

CRDC ANNUAL REPORT 2016–2017



*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: CRDC-supported Young Farming Champion Jess Lehmann, renowned cotton industry researcher Dr Robert Mensah, and cotton grower Vic Melbourne on farm at Narrabri, NSW.

Photo: Shanna K Whan.

Published: November 2017

CRDC ANNUAL REPORT 2016-17

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Australian Government
**Cotton Research and
Development Corporation**

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 26 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.

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 the Northern Territory (NT), cotton is a major employer and contributor to the local, state and national economy. The industry's national exports generate an average of \$1.9 billion in annual revenue.

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.

In 2016-17, CRDC invested \$24.1 million into 350 RD&E projects in collaboration with 122 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 industry's joint extension program CottonInfo. The adoption of best management practices is also encouraged via the industry program *myBMP*. CRDC is a founding partner of both programs.

These investments achieved real impact for cotton growers, the industry and the wider community during 2016-17 – 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 is 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 rural Australia. It is currently the major agricultural crop grown in many rural regions of NSW and QLD, with some cotton also grown in VIC and commercial trials in the NT. 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 this. 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 *myBMP*, 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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13 October 2017

The Hon. Barnaby Joyce MP
Deputy Prime Minister
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 2016-17, 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 2016-17 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 26 September 2017.

Yours sincerely

A handwritten signature in black ink, appearing to read 'Richard Haire'.

Richard Haire
Chair
Cotton Research and Development Corporation

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Section 1

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Executive Summary

REPORT FROM THE CHAIR AND EXECUTIVE DIRECTOR

CRDC strategically invests in RD&E in five core priority areas – farmers, industry, customers, people, and performance – to help deliver productivity and profitability gains to growers and the wider cotton industry. Our overall aim is to enhance the industry through innovation: to drive forward our profitability, competitiveness and sustainability.

CRDC continued to deliver real impact for cotton growers through our RD&E investments in 2016-17.

Our early season planting research with the QLD Department of Agriculture and Fisheries (QDAF) in QLD's Central Highlands – which aimed to help cotton growers in this region overcome climate challenges by changing their cotton season – was put to the commercial test this year, with great success. As a result, it is anticipated that some 80 per cent of growers in the Central Highlands region will utilise the early-planting research outcomes to plant in August for the 2017-18 season. An impact analysis, commissioned by QDAF, found that the benefit-cost ratio of the project is approximately 17.1 to 1 – that is, a \$17.10 benefit to Central QLD growers for every \$1 invested by growers and the Government through CRDC into this RD&E.

Another impact assessment conducted during 2016-17 – into two of CRDC's core investment areas, the efficient use of water and optimising crop nutrition RD&E – found that these investments have delivered major economic benefits to cotton growers.

CRDC's investment of \$4.9 million of grower and Australian Government funds into six water-use efficiency projects from 2010 to 2015 provided a return benefit of \$40.62 million to cotton growers. That's a benefit-cost ratio of 8.29 to 1, or \$8.29 in benefit for every \$1 invested. Similarly, CRDC's investment of \$11.32 million into nine nutrition research projects from 2008 to 2016 returned a benefit of \$61.15 million to growers – a benefit-cost ratio of 5.4 to 1, or \$5.40 in benefit for every \$1 invested.

In addition, one CRDC-supported innovation was commercialised in 2016-17 – Sero X – a cutting-edge biopesticide for growers that has been registered for use by Innovate Ag. The commercialisation of this product follows a 10-year study by Dr Robert Mensah of NSW Department of Primary Industries (NSW DPI), with support from the former Cotton CRC and CRDC, and significant further investment, research and product development by Innovate Ag.

These technologies and projects are just the tip of the iceberg when it comes to CRDC's investments. In 2016-17, we invested \$24.1 million into cotton RD&E across 350 projects – 350 projects designed to increase the efficiency and effectiveness, productivity and profitability of cotton growers and the Australian cotton industry.

This cannot be achieved by CRDC action alone. In 2016-17, we collaborated with 122 research partners to deliver these RD&E projects. These partners in turn have worked with hundreds of growers in on-farm trials. Over 300 growers – some 35 per cent of the industry – have hosted an on-farm trial, contributing an average of 19 hours and \$5500 towards its success.

CRDC has also worked closely with growers, Cotton Australia, the Australian Government, and other collaborative partners within the industry to identify research priorities, to shape projects and ultimately, to invest in ground-breaking RD&E for our world-leading Australian cotton industry. We thank all who have contributed to this process.

2016-17 marked the penultimate year for CRDC under the current CRDC Strategic R&D Plan 2013-18. In 2018, a new plan will come into effect, guiding our investments for five years to 2023.

REPORT FROM THE CHAIR AND EXECUTIVE DIRECTOR

Consultation with key stakeholders on critical elements of this plan began in 2016-17, and will continue in 2017-18, to help inform the plan's development.

With one year remaining under the current plan, CRDC is progressing well towards the targets set for the organisation and the industry. This progress is outlined within this report, along with details on all of our investments in the 2016-17 year, and the resulting innovations and impacts.

On behalf of our fellow Directors, we invite you to read the CRDC Annual Report for 2016-17.



Richard Haire
CRDC Chair



Bruce Finney
CRDC Executive Director

PROGRESS AGAINST CRDC STRATEGIC R&D PLAN 2013-18

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. Each year, CRDC completes an analysis of performance against the Strategic Plan measures.

2016-17 marked CRDC's fourth year of operation under the Strategic Plan. The table below shows CRDC achievements and progress against the Strategic Plan programs as

of 30 June 2017. 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 red, amber and green traffic light system is used in CRDC's monitoring and evaluation to track overall performance against the CRDC Strategic Plan.

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	●	Estimated achievement of 3.1 per cent average growth in yield per hectare per annum since 2013. CSIRO attributes these yield increases to management and the interaction of management and genetics (52 per cent); and genetic improvements (48 per cent). CRDC invests predominately in the areas of management and the interaction of management and genetics. Data from CRDC's monitoring and evaluation program has demonstrated a resulting increase in crop yield, resource-use efficiencies, and profitability. CRDC continued to invest in this area in 2016-17, with a focus on driving productivity growth through RD&E in resource efficiencies and innovative solutions.
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. Developed in response to the industry's Third Environmental Assessment, the 2014 Australian Grown Cotton Sustainability Report developed and benchmarked 45 key sustainability indicators for the Australian cotton industry. Other agricultural industries have since followed cotton's lead, demonstrating an increased sustainability focus and encouraging collaboration. The cotton industry is committed to ongoing sustainability reporting, and CRDC continued to invest in this area in 2016-17, with a focus on enhancing the industry's sustainability performance reporting ability.
Customers: The Australian cotton industry captures the full value of its products		
Double the premium for Australian cotton	●	The Australian cotton industry receives a premium for its product – at times double the premium paid for cotton from other countries – however, competition with man-made fibres continues to exert downward pressure on the global market value for cotton. As a result, CRDC's RD&E investments in 2016-17 have supported quality assurance practices to successfully sustain premiums, while investigating novel uses for cotton and disruptions to the supply chain to make 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 Cotton Australia for NSW cotton and grains industries. In addition, in support of the strategy in 2016-17, CRDC continued to fund 10 leadership and development programs, run two scholarship programs for emerging researchers, run the Grassroots Grants program to encourage local innovation, and support the Australian Cotton Conference and the Association of Australian Cotton Scientists Research Conference as a foundation sponsor. Educational attainment in cotton is commensurate with regional Australia, with 28 per cent of the population possessing post-school qualifications, up from 24 per cent in 2006.
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 monitoring and evaluation (M&E) framework enables ongoing performance reporting. In 2016-17, 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. One such assessment, of CRDC's investment in early-planting research in Central QLD, found a benefit-cost ratio of approximately 17.1 to 1: hence \$17.10 in benefit to Central QLD growers for every \$1 invested by growers and the Government through CRDC into this RD&E. In addition, CRDC's RD&E underpins the industry's best management practices program, myBMP, with industry participation in the program now at 70 per cent.

Key:
 ● The specific measure has been achieved.
 ● On target to deliver against the measure.
 ● Not on target to deliver against the measure.

Executive Summary

2016-17 YEAR IN REVIEW: RD&E ACHIEVEMENTS

CRDC RD&E: delivering real impact for cotton growers

An impact assessment of CRDC's investment in the efficient use of water and optimising crop nutrition RD&E, conducted in 2016-17, has found that these investments deliver major economic benefits to growers. The assessment found that CRDC's investment of \$4.90 million on behalf of cotton growers and the Australian Government into six water-use efficiency projects from 2010-15 returned a benefit of \$40.62 million to cotton growers, a benefit-cost ratio of 8.29 to 1. In addition, CRDC's investment of \$11.32 million of grower and Government funds into nine nutrition research projects from 2008-16 returned a benefit of \$61.15 million to growers, or 5.4 to 1. The assessment is part of a series of qualitative and quantitative impact assessments of CRDC's RD&E investments into important project clusters.

