-18.

CRDC is required to commission an independent performance review during the term of the current Funding Agreement. Forest Hill Consulting was appointed in 2017-18 to perform the review. An Independent Performance Review report will be prepared by Forest Hill Consulting during 2018-19.

Commercialisation

CRDC has detailed policies and procedures for determining its involvement in the commercialisation of the results of R&D projects where that is the preferred adoption pathway.

During 2017-18, CRDC with research partners CSIRO commercialised three items of intellectual property – Cottonspec, cotton contamination detection sensors, and stress-time threshold algorithms.

Cottonspec is a yarn quality prediction program that is able to accurately predict yarn quality parameters (yarn evenness and tensile properties for medium to fine count yarns) from High-Volume Instrument (HVI) properties. Cottonspec is a predictive model, which enables the spinner to accurately predict the yarn that will be produced from the cotton growths utilised. The use of Cottonspec by the spinners will provide the spinner with a level of predictability that will allow them to confidently use cotton. The benefit of Cottonspec is that demand for Australian cotton can be increased because of the yarn quality comparisons that can be made using Cottonspec. Cottonspec is able to show quite accurately the benefit to yarn quality and raw material costs of increasing the blend ratio of Australian cotton in mill laydowns (for Ne 40 and finer count yarns). The technology was commercialised through Uster Technologies, the world's largest supplier of technology to the world cotton spinning sector.

The cotton contamination detection sensors detect and record contamination events, where the plastic used to wrap seed-cotton modules enters the gin and gets caught on the module-hood beaters. Evidence shows that plastic wrap entering the gin process is quickly broken into smaller pieces that end up creating large issues in quality in spinning, weaving and knitting. There is a market demand for this technology as a result of the plastic used to wrap modules produced on the round module cotton picker which is used in over 85 per cent of harvesting operations, with all gins finding plastic module wrap in their gins and bales. The commercialisation partner for this technology is Pegron Pty Ltd, which is the licensed service agent for Vomax technology in Australia and service over 90 per cent of Australian cotton gins.

The stress-time threshold algorithms support the use of canopy temperature sensors, which provide a novel method for identifying plant stress. To date, the use of these sensors has been limited due to the lack of algorithms for furrow-irrigated systems critical in determining water stress. The algorithm will help the sensors provide a quantitative means of scheduling irrigations, improving confidence for growers in making decisions regarding the timing of irrigations. Using the canopy temperature sensors with the optimisation algorithms could result in a 5-10 per cent benefit in water-use efficiency in climatically challenging seasons. We are working with a leading agricultural technology company, focused on improving water-use efficiency, to commercialise this technology.

Work Health and Safety

CRDC has a strong culture of achieving best practice and continuous improvement in Work Health and Safety (WHS), as required by the *Work Health and Safety Act 2011*. This is achieved by providing the necessary resources (both human and financial) to ensure that WHS functions effectively.

In accordance with Schedule 2 Part 4 of the WHS Act, CRDC details notifiable incidents reported each year. In view of its WHS record, CRDC remains vigilant in maintaining its safety performance by conducting audits and reviews of policies and procedures.

CRDC Work Health and Safety summary

Legislative reporting requirements Schedule 2 Part 4 of the *Work Health and Safety Act 2011*	Action undertaken 2017-18
Initiatives during 2017-18 and outcomes	▪ An internal WHS audit of first aid kits, training register, fire extinguishers, smoke detectors and incident reporting records was completed in January. No substantive matters were identified. ▪ Fire warden and evacuation training. ▪ Safety issues discussed formally at workplace meetings, workplace inspections held (including vehicles) and staff consulted in resolving safety issues and physical conditions of the workplace. ▪ A flu vaccination program for all CRDC staff was offered. ▪ WHS inductions for new staff, directors and contractors. ▪ CRDC continues to support a wellbeing program of activities.
Statistics of any notifiable incidents as defined by s.38 of the WHS Act	▪ CRDC had no notifiable incidents in 2017-18.
Details of any investigations conducted during the year, including details of all notices under Part 10 of the WHS Act	▪ CRDC conducted no investigations and no notices were received from, or given to, an employee.

Freedom of information

General enquiries regarding access to documents or other matters relating to freedom of information should be made in the first instance to the Executive Director.

Funding information on individual projects funded by CRDC is available on request, unless that information has been classified as commercial-in-confidence. Information about CRDC projects is also available at the CRDC website www.crdc.com.au.

During 2017-18, CRDC had one freedom of information request. CRDC manages requests in accordance with the provisions of its freedom of information plan, in compliance with sub-section 8(1) of the *Freedom of Information Act 1982*.

Categories of documents held

Category	Nature	Access
Administration	Files	D
Annual Operating Plans	Files, Publications	C
Annual Reports	Files, Publications	C
Applications, Guidelines and Contracts	Files, Publications	C, D
Assets Register	Files	D
Financial Management	Files	D
Five-Year Plans	Files, Publications	C
Project Lists	Files, Publications	C, D
Research Reports	Files, Publications	C, D
Workshop Reports	Files, Publications	C, D

C: Documents customarily made available

D: Documents not customarily made available for reasons of privacy or commercial-in-confidence.

Contractors and consultants

CRDC employs consultants and contractors as needed, and after background checks to ensure proposed appointees have the necessary skills and experience. During 2017-18, CRDC spent $835,115, exclusive of GST, to remunerate consultants and contractors.

Privacy and confidentiality arrangements require that CRDC policy is not to disclose amounts paid to individual consultants. A list of contractors and consultants with remuneration of $10,000 or more, exclusive of GST, can be found in the following table.

Contractor	Service provided
Banki Haddock Fiora lawyers	Legal advice
Callida Consulting	Internal audit services
Carolyn Martin	Publication content
Combined Management Consultants Pty Ltd	Strategy services
Cooper Business Services	Accounting services
DXC Technology Australia Pty Ltd	ICT services
Forest Hill Consulting	Performance review services
Keo Design	Web consultant
Melanie Jenson	Publication content
Meyer Vandenberg	Legal advice
Neil Deacon Design	Publication design
Nexia Court & Co	Internal audit services
Peel HR Consulting & Mediation	HRM services
Rachel Holloway	Program management services
Revolution IT	Software consultant
SapphireOne Pty Ltd	Software support
TechMAC Pty Ltd	Program management

Payments to advertising agencies

CRDC did not engage the services of any advertising agency, market research organisation, polling organisation, direct mail organisation or media promotion organisation during the reporting year.

Payment to representative body

Cotton Australia is CRDC's industry representative body and cotton's declared representative organisation under the PIRD Act. In 2017-18, CRDC contributed $101,324 to Cotton Australia for industry consultation, capacity building of advisory panel members and RD&E projects.

These funds included $40,000 for their industry consultation role, including several specific activities:

- Industry consultation for reviewing the CRDC Strategic R&D Plan. This ensures CRDC's strategic planning continues to address evolving industry RD&E needs.
- Industry consultation and participation in CRDC forums to review RD&E funding applications and scoping of future directions in research.
- Support for capacity building and training for the Cotton Australia research advisory panels.
- A meeting to receive and discuss the CRDC Annual Report for the preceding year. This enables the industry representative body to ensure CRDC's activities for that year have met its strategic objectives and to question senior staff on any matters of interest or concern.
- Joint publications with CottonInfo.

While CRDC does not pay a fee for service to the industry representative body for these activities, it contributes to the expenses they incur in carrying them out, as authorised by section 15 of the PIRD Act, which relates to consultation with the industry stakeholder.

In 2017-18, CRDC contributed a total of $61,324 to Cotton Australia for the following co-funded project activities:

- $25,000 co-funding support for the Primary Industries Education Foundation to support the cotton industry's participation in cross-sectoral education initiatives.
- $30,000 support for the 2018 Australian Cotton Conference to increase awareness in the Australian cotton industry of research outcomes. This is a joint extension exercise in line with the Australian Government's prioritisation of extension and adoption in the Agricultural Competitiveness White Paper.
- $2500 co-funding support for the cross-sector CottonMap project lead by Cotton Australia and supported by CRDC, GRDC and commercial organisations. The online mapping tool is used by cotton growers, grain growers and graziers to help prevent spray-drift damage to cotton crops.
- $3369 co-funding support for Cotton Australia panel members to attend industry biosecurity training.
- $455 co-funding to develop a response to Khapra beetle.

SELECTION COMMITTEE REPORT

Joe Robinson
Presiding Member
Cotton Research and Development Corporation
Board Selection Committee

7 September 2018

The Hon. David Littleproud MP
Minister for Agriculture and Water Resources
PO Box 6022
Parliament House
CANBERRA ACT 2600

Dear Minister

In accordance with the requirements of section 141 of the *Primary Industries Research and Development Act 1989* (PIRD Act), I write to inform you of the activities of the Cotton Research and Development Corporation (CRDC) Board Selection Committee during the year 1 July 2017 to 30 June 2018.

The terms of the existing CRDC directors were due to end on 30 September 2017. As such, I commenced the selection process in my position as the Presiding Member of the CRDC Selection Committee.

The selection committee's nominations for five directors were provided to the office of the then Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP, on 6 July 2017.

Details of the appointments are outlined in the following report.

Yours sincerely

Mr Joe Robinson
Presiding Member

Board Selection Process

Details of the selection process were provided in the Selection Committee's Annual Report for 2016–17, included as a part of the Cotton Research and Development Corporation 2016–17 Annual Report.

There were no other activities of the Cotton Research and Development Corporation Selection Committee during 2017–18.

Board Appointments

On 6 July 2017, the Cotton Research and Development Corporation Selection Committee nominations and the names of other candidates considered suitable for appointment were provided to the then Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP, for appointment as Cotton Research and Development Corporation directors.

Subsequently, the following people were appointed for the period 1 October 2017 to 30 September 2020:

- Ms Kathryn Adams
- Mrs Elizabeth (Liz) Alexander
- Mr Greg Kauter
- Dr Jeremy Burdon
- Professor Les Copeland
- Ms Rosemary Richards

Expenses

No expenses were incurred in 2017-18.

Section 6
Financials

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CONTENTS

Australian National Audit Office

INDEPENDENT AUDITOR'S REPORT

To the Minister for Agriculture Water and Resources

Opinion

In my opinion, the financial statements of the Cotton Research and Development Corporation for the year ended 30 June 2018:

(a) comply with Australian Accounting Standards – Reduced Disclosure Requirements and the *Public Governance, Performance and Accountability (Financial Reporting) Rule 2015*; and

(b) present fairly the financial position of the Cotton Research and Development Corporation as at 30 June 2018 and its financial performance and cash flows for the year then ended.

The financial statements of the Cotton Research and Development Corporation, which I have audited, comprise the following statements as at 30 June 2018 and for the year then ended:

- Statement by the Accountable Authority, Executive Director and Chief Financial Officer;
- Statement of Comprehensive Income;
- Statement of Financial Position;
- Statement of Changes in Equity;
- Cash Flow Statement: and
- Notes to the financial statements.

Basis for Opinion

I conducted my audit in accordance with the Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing Standards. My responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Statements* section of my report. I am independent of the Cotton Research and Development Corporation in accordance with the relevant ethical requirements for financial statement audits conducted by the Auditor-General and his delegates. These include the relevant independence requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) to the extent that they are not in conflict with the *Auditor-General Act 1997*. I have also fulfilled my other responsibilities in accordance with the Code. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

Accountable Authority's Responsibility for the Financial Statements

As the Accountable Authority of the Cotton Research and Development Corporation the Board is responsible under the *Public Governance, Performance and Accountability Act 2013* for the preparation and fair presentation of annual financial statements that comply with Australian Accounting Standards – Reduced Disclosure Requirements and the rules made under that Act. The directors are also responsible for such internal control as the directors determine necessary to enable the preparation and fair presentation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the directors are responsible for assessing the Cotton Research and Develoment Corporation's ability to continue as a going concern, taking into account whether the entity's operations will cease as a result of an administrative restructure or for any other reason. The directors are also responsible for disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the assessment indicates that it is not appropriate.

Auditor's Responsibilities for the Audit of the Financial Statements

My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that

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an audit conducted in accordance with the Australian National Audit Office Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

As part of an audit in accordance with the Australian National Audit Office Auditing Standards, I exercise professional judgement and maintain professional scepticism throughout the audit. I also:

- identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for my opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control;
- obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the entity's internal control;
- evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Accountable Authority;
- conclude on the appropriateness of the Accountable Authority's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the entity's ability to continue as a going concern. If I conclude that a material uncertainty exists, I am required to draw attention in my auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify my opinion. My conclusions are based on the audit evidence obtained up to the date of my auditor's report. However, future events or conditions may cause the entity to cease to continue as a going concern; and
- evaluate the overall presentation, structure and content of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

I communicate with those charged with governance regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that I identify during my audit.

Australian National Audit Office

Mark Vial
Senior Director

Delegate of the Auditor-General

Canberra

23 August 2018

Cotton Research and Development Corporation

STATEMENT BY THE ACCOUNTABLE AUTHORITY, EXECUTIVE DIRECTOR AND CHIEF FINANCIAL OFFICER

In our opinion, the attached financial statements for the year ended 30 June 2018 comply with subsection 42(2) of the *Public Governance, Performance and Accountability Act 2013* (PGPA Act), and are based on properly maintained financial records as per subsection 41(2) of the PGPA Act.

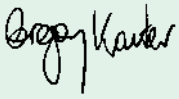
In our opinion, at the date of this statement, there are reasonable grounds to believe that the Cotton Research and Development Corporation will be able to pay its debts as and when they fall due.

This statement is made in accordance with a resolution of the Directors.

Signed

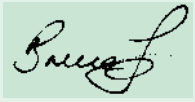
Richard Haire
Chair
23 August 2018

Signed



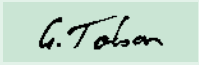
Greg Kauter
Director
23 August 2018

Signed



Bruce Finney
Executive Director
23 August 2018

Signed



Graeme Tolson
Chief Financial Officer
23 August 2018

STATEMENT OF COMPREHENSIVE INCOME
for the period ended 30 June 2018

	Notes	2018 $	2017 $	Original Budget $
NET COST OF SERVICES				
Expenses				
Employee Benefits	1.1A	**2,050,606**	2,002,847	2,094,000
Suppliers	1.1B	**1,178,146**	1,022,822	1,271,000
Grants	1.1C	**21,555,513**	20,875,100	18,979,000
Depreciation and amortisation	2.2A	**277,714**	188,702	177,000
Total expenses		**25,061,979**	24,089,471	22,521,000
OWN-SOURCE INCOME				
Own-source revenue				
Interest	1.2A	**896,533**	1,077,822	650,000
Royalties	1.2B	**1,080,040**	584,768	1,135,000
Research grants	1.2C	**4,273,184**	6,718,580	3,348,000
Other revenue	1.2D	**816,006**	958,346	262,000
Total own-source revenue		**7,065,763**	9,339,516	5,395,000
Net (cost of)/contribution by services		**17,996,216**	14,749,955	17,126,000
Revenue from Government				
PIRD Act 1989 Contribution	1.2E	**9,088,958**	6,128,948	10,213,000
Levies and penalties	1.2F	**9,092,767**	6,131,339	10,820,000
Total revenue from Government		**18,181,725**	12,260,287	21,033,000
Surplus/(Deficit) attributable to the Australian Government		**185,509**	(2,489,668)	3,907,000

STATEMENT OF COMPREHENSIVE INCOME (CONTINUED)
for the period ended 30 June 2018

	Notes	2018 $	2017 $	Original Budget $
OTHER COMPREHENSIVE INCOME				
Items not subject to subsequent reclassification to net cost of services				
Changes in asset revaluation surplus		**18,251**	-	-
Items subject to subsequent reclassification to net cost of services				
Gain/(Losses) on available-for-sale financial assets		**(22,412)**	-	-
Total other comprehensive income/(loss)		**(4,161)**	-	-
Total comprehensive income/(loss) attributable to the Australian Government		**181,348**	(2,489,668)	3,907,000

The above statement should be read in conjunction with the accompanying notes.

Budget Variances Commentary

Statement of Comprehensive Income for not-for-profit Reporting Entities The original budget is the Corporation's 2017-18 Portfolio Budget Statements (PBS).

Grants expense increased by $2.577 million due to additional RD&E projects contracted as part of new unbudgeted Rural R&D for Profit grants and additional projects approved by the Board.

Interest income increased by $0.247 million as a result of holding term deposits for longer terms at interest rates above average market rate for short term deposits.

Research Grant revenue increased by $0.925 million as a result of receiving new grants from the Rural R&D for Profit program from the Department of Agriculture and Water Resources and contributions from t he program partners.

Other revenue increased by $0.554 million as a result of an increase in surplus project funds returned by research organisations.

Commonwealth Contributions; and Industry Contributions, comprising of levies and penalties, decreased by $2.851 million as a result of a decrease in cotton production from which levies are collected and Commonwealth contributions determined in accordance with the PIRD Act 1989.

STATEMENT OF FINANCIAL POSITION
as at 30 June 2018

	Notes	2018 $	2017 $	Original Budget $
ASSETS				
Financial assets				
Cash and cash equivalents	2.1A	**7,037,525**	15,071,075	6,529,000
Investments held to maturity	2.1B	**28,000,000**	20,000,000	36,000,000
Trade and other receivables	2.1C	**5,123,189**	4,996,053	2,900,000
Other investments	2.1D	**87,588**	-	-
Total financial assets		**40,248,302**	40,067,128	45,429,000
Non-financial assets				
Land and buildings	2.2A	**725,000**	721,139	836,000
Property, plant and equipment	2.2A	**242,820**	78,599	171,000
Computer software	2.2A	**299,892**	200,892	234,000
Prepayments		**-**	-	10,000
Total non-financial assets		**1,267,712**	1,000,630	1,251,000
Total assets		**41,516,014**	41,067,758	46,680,000
LIABILITIES				
Payables				
Suppliers	2.3A	**112,359**	72,638	200,000
Grants	2.3B	**3,163,012**	2,986,054	4,000,000
Other payables	2.3C	**72,455**	66,650	-
Total payables		**3,347,826**	3,125,342	4,200,000
Provisions				
Employee provisions	3.1A	**451,330**	406,906	357,000
Total provisions		**451,330**	406,906	357,000
Total liabilities		**3,799,156**	3,532,248	4,557,000
Net assets		**37,716,858**	37,535,510	42,123,000
EQUITY				
Reserves		**273,654**	255,403	255,000
Other Reserves		**(22,412)**	-	-
Retained surplus		**37,465,616**	37,280,107	41,868,000
Total equity		**37,716,858**	37,535,510	42,123,000

The above statement should be read in conjunction with the accompanying notes.

STATEMENT OF FINANCIAL POSITION (CONTINUED)
as at 30 June 2018

Budget Variances Commentary

Statement of Financial Position for not-for-profit Reporting Entities The original budget is the Corporation's 2017-18 Portfolio Budget Statements (PBS).

Cash and cash equivalents and Investments held to maturity below PBS by $7.491 million as a result of reduction in the surplus, increase in trade and other receivables and decrease in grants payable.

Trade and other receivables above PBS by $2.223 million is represented by increases in industry levies collected and held by the Department in June 2018 and matching Commonwealth contributions.

Land and buildings below PBS by $0.111 million as a result of anticipated building improvements not commencing in the year.

Grants payable below PBS by $0.837 million is represented by a decrease in completed project milestones which have not been invoiced by research organisations.

STATEMENT OF CHANGES IN EQUITY
for the period ended 30 June 2018

	2018 $	2017 $	Original Budget $
RETAINED EARNINGS			
Opening balance			
Balance carried forward from previous period	**37,280,107**	39,769,775	37,961,000
Comprehensive income			
Surplus/(Deficit) for the period	**185,509**	(2,489,668)	3,907,000
Closing balance as at 30 June	**37,465,616**	37,280,107	41,868,000
ASSET REVALUATION RESERVE			
Opening balance			
Balance carried forward from previous period	**255,403**	255,403	255,000
Comprehensive income			
Other comprehensive income	**18,251**	-	-
Closing balance as at 30 June	**273,654**	255,403	255,000
OTHER RESERVES			
Opening balance			
Balance carried forward from previous period	**-**	-	-
Comprehensive income			
Other comprehensive income	**(22,412)**	-	-
Closing balance as at 30 June	**(22,412)**	-	-
TOTAL EQUITY			
Opening balance			
Balance carried forward from previous period	**37,535,510**	40,025,178	38,216,000
Comprehensive income			
Surplus/(Deficit) for the period	**185,509**	(2,489,668)	3,907,000
Other comprehensive income	**(4,161)**	-	-
Total comprehensive income	**181,348**	(2,489,668)	3,907,000
Closing balance as at 30 June	**37,716,858**	37,535,510	42,123,000

The above statement should be read in conjunction with the accompanying notes.