CRDC's early-planting research makes major impact in Central Queensland

CRDC-supported research examining how to help Queensland's Central Highlands cotton growers overcome climate challenges was put into practice commercially in 2016-17, with great success. The project, which started in the 2013-14 season, identified that a key tactic may be to plant considerably earlier than the traditional planting window in an effort to pull the boll-filling period forward into spring and early summer when weather conditions are at their most reliable. With the wider planting window afforded by Bollgard 3[®], for the first time in 2016-17, growers were able to put the research to the test and plant commercial areas during August. As a result of the promising results from these commercial trials, it is anticipated that some 80 per cent of growers in the Central Highlands region will use the early-planting research outcomes to plant in August for the 2017-18 season. An impact analysis, commissioned by QDAF, found that the total investment into the project was \$1.18 million, and the value of total economic benefits back to growers and the

industry was \$20.24 million – a benefit-cost ratio of approximately 17.1 to 1.

CRDC drives research outcomes across three major collaborative projects

CRDC is leading three major projects under the Australian Government's Rural R&D for Profit programme: *Smarter irrigation for profit*, *More profit from nitrogen*, and *Accelerating precision agriculture to decision agriculture*. Together, these projects and their 29 sub-projects are making major gains across the research fields of irrigation, nutrition, and big data. The *Smarter irrigation for profit* project is delivering thousands of dollars in savings to cross-sectoral growers per year through measuring performance and improving the efficiency of irrigation systems; *More profit from nitrogen* is improving nitrogen-use efficiency, which will ultimately increase growers' profitability; and *Accelerating precision agriculture* is removing barriers for growers, enabling them to capitalise on the full benefit of digital agriculture. Importantly, the *Accelerating precision agriculture* project is also delivering the first fully cross-sectoral collaborative research project, with all 15 rural research and development corporations (RDCs) partnering in the program.

World's best science the basis of the Bollgard 3[®] Resistance Management Plan

The Australian cotton industry moved into the Bollgard 3[®] era in 2016-17, with the approval of the Bollgard 3[®] Resistance Management Plan (RMP) by the Australian Pesticides and Veterinary Medicines Authority – a result of many years of collaborative research between CRDC, Cotton Australia and Monsanto. Industry contribution and consultation is a key part of the regulatory process in Australia for developing RMPs for products containing biotechnology. CRDC and industry play a critical role in providing and reviewing local and international research to assess resistance risks and mitigation strategies.

CRDC-supported innovation commercialised in 2016-17

A CRDC-supported innovation was commercialised in 2016-17: Sero X, a cutting-edge biopesticide. This world-first product was registered for use by Innovate Ag, and comes after a 10-year study lead by Dr Robert Mensah of NSW DPI, with support from the former Cotton CRC and CRDC. Significant further investment, research and product development was then undertaken by Innovate Ag. Sero X was developed for the control of *Helicoverpa* spp. and sucking pests (mirids, aphids, whitefly and small nymphs of green vegetable bugs) in conventional and Bt cotton crops. A feature of this product is that it employs three modes of action, so there is a low risk of insects building resistance to it.

Helping dryland growers maximise opportunities

A CRDC-supported project is helping identify and deliver benefits for dryland growers from Bollgard 3® and the new RMP. The project, which commenced in 2016-17, specifically targets the challenges and opportunities for dryland cotton production systems, to help growers maximise their opportunities. This is an exploratory RD&E project, developed in specific response to priorities identified by dryland cotton growers.

Research ramping up in the South

A newly created research role in southern NSW, supported by CRDC, aims to address issues faced by southern growers, particularly around germination and emergence. The role, based with NSW DPI at the Yanco Agricultural Institute, has been filled by grower-turned-researcher Steve Buster. Since starting in February 2017, Steve has been meeting with growers and consultants and has developed a number of potential experiments around sowing dates, temperatures, bed/hill formations and field geometry to meet the needs of both current and emerging cotton growers in the areas around Hillston, Condobolin, Griffith, Coleambally and Berrigan.

A long-term rotation trial to research a variety of issues, including disease, yield, trash management and the efficient use of water, both in a commercial setting and at the Yanco research station, is planned.

Helping growers to manage pest pressure while achieving high yields

Seasonal conditions in the lead up to and during the 2016-17 season resulted in high pest pressure for cotton growers. This pressure, combined with industry concerns regarding increasing insect resistance, saw CRDC, CottonInfo and key CRDC-supported industry researchers join forces to deliver an Integrated Pest Management (IPM) workshop series. It took key IPM RD&E to 130 growers and consultants across five valleys. The workshops delivered two key messages to attendees: IPM plays an essential role in helping to avoid insecticide resistance, and high-yielding cotton can be achieved using IPM. The workshop series is being reinforced by an IPM short course during 2017-18, the planning for which commenced in 2016-17.

Improving cotton's disease management capacity

CRDC's annual disease surveys project was completely reviewed in 2016-17 to improve impact and outcomes for growers. The core aim of the surveys remains the same – to ascertain the type and level of diseases present in cotton fields across NSW and QLD, as well as detect exotic diseases. A major change is that separate surveys previously undertaken by NSW DPI and QDAF pathology have now been combined within one project – ensuring greater collaboration and more strategic use of the resulting data. The new project also uses geospatial digital agricultural analysis to make better use of the data collected for identifying and testing best practice and providing links between soil characteristics, yield and disease. In addition, it engages CottonInfo regional extension officers in the pathology surveys to broaden monitoring capability and ensure the pathologists are aware of, and can quickly engage with, emerging issues.

Keeping cotton farms ahead of weed evolution

Minimising the impact of herbicide-resistant weeds remains a major focus for CRDC and cotton growers. In 2016-17, a CRDC-supported project has delivered a practical tool for growers, helping them to implement the recommended Herbicide Resistance Management Strategy (HRMS). This tool – the BarnYard Grass Understanding and Management (BYGUM) model – is delivered in partnership with CottonInfo, and is available to download from the CottonInfo website. In addition, a series of 16 workshops and masterclasses have delivered information about the impact of increasing levels of glyphosate resistance, and the strategies to delay or manage its onset, to 327 growers and consultants this year.

Predicting spray drift hazards through a hazard forecast system

A new three-year collaborative cotton and grains project, supported by CRDC and GRDC, is developing a spray hazard forecast system to minimise the damage caused by chemical spray drift. The project is a direct result of the extensive damage to cotton from phenoxy herbicides during the 2015-16 season. The project recognises that it is difficult for both growers and regulators to know when an inversion is present or is likely to form, and hence it is also difficult to know when the restriction of chemical use should apply. As such, the project is particularly focused on understanding surface temperature inversions in cotton/grain landscapes, including a more detailed understanding of when they are present. Ultimately, the project aims to provide notification of a surface temperature inversion that might result in a long-distance drift, out to 36 hours ahead, as well as real-time updates for operators of spray application machinery.

Establishing the shelf life of round modules

A CRDC-supported research project has found that round module storage has a small but detectable influence on the yellowness and elongation of cotton fibre. The project, which investigated the effect of the plastic polyethylene film used to wrap round cotton modules on moisture, heat retention and cotton fibre quality, concluded in 2016-17. The project delivered important information to growers on best practice storage for round modules, finding that the industry guidelines for traditional modules in regard to moisture content at picking, and module storage conditions, were also applicable to round modules.

Improving our ability to report cotton's sustainability performance

The cotton industry is committed to ongoing sustainability reporting, and CRDC continued to invest in this area in 2016-17, with a CRDC-supported project to enhance the industry's sustainability performance reporting ability. The project is developing a sustainability repository that can be used by the industry for different sustainability reporting needs, as well as visualisation tools that can be used to communicate the results to stakeholders, helping the industry to demonstrate its global leadership in the area of sustainability reporting.

Encouraging future leaders

CRDC invested in four leadership programs during 2016-17, designed to build a network of informed and experienced leaders. Two emerging industry leaders, Matt Bradd and Meagan Laidlaw, participated in the Australian Rural Leadership Program during 2016-17; two cotton growers, Matthew McVeigh and Tom Quigley, completed their Nuffield Scholarships, while a third, Daniel Kahl, commenced his with support from CRDC and Cotton Australia; two industry representatives, Zara Lowien and Tim Napier, participated in the Peter Cullen Trust program; and CSIRO postdoctoral fellow, Dr Priscilla Johnston, was awarded the Science and Innovation Award for Young People in Agriculture.

New partnership with Young Farming Champions education initiative

In 2016-17, CRDC formed a new partnership with Art4Agriculture for the Young Farming Champions program, which aims to identify youth ambassadors and future influencers working within cotton. The Young Farming Champions promote positive images and perceptions of farming, and engage in activities within schools, including the Archibull Prize. Through this partnership, CRDC is supporting two cotton Young Farming Champions, cotton researcher Jess Lehmann and agricultural science student Nellie Evans.

Investing in grower-led grassroots research

CRDC's Grassroots Grants program encourages Cotton Grower Associations 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 invested over \$466,000 into 52 projects across the cotton-growing valleys, including eight projects in 2016-17.

Turning ideas into actions through start-up science

CRDC partnered with start-up science company Pollenizer to run two start-up science workshops, *Rural.XO microhacks*, in 2016-17, designed to encourage entrepreneurship in the cotton industry. Under the program, cotton industry innovators were invited to participate in the workshops in Sydney in collaboration with CRDC's fellow RDC, Fisheries RDC. CRDC sponsored 20 cotton industry participants, from growers to researchers, to attend, with the best ideas emerging from the workshops having the opportunity to be incubated into start-up businesses through the follow-up program, the *Cotton-X bridging program*, which commenced in June 2017.