Budget Variances Commentary

Statement of Changes in Equity for not-for-profit Reporting Entities The original budget is the Corporation's 2017-18 Portfolio Budget Statements (PBS).

Surplus for the period below PBS by $3.721 million is a result of the decreased revenues from industry levies and Commonwealth contributions, and increase in grant expenditure, as noted in the budget variance commentary on the Comprehensive Income Statement.

CASH FLOW STATEMENT
for the period ended 30 June 2018

	Notes	2018 $	2017 $	Original Budget $
OPERATING ACTIVITIES				
Cash received				
Industry levies and penalties		**8,714,558**	5,529,683	10,820,000
Commonwealth contributions		**8,878,026**	5,957,044	10,213,000
Royalties		**1,175,411**	627,694	1,249,000
Grants		**4,693,002**	7,322,192	3,683,000
Interest		**1,154,502**	1,067,430	650,000
Net GST received		**1,811,556**	1,284,944	1,570,000
Other		**920,797**	914,285	288,000
Total cash received		**27,347,852**	22,703,272	28,473,000
Cash used				
Employees		**2,016,622**	1,926,962	2,094,000
Grants		**23,440,494**	24,655,778	20,865,000
Suppliers		**1,287,741**	1,114,323	1,430,000
Total cash used		**26,744,857**	27,697,063	24,389,000
Net cash from/(used by) operating activities		**602,995**	(4,993,791)	4,084,000
INVESTING ACTIVITIES				
Cash received				
Proceeds from sales of property, plant and equipment		-	-	-
Investments		**62,000,000**	60,800,000	42,000,000
Total cash received		**62,000,000**	60,800,000	42,000,000
Cash used				
Purchase of property, plant and equipment		**526,545**	147,391	315,000
Investments		**70,000,000**	49,800,000	46,000,000
Purchase of Shares		**110,000**	-	-
Total cash used		**70,636,545**	49,947,391	46,315,000
Net cash from/(used by) investing activities		**(8,636,545)**	10,852,609	(4,315,000)
Net increase/(decrease) in cash held		**(8,033,550)**	5,858,818	(231,000)
Cash and cash equivalents at the beginning of the reporting period		**15,071,075**	9,212,257	6,760,000
Cash and cash equivalents at the end of the reporting period	2.1A	**7,037,525**	15,071,075	6,529,000

The above statement should be read in conjunction with the accompanying notes.

CASH FLOW STATEMENT (CONTINUED)
for the period ended 30 June 2018

Budget Variances Commentary

Statement of Changes in Equity for not-for-profit Reporting Entities The original budget is the Corporation's 2017-18 Portfolio Budget Statements (PBS).

Industry levies and Commonwealth contributions decreased by $3.440 million as a result of a decrease in cotton production from which levies are collected and Commonwealth contributions determined in accordance with the PIRD Act 1989.

Grant receipts increased by $1.010 million as a result of new research grants being contracted.

Interest receipts increased by $0.505 million as a result of financial reserves being invested at above budgeted interest rates.

Other receipts increased by $0.633 million as a result of an increase in surplus project funds returned by research organisation.

Grant payments increased $2.575 million as a result of new RD&E projects being contracted as part of the new Government grants received during the year and additional projects approved by the Board.

Investments cash received and cash used increased above PBS as a result of an increase in the number of term deposits completed and reinvested during the year.

The Basis of Preparation

The financial statements are general purpose financial statements and are required by section 42 of the Public Governance, *Performance and Accountability Act 2013*.

The financial statements have been prepared in accordance with:

a) *Public Governance, Performance and Accountability (Financial Reporting) Rule 2015 (FRR)* for reporting periods ending on or after 1 July 2015; and

b) Australian Accounting Standards and Interpretations – Reduced Disclosure Requirements issued by the Australian Accounting Standards Board (AASB) that apply for the reporting period.

The financial statements have been prepared on an accrual basis and in accordance with the historical cost convention, except for certain assets and liabilities at fair value. Except where stated, no allowance is made for the effect of changing prices on the results or the financial position.

The financial statements are presented in Australian dollars and values are rounded to the nearest dollar unless otherwise specified.

New Australian Accounting Standards

All new standards, amendments to standards or interpretations that were issued prior to the sign-off date and are applicable to the current reporting period did not have a material effect, and are not expected to have a future material effect, on the Corporation's financial statements.

Taxation

The Corporation is exempt from all forms of taxation except Fringe Benefits Tax (FBT), State payroll taxes and the Goods and Services Tax (GST).

Events after the Reporting Period

There was no subsequent event that had the potential to significantly affect the ongoing structure and financial activities of the Corporation.

Accounting Judgements and Estimates

In the process of applying the Corporation's accounting policies, management has made a number of judgements and applied estimates and assumptions to future events. Information around judgements and estimates which are material to the financial statements are found in the following notes:

· Note 3.1 Employee Provisions
· Note 4.1 Available-for-sale financial assets

1. Financial Performance

This section analyses the financial performance of the Corporation for the year ended 2018.

1.1 Expenses

	2018 $	2017 $
1.1A: EMPLOYEE BENEFITS		
Wages and salaries	**1,725,528**	1,645,465
Superannuation:		
Defined contribution plans	**153,703**	152,565
Defined benefit plans	**32,323**	20,664
Leave and other entitlements	**139,052**	184,153
Total employee benefits	**2,050,606**	2,002,847

Accounting Policy
Accounting policies for employee related expenses are contained in the People and Relationships section.

1.1B: SUPPLIERS		
Goods and services supplied and rendered		
Corporate governance	**163,928**	163,275
Consultants	**363,880**	208,857
Corporate services	**28,615**	17,073
Information technology	**210,584**	233,221
Legal services	**77,617**	23,253
Levy management	**33,095**	23,876
Personnel services	**51,187**	78,376
Property services	**77,417**	87,811
General administration	**55,973**	49,890
Total goods and services supplied or rendered	**1,062,296**	885,632
Goods supplied	**126,831**	86,127
Services rendered	**935,465**	799,505
Total goods and services supplied or rendered	**1,062,296**	885,632
Other supplier expenses		
Operating lease rentals	**94,456**	111,865
Remuneration of auditors	**18,000**	22,000
Workers compensation expenses	**3,394**	3,325
Total other supplier expenses	**115,850**	137,190
Total supplier expenses	**1,178,146**	1,022,822

1.1 Expenses

	2018 $	2017 $

Leasing commitments
The Corporation does not have any leased motor vehicles at 30th June 2018.

Accounting Policy
Operating lease payments are expensed on a straight-line basis which is representative of the pattern of benefits derived from the leased assets.

1.1C: GRANTS

Public sector:		
Australian Government entities	**4,492,956**	3,885,913
State and Territory Governments	**6,154,949**	5,806,715
Universities & Colleges	**6,075,849**	6,288,740
Corporate extension activities	**647,256**	557,136
Private sector:		
Commercial entities	**4,184,503**	4,336,596
Total grants	**21,555,513**	20,875,100

Research grant commitments
The Corporation in its capacity as grantor has agreements for research grants payable that are commitments tied to the future performance of research, development and extension activities. Research grant commitments are Agreements Equally Proportionately Unperformed.

Internally funded	**11,726,315**	15,102,277
Funded through research grant revenue	**5,955,862**	10,880,959
Total research grant commitments payable	**17,682,177**	25,983,236

1.2 Own-Source Revenue and Gains

	2018 $	2017 $
OWN-SOURCE REVENUE		
1.2A: INTEREST		
Deposits	**896,533**	1,077,822
Total interest	**896,533**	1,077,822

Accounting Policy
Interest revenue is recognised by using the effective interest method.

1.2B: ROYALTIES		
Royalties	**1,080,040**	584,768
Total royalties	**1,080,040**	584,768

Accounting Policy
Revenue from royalties is recognised on an accruals basis in accordance with the substance of the relevant agreements except when the royalty cannot be measured with sufficient reliability. In the latter case, royalty revenue is recognised based on cash received.

1.2C: RESEARCH GRANTS		
Research grants	**4,273,184**	6,718,580
Total research grants	**4,273,184**	6,718,580

Research grant commitments receivable
The Corporation in its capacity as grantee has agreements for research grants receivable that are commitments tied to the future performance of research, development and extension activities and project milestones.

Rural R&D for Profit - Smarter irrigation for profit	**159,288**	477,852
Rural R&D for Profit - Accelerating precision agriculture to decision agriculture	**-**	826,561
Rural R&D for Profit - More profit from nitrogen: enhancing the nutrient use efficiency of intensive cropping and pasture systems	**3,102,870**	5,275,771
Other research grant commitments	**740,000**	1,575,158
Total research grant commitments receivable	**4,002,158**	8,155,342

Accounting Policy

Research Grants

Grant funding received from Industry, State or Commonwealth agencies is recognised when the funds are received from the grantor.

1.2 Own-Source Revenue and Gains

	2018 $	2017 $
1.2D: OTHER REVENUE		
Project refunds	**804,622**	942,430
Rental income	**5,000**	5,000
Other revenue	**6,384**	10,916
Total other revenue	**816,006**	958,346
REVENUE FROM GOVERNMENT		
1.2E: REVENUE FROM GOVERNMENT		
Department of Agriculture and Water Resources:		
PIRD Act 1989 Contribution	**9,088,958**	6,128,948
Total revenue from Government	**9,088,958**	6,128,948
1.2F: LEVIES AND PENALTIES		
Industry Levies	**9,088,958**	6,128,948
Penalties	**3,809**	2,391
Total levies and penalties	**9,092,767**	6,131,339

Accounting Policy

Revenue from Government

Funding received or receivable from non-corporate Commonwealth entities (appropriated to the Department of Agriculture and Water Resources as a corporate Commonwealth entity payment item for payment to this Corporation) is recognised as Revenue from Government unless the funding is in the nature of an equity injection or a loan. Revenue from the Department of Agriculture and Water Resources is recognised on an accrual basis from the date that the Department of Agriculture and Water Resources notifies the Corporation of the amount receivable. Revenue from government includes:

a) Industry Levies: Under section 30(1)(a) of the *Primary Industries Research and Development 1989 Act* (PIRD Act), CRDC received cotton industry levies. This contribution to the Corporation is collected and distributed by the Australian Government under the *Primary Industries (Excise) Levies 1999 Act*.

b) PIRD Act 1989 Contributions: Under section 30(1)(b) of the PIRD Act, the Australian Government provides matching payments, within certain parameters, equal to one half of the amount expended by the Corporation. Matching payments are recognised as Revenue from Government when the necessary expenditure is recognised.

2. Financial Position

This section analyses the Corporation's assets used to conduct its operations and the operating liabilities incurred as a result.
Employee related information is disclosed in the People and Relationships section.

2.1 Financial Assets

	2018 $	2017 $
2.1A: CASH AND CASH EQUIVALENTS		
Cash on hand or on deposit	**7,037,525**	15,071,075
Total cash and cash equivalents	**7,037,525**	15,071,075
2.1B: INVESTMENTS HELD TO MATURITY		
Term deposits	**28,000,000**	20,000,000
Total investments held to maturity	**28,000,000**	20,000,000

Accounting Policy

Non-derivative financial assets with fixed or determinable payments and fixed maturity dates that the Corporation has the positive intent and ability to hold to maturity are classified as held-to-maturity investments. Held-to-maturity investments are recorded at amortised cost using the effective interest method less impairment, with revenue recognised on an effective yield basis.

2.1C: TRADE AND OTHER RECEIVABLES		
Goods and services receivables		
Goods and services	**47,603**	97,992
Total goods and services receivables	**47,603**	97,992
Government receivables		
Department of Agriculture and Water Resources		
— PIRD Act 1989 Contributions receivable	**2,329,200**	2,118,268
— Industry levies receivable	**2,291,872**	1,913,663
Total government receivables	**4,621,072**	4,031,931
Other receivables		
GST receivable from the Australian Taxation Office	**370,073**	523,719
Interest	**84,441**	342,411
Total other receivables	**454,514**	866,130
Total trade and other receivables	**5,123,189**	4,996,053

No indicators of impairment were found for trade and other receivables.

Accounting Policy

Receivables

Trade receivables and other receivables that have fixed or determinable payments and that are not quoted in an active market are classified as 'receivables'. Receivables are measured at amortised cost using the effective interest method less impairment.

2.1 Financial Assets

	2018 $	2017 $
2.1D: OTHER INVESTMENTS		
Shares in unlisted companies	**87,588**	-
Net other investments	**87,588**	-

Accounting Policy

The Corporation has invested in seed preference shares in an unlisted start-up company, Flurosat Pty Ltd, over which it does not have significant influence or control. The company has been established for the purpose of commercialisation of intellectual property that may benefit the Australian cotton industry and other agriculture sectors in Australia and worldwide.

Investments in unlisted companies are accounted for in accordance with AASB 139 *Financial Instruments: Recognition and Measurement,* and have been designated as 'available-for-sale' financial assets and are expected to be recovered in more than 12 months.
See note 4.1 for further information.

2.2 Non-Financial Assets

2.2A: RECONCILIATION OF THE OPENING AND CLOSING BALANCES OF PROPERTY, PLANT, EQUIPMENT AND INTANGIBLES

	Land	Buildings	Property, plant and equipment	Computer software[1]	Total
	$	$	$	$	$
As at 1 July 2017					
Gross book value	**190,000**	**558,560**	**227,253**	**509,700**	**1,485,513**
Accumulated depreciation, amortisation and impairment		**(27,421)**	**(148,654)**	**(308,808)**	**(484,883)**
Net book value 1 July 2017	**190,000**	**531,139**	**78,599**	**200,892**	**1,000,630**
Additions - Purchases	-	-	**210,219**	**316,326**	**526,545**
Revaluations recognised in other comprehensive income	-	**18,251**			**18,251**
Impairments recognised in net cost of services				-	-
Depreciation and amortisation		**(14,390)**	**(45,998)**	**(217,326)**	**(277,714)**
Disposals:					
Gross book value	-	-	-	-	-
Accumulated depreciation and impairment	-	-	-	-	-
Net book value 30 June 2018	**190,000**	**535,000**	**242,820**	**299,892**	**1,267,712**
Net book value as of 30 June 2018 represented by:					
Gross book value	**190,000**	**535,000**	**437,472**	**826,026**	**1,988,498**
Accumulated depreciation, amortisation and impairment		-	**(194,652)**	**(526,134)**	**(720,786)**
Total net book value as at 30 June 2018	**190,000**	**535,000**	**242,820**	**299,892**	**1,267,712**

1. The carrying amount of computer software included $108,649 (2017 $5,274) purchased software and $191,243 (2017 $195,618) internally generated software.

No indicators of impairment were found in 2018 (2017: $nil).

No non-financial assets are expected to be sold or disposed of within the next 12 months.

Revaluations of non-financial assets

All revaluations were conducted in accordance with the revaluation policy stated below. On 30th June 2018, an independent valuer conducted the revaluation.

Land valuation has not changed.

A revaluation increment of $18,251 for buildings on freehold land (2017: $nil) was credited to the asset revaluation surplus by asset class and included in the equity section of the Statement of Financial Position.

2.2B: Fair Value Measurement

	Fair value measurements at the end of the reporting period	
	2018 **$**	2017 $
Non-financial assets		
Land	**190,000**	190,000
Buildings on freehold land	**535,000**	531,139
Other property, plant and equipment	**242,820**	78,599
Total non-financial assets	**967,820**	799,738
Total fair value measurements of assets in the statement of financial position	**967,820**	799,738

Accounting Policy

Fair value measurement of non-financial assets are based on Level 2 inputs that are observable for the asset either directly or indirectly. The fair value of theses assets do not have quoted prices in active markets (Level 1 inputs).

Land is assessed using market comparables being the sale prices of comparable land for similar land size and long-term land appreciation rates.

Buildings on freehold land are assessed using the discounted cash flow of future potential rental income adjusted for the market rate of interest.

Other property, plant and equipment is assessed using the depreciated replacement cost based on market prices of similar assets less depreciation.

Acquisition of Assets

Assets are recorded at cost on acquisition except as stated below. The cost of acquisition includes the fair value of assets transferred in exchange and liabilities undertaken. Financial assets are initially measured at their fair value plus transaction costs where appropriate.

Assets acquired at no cost, or for nominal consideration, are initially recognised as assets and income at their fair value at the date of acquisition, unless acquired as a consequence of restructuring of administrative arrangements. In the latter case, assets are initially recognised as contributions by owners at the amounts at which they were recognised in the transferor's accounts immediately prior to the restructuring.

Asset Recognition Threshold

Purchases of property, plant and equipment are recognised initially at cost in the statement of financial position, except for purchases costing less than $1,000, which are expensed in the year of acquisition (other than where they form part of a group of similar items which are significant in total).

The initial cost of an asset includes an estimate of the cost of dismantling and removing the item and restoring the site on which it is located.

Accounting Policy (cont.)

Revaluations

Following initial recognition at cost, property, plant and equipment are carried at fair value less subsequent accumulated depreciation and accumulated impairment losses. Valuations are conducted with sufficient frequency to ensure that the carrying amounts of assets did not differ materially from the assets' fair values as at the reporting date. The regularity of independent valuations depended upon the volatility of movements in market values for the relevant assets.

Revaluation adjustments are made on a class basis. Any revaluation increment is credited to equity under the heading of asset revaluation reserve except to the extent that it reversed a previous revaluation decrement of the same asset class that was previously recognised in the surplus/deficit. Revaluation decrements for a class of assets are recognised directly in the surplus/deficit except to the extent that they reversed a previous revaluation increment for that class.

Any accumulated depreciation as at the revaluation date is eliminated against the gross carrying amount of the asset and the asset was restated to the revalued amount.

Depreciation

Depreciable property, plant and equipment assets are written-off to their estimated residual values over their estimated useful lives to the Corporation using, in all cases, the straight-line method of depreciation.

Depreciation rates (useful lives), residual values and methods are reviewed at each reporting date and necessary adjustments are recognised in the current, or current and future reporting periods, as appropriate.

Depreciation rates applying to each class of depreciable asset are based on the following useful lives:

	2018	2017
Buildings on freehold land	**40 years**	40 years
Property, plant and equipment	**3 to 10 years**	3 to 10 years

Impairment

All assets were assessed for impairment at 30 June 2018. Where indications of impairment exist, the asset's recoverable amount is estimated and an impairment adjustment made if the asset's recoverable amount is less than its carrying amount.

The recoverable amount of an asset is the higher of its fair value less costs of disposal and its value in use. Value in use is the present value of the future cash flows expected to be derived from the asset. Where the future economic benefit of an asset is not primarily dependent on the asset's ability to generate future cash flows, and the asset would be replaced if the Corporation were deprived of the asset, its value in use is taken to be its depreciated replacement cost.

Derecognition

An item of property, plant and equipment is derecognised upon disposal or when no further future economic benefits are expected from its use or disposal.

Intangibles

The Corporation's intangibles comprise of purchased and internally developed software for internal use. These assets are carried at cost less accumulated amortisation and accumulated impairment losses.

Software is amortised on a straight-line basis over its anticipated useful life. The useful lives of the Corporation's software are 3 to 5 years (2017: 3 to 5 years).

All software assets were assessed for indications of impairment as at 30 June 2018.

2.3 Payables		
	2018 $	2017 $
2.3A: SUPPLIERS		
Trade creditors and accruals	**112,359**	72,638
Total suppliers	**112,359**	72,638
Settlement is usually made within 30 days.		
2.3B: GRANTS		
Grants		
Public sector		
Australian Government entities	**628,152**	475,027
State and Territory Governments	**533,821**	626,752
Universities and Colleges	**1,233,320**	1,154,578
Other research organisations	**-**	154,400
Private sector		
Other	**767,719**	575,297
Total grants	**3,163,012**	2,986,054
All grants payable are expected to be settled within 12 months. Settlement is usually within 30 days of completion of milestones and receipt of a tax invoice.		
2.3C: OTHER PAYABLES		
PAYG & FBT payable	**63,009**	55,875
State payroll tax	**9,446**	10,775
Total other payables	**72,455**	66,650

3. People and Relationships

This section describes a range of employment and post employment benefits provided to our people and our relationships with other key people.