Executive Summary

2016-17 YEAR IN REVIEW: ORGANISATIONAL HIGHLIGHTS

Strong support for, and involvement in, CRDC RD&E by cotton growers

The 2015-16 Cotton Growing Practices Survey, published in July 2016, sought feedback from growers about their perceptions of CRDC and support for our RD&E investments. The survey found that 99.6 per cent of growers are aware of CRDC, 88 per cent of growers are supportive of CRDC's research and investments, and 74 per cent of growers have input into CRDC about research. The 2016 Cotton Growing Practices Survey, published in May 2017, sought feedback from growers on their involvement in cotton industry research trials. It found that 35 per cent of growers had hosted a research trial on their farm in the previous season, with growers contributing an average of 19 hours and \$5500 towards their on-farm trials. The 2017 survey, which commenced in June 2017 and will report in 2017-18, marks 20 years since the first surveys of Australian cotton growers' management practices and attitudes were undertaken by CRDC.

Stakeholder survey shows partner satisfaction

In addition to the annual grower survey, CRDC also commissioned a stakeholder survey in 2016-17, to gauge the strength of the partnership with key stakeholders, including government, industry and research bodies. The survey results showed a strong level of satisfaction, with 82 per cent of key stakeholders indicating overall satisfaction; 82 per cent indicating satisfaction with CRDC's engagement; and 87 per cent indicating CRDC is an organisation they can trust. CRDC will be repeating the survey with key stakeholders on an ongoing basis, to ensure continuous monitoring of, and improvement in, relationships with partners.

New Chair to lead CRDC's innovation in cotton RD&E

Richard Haire was appointed Chair of CRDC in August 2016, following the conclusion of Dr Mary Corbett's tenure in the role. Mr Haire has held many leadership positions within the cotton industry, including Managing Director and regional head of Olam International, and Chief Executive of Queensland Cotton Corporation Pty Ltd. Mr Haire had previously served as a Director on the CRDC Board from 2011 to 2014.

CRDC Directors visit growers in the Namoi, Central Highlands and Macquarie Valleys

Over the course of the 2016-17 year, the CRDC Board visited three cotton-growing valleys, with meetings held in Narrabri, Theodore and Warren. The Board meetings also incorporated on-farm tours to meet with local growers, view the implementation of CRDC-supported research, and discuss research priorities in response to local needs. The on-farm tours and in-valley meetings ensure that CRDC remains aware of, and responsive to, the RD&E needs of the cotton industry.

Third annual Research Priority Forum identifies cotton RD&E priorities

CRDC hosted its third annual Research Priority Forum in Brisbane in May 2017, 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.

Development of CRDC's next five-year Strategic Plan begins

CRDC's current Strategic R&D Plan will conclude in June 2018, and as such, work has commenced during 2016-17 on the development of the new five-year Strategic Plan, which will guide CRDC's investments from 2018 to 2023. The Strategic Plan is CRDC's key planning document; it 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 Government to achieve its strategic RD&E priorities. As such, the plan is developed in close consultation with key stakeholders, including cotton growers, Cotton Australia, the Minister for Agriculture and Water Resources, and his Department.

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. As of 2016-17, 40 per cent of CRDC investments are in cross-sectoral RD&E, up from 25 per cent in 2015-16. 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; and at the local level, partnerships with Cotton Grower Associations on CRDC Grassroots Grants.

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 2016-17, CRDC hosted a visit by Cotton Incorporated, the US cotton research, development and marketing organisation, to further discussions regarding RD&E collaboration. There are currently four joint CRDC and Cotton Incorporated projects underway. In addition, CRDC representatives attended the International Cotton Advisory Committee (ICAC) Social Environmental and Economic Performance of Cotton (SEEP) Conference; the Better Cotton Initiative Conference; and the Sustainable Apparel Coalition Annual General Meeting.

CRDC RD&E showcased at industry events

CRDC-supported RD&E projects were showcased at the major industry event, the 18th Australian Cotton Conference, in August 2016. In all, 52 per cent of speakers on the conference agenda were supported by CRDC, with 75 per cent of presentations about research featuring CRDC-supported researchers. CRDC is continuing its support for other major industry events, the grower-focused Cotton Collective, and the researcher-focused Association of Australian Cotton Scientists' Australian Cotton Research Conference, in 2017-18, the planning for which began in 2016-17.

Cotton Futures: investing in blue-sky, transformational cotton RD&E

Cotton Futures provides a clear framework for CRDC to invest in long-term, transformational innovations to ensure the industry remains profitable, sustainable and competitive in the future. In 2016-17, CRDC invested in 25 innovative blue-sky projects under the three Cotton Futures themes: Profitable futures (Farmers program); Sustainable futures (Industry program); and Competitive futures (Customers program). These projects include new or ongoing research into precision to decision agriculture, agri-intelligence, industry resilience, developing chemicals from cotton biomass, and creating nanofibrous coatings for cotton fabrics.

CottonInfo: continuation of program to connect growers with CRDC-led R&D

2016-17 marked four years of the industry's joint extension program, CottonInfo, supported by CRDC, Cotton Australia and CSD Ltd. It also marked the formal announcement of the continuation of the program to 2021, which took place at the Australian Cotton Conference in August 2016. Studies conducted in 2016-17 have shown that 90 per cent of growers and 98 per cent of consultants are aware of CottonInfo; 86 per cent of growers and 87 per cent of consultants source information from CottonInfo; and 86 per cent of growers and 100 per cent of consultants believe CottonInfo has helped to improve practices. Three new CottonInfo Technical Specialists were appointed in 2016-17, in the areas of irrigation, nutrition, and weed management.

Deputy Prime Minister launches People in Agriculture site with CRDC

People in Agriculture is a new resource for both employers and employees working in agriculture. CRDC is among one of six agricultural bodies that partnered to invest in the development of the People in Agriculture website. The site was launched in December 2016 by Deputy Prime Minister and Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP, and CRDC Chair Richard Haire, along with representatives of the other partners: GRDC, APL, Dairy Australia, MLA, and Food and Agribusiness Solutions. The website will serve as an important repository for human resource management information.

Cotton's first Workforce Development Strategy underpins training funds for cotton growers

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. The funding will enable cotton and grains industry on-farm staff and industry personnel to undertake full and part qualifications over three years, as part of the AgSkilled program. The Workforce Development Strategy aims to ensure that the Australian cotton industry is able to attract, retain and develop people to drive the industry's competitiveness.

CRDC-supported scientist talks NRM with the Prime Minister and Deputy Prime Minister

In December 2016, CRDC-supported scientist and cotton industry researcher Dr Rhiannon Smith discussed her CRDC project with the Australian Prime Minister, the Hon. Malcolm Turnbull MP, and Federal Minister for Agriculture and Water Resources and Deputy Prime Minister, the Hon. Barnaby Joyce MP, during a visit to the University of New England (UNE). Dr Smith is a research fellow and lecturer in the School of Environmental and Rural Science at UNE, and discussed her focus – biodiversity, landscapes and ecosystem stewardship – with the Prime Minister and Deputy Prime Minister. Mr Turnbull, Mr Joyce and Dr Smith discussed research done under Dr Smith's CRDC-supported project into carbon sequestration by river red gums, including the technology she uses to measure the health of trees, how much water trees use each day, and how that translates into production.

CRDC supports young cotton leaders at GrowAg

CRDC supported three people to attend the GrowAg Summit – grower Aaron Kiely, consultant Reinder Prins, and CRDC-supporter researcher Nicole McDonald – a gathering of a hundred of the brightest young people working in Australian agriculture, hosted by CRDC's fellow RDC, RIRDC. The forum was focused on new technologies, new ideas, smart business, leadership and innovation. It highlighted that a potential major disruptor for the cotton industry was big data, with the CRDC-supported *Accelerating precision agriculture to decision agriculture* project featuring at the event.

Executive Summary

2016-17 INVESTMENT AND IMPACT

THE AUSTRALIAN COTTON INDUSTRY IN 2016-17:

4.2 million bales



produced by the Australian cotton industry

500,000 hectares planted into irrigated and dryland cotton, the largest crop in five years.

\$2.48 billion gross value of cotton production.

\$3159 per hectare profit – the indicative average profit achieved by the top 20 per cent of cotton growers.

CRDC'S INVESTMENT IN 2016-17:

\$24.1 million – CRDC's investment in cotton RD&E on behalf of cotton growers and the Australian Government

350

RD&E projects



122

research partners



5

key program areas



farmers, industry,
customers, people and
performance.

CRDC'S IMPACT IN 2016-17:

3.1%
average

↑ growth in yield per hectare – the estimated increase in productivity each year since 2013. CRDC's goal is 3 per cent per hectare per annum.

99.6% – the number of cotton growers who are aware of CRDC. 88 per cent of growers are supportive of our RD&E investments, and 74 per cent have had input into our RD&E.

100%

of those who provided feedback at the CRDC, CottonInfo and ICAN regional weed management workshops said the information learned would help with decisions in the field.

75% of participants

in the 2016 CRDC-CottonInfo IPM workshop series reported higher levels of confidence about growing high-yielding crops using IPM after the workshop. 80% recorded higher levels of confidence in their ability to conserve beneficial insects.