3.1 Employee Provisions

	2018 $	2017 $
3.1A: EMPLOYEE PROVISIONS		
Leave	**451,330**	406,906
Total employee provisions	**451,330**	406,906

Accounting Policy

Liabilities for short-term employee benefits and termination benefits expected within twelve months of the end of the reporting period are measured at their nominal amounts.

Leave

The liability for employee benefits includes provision for annual leave and long service leave.

The leave liabilities are calculated on the basis of employees' remuneration at the estimated salary rates that will be applied at the time the leave is taken, including the Corporation's employer superannuation contribution rates to the extent that the leave is likely to be taken during service rather than paid out on termination.

The liability for long service leave has been determined by reference to the Department of Finance standard parameters for the Long Service Leave Shorthand Method set out in the Financial Reporting Rule. The estimate of the present value of the liability takes into account attrition rates and pay increases through promotion and inflation.

Separation and Redundancy

Provision is made for separation and redundancy benefit payments. The Corporation recognises a provision for termination when it has developed a detailed formal plan for the terminations and has informed those employees affected that it will carry out the terminations.

3.2 Key Management Personnel Remuneration

Key management personnel are those persons having authority and responsibility for planning, directing and controlling the activities of the Corporation, directly or indirectly, including any director (whether executive or otherwise) of the Corporation. The Corporation has determined the key management personnel to be the Directors, Executive Director and General Managers. Key management personnel remuneration is reported in the table below:

	2018 **$**	2017 $
Short-term employee benefits	**760,928**	715,483
Post-employment benefits	**72,110**	67,255
Other long-term employee benefits	**51,069**	64,427
Total key management personnel remuneration expenses	**884,107**	847,165

Notes: The total number of key management personnel that are included in the above table are 10 (2017: 9).

3.3 Related Party Disclosures

The Corporation is an Australian Government controlled entity. Key management personnel include the directors and executive management.

Given the breadth of Government activities, related parties may transact with the government sector in the same capacity as ordinary citizens. These transactions have not been separately disclosed in this note.

Certain key management personnel related entities have transactions with the Corporation that occur within normal customer or supplier relationships on terms and conditions no more favourable than those which it is reasonable to expect the Corporation would have adopted if dealing with the director-related entity at arm's length in similar circumstances. Section 15 of the PGPA Rule 2014 is applied by the Board when a Director gives notice of a material personal interest in a matter. These transactions include the following entities and have been described below where the transactions are considered likely to be of interest to users of these financial statements:

	2018 $	2017 $
Transactions with Related Parties		
Kathryn Adams is a non-executive director of D2D CRC Ltd which received funding from CRDC for projects:		
RRDP1705 "Precision to decision - data systems" for the project term of 1/7/2016 to 30/12/2017.	**70,146**	395,595
Elizabeth Alexander is a non-executive director of Plant Health Australia (PHA) which received funding from CRDC for membership to PHA and collaborative plant biosecurity projects.	**11,090**	21,090
Total transactions with related parties	**81,236**	416,685

4. Managing Uncertainties

This section analyses how the Corporation manages financial risks within its operating environment.

4.1 Financial Instruments

	2018 $	2017 $
4.1A: CATEGORIES OF FINANCIAL INSTRUMENTS		
Financial Assets		
Held-to-maturity investments		
Term deposits	**28,000,000**	20,000,000
Total held-to-maturity investments	**28,000,000**	20,000,000
Available-for-sale financial assets		
Shares in unlisted companies	**87,588**	-
Total available-for-sale financial assets	**87,588**	-
Loans and receivables		
Cash and cash equivalents	**7,037,525**	15,071,075
Trade and other receivables	**132,044**	440,403
Total loans and receivables	**7,169,569**	15,511,478
Total Financial Assets	**35,257,157**	35,511,478
Financial Liabilities		
Financial liabilities measured at amortised cost		
Grants payable	**3,163,012**	2,986,054
Suppliers payable	**112,359**	72,638
Total financial liabilities measured at amortised cost	**3,275,371**	3,058,692

4.1B: FAIR VALUE INFORMATION BY FINANCIAL ASSET CLASS		
Available-for-sale financial assets have been valued under the following fair value hierarchy: · Level 3: inputs that are not observable and involve significant judgement.		
Movements in available-for-sale financial assets		
Opening balance	**-**	-
Purchases of shares in unlisted companies	**110,000**	-
Fair value gains/(losses) through other comprehensive income	**(22,412)**	-
Closing balance of available-for-sale financial assets	**87,588**	-

Accounting Policy

Financial assets

The entity classifies its financial assets in the following categories:

a) held-to-maturity investments;
b) available-for-sale financial assets; and
c) loans and receivables.

The classification depends on the nature and purpose of the financial assets and is determined at the time of initial recognition. Financial assets are recognised and derecognised upon trade date.

Effective Interest Method

Income is recognised on an effective interest rate basis except for financial assets that are recognised at fair value through profit or loss.

Available-for-Sale Financial Assets

Available-for-sale financial assets are non-derivatives that are either designated in this category or not classified in any of the other categories.

Available-for-sale financial assets are recorded at fair value. Gains and losses arising from changes in fair value are recognised directly in reserves (equity) with the exception of impairment losses. Interest is calculated using the effective interest method and foreign exchange gains and losses on monetary assets are recognised directly in profit or loss. Where the asset is disposed of or is determined to be impaired, part (or all) of the cumulative gain or loss previously recognised in the reserve is included in surplus and deficit for the period.

The Corporation holds shares in the following unlisted company:

· Flurosat Pty Ltd (holding 3.2%) is a start-up researching and developing image data analytics for crop management.

Significant accounting judgements and estimates for unlisted companies:

The shares in the unlisted company have been valued based on 'share of net assets' determined from the best information available (level 3 inputs) as the unlisted company is in start-up phase and future cash flows are uncertain.

Impairment of Financial Assets

Financial assets are assessed for impairment at the end of each reporting period.

Financial assets held at amortised cost – if there is objective evidence that an impairment loss has been incurred for loans and receivables or held-to-maturity investments held at amortised cost, the amount of the loss is measured as the difference between the asset's carrying amount and the present value of estimated future cash flows discounted at the asset's original effective interest rate. The carrying amount is reduced by way of an allowance account. The loss is recognised in the Statement of Comprehensive Income.

Available for sale financial assets – if there is objective evidence that an impairment loss on an available-for-sale financial asset has been incurred, the amount of the difference between its cost, less principal repayments and amortisation, and its current fair value, less any impairment loss previously recognised in expenses, is transferred from equity to the Statement of Comprehensive Income.

Financial assets held at cost – if there is objective evidence that an impairment loss has been incurred, the amount of the impairment loss is the difference between the carrying amount of the asset and the present value of the estimated future cash flows discounted at the current market rate for similar assets.

Financial liabilities

Grants and Suppliers payable are recognised at amortised cost. Liabilities are recognised to the extent that the goods or services have been received (and irrespective of having been invoiced).

	2018 $	2017 $
4.1C: NET GAINS OR LOSSES ON FINANCIAL ASSETS		
Held-to-maturity investments		
Interest revenue	**602,050**	878,607
Net gain on held-to-maturity investments	**602,050**	878,607
Loans and receivables		
Interest revenue	**294,483**	199,215
Net gain from loans and receivables	**294,483**	199,215
Available-for-sale financial assets		
Gain/(Losses) on available-for-sale financial assets	**(22,412)**	-
Net gains/(losses) from available-for-sale assets	**(22,412)**	-
Net gain from financial assets	**874,121**	1,077,822

Section 7

Appendices

MELANIE JENSON

APPENDIX 1: Annual Performance Statement

CRDC's purpose is the adoption of innovation that leads to increased productivity, competitiveness and environmental sustainability of the Australian cotton industry and the wider community, through investment in RD&E.

CRDC's RD&E investments are governed by the Strategic R&D Plan 2013-18, which outlines five key investment programs – farmers, industry, customers, people, and performance. 2017-18 marked CRDC's final year of operation under this Strategic Plan.

Each year CRDC completes an analysis of performance against the Strategic Plan measures. Progress is measured through the CRDC monitoring and evaluation framework. Each of the measures of success outlined in the Strategic Plan have corresponding metrics, against which performance is measured through annual quantitative and qualitative surveys.

The Annual Performance Statement below shows CRDC achievements against the Strategic Plan programs as of 30 June 2018.

Certification by the Executive Director

I, Bruce Finney as the accountable authority of Cotton Research and Development Corporation (CRDC), present the 2017-18 Annual Performance Statement of CRDC, as required under paragraph 39(1) (a) of the *Public Governance, Performance and Accountability Act 2013*.

In my opinion, this Annual Performance Statement is based on properly maintained records, accurately reflects the performance of the entity and complies with sub section 39(2) of the PGPA Act 2013, and is in accordance with 16F of the PGPA Rule 2014.

Bruce Finney
Executive Director
Cotton Research and Development Corporation

15 October 2018

Cotton Research and Development Corporation—Performance criteria	
Outcome 1	Adoption of innovation that leads to increased productivity, competitiveness and environmental sustainability through investment in research and development that benefits the Australian cotton industry and the wider community.
Objectives	**Farmers – cotton is profitable and consistently farmers' crop of choice.** Deliver RD&E for cotton producers to increase productivity, successfully protect crops from threats, optimise resource efficiencies, and innovate for improved profitability.
	Industry – the Australian cotton industry is the global leader in sustainable agriculture. Deliver RD&E for the cotton industry for stewardship of its production technologies and its biosecurity, to lead in responsible landscape management and achieve its vision for a sustainable future.
	Customers – the Australian cotton industry captures the full value of its products. Deliver RD&E for the cotton industry to set global benchmarks for cotton qualities and quality assurance, differentiate the value of Australian cotton products to customers and transform the competitive future for the Australian cotton industry.
	People – capable and connected people driving the cotton industry. Deliver RD&E for the cotton industry to ensure workforce capacity, effective networks and communication.
	Performance – measured performance of the Australian cotton industry and its RD&E drives continuous improvement. Deliver RD&E which supports a best practice framework for the cotton industry, captures and demonstrates performance and conduct reviews which enable continuous improvement by CRDC and the industry.
Delivery	**Farmers – cotton is profitable and consistently farmers' crop of choice.** Strategically prioritise investment in basic, applied and blue-sky research collaboratively with research and cross-sectoral partners to develop new knowledge, practices and technologies for on-farm application by cotton farmers.
	Industry – the Australian cotton industry is the global leader in sustainable agriculture. Strategically prioritise investment in basic, applied and blue-sky research collaboratively with research and cross-sectoral partners to develop new knowledge, practices and innovative approaches to solve industry issues.
	Customers – the Australian cotton industry captures the full value of its products. Strategically prioritise investment in basic, applied and blue-sky research collaboratively with research partners to develop new knowledge, practices, processes, higher value and novel products for the Australian cotton industry and its customers.
	People – capable and connected people driving the cotton industry. Strategically prioritise investment in research, development and extension collaboratively with research, industry and cross-sectoral partners to develop new knowledge, human capacity, support communication and adoption of R&D results.
	Performance – measured performance of the Australian cotton industry and its RD&E drives continuous improvement. Strategically prioritise investment in research, development, data capture and analysis, reviews and extension with research, industry and cross-sectoral partners to drive performance outcomes.

Performance information 2017-18			
Year	Performance criteria	Targets	Achievement against targets
2017-18	**Farmers – cotton is profitable and consistently farmers' crop of choice.** Industry productivity growth per hectare per annum.	3 per cent per hectare per annum.	Average annual increase in yield for the five years of the 2013-2018 Strategic Plan was maintained at 3 per cent per hectare per year despite reduced yields in 2016-17. The compounding annual growth remained at just above 2 per cent for the five-year period.
	Industry – the Australian cotton industry is the global leader in sustainable agriculture. Industry reports to customer needs for sustainability indicators.	Achieved through responses to the *2014 Australian Grown Cotton Sustainability Report* and Third Environmental Assessment.	The Australian cotton industry was the first agricultural industry in Australia to develop and document its performance against specific environmental, economic and social sustainability indicators. The *2014 Australian Grown Cotton Sustainability Report* developed and benchmarked 45 key sustainability indicators for the Australian cotton industry. The cotton industry is committed to ongoing sustainability reporting, and with significant CRDC support has developed a range of new sustainability targets. Benchmarks as at June 2018 for these targets are: ▪ 1.1 bales/ML (GPWI) ▪ 10 kg lint/kg of nitrogen ▪ 6 per cent of farm native vegetation managed for conservation ▪ 383 kg of CO_2e per bale of cotton produced.
	Customers – the Australian cotton industry captures the full value of its products. Customers continue to demand Australian cotton products.	Double the premium for Australian cotton.	CRDC invested in a number of projects to investigate and improve the quality of Australian cotton, and while successful, environmental impacts such as rainfall at harvest can reduce the overall quality of Australian cotton, resulting in Australia maintaining its premium rather than doubling the premium. While maintaining efforts to improve fibre quality and develop systems that alleviate risk to quality, CRDC has furthered its research efforts to develop novel high-value uses for Australian cotton. These approaches are longer term initiatives and will make Australian cotton more competitive with man-made fibres.

Performance information 2017-18			
Year	Performance criteria	Targets	Achievement against targets
2017-18	**People – capable and connected people driving the cotton industry.** Implementation of the Cotton Industry Workforce Development Strategy.	Measured improvement in the capacity of farmers to attract, retain and develop people.	CRDC and Cotton Australia collaborated to deliver the industry's first Workforce Development Strategy in 2015-16, and in 2016-17, the strategy resulted in $14.7 million in vocational training funding from the NSW Government being made available through Cotton Australia for NSW cotton and grains industries. In addition CRDC has continued support for 10 industry leadership and development programs. A study published by CRDC in 2017 to better understand and build the role of women's participation in the Australian cotton industry determined that 88 per cent of women in an industry role and 86 per cent of women on cotton farms have a diploma, degree or higher qualification, with 71 per cent involved in making major business decisions.
	Performance – measured performance of the Australian cotton industry and its RD&E drives continuous improvement. Coverage of Best Management Practice systems across cotton industry.	Goal of 80 per cent of cotton farms participating.	CRDC's RD&E underpins the industry's best management practices program, *my*BMP, with industry participation in the program now at 78 per cent. In addition, CRDC's monitoring and evaluation (M&E) framework enables ongoing performance reporting. In 2017-18, CRDC continued to measure its performance and that of the industry through M&E, including a survey of growers, a survey of consultants, an economic analysis of the industry's performance, a longitudinal study of investments, and impact assessments of specific project clusters.

Individual program performance under the CRDC Strategic Plan

Program 1: Farmers		
Theme: Successful Crop Protection		
Outcome: Cotton crops protected from pest, weed and disease threats		
Will be achieved by:	**Measure of success**	**Achieved**
Monitoring and investigating the ecological behaviours and responses of cotton pests, weeds and diseases.	World-class science foundations for managing ecological adaptations in cotton insect pests, weeds and diseases.	Understanding the ecology of cotton pests (insect, weed and pathogens) is the focus of 12 projects, including two PhDs and one post-doctoral position. This information ensures a strong scientific basis for development of best practice, and is the foundation for implementation of integrated pest, weed and disease management strategies as well as providing key biosecurity resources. As a result of these investments, 16 peer-reviewed papers were published in this area during 17-18, including two high-impact papers (below) that are published by invitation only: ▪ The management of insect pests in Australian Cotton: An evolving story. Lewis J Wilson, Mary EA Whitehouse and Grant Herron. *Annual Review of Entomology* (2018), Volume 63: 215-237 ▪ Advances in attract-and-kill for agricultural pests: Beyond Pheromones. Peter C Gregg, Alice P Del Socorro, and Peter J Landolt. *Annual Review of Entomology* (2018), Volume 63: 453-470
Testing practices that deliver improved management of insect pests, weeds and diseases.	85 per cent of farmers adopting improved practices that reduce the reliance on pesticide inputs.	In 2017-18, more than 95 per cent of the Australian cotton crop was Bollgard 3 cotton. It is testament to the R&D that supports the ongoing stewardship of this valuable technology and the formation of a robust resistance management plan. As a result of the adoption of this technology and improved IPM practices: ▪ 90 per cent of spray decisions consider risk to bees ▪ 90 per cent of spray recommendations are based on established industry thresholds ▪ 91 per cent of farm advisors aim to conserve beneficial insects wherever possible ▪ 83 per cent of growers follow the Insect Resistance Management Strategy.

Program 1: Farmers		
Will be achieved by:	**Measure of success**	**Achieved**
Improving capacity, knowledge and adoption of techniques to successfully protect the cotton crop.	50 per cent of farmers adopting improved practices that reduce the incidence of insect pests, weeds and diseases affecting cotton on their farm.	The ecology and best practice recommendations developed by research are packaged and communicated to industry through investment in CottonInfo. The CRDC and CottonInfo *Cotton Pest Management Guide* and *Australian Cotton Production Manual* are sought-after publications with annual subscriptions of 3000 and 2800, respectively. They consistently rank as the most preferred method of receiving R&D information among consultants. CRDC research is also used annually to update the industry's best management practice program. Collectively, these efforts have resulted in: ▪ 78 per cent of growers participating in the industry's Best Management Practice Program ▪ 84 per cent of crop rotations being used as part of an integrated weed management strategy ▪ 77 per cent of cropping decisions considering cotton pest risks ▪ 77 per cent of cropping decisions considering cotton disease risks.
Theme: Productive Resource Efficiencies		
Outcome: Inputs for cotton production are optimised		
Will be achieved by:	**Measure of success**	**Achieved**
Delivering benchmarks of on-farm resource-use efficiencies.	Farmers are able to increase their productivity: ▪ per hectare of land. per unit of nitrogen fertiliser. ▪ per ML of water. ▪ per unit of CO_2 emitted.	Two projects have provided benchmarks of on-farm resource-use efficiencies for water and energy use. The Australian cotton industry has used values of Gross Production Water Use Index (GPWUI farm) to benchmark water-use efficiency since 1988-89. Commonwealth grants have also been used to benchmark energy efficiency and greenhouse gas emissions on farms. The benchmarks for leading indicators determined during 17-18 are: ▪ 5-year average yield 2013-2018 of 10.67 bales/ha compared with previous 5-year average 2008-2013 of 8.9 bales/ha (19.9% increase) ▪ 7 kg of lint per kg of nitrogen used ▪ 1.22 bales of cotton per ML of water ▪ 0.6 kg lint per kg of CO_2e

Program 1: Farmers		
Will be achieved by:	**Measure of success**	**Achieved**
Developing and proving decision systems and practices that deliver optimal resource efficiencies on cotton farms.	Farmers are able to increase their productivity: ▪ per hectare of land. ▪ per unit of nitrogen fertiliser. ▪ per ML of water. ▪ per unit of CO_2 emitted.	A number of projects continue to investigate nitrogen (N), in particular looking at the interactions of irrigation and fertiliser application; developing a comprehensive understanding of the N requirements of high-yielding cotton crops; and the N loss pathways associated with each stage of the cotton farming system. The *Smarter Irrigation for Profit* project ended during 2017-18. It concluded that there is no universal best type of irrigation system and that well-designed and well-managed surface irrigation systems can achieve application efficiencies of 95 per cent. Case studies demonstrated that 10 to 20 per cent improvements in water productivity, efficiency and farmer profitability could be obtained. Research aimed at better management of carbon in cotton soils by including corn in the rotation has demonstrated the potential for a range of benefits, including the increased yield of cotton in the crop following corn; higher levels of soil carbon (especially at depth, i. e. 60–120 cm); increased cotton-root densities and rooting depth; and a decrease in black root rot infestation.
Developing new systems and tools to support farm decision-making processes.	Farmers are able to increase their productivity: ▪ per hectare of land. ▪ per unit of nitrogen fertiliser. ▪ per ML of water. ▪ per unit of CO_2 emitted.	The Rural R&D *Smarter Irrigation for Profit project* in conjunction with current irrigation projects have demonstrated that advances in the optimisation and automation of irrigation applications can drive gains in production and profit, with improvements of 10 to 20 per cent reported. Remote sensing and satellite imagery can now be used as indicators of crop stress and spatial variability, and the industry is close to fully understanding how weather forecasts and canopy temperature sensors can be used to refine scheduling decisions. Similarly, a current project is seeking to use satellite and remote sensing to improve nutrition input decisions to reduce system losses, increase efficiency and enhance system profitability.
Improving capacity, knowledge and adoption of techniques to optimise resource uses.	Farmers are able to increase their productivity: ▪ per hectare of land. ▪ per unit of nitrogen fertiliser. ▪ per ML of water. ▪ per unit of CO_2 emitted.	CRDC has launched the revised version of *NUTRIpak*, which provides growers and consultants with the latest science in cotton nutrition. CRDC also sponsored the Optimising Irrigation and Nitrogen Tour that took 12 CRDC-funded researchers to cotton farms in six cotton-growing valleys to deliver the latest outcomes from cotton irrigation and nutrition research. This tour reached over 400 growers, consultants and industry personnel.