17.1:1

the benefit-cost ratio of CRDC's early-planting research in the QLD Central Highlands: \$17.10 in benefit to growers for every \$1 invested by growers and the Government through CRDC into this RD&E.

8.29:1

the benefit-cost ratio of CRDC's investment in water-use efficiency RD&E: \$8.29 in benefit to growers for every \$1 invested by growers and the Government through CRDC into this RD&E.

5.4:1

the benefit-cost ratio of CRDC's investment in nutrition RD&E: \$5.40 in benefit to growers for every \$1 invested by growers and the Government through CRDC into this RD&E.

BYGUM *the BarnYard Grass Understanding and Management (BYGUM) model: a new tool for growers to help minimise the impact of herbicide-resistant weeds.*

93% of participants in the 2016 **Smarter Irrigation Technology Tour** said they would do something differently on their farm as a result of the tour.

A research collaboration with GRDC

to specifically address the issue of spray drift by better understanding – and reporting – surface temperature inversions.

\$14.7 million

– the amount of vocational training funds allocated by the NSW Government to the NSW cotton and grains industries through Cotton Australia, underpinned by the industry's first Workforce Development Strategy developed by CRDC and Cotton Australia.

2 research projects

– to specifically address needs of dryland growers and those in southern NSW.

3 major collaborative projects

– driven by CRDC under the Rural R&D for Profit programme: *Smarter irrigation for profit*, *More profit from nitrogen*, and *Accelerating precision agriculture to decision agriculture*. Accelerating precision agriculture is the first fully cross-sectoral collaborative research project, involving all 15 RDCs.

New partnerships with start-up companies

NEW

Pollenizer and X.Lab to encourage cotton industry disruptors and entrepreneurs.

**35%**

the number of growers who hosted a research trial on their farm in 2015-16.



These growers contributed an average of 19 hours and \$5500 towards these trials.

**40%**

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

**52%**

of presenters at the 18th Cotton Conference in 2016 represented CRDC's investments in RD&E.

86%

of growers and

100%

of consultants

believe CottonInfo has helped to improve practices

1 CRDC-supported innovation commercialised: Sero X.

70% of growers: estimated to now be participating in myBMP.

Section 2

CRDC Business

CRDC role

CRDC operations

Setting the research
priorities

Cooperation and
collaboration



RUTH REDFERN

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 2016-17, CRDC invested \$24.1 million in RD&E into 350 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 2016-17, CRDC partnered with 122 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.

Core programs

CRDC has established five strategic outcomes to be achieved under the 2013-18 Strategic R&D Plan that informed the key focus areas for R&D investment in 2016-17:

- **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 2016-17, CRDC invested in 25 innovative blue-sky projects under the three Cotton Futures themes, 20 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 programme, such as the CRDC-led *Accelerating precision agriculture to decision agriculture* project.

Overall, CRDC has budgeted to invest \$8.5 million in Cotton Futures research projects in 2013-18 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.

CRDC OPERATIONS

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 specialists (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, *myBMP* (who can assist growers to sign up for, and participate in, *myBMP*, providing a critical link between research extension and best practice).

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

During 2016-17, CottonInfo engaged with growers, consultants and the wider industry at 145 events, with 2300 cotton industry personnel in attendance: 1200 growers and farm workers; 400 consultants; 300 agribusiness personnel; and 400 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 R&D. A variety of monitoring and evaluation projects are funded under CRDC's performance program, designed to ensure the impact of investment in R&D can be captured and demonstrated.

One such evaluation – a CRDC analysis of a study by the Cotton Innovation Network – showed the CRDC accounted for 32 per cent of total cotton R&D investments in Australia and was involved in over 80 per cent of all cotton R&D. Overall, public and private R&D investment in the cotton sector is in the order of \$60 million annually – supporting an industry that generates an average of \$1.9 billion per annum in export revenue and contributes to broader economic, environmental and social benefits.

As this evaluation shows, in order to achieve industry efficiency, CRDC works in collaboration with other cotton industry bodies and other RDCs 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 R&D Plan

CRDC's 2013-18 Strategic R&D Plan will conclude in June 2018, and as such, work commenced during 2016-17 on the development of the new five-year Strategic Plan, which will guide CRDC's investments from 2018 to 2023. The Strategic Plan is CRDC's key planning document, setting the direction for the organisation's operation and investments in cotton R&D over the five years, enabling the industry to achieve its long-term vision, and the Australian Government to achieve its strategic R&D priorities. As such, the plan is 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.



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.

In turn, these priorities help to shape CRDC's strategic RD&E priorities, which are formalised under the 2013-18 Strategic R&D Plan.

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 R&D Plan, including R&D 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 R&D:

- 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 May 2017 research priority forum, the Cotton Australia research advisory panels identified key areas of focus for future RD&E investment, including:

- Tactics for management of priority weeds.
- Management of cotton under stress from heat and humidity.
- Improving IPM to manage silverleaf whitefly and mealybugs.

- Understanding soil constraints.
- A collaborative approach to spray drift and herbicide-resistance management, and understanding the social science behind adoption of best practice spray application.
- Alternatives to pupae busting.
- Alternative management strategies for healthy water systems and feasibility of managed aquifer recharge.
- Decision support systems for irrigation.
- Understanding the impact of weather, harvest and storage on cotton colour.
- Understanding consumer perceptions of Australian cotton quality.
- Developing international collaborations on differentiated products.
- Building industry capacity: building Cotton Grower Association capacity, and understanding the impact of visa system changes.

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 R&D 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	

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

The Australian, state and territory governments, rural R&D corporations, 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 or are being 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.

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.

The Vision 2029 elements were central to the development of the CRDC Strategic R&D Plan 2013-18, and continue to play a key role in guiding CRDC's investments each year, to ensure CRDC is contributing to their achievement.

CRDC Business

COOPERATION AND COLLABORATION

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

CRDC's cooperation extends from national 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 2016-17, CRDC partnered with 122 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. It was estimated in 2015-16 that the grower members of TIMS collectively contributed approximately \$32,600 in time to this committee.

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. The 2016 CRDC Grower Practices Survey, published in May 2017, sought feedback from growers on their involvement in cotton industry research trials. It found that 35 per cent of growers had hosted a research trial on their farm in the previous season, with growers contributing an average of 19 hours and \$5500 towards their on-farm trials.

Cotton industry programs: CottonInfo and myBMP



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.



Similarly, myBMP, 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 programme.



MELANIE JENSON

Australian Government grants

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

Ongoing projects during 2016-17

CRDC managed five ongoing projects in 2016-17 under the Government's grant programs, contributing a combined \$13.4 million into RD&E funding across the life of the projects, 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:

- **Carbon farming in the Australian cotton industry** (*funded 2013-17, with \$1.3 million from the Carbon Farming Futures Extension and Outreach program*).
- **Determining optimum nitrogen strategies for abatement of emissions for different irrigated cotton systems** (*funded 2013-17, with \$770,000 from the Carbon Farming Futures Action on the Ground program*).
- **Smarter irrigation for profit** (*funded 2015-18, with up to \$4 million from the Rural R&D for Profit Programme – 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 programme – 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 programme – round two*). Involves all 14 of CRDC's fellow RDCs and other research partners.

CRDC is also involved in four other ongoing projects under rounds one and two of the Rural R&D for Profit programme, led by other RDCs and administered by the Department:

- **Stimulating private sector extension in Australian agriculture to increase returns from**

R&D (*led by Dairy Australia; \$1.6 million from the Rural R&D for Profit programme – round one*).

- **Improved use of seasonal forecasting to increase farmer profitability** (*led by RIRDC; \$1.8 million from the Rural R&D for Profit programme – round one*).
- **A profitable future for Australian agriculture: Biorefineries for higher value animal feeds, chemicals, and fuels** (*led by SRA; \$3 million from the Rural R&D for Profit programme – round one*).
- **Digital technologies for more dynamic management of disease, stress and yield** (*led by AGWA; \$3 million from the Rural R&D for Profit programme – round two*).

New projects commencing 2017-18

In 2017-18, new projects commencing under round three of the Rural R&D for Profit programme were announced, along with a project under the Established Pest Animals and Weeds Measure of the Australian Government's Agricultural Competitiveness White Paper.

These projects, all administered by the Department of Agriculture and Water Resources, with CRDC as a project partner, are as follows:

- **Forewarned is forearmed: managing the impacts of extreme climate events** (*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 programme – round three*).
- **Improving plant pest management through cross-industry deployment of smart sensor, diagnostics and forecasting** (*led by Horticulture Innovation Australia in partnership with CRDC; \$6.8 million in funding from the Rural R&D for Profit programme – round three*).
- **Increasing farmgate profits, the role of natural capital accounts** (*led by Forest and Wood Products Australia in partnership with CRDC; \$900,000 in funding from the Rural R&D for Profit programme – round three*).
- **Biological control and taxonomic advancement for management in the Noogoora burr complex** (*led by NSW DPI in partnership with CRDC; \$559,700 from the Control Tools and Technologies for Established Pest Animals and Weeds programme*).



Section 3

Corporate Operations

Business financials

Our investments in RD&E

Investments against
Government priorities

CRDC's investment in RD&E is funded through an industry levy and matching Commonwealth contributions. In 2016-17, CRDC invested \$24.1 million in cotton RD&E throughout the industry supply chain. In 2017-18, CRDC estimates cotton RD&E expenditure will be \$22.4 million.