Program 1: Farmers		
Theme: Profitable Futures		
Outcome: Innovations in cotton production		
Will be achieved by:	**Measure of success**	**Achieved**
Investigating the application of new technologies and different scientific approaches which have the potential to deliver significant improvements and economic returns to the cotton farming system.	Farmers are profitable: ▪ On-farm innovations and partnerships established to drive profitability. ▪ Improving gross margins for Australian cotton systems.	The objective of the Cotton Futures profitable futures theme is to increase cotton producer profitability through improved productivity and certainty of production. Advanced projects were incorporated as part of the Australian Government's Rural R&D for Profit program. With the support of all RDCs, the RRD4P project *Accelerating precision to decision agriculture* demonstrated that the implementation of digital agriculture across all production could increase the GVP by 25 per cent, or $20.3 billion. Improved management systems, more favourable growing conditions, and better genetics increased growers' average net profit to $1257 per ha for the five-year period 2013-2017 compared with $78 per ha for 2008-2012 (Boyce Report 2017).

Program 2: Industry		
Theme: Respected Stewardship		
Outcome: Industry protects its production technologies and its biosecurity		
Will be achieved by:	**Measure of success**	**Achieved**
Monitoring for and investigating changes in pest and weed susceptibility to biotechnologies and crop protection products used by the cotton industry.	Industry is able to maintain access to, and the effectiveness of, biotechnologies and crop protection products.	CRDC supports significant monitoring programs for conventional crop protection products and the Bt proteins Cry1Ac, Cry2Ab and VIP. These monitoring programs continue to support the robust RMP for Bt cotton as well as the Insecticide Resistance Management Strategy (IRMS) for conventional insecticides. These pre-emptive programs enable industry to respond effectively and early if a change in the resistance frequency of pest population is detected. There have been no significant increases in resistance allele frequencies in target species over the last five years. The prevalence of glyphosate resistance, however, continues to increase across broadacre agricultural production areas, largely driven by the use of glyphosate for controlling fallow weeds.
Exploring tactics and strategies that lower the risks of pesticides to the environment and resistance evolution in populations of key insect pests and weeds.	100 per cent of farmers are aware of the underlying risks of trait and agricultural chemical resistance. 100 per cent of insecticide-use decisions are consistent with the Insecticide Resistance Management Strategy (IRMS). The cotton industry demonstrates pesticide management practices that lower the risks posed to the environment and the evolution of resistance in target insect pest and weed populations.	There is a high level of awareness of the risks of trait and agricultural chemical resistance. The 2017-18 Grower Survey found that 90 per cent of growers used industry-recommended thresholds when making spray decisions in Bollgard 3 cotton, and 83 per cent of growers agreed that all their insecticide-use decisions were consistent with the IRMS. During 2017-18, CRDC and GRDC expanded their commitment to the development of a system to better enable growers and applicators to know when conditions are safe to apply agricultural chemicals. This project, which aims to minimise the likelihood of off-target movement of crop protection chemistries, will develop a network of towers covering cotton- and grain-growing regions across the eastern states.
Developing and supporting the industry's capacity to effectively steward key technologies and products.	The cotton industry has the necessary science to provide informed input into the development of resistance management plans for biotech traits.	The development of an effective resistance management plan (RMP) for Bollgard 3 cotton and the current development of an RMP for next-generation herbicide-tolerant cotton demonstrates the scientific capacity of the Australian cotton industry.

Program 2: Industry		
Will be achieved by:	**Measure of success**	**Achieved**
Supporting the industry's preparedness and ability to deal with biosecurity threats.	Industry is capable of managing its biosecurity responsibilities: ▪ The cotton industry is able to meet its biosecurity obligations. ▪ The cotton industry is prepared to effectively respond to biosecurity incursions.	CRDC is actively supporting the Plant Biosecurity Research Initiative (PBRI) involving all of the plant-based RDCs formed during 16-17. This initiative is enabling the plant-based RDCs to more effectively collaborate and co-invest in biosecurity issues common to these industries and develop the required capacity to support biosecurity research in Australia. Investments further support surveillance in Australia's near neighbours to identify the existence of pest and disease threats that might affect Australian industries, resulting in greater preparedness for biosecurity incursions. Biosecurity awareness in the cotton industry is promoted through industry publications and CottonInfo. The CottonInfo team have undertaken specialist biosecurity training and are an important resource if an incursion is detected.

Program 2: Industry		
Theme: Responsible Landscape Management		
Outcome: Industry leads in managing natural assets		
Will be achieved by:	**Measure of success**	**Achieved**
Defining the values and drivers relating to the management of natural landscapes and systems in cotton-growing regions	Industry participation in the collective management of natural landscapes: ▪ Regional delivery partnership for every major cotton-growing region.	Following the release of the 2014 *Australian Grown Cotton Sustainability Report,* the industry's sustainability working group, supported by CRDC and Cotton Australia, has developed 10 key targets to support the industry vision for Australia to be a global leader in sustainable cotton production. These targets, which cover a range of environmental, social and economic topics, aim to address the largest impacts of cotton production. Achievement of the targets at both a regional and national scale are supported by Cotton's NRM technical lead and through the CottonInfo Joint Venture partnership.
Recording and demonstrating improved environmental performance of the cotton industry.	Industry contributes to the improvement of landscape systems knowledge and science: ▪ A comprehensive database documenting the extent and condition of the natural assets the industry utilises and manages.	A Rural R&D for Profit round 3 project led by Forest and Wood Products Australia is applying natural capital accounting on cotton enterprises to value the natural capital asset base and to improve soil, water and natural resource management practices to increase environmental sustainability. Under this project, an inventory of primary natural asset data (vegetation map, soils, water resources) has been compiled and mapped, while secondary data sets (patch size and connectivity) are currently being compiled.
Identifying and proving integrated management strategies which deliver environmental and productivity gains.	Recognition by national and global initiatives for biodiversity management.	Current investments have demonstrated the value to cotton growers of using native vegetation to support insect and pest control in cotton production environments. A paper published in the *Ecological Management and Restoration* journal provides economic, yield and insect data to demonstrate direct ecosystem service benefits to production. Yields produced under this management system were equivalent to yields under conventional management, but production costs were 10 per cent less than the average of the top 20 per cent of growers.
Researching the connectivity between cotton farms and natural systems in the landscape.	One million hectares of floodplain vegetation managed under best practice.	Investments have demonstrated the value of best practice management of floodplain vegetation and have provided knowledge for key environmental assets in cotton landscapes – riparian vegetation, deep drainage, groundwater and ecosystem services.
Supporting initiatives and partnerships to improve the knowledge and capacity to manage natural landscapes and systems in cotton regions.	Two national science-based collaborations for the industry to inform surface and groundwater management.	Two national science-based collaborations were established to better understand aquifer recharge and water quality. A groundwater health index has been developed, which the European Union is interested in, that shows as much as 70 per cent of groundwater in some locations is sourced directly from the Great Artesian Basin.

Program 2: Industry		
Theme: Sustainable Futures		
Outcome: An industry achieving its vision		
Will be achieved by:	**Measure of success**	**Achieved**
Scoping and investigating critical threats and opportunities which may influence the long-term sustainability of the Australian cotton industry.	Industry is capable of leading and adapting to change.	The objective of the Cotton Futures sustainable futures theme is to achieve an increasingly resilient and responsible cotton industry. In 2017-18, 62 trends likely to affect the Australian cotton industry were identified and narrowed down to 16 likely to have a significant impact. Key factors likely to affect the sustainability of the Australian cotton industry included: ▪ Social licence ▪ Water ▪ Energy ▪ Climate ▪ Workforce ▪ Connectivity and data. These trends underpin CRDC's 2018-23 Strategic RD&E Plan, and are pivotal in assisting the industry achieve its Vision 2029.
Supporting innovative approaches to solve traditional industry issues and drive future sustainability.	Innovations and partnerships established to drive cotton industry sustainability.	The objective of the Cotton Futures sustainable futures theme is to achieve an increasingly resilient and responsible cotton industry. To achieve this objective, the Australian cotton industry has developed eight sustainability targets aimed at improving the sustainability of Australian cotton across the many organisations, individuals and aspects of the cotton value chain. The Australian-Grown Cotton Sustainability Targets are to: 1. Increase irrigated cotton water-use efficiency by 20 per cent every five years 2. Reduce the carbon footprint by 15 per cent every five years 3. Increase farm biodiversity by 10 per cent every five years 4. Reduce the hazard of pesticides by 5 per cent every five years 5. Increase the amount of cotton grown per hectare of land by 15 per cent every five years 6. Increase irrigated cotton profitability by 15 per cent every five years in real terms 7. Ensure quality of work life is above national agricultural averages 8. Ensure wellbeing and social capital is equal to or above national trends.

Program 3: Customers		
Theme: Assured Cotton		
Outcome: The integrity and qualities of Australian cotton set global benchmarks for customers		
Will be achieved by:	**Measure of success**	**Achieved**
Improving Australian fibre quality testing standards and procedures and the capacity to measure and manage contamination.	Australia has the best ranking for non-contamination in the International Textile Manufacturers Federation (TMF) survey.	Research continues to further improve the non-contamination and quality status of Australian cotton, looking at harvest management, minimising plastic contamination and improving moisture management in the round-module harvester system. Contamination sensors developed with research partner CSIRO have been installed in 10 gins in Australia. These sensors enable gins to identify contaminants within modules and to be able to minimise the impact of contaminants on fibre quality.
Supporting the development and implementation of post-farmgate BMPs.	Customers recognise and use Australia's BMP standards as their guarantee of quality assurance.	Extensively updated during 2017, the BMP handbook for classing was used to audit and determine compliance with BMPs in the 2017 season. Similarly, the BMP handbook for ginning was updated in 2017 and used to audit 87 per cent of gins during the 2017 ginning season to assure compliance and quality assurance.
Developing and implementing a standardised reporting system for Australian cotton product quality and traceability.	Australia uses standardised reporting systems for product quality and traceability for farmers, industry and customers.	The recent emergence of a number of commercial technologies that provide for traceability of cotton has led to CRDC shifting its focus to developing a comprehensive understanding of the data and information needs along the entire supply chain.
Benchmarking Australian cotton against key international programs for product stewardship and sustainability.	Australia can respond to customer needs for reporting against sustainability indicators.	Sustainability indicators and targets for Australian cotton farming have been developed, informed by international initiatives, including the Better Cotton Initiative and the International Cotton Advisory Committee's Expert Panel on the Social, Economic and Environmental Impact of Cotton. Accreditation of growers through the industry's *my*BMP program now enables Australian growers to be accredited under the Better Cotton Initiative program, returning a premium to growers for the supply of *my*BMP-accredited cotton lint.
Theme: Differentiated Products		
Outcome: Customers recognise the differentiated value of Australian cotton products		
Will be achieved by:	**Measure of success**	**Achieved**
Identifying opportunities for improvements in fibre quality and cotton products.	Customers value the qualities of Australian cotton.	A number of research projects that aim to add functionality to cotton fabrics were initiated during the 2013-18 Strategic Plan. One in particular has resulted in the development of an innovative coating technique that can imbue cotton fabrics with considerably enhanced moisture-management ability. Cotton fabrics after treatment can proactively transfer water from one side to the other, leaving a nice dry environment behind. They maintain a high permeability to air and moisture even if the fabrics are fully wetted with water. The treatment also enhances heat dissipation due to moisture evaporation, and creates a transitory cooling effect. The technology is useful for the development of high-performance sportswear, summer clothing, and military uniforms. CRDC is working with research partner Deakin University to commercialise this innovative treatment.

Program 3: Customers		
Theme: Differentiated Products		
Outcome: Customers recognise the differentiated value of Australian cotton products		
Will be achieved by:	**Measure of success**	**Achieved**
Demonstrating the value of different fibre classes and defining fibre quality parameters that secure a premium market.	Customers value the qualities of Australian cotton.	A project investigating novel spinning technologies to produce fine and high-quality yarns from Australian cotton has resulted in the development of a device that significantly improves the yarn quality of cotton. CRDC is working with research partner Deakin University to commercialise this device, which will enhance the quality of Australian cotton.
Developing customer-based partnerships for the development of high-value and novel products, which differentiate Australian cotton.	Partnerships established to demonstrate the potential for differentiating Australian cotton.	Research projects have demonstrated proof of concept in improved functionality, such as enhancing the moisture management properties of cotton fabrics, adding anti-microbial activity, and enhancing the dye-ability of cotton. Commercial partnerships to exploit these innovations are being developed.
Theme: Competitive Futures		
Outcome: The demand for Australian cotton products is positively transformed		
Will be achieved by:	**Measure of success**	**Achieved**
Investigating existing and future markets for Australian cotton and communicating these findings to the Australian cotton industry.	Customers continue to demand Australian cotton products: ▪ Provide the Australian cotton industry with knowledge of fabric innovations and future market opportunities.	The objective of the competitive futures theme is to capture increased value through supply chain transformation and development of new products and markets. Research has identified new innovations in cotton functionality and high-value uses, including carbon fibre application. Based on these innovations and the potential of outcomes from new research initiatives, goals that have been included in the 2018-23 Strategic Plan include: ▪ Reduce the length and complexity of the supply chain to add $1 billion of value to the Australian cotton industry by 2029. ▪ Explore, identify and realise new end uses of cotton to add $2 billion of value to the Australian cotton industry by 2029.
Facilitating the development of new technologies and systems to improve the competitiveness of Australian cotton.	Development of alternative and high-value cotton products.	Research has demonstrated the feasibility of producing technical grade regenerated cellulose fibres for the development of bio-based carbon fibre with 40 per cent greater tensile strength than that developed from wood pulp.

Program 4: People		
Theme: Workforce Capacity		
Outcome: A skilled educated and progressive industry workforce		
Will be achieved by:	**Measure of success**	**Achieved**
Investigating effective strategies for attracting, developing and retaining people in cotton.	Opportunities for workforce development are demanded by industry.	CRDC and Cotton Australia developed the first on-farm Workforce Strategy. The strategy outlines key initiatives for attraction, retention and development of on-farm labour and, with additional investment into the People in Agriculture program, will provide key resources for growers and employees. A PhD study investigating cotton farm workers' experiences of job satisfaction found that: ▪ Perceptions that workers are valued and their employer cares about their wellbeing are directly related to their sense of job satisfaction. ▪ Farm workers' job satisfaction is important for farm business productivity because this factor closely aligns with work engagement. ▪ Investment in improving farm workers' confidence in their skills, and ensuring they feel valued and cared for, may help workers who are doing this work because of limited career options to regain a sense of capacity for choice of a career that improves their current work engagement. ▪ Investment in improving farm workers' confidence in their skills, and ensuring they feel valued and cared for, improves work engagement as these strategies lead to their higher identification with the values of farming.
Supporting initiatives which lead to the continuous improvement of human resource management, including on-farm Workplace Health and Safety.	A 10 per cent reduction in cotton farm-related injuries by 2018.	CRDC currently has invested in the AgriFutures-led Primary Industries Health and Safety Program aimed at addressing on-farm health and safety. This project has delivered campaigns to increase awareness and tactics to address specific incidents (such as rollover protection for quad bikes). CRDC has also co-invested with other RDCs in the People in Agriculture, and the *my*BMP human resource management (HRM) module update, to ensure that growers are able to access best practice information.
Understanding opportunities for greater Aboriginal participation in cotton and partnering with organisations to support the development of a culturally aware cotton workforce.	Opportunities for learning are demanded by industry.	CRDC has supported student workplace scholarships through the Aboriginal Employment Strategy. The latest placement of an Indigenous student on a cotton farm resulted in an offer of full-time employment with support to continue professional and educational development post-high school.

Program 4: People		
Theme: Workforce Capacity		
Outcome: A skilled educated and progressive industry workforce		
Will be achieved by:	**Measure of success**	**Achieved**
Supporting educational opportunities which increase the skills and knowledge of current workforces and will meet the needs of future workforces.	▪ 50 Horizon scholars by 2018. ▪ 30 completed Summer Scholarships by 2018. ▪ 300 students having completed the UNE Cotton Course by 2018. ▪ On-farm skill development. ▪ 50 cotton farmers awarded a new Diploma in Human Resources by 2018.	In 2014, CRDC and Cotton Australia developed the first on-farm Workforce Strategy, which helped Cotton Australia and GRDC attract $14.7m toward the development of the AgSkilled program. The program, administered under Training Services NSW Smart and Skilled, has provided key training and upskilling initiatives for the cotton and grains industries. In 2017-18, CRDC supported eight CRDC Summer and Honours Scholarships and seven AgriFutures Horizon Scholarships to develop undergraduate agricultural students. CRDC also invested in two new PhD scholarships and one new post-doctoral scholarship during the 2017-18 year, taking the total number of PhD scholars supported by CRDC to 15, and post-doctoral scholars to three.
Creating opportunities for, and supporting the development of, leadership skills.	Participation in leadership programs.	CRDC supported the Future Cotton Leaders program with Cotton Australia, two Nuffield scholars, and four participants in the Australian Rural Leadership Program.

Program 4: People		
Theme: Networks		
Outcome: A skilled educated and progressive industry workforce		
Will be achieved by:	**Measure of success**	**Achieved**
Establishing and empowering creative forums and initiatives which build relationships.	▪ 10 conferences and forums are coordinated which promote industry, cross-sectoral and community knowledge sharing.	CRDC provided support for the 2018 Australian Cotton Conference, supported the Australian Cotton Fibre Expo, and provided nine travel scholarships for industry researchers to attend national and international conferences for increased awareness and knowledge. As an active participant in cross-RDC collaborative forums, CRDC is developing collaborative and co-investment initiatives with fellow RDCs to ensure stakeholder needs are met. Additionally, CRDC supported numerous industry and technical forums throughout 2017-18.
Supporting and participating in collaborative cross-sectoral RD&E initiatives.	▪ CRDC is an active member of key industry and government initiatives. ▪ Agriculture Senior Officials Committee (AgSOC) cotton and cross-sectoral strategies supported.	CRDC participated in activities that include joint national strategic R&D planning with AgSOC, particularly in relation to climate change, soils and water, human capacity, communication, and impact evaluation. CRDC is a participant in the soils cross-sectoral strategy with the Department of Agriculture and Water Resources and other RDCs.
Creating and facilitating opportunities for national and international RD&E exchange.	▪ 50 travel scholarships are supported by 2018.	CRDC supported nine travel scholarships and scientific exchanges during 2017-18 to enable growers, advisors and researchers to participate in key industry, national and international forums. CRDC has established relations with its US counterpart (CottonInc), USDA and Texas Tech University, which resulted in three scientific exchanges in 2017.
Facilitating engagement with stakeholders for prioritising and capturing advice on RD&E issues. Honing research expertise and the application of science from core research disciplines.	The cotton industry has effective collaborative structures for prioritising RD&E.	CRDC supported the activities of the Cotton Australia grower advisory panels that provided advice on RD&E in 2017-18. CRDC has also introduced research partnership forums to enable greater input from researchers and external expertise to broaden idea input to cotton research. Additionally, CRDC supported the activities of the Cotton Innovation Network, which is part of the AgSOC RD&E framework and was formed to help the cotton industry RD&E strategy. The main purpose of the Cotton Innovation Network is to ensure the industry gets best value for its investment in research to achieve key outcomes.

Program 4: People		
Theme: Communication		
Outcome: Stakeholder information needs are met		
Will be achieved by:	**Measure of success**	**Achieved**
Providing information for demand-driven communication strategies and performance reporting	Communications systems for all CRDC stakeholders are meeting their communication needs.	CRDC invested $2.9 million in the CottonInfo joint venture during 2017-18 to help development and extension of research outcomes. One key optimism factor identified in the 2017 Grower Survey was that 59 per cent of growers said new R&D and access to that information was the number one reason to be optimistic about being involved in the cotton industry: A quote from a survey participant: "The industry is extremely well researched. That information is readily available".
Applying innovative communication methods.	The information and services derived from CRDC investments are in demand and the technologies adopted.	CRDC is continuously applying innovative communication methods to communicate the outcomes of investments to its core stakeholders and target audiences. ▪ 90 per cent of growers and 98 per cent consultants are aware of CottonInfo; ▪ 86 per cent of growers and 100 per cent of consultants believe CottonInfo has helped to improve practices.