Cotton production for the 2016-17 year is estimated to be 4.2 million bales of ginned cotton – up from the 2.8 million bales achieved in 2015-16. As a result of seasonal conditions and a larger proportion of dryland production, the yield for 2016-17 is expected to average 7.6 bales per hectare – down from the 10.2 bales per hectare average achieved in 2015-16.

Forward estimates by industry and ABARES are for an increase in cotton production in 2017-18 to 4.8 million bales.

An above-average cotton production year and an outlook for industry growth have provided CRDC the opportunity to increase R&D expenditure, after a period of drought had necessitated the use of financial reserves to sustain cotton industry RD&E.

To achieve the strategic priorities of the 2013-18 R&D Plan, CRDC has budgeting for \$100 million of expenditure over the five years of the Strategic Plan.

Revenue

Cotton levy revenue is collected at the point of ginning, that is, when cotton has been picked and delivered to cotton gins. Cotton farmers pay a levy of \$2.25 for each 227-kilogram bale of cotton. A new levy was introduced on 1 April 2017 for seed cotton exports 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.

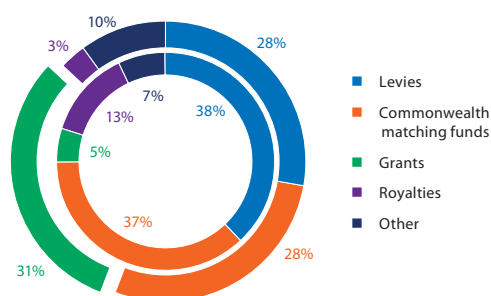
The setting and collection of the industry levy is enabled by the *Primary Industries (Excise) Levies Act 1999* and the *Primary Industries Levies and Charges Collection Act 1991* respectively. The Australian Government matching contributions in 2016-17 were capped at the value of levies collected, as it was lower than the 0.5 per cent of the three-year average gross value of production.

Revenue (Actuals)	2016-17 (\$m)
Industry levies	6.131
Australian Government	6.129
Royalties	0.585
Interest	1.078
Research Grants	6.719
Other	0.958
TOTAL	21.600

BUSINESS FINANCIALS

As the following graph demonstrates, in the five years from 2012-13 to 2016-17, the proportion of grant revenue generated by partnerships with the Australian Government, RDCs and commercial enterprises has increased from five per cent of total revenue to 31 per cent of total revenue. The Australian Government's Rural R&D for Profit programme grants, administered by the Department of Agriculture and Water Resources, contributed a total of \$3.6 million in revenue to CRDC in 2016-17, and have also attracted additional grant revenue of \$1.6 million in 2016-17 from program partners.

**Change in CRDC revenue mix over five years:
2012-13 (inner circle) to 2016-17 (outer circle).**



Total revenue for 2016-17 of \$21.600 million was \$8.427 million (64 per cent) above budget of \$13.173 million. Total 2016-17 revenue comprised of:

- Industry levy revenue of \$6.131 million, which includes \$3.287 million (54 per cent) from the 2015-16 crop and \$2.842 million (51 per cent) from the 2016-17 estimated crop.
- Australian Government matching contribution of \$6.129 million was capped at the value of levies collected.
- \$0.585 million in royalties from the sale of CRDC-funded CSIRO seed varieties.
- Interest revenue of \$1.078 million was 54 per cent above budget, due to the higher level of cash reserves under CRDC management generated by above-budget revenues in the current and prior years.
- External grants of \$6.719 million included Rural R&D for Profit, Carbon Farming Initiative, Action on the Ground, Filling the Research Gap and co-investments from project partners.
- Other revenue of \$0.958 million, which includes project refunds.

Expenditure and investment

Actual expenditure for 2016-17 was \$24.089 million, an increase of \$3.688 million over the budgeted expenditure of \$20.401 million.

Actual (\$m)	2012-13	2013-14	2014-15	2015-16	2016-17
Cotton Crop Size (millions of bales)	4.49	3.90	2.31	2.77	4.27*
Total Revenue	30.915	27.479	20.073	18.935	21.600
Industry levies	11.801	10.997	7.298	6.054	6.131
Australian Government	11.523	11.239	7.295	6.053	6.129
Royalties	3.971	1.830	1.707	0.745	0.585
Interest	1.726	1.779	1.596	1.282	1.078
Research Grants	1.356	1.243	0.925	4.127	6.719
Other**	0.538	0.411	1.252	0.674	0.958
Expenditure total	19.301	21.293	22.826	20.555	24.089
Cotton RD&E activities	15.632	18.203	19.244	17.052	20.318
Total equity position	38.931	44.488	41.645	40.025	37.536

* ABARES estimate, *Agricultural Commodities June 2017*.

** 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 2016-17 was allocated to the following activities:

Cost Allocation Activity	2016-17
Direct R&D Expenditure (project costs)	\$16,611,829
Indirect R&D Expenditure (administration costs)	\$3,771,507
Grant-funded expenditure (R&D not eligible for Commonwealth Matching)	\$3,706,135
Total Expenditure	\$24,089,471

Portfolio Budget Statement

The CRDC Portfolio Budget Statement released in May 2017 provided an estimate of CRDC's outcomes, outputs, performance and financial position for 2017-18 to 2020-21. The statement was consistent with the CRDC Strategic R&D Plan 2013-18 and the Annual Operational Plan 2017-18.

Outcomes and outputs 2016-17

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	2016-17
TOTAL Budgeted Revenue	\$13,173,000
TOTAL Actual Revenue	\$21,599,803
TOTAL Budgeted Cost of Outputs	\$20,401,000
TOTAL Actual Cost of Outputs*	\$24,089,471

* 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 \$8.427 million is a result of new unbudgeted grants, the 2016-17 crop being above budget, increased interest received and increased project refunds. The larger crop has provided

additional levies, Commonwealth contributions and royalties of \$1.436 million. Research grants have increased by \$5.961 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 2017 Agricultural Commodities report estimated the average storage level of public irrigation dams serving the Australian cotton-growing region was 66 per cent of capacity as at 25 May 2017, up from 28 per cent at the same time in 2016. Seasonal inflows into the main cotton irrigation dams can be expected before November 2017.

CRDC has budgeted for a \$3.908 million operating surplus for 2017-18. This reflects revenue of \$26.428 million and expenditure of \$22.520 million. Industry levy revenue and Commonwealth contributions will continue to be drawn from two crop seasons, 2016-17 and 2017-18.

The size of industry levies and Commonwealth contributions is heavily reliant upon crop production, which was budgeted to be 5.5 million bales for 2017-18. CRDC expects that the Australian Government matching contributions will be based on matching industry levy revenue in 2017-18.

Forecast expenditure

Budgeted expenditure for 2017-18 is \$22.520 million, a decrease of \$1.569 million below the 2016-17 actual expenditure. The forecast expenditure for the next two years for RD&E is budgeted at \$25.115 million in 2018-19 and \$19.702 million in 2019-20.

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 \$4.118 million in 2017-18.

Corporate Operations

OUR INVESTMENTS IN RD&E

CRDC used the Strategic R&D Plan 2013-18 to guide its program investments in 2016-17. The plan was developed with extensive industry, government and stakeholder consultation and was evaluated in the preparation of the Annual Operational Plan 2016-17.

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.

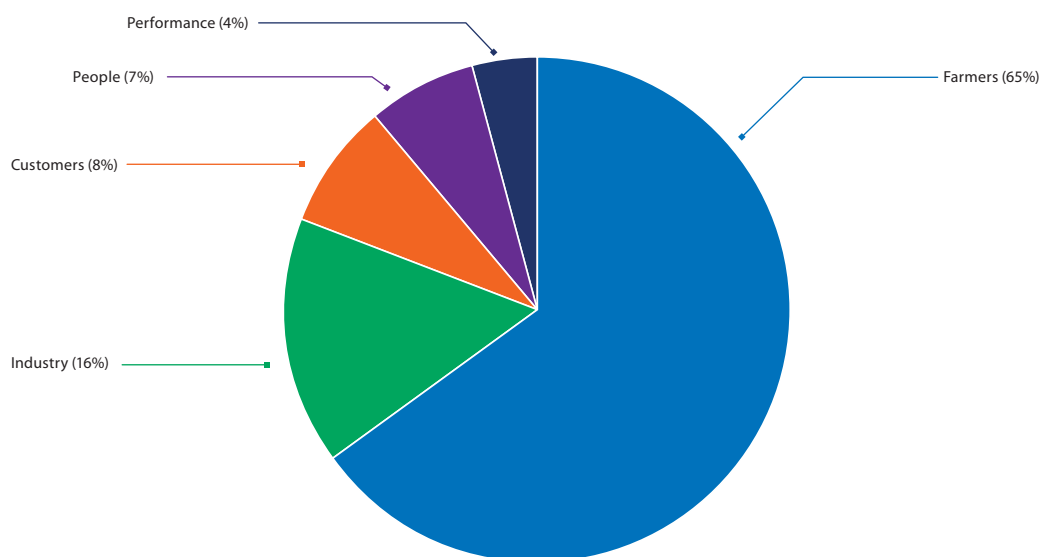
The portfolio includes RD&E that seeks to 'protect and defend' the production base from pest threats; increase productivity while ensuring resource-use efficiency; enhance product value through the supply chain; build a capable industry; and create an element of research discovery.

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	141	49	21	124	15	350
Program expenditure (\$m)*	13.3	3.2	1.7	1.4	0.7	20.3
Program percentage (of expenditure)	65%	16%	8%	7%	4%	100%

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

**Total number of CRDC projects**

CRDC projects	2012-13	2013-14	2014-15	2015-16	2016-17
Active projects	50	61	118	150	155
New projects funded	153	142	162	141	205
Projects completed	142	85	130	136	193
Continuing projects	61	118	150	155	167

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

Corporate Operations

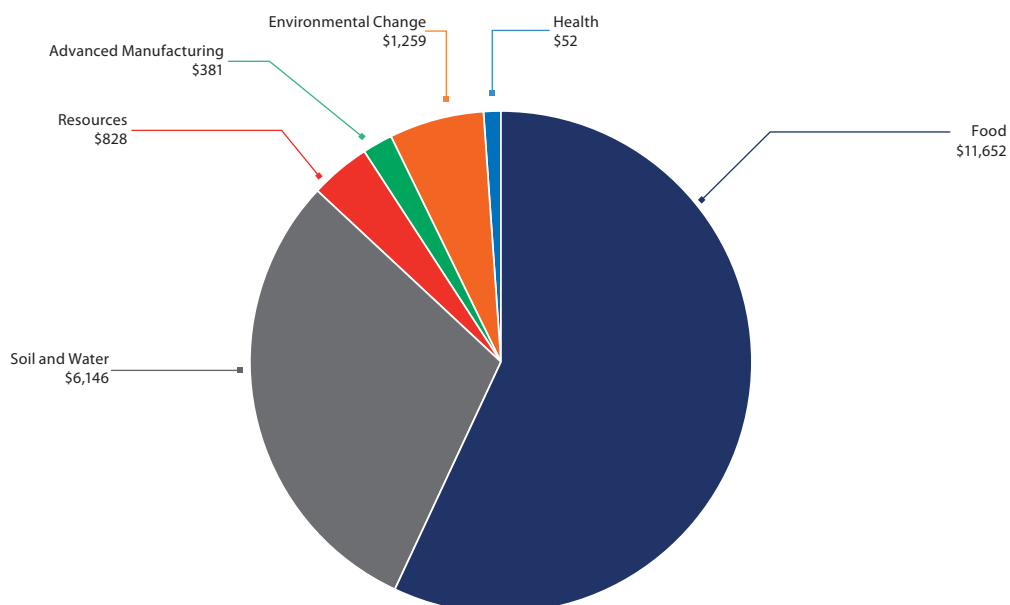
INVESTMENTS AGAINST GOVERNMENT PRIORITIES

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	\$11,652
■ Soil and Water	\$6,146
■ Transport	—
■ Cybersecurity	—
■ Energy	—
■ Resources	\$828
■ Advanced Manufacturing	\$381
■ Environmental Change	\$1,259
■ Health	\$52
TOTAL	\$20,318

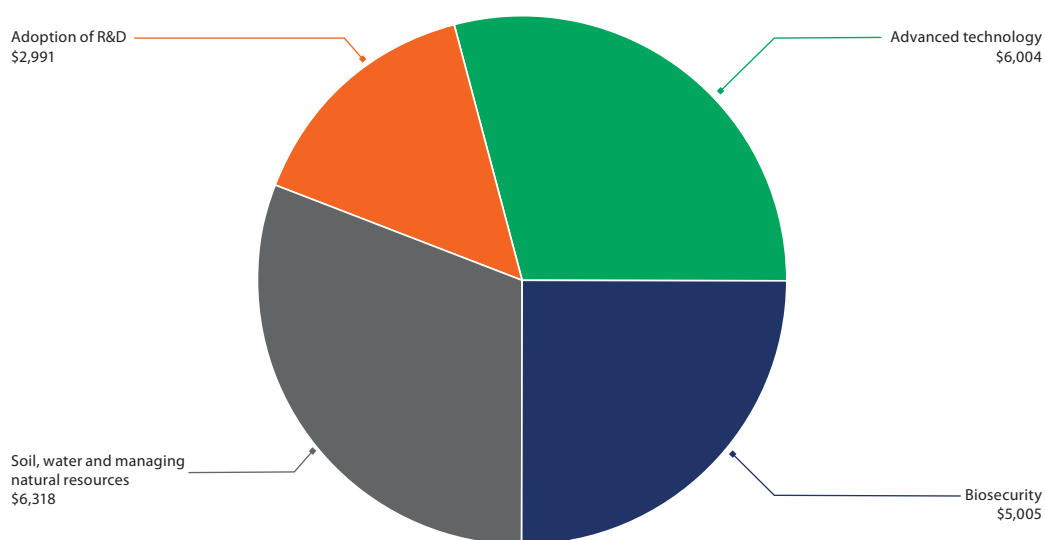
Some figures have been rounded up or down.



INVESTMENTS AGAINST GOVERNMENT PRIORITIES

CRDC investment by Rural RD&E Priorities

Rural RD&E Priorities	CRDC investment (\$'000)
■ Advanced technology	\$6,004
■ Biosecurity	\$5,005
■ Soil, water and managing natural resources	\$6,318
■ Adoption of R&D	\$2,991
TOTAL	\$20,318



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



RD&E Portfolio

PROGRAM 1: FARMERS

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 CO₂ 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 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).

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 2016-17 investment in this area included the following projects:

- *Commercial development and evaluation of a machine vision-based weed spot sprayer*, with NCEA;
- *Digital technologies for dynamic management of disease, stress and yield*, with AGWA;
- *Enhancing IPM in cotton systems*, with CSIRO;
- *Management options enhancing beneficial microbial functions in cotton soils*, with CSIRO;
- *Regional weed management workshops for growers and advisors*, with ICAN;
- *Staying ahead of weed evolution in changing cotton systems*, with UQ; and
- *Viruses, vectors and endosymbionts: Exploring interactions for control*, with UQ.

The *Commercial development and evaluation of a machine vision-based weed spot sprayer* project will deliver improved spot spraying for growers of cotton and other broadacre crops through the ability to map and differentiate different weed species. The project has made strong progress in developing image analysis techniques and algorithms to discriminate volunteer cotton in fallow fields and in crop. The project links to similar research in sugar and horticulture, and has commenced steps towards commercialising the approach to enable growers to access this technology. The project is due for completion in 2017-18.

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 programme, administered by the Department of Agriculture and Water Resources. It commenced in 2016-17 and is led by AGWA, with CRDC and Horticulture Innovation Australia as project partners. The project aims to integrate systems capable of simultaneous measurement and data provision to assist cross-sectoral holistic decision making for the management of yield, disease and stress in cotton, grapes and horticulture.

One of the cotton-specific projects under this collaborative project focuses on the development of a specific genetic tool to determine strain and pre-plant soil populations of the pathogen *Verticillium dahliae*. The tool is designed to become a management tool for growers, helping them to assess the effect of their management strategies on verticillium inoculum levels, and assess the risk of disease in field prior to planting. The project is due for completion in 2018-19.

The *Enhancing IPM in cotton systems* project recognises that cotton faces ongoing challenges from a range of insect and mite pests (particularly mirids, green vegetable bug and silverleaf whitefly), and that their management requires ongoing effort in the assessment of control options for integrated pest management (IPM). Over the past year, in response to industry issues, this project

has continued to provide significant IPM capacity with an increased focus on silverleaf whitefly, increasing industry understanding on the impact of beneficials. Research is also underway to better understand any link between cotton colour, honeydew from whitefly, and weathering.

This project also ensures the industry information to support IPM decisions remains current and accurate. During the last 12 months, the project has reported on seven insecticidal compounds, impact on beneficials, and established thrip trials that include new products coming to market, ensuring the industry is equipped with independent data to inform IPM decisions. The lead researcher on this project was an important contributor to the CottonInfo IPM workshop series, headlining the workshops with other IPM researchers. The project is due for completion in 2017-18.

The *Management options enhancing beneficial microbial functions in cotton soils* investigated how management practices in current Australian cotton farming systems, such as reduced tillage, crop rotation, residue retention, organic manure application and reduced insecticide use, can change the levels of key soil microbial functions. The soil microbial functions need to be optimised to help sustain cotton production, improve nutrient-use efficiency, reduce soil-borne diseases and maintain environmental health.

As such, this project used existing field experiments, complemented with laboratory experiments, to improve the understanding of management impacts on key beneficial microbial communities. Soil analysis from the two long-term cropping systems experiments at ACRI found that cropping history, fertiliser and stubble management have a significant influence on the microbial activity of microbial groups involved in nitrogen and carbon cycling processes. The project also found that legumes in rotation have a significant positive effect on microbial catabolic diversity and activity and nitrogen mineralisation potential, and that lower diversity and abundance of total fungi were associated with higher disease

incidence in cotton systems. The project concluded in 2016-17 and the final report is available at CRDC's online library, Inside Cotton.

The *Regional weed management workshops for growers and advisors* project aims to build industry capacity to manage weeds through the delivery of a series of training workshops and masterclasses for growers and advisors during 2016-17 and 2017-18. The workshops focus on the impact of increasing levels of glyphosate resistance to farming systems, and the strategies to delay or manage its onset. A total of 327 growers and consultants attended 16 workshops and masterclasses during 2016-17, with 100 per cent of those who provided feedback on the events indicating the information learned would help with decisions in the field. The project is due to conclude in 2017-18, following completion of another seven workshops.