Program 5: Performance		
Theme: Best Practice		
Outcome: World's best practice underpins the performance of the cotton industry		
Will be achieved by:	**Measure of success**	**Achieved**
Supporting a best practice framework as the primary integrated planning, risk management, benchmarking, knowledge development and delivery system.	The cotton industry's *my*BMP program is the primary resource for farmers accessing best practice knowledge and tools.	CRDC's invested in a review of the *my*BMP platform in 2017-18 and is working with Cotton Australia to implement the recommendations, ensuring it can meet future capability requirements.
Promoting best practices through the development and delivery Joint Venture.	▪ An 80 per cent coverage of best management practice systems across the Australian cotton industry. ▪ The cotton industry's *my*BMP program is nationally recognised and integrated with other agricultural sector best management practice programs.	CRDC has invested in the review of all of the *my*BMP modules during 2017-18 to ensure the modules reflect the latest R&D and their applicability for implementation on-farm. This has resulted in greater alignment with on-farm needs. Participation in the *my*BMP program is currently 78 per cent.

Program 5: Performance		
Theme: Monitoring and Evaluation		
Outcome: Industry and RD&E performance is captured		
Will be achieved by:	**Measure of success**	**Achieved**
Developing and implementing an internal M&E framework for evaluating CRDC's investment portfolio balance and its RD&E performance.	A rigorous monitoring and evaluation platform that measures and reports on the performance of CRDC's research and development investments.	CRDC has a rigorous M&E framework in place for evaluating the performance of its investments and to ensure compliance with the PGPA Act.
Conducting annual surveys to capture practice change.	An industry performance monitoring and evaluation framework that is consistent with national and international standards.	CRDC invests in two projects to assess industry performance: an annual Grower Survey, and a survey conducted by Crop Consultants Australia. These surveys provide details of current industry practice from a grower and a consultant perspective.
Establishing a framework through which industry performance can be nationally and internationally reported.	Providing the industry with cotton sustainability indicators and supporting its capacity to report against these indicators.	As a result of the Third Environmental Assessment, CRDC invested in a project to develop sustainability indicators, enabling the industry to report its performance at a national and international level. Since the development of the indicators, CRDC has further invested to identify eight sustainability targets to be achieved every five years, further enabling the industry to report its performance nationally and internationally.

Program 5: Performance		
Theme: Reviews		
Outcome: Continuous improvement in industry and RD&E performance		
Will be achieved by:	**Measure of success**	**Achieved**
Undertaking scientific discipline reviews of the industry's RD&E.	Independent reviews of CRDC's research and development performance.	CRDC has completed a review of its leadership and capacity-building investments, nutrition, water, sustainability, *my*BMP and Bt resistance management projects as part of its ongoing program to review the impact of RD&E that the corporation invests in and the ROI those investments deliver to stakeholders.
Commissioning and participating in independent reviews of CRDC's RD&E and organisational performance.	Independent reviews of the CRDC's research and development performance.	CRDC's M&E framework enables performance monitoring of the R&D portfolio and has participated in an external review its organisational performance during the 2017-18 year. The review has identified opportunities for improvement in CRDC's processes.
Commissioning independent reviews of the social, environmental and economic performance of the industry.	Independent reviews of the social, environmental and economic performance of the industry's performance.	CRDC invested in a project to develop sustainability indicators, enabling the industry to report its performance at a national and international level. Since the development of the indicators, CRDC has invested to identify eight sustainability targets to be achieved every five years, further enabling the industry to report its performance nationally and internationally.
Participating in cross-sectoral RD&E impact evaluations and reviews.	Independent reviews of the social, environmental and economic performance of the industry's performance.	CRDC is working with CRRDC to undertake independent impact evaluations based on the Council's approved methodology. A total of six reviews of project clusters have been undertaken to date, with CRDC being able to clearly demonstrate impact.

Appendix 2: Australian Government Priorities

CRDC is accountable to the Australian Government through the Minister for Agriculture and Water Resources and the Australian cotton industry. CRDC operates under two key pieces of legislation: the *Primary Industries Research and Development Act 1989* (PIRD Act), and the *Public Governance, Performance and Accountability Act 2013* (PGPA Act).

The PIRD Act makes provision for funding and administration of primary industry research and development with a view to:

- Increasing the economic, environmental and social benefits to members of primary industries and to the community in general by improving the production, processing, storage, transport or marketing of the products of primary industries
- Achieving the sustainable use and sustainable management of natural resources
- Making more-effective use of the resources and skills of the community in general and the scientific community in particular
- Supporting the development of scientific and technical capacity
- Developing the adoptive capacity of primary producers
- Improving accountability for expenditure on research and development activities in relation to primary industries.

Descriptions of the Australian Government's Science and Research Priorities and Rural RD&E Priorities are outlined below.

Science and Research Priorities

1: Food

1.1 Knowledge of global and domestic demand, supply chains and the identification of country-specific preferences for food (and fibre).

1.2 Knowledge of the social, economic and other barriers to achieving access to healthy Australian food (and fibre).

1.3 Enhanced food production through:

1.3.1 novel technologies, such as sensors, robotics, real-time data systems and traceability, all integrated into the production chain.

1.3.2 enhanced food production through better management and use of waste and water; increased food (and fibre) quality, safety, stability and shelf life.

1.3.3 enhanced food production through protection of food (and fibre) sources through enhanced biosecurity.

1.3.4 enhanced food production through genetic composition of food (and fibre) sources appropriate for present and emerging Australian conditions.

2: Soil and Water

2.1 New and integrated national observing systems, technologies and modelling frameworks across the soil-atmosphere-water-marine systems.

2.2 Better understanding of sustainable limits for productive use of soil, freshwater, river flows and water rights, terrestrial and marine ecosystems.

2.3 Minimising damage to, and developing solutions for restoration and remediation of, soil, fresh and potable water, urban catchments and marine systems.

3: Transport

3.1 Low-emission fuels and technologies for domestic and global markets.

3.2 Improved logistics, modelling and regulation: urban design, autonomous vehicles, electrified transport, sensor technologies, real-time data and spatial analysis.

3.3 Effective pricing, operation, and resource allocation.

4: Cybersecurity

4.1 Highly secure and resilient communications and data acquisition, storage, retention and analysis for government, defence, business, transport systems, emergency and health services.

4.2 Secure, trustworthy and fault-tolerant technologies for software applications, mobile devices, cloud computing and critical infrastructure.

4.3 New technologies and approaches to support the nation's cybersecurity: discovery and understanding of vulnerabilities, threats and their impacts, enabling improved risk-based decision making, resilience and effective responses to cyber intrusions and attacks.

4.4 Understanding the scale of the cybersecurity challenge for Australia, including the social factors informing individual, organisational, and national attitudes towards cybersecurity.

5: Energy

5.1 Low-emission energy production from fossil fuels and other sources.

5.2 New clean energy sources and storage technologies that are efficient, cost effective and reliable.

5.3 Australian electricity grids that can readily integrate and more efficiently transmit energy from all sources, including low- and zero-carbon sources.

6: Resources

6.1 A fundamental understanding of the physical state of the Australian crust, its resource endowment and recovery.

6.2 Knowledge of environmental issues associated with resource extraction.

6.3 Lowering the risk to sedimentary basins and marine environments due to resource extraction.

6.4 Technologies to optimise yield through effective and efficient resource extraction, processing and waste management.

7: Advanced Manufacturing

7.1 Knowledge of Australia's comparative advantages, constraints and capacity to meet current and emerging global and domestic demand.

7.2 Cross-cutting technologies that will de-risk, scale up, and add value to Australian manufactured products.

7.3 Specialised, high value-add areas, such as high-performance materials, composites, alloys and polymers.

8: Environmental Change

8.1 Improved accuracy and precision in predicting and measuring the impact of environmental changes caused by climate and local factors.

8.2 Resilient urban, rural and regional infrastructure.

8.3 Options for responding and adapting to the impacts of environmental change on biological systems, urban and rural communities and industry.

9: Health

9.1 Better models of health care and services that improve outcomes, reduce disparities for disadvantaged and vulnerable groups, increase efficiency and provide greater value for a given expenditure.

9.2 Improved prediction, identification, tracking, prevention and management of emerging local and regional health threats.

9.3 Better health outcomes for Indigenous people, with strategies for both urban and regional communities.

9.4 Effective technologies for individuals to manage their own health care, for example, using mobile apps, remote monitoring and online access to therapies.

Rural RD&E Priorities

1 **Advanced technology.** To enhance innovation of products, processes and practices across the food and fibre supply chains through technologies such as robotics, digitisation, big data, genetics and precision agriculture.

2 **Biosecurity.** To improve understanding and evidence of pest and disease pathways to help direct biosecurity resources to their best uses, minimising biosecurity threats and improving market access for primary producers.

3 **Soil, water and managing natural resources.** To manage soil health, improve water-use efficiency and certainty of supply, sustainably develop new production areas, and improve resilience to climate events and impacts.

4 **Adoption of R&D.** Focusing on flexible delivery of extension services that meet primary producers' needs and recognising the growing role of private service delivery.

As part of CRDC's Annual Performance Statements, the following outputs and outcomes were delivered during 2017-18 to address the Science and Research Priorities and Rural RD&E Priorities.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2017-18
Advanced technology To enhance innovation of products, processes and practices across the food and fibre supply chains through technologies such as robotics, digitisation, big data, genetics and precision agriculture.	▪ Food ▪ Soil and Water ▪ Advanced Manufacturing	Three specific focus areas were identified in cotton futures workshops to increase productivity and certainty of production: autonomous farming, agri-intelligence systems, and future cotton farms. To date, through discrete investments and through the Rural R&D for Profit Program, CRDC has invested in 10 projects to address these outcomes, including: ▪ Machine vision spot sprayer that is in incubation with John Deere ▪ A novel topical vegetable and cotton virus protection system to manage pests and diseases through RNAi ▪ Identifying advanced sensors and using digital technologies to preserve fibre quality ▪ Bio-sensors to detect key herbicides to minimise off-target impacts ▪ Developing precision management systems for improved fibre quality ▪ Smart autonomous irrigation ▪ Hyperspectral and multispectral analysis of nitrogen status and yield projection ▪ Development of a spray hazard warning system ▪ Novel spinning technology for fine and high-quality Australian cotton yarns ▪ Smart cotton and carbon fabrics.
Biosecurity To improve understanding and evidence of pest and disease pathways to help direct biosecurity resources to their best uses, minimising biosecurity threats and improving market access for primary producers.	▪ Food	▪ CRDC, along with the plant-based RDCs, continue to develop and support the Plant Biosecurity Research Initiative. The aim of this initiative is to enhance the coordination and funding for research and development, deliver vital projects and attract further co-investment to manage biosecurity risks. CRDC has been active in developing the strategic plan and framework for the PBRI to enable investment in significant biosecurity initiatives. ▪ 93 per cent of cotton growers are supportive of biosecurity measures and are more likely to consult with a private expert on finding an unusual pest or disease than other agricultural industries (79 per cent for cotton growers vs 32 per cent overall). ▪ The industry has achieved a 93 per cent decline in active ingredient per hectare (ai/ha) insecticide use. ▪ The latest CRDC-supported grower survey has found that: — 90 per cent of spray decisions consider risk to bees — 90 per cent of spray recommendations are based on established industry thresholds — 91 per cent of farm advisors aim to conserve beneficial insects wherever possible — 83 per cent follow the insect resistance management strategy — 65 per cent of the industry is financially affected by Verticillium wilt.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2017-18
Soil, water and managing natural resources To manage soil health, improve water-use efficiency and certainty of supply, sustainably develop new production areas and improve resilience to climate events and impacts.	▪ Food ▪ Soil and Water ▪ Environmental Change ▪ Health	▪ CRDC measures cotton's footprint: — Cotton yields increased by an average of 3 per cent per annum between 1990 and 2017, though lower yields in 2016-17 resulted in the average annual yield increase being 2 per cent between 2012 and 2017. — 10 kg of lint/kg of nitrogen — 1.1 bales of cotton per ML (GPWI) — 383 kg of CO_2e per bale of cotton ▪ CRDC is investing in research to synthesise natural resource assets in cotton-growing regions, develop a sustainability strategy and corresponding targets for sustainable production, improve water use in a changing climate, and to better understand the physical, chemical and biological processes for plant growth and nutrient cycling down the whole soil profile.
Adoption of R&D Focusing on flexible delivery of extension services that meet primary producers' needs and recognising the growing role of private service delivery.	▪ Food ▪ Soil and Water ▪ Energy ▪ Resources ▪ Advanced Manufacturing ▪ Environmental Change ▪ Health	▪ During 2017-18, CottonInfo engaged with growers, consultants and the wider industry at 130 events, with 4200 cotton industry personnel in attendance: 1700 growers and farm workers; 700 consultants; 300 agribusiness personnel; and 1500 people representing the wider industry, including supply chain, government, and natural resource management bodies. ▪ CottonInfo conducted an irrigation and nitrogen tour that attracted over 400 participants across the industry. The tour aimed to improve awareness and management of irrigation impact on nutrition uptake and losses in cotton production systems. ▪ CottonInfo ran IPM workshops that aimed to provide new industry entrants with an understanding of IPM from a systems perspective. The area-wide management works facilitated the sharing of experiences across valleys and regions. Three hundred and fifty people were involved in the IPM workshops and area-wide management groups. ▪ Participation in the *my*BMP program is 78 per cent ▪ 90 per cent of growers and 98 per cent consultants are aware of CottonInfo; ▪ 86 per cent of growers and 100 per cent of consultants believe CottonInfo has helped to improve practices.

Science and Research Priorities per CRDC RD&E program 2017-18 ($'000)

Science and Research Priorities	Food	Soil and Water	Transport	Cybersecurity	Energy	Resources	Advanced Manufacturing	Environmental Change	Health	TOTAL
Expenditure	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	$'000	**($'000)**
Program 1: Farmers	$6,032	$5,828	$0	$0	$0	$782	$25	$393	$20	**$13,080**
Program 2: Industry	$2,656	$1,072	$0	$0	$89	$134	$0	$651	$0	**$4,602**
Program 3: Customers	$962	$40	$0	$0	$13	$0	$191	$5	$0	**$1,211**
Program 4: People	$1,208	$66	$10	$0	$2	$0	$0	$0	$0	**$1,286**
Program 5: Performance	$713	$16	$0	$0	$0	$0	$0	$0	$0	**$729**
TOTAL*	**$11,571**	**$7,022**	**$10**	**$0**	**$104**	**$916**	**$216**	**$1,049**	**$20**	**$20,908**

* Excludes budgeted employee and supplier expenditure and corporate research activities that support R&D planning and adoption. Some funding totals have been rounded up or down to the closest whole number.

Rural RD&E Priorities per CRDC RD&E program 2017-18 ($'000)

Rural RD&E Priorities	Advanced Technology	Biosecurity	Soil, Water and Managing Natural Resources	Adoption of R&D	TOTAL
Expenditure	$'000	$'000	$'000	$'000	**$'000**
Program 1: Farmers	$3,672	$2,870	$5,692	$846	**$13,080**
Program 2: Industry	$547	$2,440	$1,257	$358	**$4,602**
Program 3: Customers	$677	$82	$131	$321	**$1,211**
Program 4: People	$227	$97	$72	$890	**$1,286**
Program 5: Performance	$0	$29	$29	$671	**$729**
TOTAL*	**$5,123**	**$5,518**	**$7,181**	**$3,086**	**$20,908**

* Excludes budgeted employee and supplier expenditure and corporate research activities that support R&D planning and adoption. Some funding totals have been rounded up or down to the closest whole number.

Appendix 3: Environmental Performance

CRDC has integrated the principles of ecologically sustainable development under section 516A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) into its planning framework. As such, each of the measures of success within the CRDC program areas (outlined in the Strategic Plan) consider triple bottom line outputs.

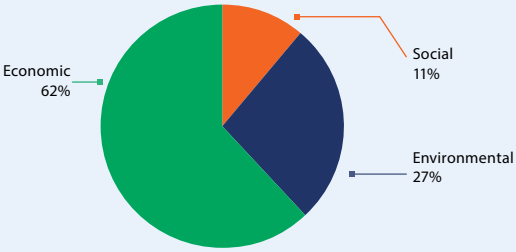
In line with this, the Annual Operational Plan 2017-18 was designed to ensure RD&E investments provide measurable economic, environmental and social benefits to the cotton industry and the wider community.

Environmental and social objectives underpin the economic viability of the industry. Improvements in the efficient use of resources (water, energy, nutrition and chemicals), crop yields per hectare, and efficient farming methods aid the economic performance of cotton growers.

A contracted project with Crop Consultants Australia gathers information about on-farm practices and attitudes across the industry. CRDC analyses this information and provides valuable guidance for researchers for future RD&E directions.

CRDC RD&E investments across economic, environmental and social performance outcomes 2017-18

Performance outcomes	CRDC investment (%)
Economic	62%
Environmental	27%
Social	11%
Total	100%



CRDC program contributions to economic, environmental and social outcomes 2017-18 ($'000)

Contributions	Economic	Environmental	Social	Total
CRDC programs	Investment total	Investment total	Investment total	Investment total
Program 1: Farmers	$9,053	$3,432	$595	**$13,080**
Program 2: Industry	$2,311	$1,580	$711	**$4,602**
Program 3: Customers	$866	$208	$137	**$1,211**
Program 4: People	$361	$138	$787	**$1,286**
Program 5: Performance	$340	$244	$145	**$729**
Total	**$12,931**	**$5,602**	**$2,375**	**$20,908**
Percentage	**62%**	**27%**	**11%**	**100%**

* Excludes budgeted employee and supplier expenditure, and corporate research activities that support R&D planning and adoption.