The *Staying ahead of weed evolution in changing cotton systems* project aims to minimise the adverse impacts of glyphosate-resistant weeds, or potential impacts of multiple-resistant weeds, on the cotton industry. It aims to do this through understanding the drivers for resistance and evaluating new tactics for weed control. The project looks at herbicide resistance from a molecular perspective, conducting ecology studies of key weed species (awnless barnyard grass, Feathertop Rhodes, windmill grass, fleabane and sowthistle) and testing herbicide and non-herbicide tactics that support weed management best practice.

The project has been integral in developing the industry's recommended strategy of 2+2+0: two non-glyphosate tactics targeting both grasses and broadleaf weeds during the cotton crop, plus two non-glyphosate tactics in summer fallow/rotations targeting both grasses and broadleaf weeds, plus zero survivors setting seed. It has also developed the BarnYard Grass Understanding and Management (BYGUM) model that underpins the strategy. BYGUM has been publically released this year via CottonInfo as a tool that provides new ways to look at the economics of summer weed control in Australian cotton/grains systems.

PROGRAM 1: FARMERS

Growers and consultants can now compare tactics to evaluate profitability of control strategies in Australian cotton cropping.

The project is now developing a multi-species, multi-herbicide resistance model that will enable the industry to understand how much diversity is required to maintain a sustainable weed management system. The project is due to conclude in 2018-19.

The *Viruses, vectors and endosymbionts: Exploring interactions for control* project seeks to contribute to our fundamental understanding of vector, virus and endosymbiont interactions, to enhance the industry's preparedness for the potential incursion and establishment of cotton leaf curl disease (CLCuD) in Australia. CLCuD is a viral infection of cotton and other susceptible host plants that is transmitted by silverleaf whitefly (*Bemisia tabaci*). Genomic data has been generated

to investigate the endosymbiont and whitefly diversity present in Australia, which will be used to support improved diagnostics for exotic whitefly. Research conducted under this project has confirmed that CLCuD is a significant threat to the Australian cotton industry, with Australian varieties confirmed as susceptible to the virus. The project is due to conclude in 2017-18.



RUTH REDFERN

Case study: IPM workshop series keeps IPM on the agenda

CottonInfo and CRDC held an Integrated Pest Management (IPM) workshop series in November–December 2016, taking the IPM message out to 130 growers and consultants across five cotton-growing valleys.

Experienced industry researchers Dr Lewis Wilson, Dr Mike Bange, Dr Robert Mensah, Dr Paul Grundy, Dr Jamie Hopkinson and Dr Sandra McDougall were among those who presented at the workshops held at Warren, Griffith, Cecil Plains, Boggabilla and Boggabri.

The workshops had two clear messages for growers and consultants: IPM plays an essential role in helping to avoid insecticide resistance, and IPM helps you achieve high-yielding cotton.

As a result of the workshops, 75 per cent of participants reported high levels of confidence about growing high-yielding crops using IPM. As well, 80 per cent recorded high confidence in their ability to conserve beneficial insects.

According to CRDC's R&D Manager Susan Maas – who also presented at the workshops along with CottonInfo IPM technical specialist Sandra Williams – while Bollgard 3® offers additional resilience against cotton's primary foe, *Helicoverpa* spp., there are growing risks of widespread insecticide resistance forming in many other pest species if the principles of IPM are ignored.

'Researchers have recently detected rising levels of insecticide resistance in silverleaf whitefly to a cornerstone product. Resistance in mites and aphids is already present, and sucking pests such as mirids could be next,' said Susan.

CSIRO's Dr Wilson said the cotton industry must continue to strive for a strong IPM system to support Bollgard 3®.

'If we drift into increased use of sprays in the belief that this is keeping retention high and pushing up yield, then we risk the future that has happened in the United States' Mississippi Delta,' Lewis said.

'Growers there are now spraying more in Bt cotton than they were in conventional cotton. This is due to resistance to insecticides in *Lygus*, emerging Bt resistance in *Helicoverpa* and increasing secondary pest problems (like mites) as a result of increased spraying. We don't want to end up there, so we need to realise that while Bollgard 3® is a great platform for IPM, it also benefits from the support of a strong IPM system.'

In Australia, CRDC's annual insecticide monitoring programs have detected increasing resistance to key products by silverleaf whitefly and mites. Both are species that flare easily and require careful IPM to manage effectively.

Insecticide resistance monitoring is an essential component of the cotton industry's Insect Resistance Management Strategy (IRMS), with results of the program used to ensure the IRMS remains effective and relevant to the country's dynamic insect populations. The IRMS is available within the annual CRDC and CottonInfo Cotton Pest Management Guide.

For more, download the *Cotton Pest Management Guide* at www.cottoninfo.com.au/publications/cotton-pest-management-guide.



Dr Lewis Wilson discusses IPM in field with growers and consultants at the Boggabilla IPM workshop.

RUTH REDFERN

PROGRAM 1: FARMERS

Case study: A new look at the economics of weed control

The cotton industry has a new decision support tool for the management of glyphosate-resistant barnyard grass. BYGUM (BarnYard Grass Understanding and Management) gives growers and consultants new ways to look at the economics of summer weed control in Australian cotton/grains systems.

Developed by David Thornby from Innokas Intellectual Services with support from CRDC, this weed management scenario testing tool combines biological, agronomic and economic factors to examine the economics of farm managers' current summer grass management strategies, and compare them to new tactics – which could be what your neighbours are doing, what your agronomist recommends, or new ideas from elsewhere.

'BYGUM can let you test changes in crop prices, rotations, weed management costs, herbicide availability or efficacy, and more,' David says.

It is free to download, use, and share. It needs only a copy of Microsoft Excel, preferably on a Windows computer (BYGUM does run on many Mac systems but won't run on an iPad or Android device at present). BYGUM is designed to be simple to use but with powerful possibilities for planning and learning about summer weed management.

BYGUM is based on RIM (Ryegrass Integrated Management), a long-established tool for testing ryegrass management strategies in winter-cropping systems in western and southern Australia. RIM was developed by Australian Herbicide Resistance Initiative in conjunction with the University of Western Australia, with support from GRDC.

'BYGUM takes the well-tested framework of RIM and extends it to northern subtropical Australian farming systems, where summer and winter crops are both used, and fallows are an important part of the system,' David says.

'Running a simulation in BYGUM is a two-step process: first, set up the parameters of the system; second, design a rotation and specify your summer grass management practices. BYGUM's five-year rotation results update with every change so there is no need to 'run' the model or collect output files.

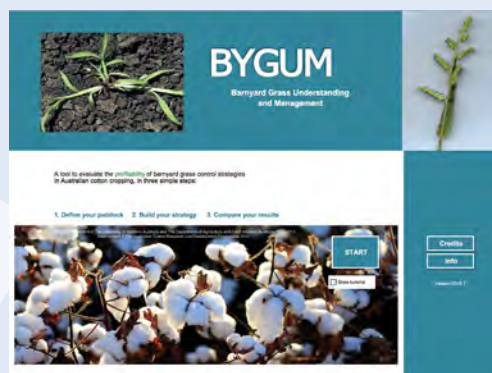
'At any time, BYGUM can give a comparison between the current setup and one other scenario, which means users can always see how the current strategy compares to their benchmark.'

'BYGUM isn't designed to tell you exactly how much you'll make every year.'

'What it does do is allow comparisons of the likely bottom line, for your given set of inputs, between different possible weed management and cropping scenarios,' David said.

BYGUM allows growers to save several scenarios and to compare two at a time, side by side. With it you can compare crop yields with weed competition factored in; gross margins; weed seedbank densities and adult plant numbers; and the effects of different rotations and weed management strategies.

BYGUM is free to growers and consultants and is available on the CottonInfo website at www.cottoninfo.com.au/barnyard-grass-understanding-and-management-bygum



Case study: Breaking the Verticillium cycle

Verticillium wilt is caused by the soil-borne fungal pathogen *Verticillium dahliae*. Recent research has found three strains in Australian cotton: two non-defoliating (VCGs 2A and 4B) and a defoliating strain (VCG 1A). It is unclear why only now the disease is causing such significant damage.

CRDC is involved in several Verticillium research projects. The QDAF pathology group headed by Dr Linda Smith is working in collaboration with CSIRO and NSW DPI to improve the approach to the industry disease survey to deliver improved understanding of management of cotton disease and disease-suppressive farming systems. This is taking place as part of the *Digital technologies for dynamic management of disease, stress and yield* project, a cross-sectoral project under the Australian Government's Rural R&D for Profit programme, administered by the Department of Agriculture and Water Resources.

In addition, NSW DPI researchers are testing potential innovative solutions to cotton diseases to identify the best time and approach to introducing potential control products such as fungicides. Grower trials are also underway across six sites in northwest NSW, in conjunction with CottonInfo.

The partnership approach between growers and cotton pathologists is making a breakthrough in the management of Verticillium wilt for the benefit of the entire industry. In a trial at Narrabri, a cotton field with extremely high inoculum levels of the non-defoliating strain of VCG2A has shown a dramatic reduction.