Appendix 4: RD&E Portfolio

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 1: FARMERS: Successful Crop Protection					
2017 FUSCOM	CRDA1801	CRDC	Susan Maas	26/07/17	8/09/17
2018 FUSCOM	CRDA1810	CRDC	Sharna Holman	31/05/18	29/08/18
A novel Silverleaf whitefly management tactic that reduces reliance on insecticides.	UQ1801	UQ	Gimme Walter	1/07/17	30/06/18
A short course in plant and soil nematology	DAQ1804	QDAF	Tim Shuey	26/11/17	1/12/17
Biology of *Amarathus hybridus, A. mitchelli,* and *A. powelii*: emerging weeds of cotton systems	UQ1703	UQ	Asad Khan	1/01/17	31/12/19
Centre for Biopesticides & Semiochemicals: Development of new tools & strategies for Integrated Pest Management	DAN1404	NSW DPI	Robert Mensah	1/07/13	30/06/18
Centre for Biopesticides & Semiochemicals: Novel insecticides and synergists from endemic and exotic flora	UWS1401	UWS	Robert Spooner-Hart	1/10/13	30/09/18
Centre for Biopesticides & Semiochemicals: Semiochemical management for occasional pests of cotton and grains	UNE1404	UNE	Peter Gregg	1/10/13	30/06/18
Commercial development and evaluation of a machine vision-based weed spot sprayer	NEC1402	NCEA	Steven Rees	1/07/13	1/04/19
Digital technologies for dynamic management of disease, stress and yield program	AGWA1701	AGWA	Liz Waters	1/08/16	30/06/19
Enhancing Integrated Pest Management in cotton systems	CSP1401	CSIRO	Lewis Wilson	1/07/13	30/06/18
Establishing southern cotton - Integrated Pest Management	DAN1501	NSW DPI	Sandra McDougall	1/07/14	15/11/17
Hard-to-control weeds in northern cotton farming systems - CottonInfo technical lead (*my*BMP module lead)	DAN1402	NSW DPI	Eric Koetz	1/07/13	30/06/18
Improving the management of cotton diseases in Australian cotton farming systems	RRDP1724	QDAF	Linda Smith	1/07/16	30/06/19
Innovative solutions to cotton diseases	DAN1703	NSW DPI	Duy Le	1/07/16	31/12/20
Major capital item: Autoclave - ACRI Cotton Pathology Laboratory	DAN1704	NSW DPI	Rod Jackson	1/03/17	30/09/17
Managing verticillium risk for cotton	RRDP1723	NSW DPI	Karen Kirkby	1/07/16	30/06/19
Mirid and mealybug best practice management	DAQ1802	QDAF	Richard Sequeira	1/07/17	30/06/20
Northern Australia cotton development & coordination leader	CSP1602	CSIRO	Steve Yeates	1/10/15	30/06/18
Novel topical vegetable & cotton virus protection: BIOCLAY	HIA1803	HIA / UQ	Neena Mitter	26/03/18	30/06/20

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PhD: Developing the weed control threshold	DAN1601	NSW DPI	Graham Charles	1/11/15	30/6/18
PhD: Electrophysiological and molecular identification of novel biopesticides	UWS1601	UWS	Michelle Mak	1/07/15	30/06/19
Regional weed management workshops for growers and advisors	CRDC1621	ICAN	John Cameron	1/03/16	30/09/17
Staying ahead of weed evolution in changing cotton systems	UQ1501	UQ	Jeff Werth & Bhagirath Chauhan	1/07/14	30/06/19
The use of area wide management, Integrated Pest Management, detergents and oils for the suppression of whitefly population in cotton for the reduced reliance and use of chemical controls	CRDC1803	Elders	Emma Ayliffe	1/07/17	30/06/19
Transformation of *Verticillium dahliae*, causal agent of Verticillium wilt of cotton, with the GFP gene	DAN1809	NSW DPI / UQ	Aphrika Gregson	1/12/17	31/12/19
Travel: Present & attend 2017 FUSCOM	CRDC1813	Microbiology Laboratories Australia	Maria Manjarrez	26/07/17	10/08/17
Travel: RRD4P digital technologies - management & steering committee meeting	DAN1806	NSW DPI	Karen Kirkby	5/10/17	6/10/17
Understanding the ecology of reniform nematodes in cotton	DAQ1803	QDAF	Linda Smith	11/11/17	30/06/19
US Weed Tour	CRDC1810	CRDC	Susan Maas	1/9/17	15/9/17
Viruses, vectors and endosymbionts: Exploring interactions for control	UQ1305	UQ	Daisy Stainton	1/04/13	31/08/17
FARMERS: Productive Resource Efficiencies					
A sprayable water barrier to line irrigation channels: Scoping study	CSE1802	CSIRO	Keith Bristow	1/10/17	30/9/18
Agronomy for resilient future cotton systems	CSP1601	CSIRO	Michael Bange	1/07/15	30/06/19
Benchmarking water-use efficiency and crop productivity in the Australian cotton industry	DAN1505	NSW DPI	Ali McCarthy	1/07/14	30/06/19
BestWeather climate consultancy	CRDC1736	BestWeather	Matt Davey	21/03/17	31/03/18
Improving water-use efficiency in a changing climate	CSP1804	CSIRO	Katrina Broughton	1/07/17	30/06/20
Improving water-use efficiency in a changing climate	UNSW1802	UNSW	John Triantafilis	1/07/17	30/06/20
Increasing profitability through improved nitrogen-use efficiency and reducing gaseous losses of nitrogen	AOTG1601	QUT	Peter Grace	1/07/15	30/06/18
International Collaboration workshop: Identifying the research opportunities for sensors and digital agriculture to preserve fibre quality from the farm to the warehouse	CRDA1804	CRDC	Allan Williams	1/12/17	19/04/18
International Student Exchange: *Helicoverpa armigera* - examining the interaction of diet and Bt sensitivity	CLW1801	CSIRO	Ashley Tessnow	23/06/17	23/08/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Irrigation agronomy for tailored and responsive management with limited water	RRDP1602	CSIRO	Hizbullah Jamali	1/07/15	30/06/18
Literature review to assess feasibility of biosensor for key herbicide	CRDC1829	Monash	Beatriz Prieto-Simon	10/03/18	30/04/18
Major capital item: Precision planter	DAN1706	NSW DPI	John Smith	14/06/17	14/06/18
Minimising yield variability to maximise yield	DAN1801	NSW DPI	Guna Nachimuthu	1/07/17	30/06/21
Mitigating and managing soil compaction for sustainable cotton production	CSP1701	CSIRO	Michael Braunack	1/07/16	31/08/17
More Profit from Nitrogen - Enhancing nutrient-use efficiency in cotton	RRDP1712	NSW DPI	Graeme Schwenke	1/07/16	30/06/21
More Profit from Nitrogen - Improved nitrogen-use efficiency through accounting for deep soil and mineralisable N supply, and deployment of Enhanced Efficiency Fertilisers to better match crop nitrogen demand	RRDP1717	NSW DPI	Lukas Van Zwieten	1/07/16	31/05/20
More Profit from Nitrogen - Improving dairy farm nitrogen efficiency using advanced technologies	RRDP1715	UMELB	Helen Suter	1/07/16	30/11/19
More Profit from Nitrogen - Increasing nitrogen-use efficiency in dairy pastures	RRDP1714	QUT	David Rowlings	1/07/16	30/11/19
More Profit from Nitrogen - New technologies and managements: transforming nitrogen-use efficiency in cane production.	RRDP1719	QDAF	Matt Redding	1/09/16	30/06/21
More Profit from Nitrogen - Optimising nitrogen and water interactions in cotton	RRDP1713	NCEA	Alice Melland	1/07/16	31/08/18
More Profit from Nitrogen - Optimising nutrient management for improved productivity and fruit quality in cherries	RRDP1721	UTAS	Nigel Swarts	1/08/16	30/06/21
More Profit from Nitrogen - Optimising nutrient management for improved productivity and fruit quality in mangoes	RRDP1720	NTDPIR	Mila Bristow	1/08/16	30/06/21
More Profit from Nitrogen - PMA Meetings	RRDP1722	CRDC	Allan Williams	1/07/16	30/06/20
More Profit from Nitrogen - Potentially mineralisable N soil analysis	RRDP1812	ICD Project Services	Marguerite White	21/03/18	31/12/18
More Profit from Nitrogen - Project Communications	RRDP1735	CRDC	Allan Williams	1/07/16	30/04/20
More Profit from Nitrogen - Quantifying the whole farm systems impact of nitrogen best practice on dairy farms	RRDP1716	UMELB	Richard Eckard	1/07/16	30/04/20
More Profit from Nitrogen - Science Leadership and Project Coordination	RRDP1711	ICD Project Services	Marguerite White	21/11/16	30/06/20
More Profit from Nitrogen - Smart blended use of enhanced efficiency fertilisers to maximise sugarcane profitability	RRDP1718	DSITI	Weijin Wang	1/07/16	30/04/20
More Profit from Nitrogen - Video and project case study	RRDP1813	ICD Project Services	Marguerite White	21/03/18	31/12/18

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
More Profit from Nitrogen - YourData platform	RRDP1727	Coutts J&R	Jeff Coutts	1/02/17	30/06/21
More Profit from Nitrogen- Mid-Term evaluation	RRDP1736	Coutts J&R	Jeff Coutts	1/06/18	30/09/18
New materials and options for reducing water losses from evaporation and seepage	NEO1701	NeoTop Water Systems	Andrew Hamilton	1/07/16	1/10/18
NUTRIpak: editing and updating	CRDC1820	Kechdow Pty Ltd	Chris Dowling	8/08/17	31/08/17
Opportunities for dryland cotton with Bollgard 3	DAQ1703	QDAF	Paul Grundy	1/07/16	30/06/21
Optimising management of manure in Southern NSW cotton production	DU1603	Deakin	Wendy Quayle	1/07/15	30/06/18
Optimising seedling emergence	DAN1701	NSW DPI	Deb Slinger	1/07/16	30/06/19
PhD: Improving precision agriculture and climate adaptation for the Australian Cotton Industry	ANU1602	ANU	James Latimer	1/02/16	30/06/19
PhD: Monitoring soil water dynamics for improving water-use efficiency	UNSW1801	UNSW	Ehsan Zare	1/07/17	30/06/20
PhD: Next-generation fertilisers for nutrient stewardship in cotton production	UQ1702	UQ	Rhys Pirie	15/1/17	15/1/20
PhD: The impact of irrigation methods and management strategies on nitrogen fertiliser recovery in cotton in southern QLD	UQ1502	UQ	John Smith	1/07/14	31/12/20
PhD: Utilising novel plant growth regulators to develop resilient future cotton systems	CSP1604	CSIRO	Claire Welsh	1/04/16	31/03/19
Postdoc: Cotton production in a future climate	CSP1501	CSIRO	Katie Broughton	1/07/14	31/01/18
Postdoc: Professor of soil biology	UNE1403	UNE	Oliver Knox	1/01/14	31/12/18
Precision management for improved cotton quality	CMSE1802	CSIRO	Robert Long	1/07/17	30/06/20
Quantifying the effectiveness of cover crops as a means of increased water infiltration and reduced evaporation in the northern region	GRDC1801	QDAF / GRDC	David Lawrence	1/5/17	30/4/20
Seasonal benchmarking with canopy temperature sensors	CSD1701	CottonInfo	Amanda Thomas	1/12/16	30/6/18
Smart irrigation - When and how much?	RRDP1601	DEDJTR	Mike Morris	1/07/15	31/05/18
Smarter Irrigation - 2018 CottonInfo Researchers Tour: Optimising Irrigation and Nitrogen (CottonInfo technical lead, *my*BMP module lead)	RRDP1804	NSW DPI / CottonInfo	Ali Chaffey	9/11/17	14/03/18
Smarter Irrigation - Communication Officer	RRDP1808	Melanie Jenson	Melanie Jenson	10/01/18	31/05/18
Smarter Irrigation - Develop precise and automated control systems for a range of irrigation systems	RRDP1603	NCEA	Joseph Foley	1/07/15	31/05/18
Smarter Irrigation - Educating growers in innovative on-farm water management and scheduling practices	RRDP1734	SRA	Andres Jaramillo	1/07/17	31/05/18
Smarter Irrigation - Evaluation of scheduling tools for the sugar industry	RRDP1609	SRA	Andreas Jaramillo	31/05/16	31/05/18

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Smarter Irrigation - Grower-led cotton automation integration trial	RRDP1730	GVIA	Lou Gall	15/04/17	31/05/18
Smarter Irrigation - Grower-led irrigation system comparison in the Gwydir Valley	RRDP1606	GVIA	Louise Gall	1/07/15	30/04/18
Smarter Irrigation - Improved use of seasonal forecasting to increase farmer profitability	RIRDC1603	AgriFutures	Michael Beer	1/07/15	30/06/18
Smarter Irrigation - Increasing farm profit through efficient use of irrigation for dairy farms	RRDP1604	UTAS	James Hills	1/07/15	31/05/18
Smarter Irrigation - Integrated irrigation, dairy	RRDP1732	DA	Monique White	1/03/17	31/05/18
Smarter Irrigation - Maximising on-farm irrigation profitability: southern connected systems	RRDP1605	NSW DPI	Peter Regan	1/07/15	31/05/18
Smarter Irrigation - NCEA technical support for technology integration & scheduling projects	RRDP1731	USQ	Joseph Foley	1/03/17	31/05/18
Smarter Irrigation - Project Evaluation	RRDP1807	Peter R Day Resource Strategies	Peter Day	1/02/18	30/04/18
Smarter Irrigation - Project leadership and coordination	RRDP1801	USYD	Guy Roth	1/07/17	30/05/18
Smarter Irrigation - Publication & case studies graphic design	RRDP1814	Black Canvas	Kristy Fielder	1/06/18	30/06/18
Smarter Irrigation - Scheduling Technology Matrix	RRDP1733	DA	Monique White	1/05/17	31/05/18
Smarter Irrigation - Technology development and review of intellectual property and commercialisation strategies	RRDP1811	TechMAC	Dallas Gibb	1/03/18	18/06/18
Smarter Irrigation: Optimised Dairy Irrigation Farms	RRDP1607	DA	Monique White	1/07/15	31/05/18
Soil system research – physical, chemical and biological processes for plant growth and nutrient cycling down the whole soil profile	UNE1601	UNE	Oliver Knox	1/07/15	30/01/19
Travel: International Soil and Tillage Research Organisation	CRDC1802	McKenzie Soil Management	David McKenzie	27/08/17	3/09/17
Travel: Plant Growth Regulator Society, America Annual Conference, 6–19 August 2017	CSP1801	CSIRO	Claire Welsh	3/07/17	19/08/17
FARMERS: Profitable Futures					
Agri-intelligence in cotton production systems - Stage 1	QUT1701	QUT	Tristan Perez	1/01/17	31/12/18
PhD: Building climate change resilience in cotton through translational physiology	ANU1704	ANU	Demi Gamble	27/02/17	27/03/20
PhD: Characterisation of brassinosteroid effects and brassinosteroid responsive genes in cotton for growth and stress tolerance enhancement	UNE1605	UNE	Anahid A Essa Al-Amery	1/05/14	28/02/19
Precision to Decision - Agribusiness linkage	RRDP1702	AFI	Richard Heath	1/07/16	31/12/17
Precision to Decision - Data communications	RRDP1703	UNE	David Lamb	1/07/16	30/12/17
Precision to Decision - Data rules	RRDP1704	Griffith	Leanne Wiseman	1/07/16	30/05/18

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Precision to Decision - Data rules II	RRDP1706	USC	Jay Sanderson	1/07/16	30/05/18
Precision to Decision - Data sources	RRDP1707	CSIRO	Simon Barry	1/07/16	30/12/17
Precision to Decision - Data systems	RRDP1705	D2D CRC	Brenton Cooper	1/07/16	30/12/17
Precision to Decision - Executive summary report	RRDP1802	AgriKnowHow	Emma Leonard	1/09/17	31/01/18
Precision to Decision - Graphic design services	RRDP1803	Black Canvas	Kristy Fielder	21/09/17	8/11/17
Precision to Decision - Graphic design services II	RRDP1806	Black Canvas	Kristy Fielder	1/02/18	28/02/18
Precision to Decision - PMA, PMC, Agribusiness forums & Regional workshops	RRDP1708	CRDC	Rohan Rainbow	1/07/16	28/02/18
Precision to Decision - Producer survey to identify needs and issues	RRDP1725	CSIRO	Emma Jakku	15/12/16	30/12/17
Precision to Decision - Project leadership and coordination	RRDP1701	Rainbow & Associates P/L	Rohan Rainbow	1/07/16	15/05/18
Precision to Decision - Sponsorship: ABARES National Outlook 2018 Conference	RRDP1805	ABARES	Tom Jackson	1/12/17	6/03/18
Precision to Decision - Travel: Austrade World Agri-Tech Innovation Summit Delegation 2018	RRDP1809	AFI	Richard Heath	7/03/18	24/03/18
Precision to Decision - Travel: International Precision Ag Conference, Canada	RRDP1815	CRDC	Jane Trindall	7/03/18	29/06/18
Precision to Decision - Travel: International Precision Ag Conference, Canada & Interest Group and Agricultural Data, Germany	RRDP1810	Griffith	Leanne Wiseman	7/03/18	29/06/18
Precision to Decision – Analysis of the economic benefit and strategies for delivery of decision agriculture	RRDP1726	AFI	Richard Heath	1/12/16	31/08/17
Precision to Decision Phase II - Support application framework and design	CRDC1836	Barnett Consulting	Paul Barnett	1/06/18	30/06/18
The platform for monitoring and analysis of cotton canopy nitrogen status and yield projection using calibrated aerial and satellite imagery	FLUR1801 was CRDC1827	FluroSat	Anastasia Volkova	11/12/17	1/08/18
OUTCOME 1: FARMERS PROGRAM TOTAL: $13,079,923. 61					

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 2: INDUSTRY: Respected Stewardship					
Biosecurity scenario/training 2016-17	CRDA1711	CRDC	Susan Maas	3/04/17	14/07/17
Biosecurity scenario/training 2016-17: facilitation	PHA1702	PHA	Stephen Dibley	3/04/17	14/07/17
Conventional insecticide resistance in Helicoverpa - monitoring, management and novel mitigation strategies in Bollgard 3	DAN1506	NSW DPI	Lisa Bird	1/07/14	30/06/19
Cotton Map 2017-18	CA1801	CA	Nicola Cottee	1/07/17	30/06/18
Development of a spray drift hazard prediction system	MRES1701	MRES	Graeme Tepper	1/07/16	30/06/19
Disease review (and biosecurity group meeting)	CRDA1808	QDAF	Sharna Holman	16/05/18	16/05/18
Helicoverpa punctigera in inland Australia – what has changed?	UNE1502	UNE	Peter Gregg	1/07/14	31/12/17
Improving plant pest management through cross industry deployment of smart sensor, diagnostics and forecasting	HIA1802	HIA	Wee tek Tay & Dean Brooks	1/02/18	20/05/22
Khapra beetle response	CA1708	CA	Nicola Cottee	12/01/17	30/06/18
Managing Bt resistance and induced tolerance in Bollgard 3 using refuge crops	CSE1601	CSIRO	Mary Whitehouse	1/07/15	30/06/18
Monitoring Silverleaf Whitefly insecticide resistance	DAQ1701	QDAF	Jamie Hopkinson	1/07/16	30/06/19
National biosecurity and disease extension and coordination and Central QLD regional extension - CottonInfo technical lead (*my*BMP module lead)	DAQ1801	QDAF	Sharna Holman	1/07/17	30/06/20
National Residue Survey for Cotton	CA1705 was CRDC1716	CA	Nicola Cottee	9/02/17	9/02/19
NCEDD: Stewardship of biotechnologies and crop protection	SC1601	Ceeney Agricultural Consultants	Sally Ceeney	1/07/15	30/06/18
Plant Biosecurity RD&E Strategy 2016-17	PHA1703	PHA	Rodney Turner	1/06/17	30/06/18
Plant Biosecurity Research Initiative (PBRI)	HIA1801	HIA	Jo Luck	19/06/17	17/06/20
Postdoc: Application of genomic tools to monitoring for resistance alleles in *Helicoverpa* spp.	CSE1801	CSIRO	Tom Walsh	1/07/17	30/06/20
Resistance research and monitoring to enhance stewardship of Bt cotton and management of *Helicoverpa* spp.	CSE1701	CSIRO	Sharon Downes	1/07/16	30/06/19
Sponsorship: Science Protecting Plant Health Conference, 2017	CRDC1738	QAAFI	Jenny Lawler	3/04/17	28/09/17
Surveillance and studies for endemic and exotic virus diseases of cotton	DAQ1601	QDAF	Murray Sharman	1/07/15	30/06/19

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
The sustainable chemical control and resistance management of aphids, mites and mirids in Australian cotton, 2014-2019	DAN1507	NSW DPI	Grant Herron	1/07/14	30/06/19
TIMS insecticide tech panel meeting 2018 and CottonInfo cotton insecticide resistance technical lead (*my*BMP module lead)	CRDA1807	Ceeney Agricultural Consultants	Sally Ceeney	10/05/18	10/05/18
Travel: 2016-17 Biosecurity scenario/training - CA panel members	CA1707	CA	Nicola Cottee	22/05/17	14/07/17
Travel: Plant pest meeting for improving plant pest management	UQ1803	UQ	Dean Brooks	20/11/17	22/11/17
Weed review	CRDA1809	QDAF	Sharna Holman	16/05/18	16/05/18
INDUSTRY: Responsible Landscape Management					
Appropriate land-use methodology for Australian cotton life-cycle assessments	UQ1701	UQ	Francois Visser	1/07/16	30/06/19
Baselining Lower Namoi groundwater and evaluating Pilliga coal seam gas developments	UNSW1601	UNSW	Bryce Kelly (PhD Charlotte Iverach)	1/07/15	30/06/18
Biological control and taxonomic advancement for management in the Noogoora burr complex	DAN1805	NSW DPI	Graham Charles	1/07/17	28/06/19
Climate and energy for cotton farming businesses - CottonInfo technical lead (*my*BMP module lead)	AE1801	AgEcon	Jon Welsh	1/07/17	30/06/20
Cotton Rivercare Champion	CRDC1602	Capricorn North Pty Ltd	Mark Palfreyman	1/09/15	30/06/18
CottonInfo NRM technical lead and extension campaigns (*my*BMP module lead)	CRDC1805	Stacey Vogel Consulting	Stacey Vogel	1/07/17	30/06/20
Developing the groundwater health index (GHI) as an industry-wide monitoring tool	MQ1501	Macquarie	Grant Hose	1/07/14	30/06/18
Improving the ability of the Australian cotton industry to report its sustainability performance	QUT1705	QUT	Erin Peterson	1/10/16	30/10/19
Keeping pest populations lower for longer: Connecting farms and natural systems	CSE1501	CSIRO	Vesna Gagic	1/07/14	30/06/18
Managing Climate Variability Program - Phase 5	MLA1701	MLA	Tom Davison	1/07/16	30/06/21
Managing natural landscapes on Australian cotton farms to increase the provision of ecosystem services	GU1701	Griffith	Samantha Capon	1/07/16	30/06/19
Managing riparian corridors on cotton farms for multiple benefits	UNE1602	UNE	Rhiannon Smith	1/07/15	30/06/18
PhD: Effects of climatic fluctuation and landuse change on soil condition in the lower Lachlan	US1403	USYD	Patrick Filippi	3/03/14	2/09/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PhD: Sustainable water extractions: Low flow regia and critical flow thresholds	UNE1406	UNE	Marita Pearson	1/01/14	30/12/19
Quantifying the nitrogen cycle: from farm gate to catchments, groundwater and atmosphere	ANSTO1801	ANTSO	Dioni Cendon	1/07/17	30/06/20
Quantifying the potential environmental impacts of pesticides used on cotton farms	DAN1803	NSW DPI	Mick Rose	1/07/17	30/06/20
Synthesis of natural resource assets in the cotton growing region of eastern Australia	FWPA1801	Eco Logical Aust	Julian Wall	1/07/17	30/06/20
Travel: Attend and present at the International Tri-Conference for Precision Agriculture 2017	US1801	USYD	Patrick Filippi	15/10/17	18/10/17
INDUSTRY: Sustainable Futures					
Australian Cotton Industry Sustainability Strategy and sustainability targets	CRDC1828	Sustenance Asia Pty Ltd	Chris Cosgrove	2/01/18	29/06/18
Biodegradation of dyed cotton fabrics	NCSU1701	NCSU	Dr Nelson Vinueza	1/01/16	31/12/18
Development of next generation evaporation mitigation technology with increased resistance to wind	UM1801	UMELB	Greg Qiao	1/09/17	31/08/18
Innovative approaches to water security for Australian cotton irrigators	DAN1802	NSW DPI	David Mitchell	1/07/17	30/06/18
Micro particles generated from laundering of cotton and other fabrics	NCSU1702	NCSU	Richard Venditti	1/01/17	31/12/18
OUTCOME 2: INDUSTRY PROGRAM TOTAL: $4,602,427. 54					

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 3: CUSTOMERS: Assured Cotton					
Enhancing and testing the Cotton Carbon Management Tool (CCMT)	UQ1503	UQ	Francois Visser	1/07/14	30/09/17
Investigating the relative contributions of weathering, insect honeydew and fungal agents to cotton colour grade changes and discounts	CSP1703	CSIRO	Simone Heimoana	1/07/16	30/06/18
Major capital item: Miniscan ES, Portable Spectrophotometer	CSP1802	CSIRO	Simone Heimoana	1/10/17	31/01/18
Managing cotton quality to maintain Australia's premium status - CottonInfo technical lead (*my*BMP module lead)	CMSE1801	CSIRO	Rene Van der Sluijs	1/07/17	30/06/20
Sustainable Apparel Coalition Membership 2015, 2016	CRDC1608	SAC	Scott Miller	18/08/15	31/07/17
Sustainable Apparel Coalition Membership 2017	CRDC1817	SAC	Glenn Robinson	1/08/17	31/07/18
CUSTOMERS: Differentiated Products					
An eco-friendly treatment to improve the look and handle of cotton fabric	DU1701	Deakin	Rangam Rajkhowa	1/10/16	30/09/18
Application of aqueous glycine to improve quality and efficiency of cotton dyeing	DU1703	Deakin	Rangam Rajkhowa	1/1/17	30/5/18
Breathable cotton for compression athletic wear (CAW)	DU1601	Deakin	Maryam Naebe	1/07/15	30/12/17
Continuous mercerisation of loose-stock cotton without fibre shrinkage	RMIT1802	RMIT	Rajiv Padhye	1/02/18	30/07/18
Facilitating the adoption of textile R&D 'from the lab to the real world' Part 1	CRDC1826	Limebranch Pty Ltd	Meriel Chamberlin	24/11/17	23/03/18
Green and efficient textile dyeing and finishing technology using nanocellulosic and finishing technology using nanocellulosic fibres	UG1801	University of Georgia	Sergiy Minko	1/01/18	31/12/18
Improved thermal management performance of bedding systems	RMIT1701	RMIT	Olga Troynikov	1/1/17	30/6/18
Novel anti-wetting & self-sterilising cotton fabrics	DU1501	Deakin	Xin Lui & Yan Zhao	1/07/14	30/09/17
Novel spinning technologies for fine and high-quality Australian cotton yarns	DU1502	Deakin	Xungai Wang	1/07/14	31/12/17
PhD: High-value bio-extractives and bioethanol from cotton gin trash	DAN1504	NSW DPI	Mary Egbuta	1/07/14	31/08/17
PhD: Low-wax Australian cotton - reducing the scouring requirements of cotton fabric	CMSE1403	CSIRO	Katherine Birrer	1/04/14	28/04/18
Potent mould and mildue-resistant cotton fabrics	DU1802	Deakin	Xin Lui & Yan Zhao	26/03/18	25/03/19
Smart cotton/carbon fabrics for electromagnetic interference shielding	DU1602	Deakin	Jin Zhang	1/07/15	30/06/18

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
CUSTOMERS: Competitive Futures					
Cotton gin trash conversion to biofuels: pre-feasibility study	AE1802	AgEcon	Jon Welsh	15/08/17	26/10/17
Developing renewable fine chemicals from cotton biomass: A profitable future for Australian agriculture: Biorefineries for higher-value animal feeds, chemicals and fuels	SRA1601	QUT	William Doherty	1/07/15	1/04/19
Exploring nanofibrous coating on cotton fabric with versatile protection and dynamic comfort	RMIT1702	RMIT	Olga Gavrilenko	1/02/17	30/04/20
Identifying technical benefits in producing regenerated cellulose fibres from cotton for carbon fibre production: Phase II	DU1801	Deakin	Nolene Byrne	1/07/17	30/10/18
Life Cycle Assessment (LCA) training	CRDA1806	Lifecycles	Tim Grant	13/06/18	15/06/18
Travel: New value opportunities through supply chain innovation in the cotton industry	CRDC1833	University of Cambridge	Sze Ning Chng	30/04/18	8/06/18
OUTCOME 3: CUSTOMERS PROGRAM TOTAL: $1,211,446. 01					

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 4: PEOPLE: Workforce Capacity					
AES & PIHSP program lead, final report summaries	CRDC1821	Sally Knight	Sally Knight	1/07/17	30/06/18
AES student sponsorship - Montana Jones	AES1601	Merced Farming	Montana Jones	4/02/16	30/11/17
Australian Future Cotton Leaders Program 2018	CA1806	CA	Jo Eady	1/03/18	30/12/18
Australian Rural Leadership Foundation Trail Course 2018 - Susan Maas & Nicola Cottee	RIR1803	ARLF	Susan Maas & Nicola Cottee	26/04/18	4/05/18
Australian Rural Leadership Program Course 23 - Matthew Bradd	RIR1701	ARLF	Matthew Bradd	1/08/16	31/10/17
Australian Rural Leadership Program Course 23 - Meagan Laidlaw	RIR1702	ARLF	Meagan Laidlaw	1/08/16	31/10/17
Australian Rural Leadership Program Course 24 - Richard Malone	RIR1802	ARLF	Richard Malone	1/08/17	31/10/18
Australian Rural Leadership Program Course 24 - Timothy Chaffey	RIR1801	ARLF	Timothy Chaffey	1/08/17	31/10/18
Co-investment in PIEFA membership for the cotton industry: 2016-17 & 2017-18	CA1706	CA	Ali Briggs	1/07/16	30/06/18
Co-Sponsorship: TAFE Plus Statement in Introduction to Robotics	CRDC1837	TAFE NSW	Pam Hill	5/04/18	30/06/18
Cotton industry 'People' research forum	CRDA1803	CRDC	Ian Taylor	19/11/17	20/11/17
Cotton Young Farming Champions program 2017	CRDC1728	PYIA	Lynne Strong	1/12/16	30/01/19
Developing education capacity for the Australian cotton industry	CSE1602	CSIRO	Trudy Staines	1/07/15	30/06/18
Horizon Scholarships - Camilla a'Beckett	RIRDC1504	AgriFutures	Camilla a'Beckett	31/03/15	31/12/17
Horizon Scholarships - Felicity Taylor	RIRDC1401	AgriFutures	Felicity Taylor	31/03/14	31/12/17
Horizon Scholarships - Holly Chandler	RIRDC1702	AgriFutures	Holly Chandler	1/07/16	31/12/19
Horizon Scholarships - Michael Wellington	RIRDC1405	AgriFutures	Michael Wellington	31/03/14	31/12/17
Horizon Scholarships - Sam Johnston	RIRDC1403	AgriFutures	Sam Johnston	31/03/14	31/12/17
Horizon Scholarships - Sam Knight	RIRDC1602	AgriFutures	Sam Knight	1/07/15	31/12/19
Horizon Scholarships - Scott Nevison	RIRDC1503	AgriFutures	Scott Nevison	31/03/15	31/12/18
Narrabri High School - 2017 Science and Engineering Superchallenge, Newcastle	CRDC1816	NHS	Michelle Charambous	17/08/17	17/08/17
Nuffield Scholarship - Daniel Kahl	CRDC1711	Nuffield	Daniel Kahl	1/07/16	30/09/18
Nuffield Scholarship - Luke McKay	CRDC1801	Nuffield	Luke McKay	1/07/17	30/09/19
People in farming - employment starter kit (ESKi) website	DA1502	DA	Sally Roberts	28/02/18	1/03/21
PhD: Career motivational factors of cotton growers' attraction to and retention in the cotton industry	USQ1401	USQ	Geraldine Wunsch	1/07/13	31/07/17
PhD: Human capacity needs and management on cotton farms	UNE1402	UNE	Will Winter	1/07/13	29/08/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Postdoc: Understanding and planning for the future cotton workforce	USQ1801	USQ	Nicole McDonald	3/10/17	30/09/20
Scholarship: Startup Catalyst Future Founders Mission to Silicon Valley	CRDC1807	Startup Catalyst	Harry Roache-Wilson	6/07/17	14/12/17
Science & Innovation Awards 2018 - Rhys Pirie	ABA1701	ABARES	Rhys Pirie	1/07/16	30/06/18
Sponsorship: GrowAg Summit 2016	RIRDC1703	AgriFutures	Jennifer Medway	21/09/16	23/09/17
Summer/Honours Scholarship: Design of versatile protective cotton fabrics with colour and patterns	RMIT1801	CSIRO	Oliva Williamson	1/02/18	30/11/18
Summer/Honours Scholarship: Establishing precision/digital agriculture at 'Llara'	US1802	USYD	Bradley Ginns	1/12/17	25/11/18
Summer/Honours Scholarship: Estimating soil water use in cotton systems	CSP1803	USYD	Harry Gaynor	8/01/18	30/11/18
Summer/Honours Scholarship: Evaluation of relative damage caused by two-spotted mite, bean spider mite and strawberry mite in cotton	DAN1808	UTAS	Chris Shafto	1/01/18	31/12/20
Summer/Honours Scholarship: Genetic diversity, population connectivity and glyphosate resistance in Windmill grass	UQ1804	UQ	Yu Shen	1/07/17	30/06/18
Summer/Honours Scholarship: Improving mid-season potassium uptake by cotton	UNE1801	UNE	Emily Young	1/12/17	31/07/18
Summer/Honours Scholarship: Developing versatile protective coating on cotton fabric	CRDC1724	RMIT	Zhaowei Xu	1/02/17	30/11/17
Summer/Honours Scholarship: Effects of application uniformity change on energy requirement for Australian lateral move irrigation machines	USQ1701	USQ	Benton Munro	30/11/16	12/10/17
Wee Waa High School - robotics comp	CRDC1806	WWHS	Annabel Doust	1/01/18	30/06/18
PEOPLE: Networks					
AgVet Collaborative Forum - Plant Industries - Phase 3	RIRDC1701	AgriFutures	Jennifer Medway	1/07/16	1/12/19
Automation of recycle system - IREC Field Station	IREC1701	IREC	Rob Houghton	1/03/17	31/08/18
CCRSPI 2017- 2020	CCR1801	CCRSPI		1/07/17	30/06/20
Facilitation of Cotton Innovation Network Strategy	CRDC1835	Barnett Consulting	Paul Barnett	10/05/18	24/05/18
Facilitate Start Up Alley, Cotton Conference 2018	XL1802	XLAB	Tim Parsons	7/05/18	15/08/18
Grassroots Grants: Grower development and extension programs	CGA1807	Southern Valley CGA	Emma Ayliffe	1/11/17	28/02/18
Grassroots Grants: Implementing Innovative Irrigation - Central QLD 2018 Sticky Beak Tour	CGA1804	Dawson Valley CGA	Simon Green	8/11/17	30/01/18
Grassroots Grants: Implementing Innovative Irrigation - Central QLD Style	CGA1803	CHCGIA	Aaron Kiely	3/10/17	9/11/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Grassroots Grants: Improving skills and capacity of Darling Downs growers	CGA1810	Darling Downs CGA	Adam McVeigh	12/02/18	30/06/18
Grassroots Grants: In-field research trials comparing dryland cotton to dryland sorghum on various row configurations (third year)	CGA1802	Mungindi CGA	Joanna Weier	1/10/17	30/06/18
Grassroots Grants: Irrigation scheduling training using canopy sensors	CGA1607	Lower Namoi CGA	Geoff Hunter & Steve Madden	15/10/16	30/06/18
Grassroots Grants: Local weather data access	CGA1808	Dawson Valley CGA	Bron Christensen	1/12/17	1/02/18
Grassroots Grants: Lower Namoi CGA weather stations network	CGA1801	Lower Namoi CGA	Jeff Hamblin	1/10/17	30/06/18
Grassroots Grants: Macintyre Valley weather station network and upgrades	CGA1809	MacIntyre Valley CGA	Cate Wild	1/12/17	30/06/18
Grassroots Grants: Silverleaf whitefly and mealybug meetings	CGA1806	Gwydir Valley CGA	Janelle Montgomery	1/11/17	1/03/18
Grassroots Grants: Spreader Workshop	CGA1805	Upper Namoi CGA	Andrew Watson	1/10/17	30/06/18
Grassroots Grants: Strengthening CGA policy and procedures	CGA1608	CHCGIA	Emma McCullagh	1/10/15	30/09/17
Grassroots Grants: Upgrade to Darling Downs weather station network	CGA1708	Darling Downs CGA	Adam McVeigh	13/12/16	1/9/17
Grassroots Grants: Weather station access to minimise the spray drift in the Macquarie	CGA1704	Macquarie CGA	Amanda Thomas	1/09/16	1/05/18
Grower RD&E advisory panels - Capacity Building	CA1802	CA	Nicola Cottee	1/07/17	30/06/18
Grower RD&E advisory panels - R&D Consultation	CA1803	CA	Nicola Cottee	1/07/17	30/06/18
IREC Field Station Automated Irrigation	IREC1801	IREC	Emma Ayliffe	30/04/18	30/06/19
Joint RDC Community Trust Project - Scoping Study	RIRDC1802	AgriFutures	Jennifer Medway	7/06/18	15/12/18
Major capital item: Planter bar and trailer	CGA1703	DCRA	Ian Gourley	1/09/16	30/10/17
National RD&E Water Use in Agriculture Cross Sector Strategy	DA1701	DA	Cathy Phelps	3/11/16	30/6/18
Northern NSW Freight and Infrastructure Study	CRDC1812	ARTC	Michael Clancy	1/7/17	18/11/17
PHA secretariat support (Biosecurity RD&E strategy)	PHA1802	PHA		1/07/17	30/06/18
Plant Health Australia Membership Subscription 2017-18	PHA1801	PHA	PHA	1/07/17	30/06/18
Sponsorship: 19th Australian Cotton Conference Foundation Sponsorship	CA1804	CA	Fleur Anderson	1/12/17	30/09/18
Sponsorship: 2017 RIRDC Rural Women's Award Gala Dinner	RIRDC1704	AgriFutures	Jennifer Medway	19/05/17	13/09/17
Sponsorship: 2018 Rural Women's Award Gala Dinner	RIRDC1801	AgriFutures	Jennifer Medway	28/05/18	15/10/18

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Sponsorship: 5th Australian Soil Judging Competition	CRDC1814	Soil Science Australia	Luke Finn	27/07/17	29/09/17
Sponsorship: AACS 2017 Australian Cotton Researcher Conference	CRDC1720	AACS	Danny Llewellyn	5/09/17	7/09/17
Sponsorship: Agcatalyst 2018	CSP1805	CSIRO	Gavin Purtell	31/05/15	16/08/18
Sponsorship: APEN International Conference 2017	CRDC1707	APEN	Jeanette Long	5/07/16	15/09/17
Sponsorship: Australian Cotton Fibre Expo - sponsorship to attend Cotton Conference	CRDC1713	Australian Cotton Fibre Expo	Melanie Moloney	20/7/16	6/8/17
Sponsorship: Australian Cotton Fibre Expo 2017	CRDC1811	Australian Cotton Fibre Expo	Melanie Moloney	15/07/17	15/10/17
Sponsorship: Central Highlands AgTech Forum	CRDC1742	Central Highlands Development Corporation	Sharna Holman	6/06/17	8/12/17
Sponsorship: Cotton Insights International Cotton Conference, Bremen 2018	CRDC1825	Bremer Baumwollbörse	Bremer Baumwollbörse	22/11/17	23/03/18
Sponsorship: Digital Farmers: Bringing AgTech to life Conference	AFI1801	AFI	Mick Keogh	13/03/18	14/06/18
Sponsorship: MIT Bootcamp 2018	QUT1801	QUT	Prof. Rowena Barrett	1/11/17	31/03/18
Sponsorship: Start Up Alley at the 19th Australian Cotton Conference	CA1805	CA	Fleur Anderson	1/05/18	9/08/18
Strategic investment plan program logic and measurement development workshop facilitation	CRDC1819	Clear Horizon Consulting	Jill Campbell	3/8/17	21/8/17
Travel: Attend and Present at the 2017 Australian Cotton Research Conference	UQ1802	UQ	Dean Brookes	25/08/17	7/09/17
Travel: Attend APS Annual meeting & Scientific Exchange, Texas	DAN1705	NSW DPI	Karen Kirkby	26/05/17	26/08/17
Travel: Attend RIRDC Rural Women's Award Gala Dinner 2017	CRDC1822	CRDC	Various	10/08/17	13/09/17
Travel: Participate in the 2017 Australian Cotton Research Conference	CCA1801	CCA	Fiona Anderson	18/08/17	8/09/17
Travel: Present and attend ABARES Regional Outlook Conferences 2018	CRDC1834	Rainbow & Associates P/L	Rohan Rainbow	31/5/18	10/10/18
Travel: Third International Whitefly Symposium Australia 2018, presenter	DAQ1805	QDAF	Richard Sequeira	1/6/18	21/9/18
Travel: Third International Whitefly Symposium Australia 2018, presenter	CSP1807	CSIRO	Simone Heimoana	27/06/18	23/09/18
Travel: US Cotton Industry tour & precision Ag work experience	CRDC1740	Landmark	Casey Onus	1/05/17	31/07/17
WeedSmart Phase 4	UWA1801	UWA	Lisa Mayer	1/07/17	30/06/20
X-Lab Cotton Bridging Program	XL1701	XLAB	Allen Haroutonian	19/06/17	7/08/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PEOPLE: Communication					
Catapult program CRDC Innovation (Phase I)	XL1801	XLAB	Allen Haroutonian	1/04/18	30/06/19
Communications support projects	CRDC1744	House of Communications	Bernadette Pilling	1/06/17	31/12/18
Cotton industry database management	CRDC1804	Making Data Easy P/L	Lee Armson	1/07/17	30/06/20
CottonInfo trial: Assessing green manure vetch to reduce the impact of Black Root rot on cotton production	CSD1801	CottonInfo	Kieran O'Keeffe	1/07/17	15/12/17
CottonInfo trial: Improving the distribution uniformity of fertiliser spreaders to optimise fertiliser (urea) application	CSD1802	CottonInfo	Janelle Montgomery	1/09/17	31/10/17
CottonInfo trial: Measuring nitrogen loss during early season irrigation	CSD1803	CottonInfo	Janelle Montgomery	1/09/17	30/06/18
CottonInfo: Facilitation of team workshop	CRDC1823	AJM Community and Commercial	Austin McLennan	22/917	18/10/17
Editing and layout: *NUTRIpak*	CRDC1809	Bizwordz	Brian Clarke	5/7/17	31/5/18
Proofreading the *Australian Cotton Production Manual 2018*	CRDC1831	Helen Wheels HR	Helen Dugdale	19/04/18	27/04/18
Proofreading the *Cotton Pest Management Guide 2017*	CRDC1808	Helen Wheels HR	Helen Dugdale	14/07/17	21/07/17
Stimulating private sector extension in Australian agriculture to increase returns from R&D	DA1601	DA	Ruth Nettle	1/07/15	30/06/18
Videos: Documenting the production of best practice Australian cotton	DAQ1702	QDAF	Paul Grundy	1/07/16	30/06/18
OUTCOME 4: PEOPLE PROGRAM TOTAL: $1,285,776. 94					

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 5: PERFORMANCE: Best Practice					
CottonInfo technical lead: 'Science into best practice', linking research with CottonInfo (Integrated Pest Management technical lead and *my*BMP module lead)	CSP1504	CSIRO	Sandra Williams	1/07/17	30/06/18
CottonInfo technical lead: nutrition and water	DAN1807	NSW DPI	John Smith	1/07/17	30/06/19
CottonInfo: team workshop	CRDA1802	CottonInfo	Warwick Waters	13/10/17	17/10/17
*my*BMP database review	CRDC1743	Ardrossi Pty Ltd	Mel Ziarno	1/07/17	30/11/17
*my*BMP database review: Caspio setup	CA1807	CA	Rick Kowitz	1/06/18	31/03/19
*my*BMP database review: Phase II	CRDC1830	Ardrossi Pty Ltd	Mel Ziarno	1/06/18	31/03/19
*my*BMP support and program coordination	CRDC1815	Rachel Holloway	Rachel Holloway	1/07/17	30/06/18
PERFORMANCE: Monitoring and Evaluation					
CCA Consultants Survey: Annual qualitative and quantitative surveys for Australian cotton industry	CCA1601	CCA	Liz Todd	1/07/15	31/10/17
Cotton Comparative Analysis Report 2016-17	BCA1801	BCA	Phil Alchin	1/07/17	30/06/18
CottonInfo: Monitoring and evaluation support system	CRDC1818	Coutts J&R	Jeff Coutts	1/07/17	30/06/19
CRDC Cotton Grower Survey	CRDC1733	Intuitive Solutions	Michael Sparks	3/03/17	1/12/19
CRDC Strategic Plan 2018-23: Developing the MERI framework	DAN1804	NSW DPI	Claire Norris	1/07/17	28/02/18
Development of strategy dashboard	CRDC1824	John Robinson Consulting Services Pty Ltd	Kate Delaney	9/10/17	9/12/17
Longitudinal assessment of the cotton industry's 'People' investments	CRDC1710	Jennifer Moffatt	Jennifer Moffatt	1/07/16	31/12/18
Measuring and reporting the value of capacity building on farms and in research	CRDC1701	QualData	Gordon Stone	1/07/16	30/06/19
PERFORMANCE: Reviews					
Impact assessment of selected clusters of projects - Stage III: Sustainability cluster and *my*BMP cluster	CRDC1731	Agtrans Research & Consulting	Peter Chudleigh	27/02/17	18/08/17
R&D Managers Forum	CRDA1805	CRDC	Ian Taylor	27/02/18	28/02/18
Reinventing Australian agricultural statistics	AFI1802	AFI	Mick Keogh	3/04/18	30/11/18
Review of irrigation and energy projects	CRDC1827	Sapphire Irrigation Consulting	Peter Smith	12/12/17	15/02/18
Risk management in Australian agriculture	AFI1803	AFI	Mick Keogh	3/04/18	30/11/18
OUTCOME 5: PERFORMANCE PROGRAM TOTAL: $728,683. 15					
TOTAL CRDC RD&E INVESTMENT $20,908,257. 25					

Appendix 5: Glossary and Acronyms

Term	Description
AACS	Australian Association Cotton Scientists
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACIC	Australian Cotton Industry Council
ACRI	Australian Cotton Research Institute
ACSA	Australian Cotton Shippers Association
AEL	Australian Eggs Limited
AES	Aboriginal Employment Strategy
AFI	Australian Farm Institute
AFM	atomic force microscopy
AFSS	AgriFood Skills Solutions
Agtrans	Agtrans Research & Consulting
AgSOC	Agriculture Senior Officials Committee
AGWA	Australian Grape and Wine Authority
ai/ha	active ingredient per hectare
ALS	Australian long-staple cotton
AMPC	Australian Meat Processing Council Limited
Annual Report	A report prepared by the Directors of CRDC in accordance with section 46 of the *Public Governance, Performance and Accountability Act 2013*, section 28 of the *Primary Industries Research and Development Act 1989* and clause 11. 10 of the Funding Agreement 2015-19.
ANU	Australian National University
APEN	Australasia-Pacific Extension Network
APL	Australian Pork Limited
App	Application program available from smart devices, such as mobiles
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARLF	Australian Rural Leadership Foundation
ARLP	Australian Rural Leadership Program
AUSAgLCI	Australian Agriculture Life Cycle Inventory
AVG	aminoethoxyvinylglycine
AWI	Australian Wool Innovation Limited
Balanced Portfolio	A research and development investment portfolio incorporating issues of critical national importance based on government and levy-payer priorities and balancing long-term, short-term, high and low risk, and strategic and adaptive research needs and includes consideration of regional variations and needs.
BCA	Boyce Chartered Accountants
BIPL	Blast Industry Pty Ltd
BMP	Best Management Practices program
Bollgard II®	Cotton varieties contain two genes resistant to *Helicoverpa* spp.
Bollgard 3®	Cotton varieties contain three genes resistant to *Helicoverpa* spp.
Bt	*Bacillus thuringiensis* (crystal protein gene expressed in Bollgard II® and Bollgard 3® cotton varieties, resistant to *Helicoverpa* spp.)
BS	Budget Statements
BYGUM	BarnYard Grass Understanding and Management

Term	Description
C	carbon
CA	Cotton Australia
CBTV	Cotton Bunchy Top Virus
CCA	Crop Consultants Australia Inc.
CCMT	Crop Carbon Management Tool
CCRSPI	National Climate Change Research Strategy for Primary Industries
CDI	Corporate Development Institute
CGA	Cotton Grower Association
CGT	Cotton Gin Trash
CHCGIA	Central Highlands Cotton Growers and Irrigators Association
CHDC	Central Highlands Development Corporation
CLCuD	Cotton leaf curl disease. CLCuD is a viral infection of cotton and other susceptible host plants that is transmitted by silverleaf whitefly *(Bemisia tabaci)*.
CMSE	CSIRO Materials Science and Engineering
Corporation, the	Cotton Research and Development Corporation
CCMT	Cotton Carbon Management Tool: a crop carbon footprint calculator for cotton growers
Cotton CRC	Cotton Catchment Communities Cooperative Research Centre
CottonInfo team	Team of regional extension officers, technical leads and *my*BMP specialists, formed under a joint venture between CRDC, Cotton Australia and CSD
CottonLEADS	Australian and United States program to lead responsible cotton production sustainably
CPLM	Centre Pivot Lateral Move irrigation system
CQ	Central Queensland
CRC	Cooperative Research Centre
CRC Polymers	Cooperative Research Centre for Polymers
CRDC	Cotton Research and Development Corporation
CRRDC	Council of Rural Research and Development Corporations
CSD	Cotton Seed Distributors Ltd (a grower-owned cooperative)
CSG	Coal seam gas
CSIRO	Commonwealth Scientific and Industrial Research Organisation
D2D CRC	Data to Decisions Cooperative Research Centre
DA	Dairy Australia Limited
Deakin	Deakin University
DEDJTR	Department of Economic Development, Jobs, Transport and Resources (Victoria)
DMA	dynamic mechanical analysis
DNRM	Department of Natural Resources and Mines (Queensland)
DCRA	Dryland Cotton Research Association
DSC	differential scanning calorimeter
DSITI	Department of Science, Information Technology and Innovation (Queensland)
ELS	Extra-long staple
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
EPI	Environmental Performance Indicator
ESD	Ecologically sustainable development

Term	Description
F1	F1 screens involve testing the offspring of single-pair matings between moths from Cry2Ab-resistant strains maintained in the laboratory (sP15 for *H. armigera* and Hp4-13 for *H. punctigera*) and moths raised from eggs collected from field populations
Farrer	Farrer Memorial Agricultural High School
FRDC	Fisheries Research and Development Corporation
FUSCOM	An annual forum bringing together Australia's pathology and virology research community, plant breeders, growers and consultants to share information and coordinate efforts on disease control.
FWPA	Forest and Wood Products Australia Limited
g/ha	grams per hectare
GHI	Groundwater health index
GIS	Geographic Information System
GM	Genetically Modified
GPWUIfarm	Gross Production Water Use Index farm
GRDC	Grains Research and Development Corporation
Griffith	Griffith University
GVIA	Gwydir Valley Irrigators Association
ha	hectare
Helicoverpa spp.	Cotton's major insect pests (*H. armigera* and *H. punctigera*)
HIA	Horticulture Innovation Australia
HRMS	Herbicide Resistance Management Strategy
HVI	High-Volume Instrument
ICAN	Independent Consultants Australia Network
ICT	Information and Communications Technology
IDM	Integrated Disease Management
IP	Intellectual Property
IPM	Integrated Pest Management
IREC	Irrigation Research and Extension Committee
IRMS	Insecticide Resistance Management Strategy
IT	Information Technology
IWM	Integrated Weed Management
K	potassium
KPI	Key Performance Indicator (measure of success)
LCA	Life Cycle Assessment
LiveCorp	Australian Livestock Export Corporation Limited
M&E	Monitoring and Evaluation
Macquarie	Macquarie University
MCF	Mill Correction Factor
MDB	Murray-Darling Basin
ML	megalitre
MLA	Meat and Livestock Australia
MP	Member of Parliament
MRES	Micro Meteorology Research and Education Services
*my*BMP	Best Management Practices Program

Term	Description
N	nitrogen
NAQS	Northern Australia Quarantine Strategy
NCEA	National Centre for Engineering in Agriculture
NCSU	North Carolina State University
Newcastle	University of Newcastle
NFF	National Farmers' Federation
NPIRDEF	National Primary Industries RD&E Framework
NPSI	National Program for Sustainable Irrigation
NQ	North Queensland
NRM	Natural Resource Management
NSW	New South Wales
NSW DPI	NSW Department of Primary Industries
NWPPA	National Working Party of Pesticide Application
NZ	New Zealand
NTDPIR	Northern Territory Department of Primary Industry and Resources
P	phosphorus
PBS	Portfolio Budget Statements
PCT	Peter Cullen Trust
PGPA Act	*Public Governance, Performance and Accountability Act 2013*
PHA	Plant Health Australia
PhD	Doctor of Philosophy
PIB	Peak Industry Body
PICSE	National Primary Industry Centre for Science Education
PIEFA	Primary Industries Education Foundation Australia
PIHSP	Primary Industries Health and Safety Partnership
Pima cotton	*Gossypium barbardense*. Related to Egyptian cotton, having extra-long and fine staples. Limited Australian production.
PIRD Act	*Primary Industries Research and Development Act 1989*
PISC	Primary Industries Standing Committee
Plant Biosecurity CRC	Plant Biosecurity Cooperative Research Centre
Postdoc	Post-Doctorate
PwC	Pricewaterhouse Coopers
QAAFI	Queensland Alliance for Agricultural and Food Innovation
QDAF	Queensland Department of Agriculture and Fisheries
QDSITI	Queensland Department of Science, Information Technology and Innovation
QLD	Queensland
QTT	Quick Test Technology
QUT	Queensland University of Technology
R&D	Research and Development
RD&E	Research, Development and Extension
RDC	Rural Research and Development Corporation
REFCOM	An annual forum of researchers, growers, consultants and representatives from technology providers and the industry to discuss research project progress and communication on Bt resistance.

Term	Description
REO	Regional Extension Officers
RH	relative humidity
RIC	Research and Innovation Committee
RINPAS	Research & Innovation Network for Precision Agriculture Systems
RIRDC	Rural Industries Research and Development Corporation
RMP	Resistance Management Plan
RO	Representative Organisation
RRDP grants	Rural R&D for Profit grants
RRR	Roth Rural and Regional Pty Ltd
S	sulphur
SAC	Sustainable Apparel Coalition
SLW	silverleaf whitefly
spp.	species
SRP	Science and Research Priorities
SRA	Sugar Research Australia
STBIFM	Sustaining the Basin: Irrigation Farm Modernisation program
Tg	glass transition
TIMS	Transgenic and Insect Management Strategy Committee
TRAIL	Training Rural Australians in Leadership
TSW	TSW Analytical
UA	University of Adelaide
UMELB	University of Melbourne
UNCGA	Upper Namoi Cotton Growers Association
UNE	University of New England
UNSW	University of New South Wales
Upland cotton	*Gossypium hirsutum*. Comprises the vast majority of the Australian cotton crop, with Pima cotton comprising the remainder.
UQ	University of Queensland
USC	University of the Sunshine Coast
USDA	United States Department of Agriculture
USQ	University of Southern Queensland
USYD	University of Sydney
UTAS	University of Tasmania
UTS	University of Technology, Sydney
UWA	University of Western Australia
UWS	University of Western Sydney
VCG	Vegetative Compatibility Group
Verticillium wilt	Verticillium wilt is a disease of cotton caused by the soil-borne fungal pathogen *Verticillium dahliae*.
VIC	Victoria
WHS	Workplace Health and Safety
Wincott	Women's Industry Network - Cotton
WUE	Water-use efficiency
Zn	zinc

Appendix 6: Annual reporting requirements

CRDC prepared this Annual Report in accordance with the provisions of section 28 of the *Primary Industries Research and Development Act 1989*, section 46 of the *Public Governance, Performance and Accountability Act 2013* (PGPA Act), the PGPA Rule 2014 and the Statutory Funding Agreement 2015-2019.

Additional information beyond the requirements of the PGPA Act required to meet the requirements of the Statutory Funding Agreement were provided to the Commonwealth separately by the CRDC.

CRDC prepared this report in accordance with the following items outlined in Clause 11. 10 of the Statutory Funding Agreement 2015-2019.

- Contribution to the implementation of relevant Industry sector and cross-sectoral strategies under the RD&E Framework.
- The rationale for the mix of projects included in the Balanced Portfolio.
- Report on CRDC's research extension activities.
- Collaboration with Industry and other research providers.
- Sources of income including separate identification of R&D Payments, Commonwealth Matching Payments, and any other forms of income and Marketing payments and Voluntary Contributions.
- Full cost of R&D and Marketing programs allocated in accordance with the Cost Allocation Policy.
- Progress in implementing R&D Plan including progress against KPIs and the achievement of key deliverables and associated outcomes.
- For each program bring the KPIs in the R&D plan and AOP together and demonstrate how the deliverables funded advanced the outcomes.
- Assessment of the efficiency and effectiveness of investments.
- Progress in implementing the Guidelines for the 2016-17 Annual Report including reporting against the Rural RD&E Priorities, the Science and Research Priorities and the Levy Principles and Guidelines in relation to the introduction of new levies or changes to existing levies.
- Consultation with the RO(s) on plans and activities.
- Other relevant matters notified to CRDC by the Commonwealth.

CRDC prepared this Annual Report in accordance with section 28 of the *Primary Industries Research and Development (PIRD) Act 1989*.

(a) This Annual Report includes the following particulars as instructed by directors during 2017-18.

(i) Report the particulars of the R&D activities that CRDC co-ordinated or funded, wholly or partly, during the period.

(ia) Report the particulars of the marketing activities that CRDC coordinated or funded, wholly or partly, during the period.

(ii) Report the amount spent in relation to R&D and marketing activities.

(iib) Report the particulars of the impact of R&D Plan and marketing activities on industry.

(iii) Include particulars of revisions of the R&D Plan that have been approved by the Minister.

(iv) Any agreements entered into under s13 and s14 of the PIRD Act and the activities in relation to the agreements entered into during or prior to the period.

(v) Activities in relation to applying for patents for inventions, commercially exploiting patented inventions and granting licences under patented inventions.

(vi) Activities of any companies in which the Corporation has an interest.

(vii) Activities relating to the formation of a company.

(viii) Significant acquisitions and dispositions of real property (land and buildings).

(b) Include an assessment of the extent to which CRDC's operations during the period have achieved its objectives as stated in its R&D plan; and implemented the AOP.

(c) An assessment of the extent to which CRDC has, contributed to the attainment of the objects of the PIRD Act.

(d) Particulars of sources and expenditure of funds, including commodity, cross commodity and regional classifications; and funds derived from transfer under s144.

(e) Accountability to representative organisations.

CRDC provides representative organisations a copy of the CRDC Annual Report as soon as practicable after the Corporation's annual report has been submitted to the Minister and tabled in Parliament.

CRDC prepared this Annual Report in accordance with the following sections of the PGPA Act 2013.

s39 (1) (b) Include a copy of the annual performance statements.

s43 (4) Include a copy of the annual financial statements and the Auditor-General's report.

s46 (3) The annual report must comply with any requirements prescribed by the rules.

CRDC prepared this Annual Report in accordance with the following sections of Rule 2014.

s17BB Report must be approved and signed by accountable authority and include details of how and when approval was given and state that accountable authority is responsible for the preparation and contents of the Annual Report (as required in section 46 of the PGPA Act and in accordance with the Finance Minister's Orders).

s17BC Report must comply with the guidelines for presenting documents to the Parliament.

s17BD Report must be constructed having regard to the interests of the Parliament and other users. Information included in the report must be relevant, reliable, concise, understandable and balanced.

CRDC prepared this Annual Report in accordance with section 17BE of Rule 2014 and the following particulars as instructed by directors during 2017-18.

(a) (b) Report must specify the enabling legislation and include a summary of its objects and functions and the purpose of the entity (from R&D Plan).

(c) Report must specify the name of the responsible Minister(s).

(d) (e) Report must provide details of Directions issued under legislation by the responsible Minister, or other Minister and General Policy Orders (GPO) that apply to CRDC under s22 of the PGPA Act.

(f) Report must provide particular of any non-compliance of a direction or GPO.

(g) Include a copy of relevant years annual performance statement (PGPA Act s39 (1)(b) and section 16F of PGPA Rule 2014).

(h) (i) Include a statement of any significant issue, and remedy action taken, reported to the responsible Minister under s19(1)(e) of the PGPA Act that relates to non-compliance with the finance law in relation to the entity.

(j) Must include information about the directors including names, qualifications, experience, attendance of board meetings, and whether the director is an executive or non-executive director.

(k) (l) Must provide an outline of the organisational structure, including subsidiaries, location of major activities and facilities and information on the main corporate governance practices.

(m) Must include information on the main corporate governance practices including Governance committees, education and performance review processes for directors, ethics and risk management policies.

(n) (o) Disclose the decision-making process undertaken by the board for related entity transactions including payment(s) or grants approved to another Commonwealth entity or company; the value of transaction or number of transactions in aggregate value.

(p) Highlight significant activities and changes that affected the operations or structure during the financial year.

(q) Include particulars of judicial decisions and/or administrative tribunals.

(r) Include particulars of any report on the entity including reports made by the Auditor-General (other than audit of financial statements s43 PGPA Act), a Parliamentary committee, the Commonwealth Ombudsman and/or the OAIC.

(s) Explanation on any missing information from the subsidiary and how this affects the annual report.

(t) Must include details of any indemnity given to the accountable authority, any member of accountable authority or officer against a liability, including premiums paid, or agreed to be paid, for insurance against the authority, member or officer's liability for legal costs.

(u) Must provide an index identifying where the requirements of s17BE are to be found.

Appendix 7: Index

Appendix 7: Index
PGPA ACT 2013 and Rule 2014 S. 17BE Requirements

PIRD ACT 1989 Requirements

Other Reporting Requirements


MELANIE JENSON

Australian Government

Cotton Research and Development Corporation

www.crdc.com.au