Peter, Janet, Tony and Kylie Dampney approached (former) CSD pathologist Dr Stephen Allen and NSW DPI's Dr Karen Kirkby for help in 2011, after severe patches of *V. dahliae* heavily impacted cotton yields. The pathologists suggested trialling sorghum and durum wheat rotations, and began assessing and monitoring inoculum levels in one of the worst affected fields to assess the trial's impact.

'Before the trial started we were seeing yield reductions of 20 to 30 per cent,' Tony said. 'To see that the inoculum levels are now zero is fantastic

and we look like planting cotton next season, for the first time in five years. We learned a lot from being involved with the researchers, and if not for this trial, we would be battling an even bigger problem.'

Up until this trial, *V. dahliae* was almost impossible to eradicate once introduced to a field or farm, with growers reporting estimated yield losses of 10–62 per cent. Karen Kirkby said it was a leap of faith for the Dampneys to be part of these long-term experimental management strategies to drive down soil inoculum levels, as the approach has not been quantified in cotton in Australia.

CRDC is also funding the development of a fee-for-service *V. dahliae* molecular diagnostic and quantification tool. This is being undertaken as part of the *Digital technologies for dynamic management of disease, stress and yield* program, a project under the Australian Government's Rural R&D for Profit programme.

'Based on what we have seen at the Dampney's farm, this tool has the potential to significantly help researchers and growers assess the effect of management strategies on inoculum levels as well as assess the risk of disease in fields prior to planting. When this tool is released, growers and agronomists will be able to send in soil samples to be tested, much like they do for nutrient analysis,' Tony said.

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



Narrabri grower Tony Dampney, with NSW DPI pathologist, Dr Karen Kirkby.

MELANIE JENSON

**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 resource 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 2016-17 investment in this area included the following key projects:

- *More profit from nitrogen: enhancing the nutrient-use efficiency of intensive cropping and pasture systems*, with various industry and research partners, including Dairy Australia, Sugar Research Australia (SRA), Horticulture Innovation Australia (HIA), NSW DPI, NCEA, QUT, University of Melbourne, QDAF, UTAS, QLD Department of Science, Information Technology and Innovation (QDSITI), and the Northern Territory Department of Primary Industry and Resources (NTDPIR);
- *Opportunities for dryland cotton with Bollgard 3®*, with QDAF;
- *Smarter irrigation for profit*, with various research partners, including National Centre for Engineering in Agriculture (NCEA), RIRDC, SRA, Gwydir Valley Irrigators Association (GVIA), University of Tasmania (UTAS), CSIRO, NSW DPI, Dairy Australia, Roth Rural and Regional, and the Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR); and
- *Strengthening the Central Highlands cotton production system*, with QDAF.

The *More profit from nitrogen: enhancing the nutrient-use efficiency of intensive cropping and pasture systems* project is a cross-sectoral project under the Australian Government's Rural R&D

for Profit programme, administered by the Department of Agriculture and Water Resources. It commenced in 2016-17 and is led by CRDC in conjunction with fellow RDCs, Dairy Australia, Sugar Research Australia, and Horticulture Innovation Australia, and other research partners.

The project brings together Australia's four major intensive users of nitrogenous fertilisers: cotton, dairy, sugar and horticulture. For each of these industries, nitrogen (N) is a significant input cost to producers and a substantial contributor to environmental footprints. Collectively, the program aims to increase farm profitability and reduce environmental impact by increasing nitrogen-use efficiency (NUE), resulting in a reduction of the amount of N required in producing each unit of product.

To achieve improved NUE, the program is striving to deliver three major outcomes: provide greater knowledge and understanding of the interplay of soil, weather, climatic and farm management factors to optimise N formulation, rate and timing across industries, farming regions and irrigated/ non-irrigated situations; provide greater knowledge and understanding of the contribution (quantifying rate and timing) of mineralisation to a crop or pasture's nitrogen budget; and provide greater knowledge and understanding of how enhanced efficiency fertiliser formulations can better match a crop or pasture's specific N requirements.

The project comprises a series of 10 sub-projects, including two cotton-specific projects: *Enhancing nitrogen-use efficiency and improving phosphorus nutrition in cotton* (NSW DPI) and *Optimising nitrogen and water interactions in cotton* (USQ). The first aims to increase understanding of the intricate relationship between soil and fertiliser N and phosphorus supply, fertiliser placement, fertiliser timing, and irrigation strategy to achieve greater NUE and improved phosphorus soil nutrition. The second aims to build cotton growers' confidence to adopt strategic N fertiliser application rates by better understanding how to optimise N supplied to cotton crops from organic matter in soil. The overarching *More profit from nitrogen* project is due for completion in 2019-20.

The *Opportunities for dryland cotton with Bollgard 3®* project focuses on dryland cotton systems, with particular emphasis on deriving benefits and opportunities from Bollgard 3® and the new Resistance Management Plan (RMP). The project, which commenced in 2016-17, uses an investigative systems R&D approach to examine challenges and opportunities for dryland cotton production systems. The project examines tactics that may ameliorate abiotic/biotic factors affecting seedling establishment, considers how the new RMP changes cotton production tactics and overall systems productivity with grains sequences, and develops and tests the reliability of crop destruction tactics that minimise cultivation. The project is due for completion in 2020-21.

The *Smarter irrigation for profit* project is another cross-sectoral project under the Australian Government's Rural R&D for Profit programme, administered by the Department of Agriculture and Water Resources. It is led by CRDC in conjunction with fellow RDCs, Dairy Australia, RIRDC, Sugar Research Australia and other research partners.

The project is a large-scale, ambitious project designed to achieve a 10–20 per cent improvement in water productivity, efficiency and farmer profitability across the cotton, dairy, rice and sugar industries, while also improving cross-sector industry research collaborations. It is designed to increase on-farm profitability by integrating new irrigation scheduling and delivery technologies into good irrigation practice.

The project commenced in 2015-16 and comprises a series of 11 sub-projects, including cotton-specific projects around irrigation automation, grower-led irrigation systems comparisons, and maximising on-farm irrigation profitability.

Three such sub-projects, the 2016 *Irrigation automation tour*, the *IREC cross-sector northern tour*, and the *Dairy and cotton tour*, all ran during 2016-17, building upon the strong success of the 2015 *Irrigation automation tour*.

The tours, hosted with support from CRDC, took groups of growers, irrigators and consultants to different regions and sectors to see irrigation technologies in action. The overarching *Smarter irrigation for profit* is due for completion in 2017-18.

The *Strengthening the Central Highlands cotton production system* project aimed to better understand and seek solutions to problems affecting cotton productivity in the Central Highlands region. It sought to examine the relationship between the local climate and plant development to determine where and if agronomic management practices can be changed to reduce production risks, decrease the incidence of lint quality discounts and, where possible, disadvantage diseases such as boll rots.

The researchers identified that a key tactic may be to plant considerably earlier than the traditional window in an effort to bring forward the boll-filling period into spring and early summer when weather conditions are at their most reliable in the Central Highlands. Through the course of the project's trials, the researchers demonstrated that August sowing is quite reliable due to the relatively warm days and good solar radiation. Planting with degradable film to increase ground temperature was initially investigated but found to be unnecessary for soil temperatures.

The early-sowing trials were replicated commercially for the first time in the 2016-17 season, with great success, and is expected to be widely adopted for the 2017-18 season. The project concluded in 2016-17. An impact analysis, commissioned by QDAF, found that the total investment into the project was \$1.18 million, and the value of total economic benefits back to growers and the industry was \$20.24 million – a benefit-cost ratio of approximately 17.1 to 1.



PROGRAM 1: FARMERS

Case study: Focus on improving dryland systems

In the new era of Bollgard 3®, CRDC is supporting a five-year dryland systems project, headed by long-term industry researcher Dr Paul Grundy. The project focuses on dryland cotton systems with particular emphasis on deriving benefits and opportunities from Bollgard 3® and the new Resistance Management Plan (RMP).

‘With a changed RMP, Bollgard 3® offers new opportunities and challenges for dryland cotton production and the broader farming system,’ Paul said.

‘Greater sowing window flexibility and reduced end-of-season tillage requirements should enable increased dryland systems’ productivity and expansion.’

Conducted by dedicated researchers, this project provides an opportunity to discover and measure the implications of changes to farming operations and systems over five years.

‘The immediate focus for many will be on the more immediate gains in soil-plant available water content (PAWC) and the benefits of this for a following grains crop. But the implications of this change are less clear for crop destruction, weed management and farm hygiene, or the opportunity to incorporate P and K fertilisers that might be important for the next cotton crop in three to five years in the future.

‘Similarly there will be trade-offs between managing cotton crops for earlier maturity to realise key pupae-busting dates (in terms of yield or quality) against the relative productivity gains that may or may not arise following grain crop sequences.’

Systems studies conducted during this project will aim to develop data to provide growers with answers to these types of questions.

‘CRDC has funded this project in an effort to leverage the opportunities offered by Bollgard 3® for dryland cotton growers. The project proposes an integrated approach to developing a package of measures that aim to increase the potential and success of dryland cotton production and the associated farming system off the back of Bollgard 3®,’ said CRDC’s General Manager R&D Investment Ian Taylor.

‘A more successful, reliable and expanded dryland cotton sector would serve to increase land area productivity, the more efficient utilisation of crop inputs and soil moisture, and thus would underpin profitability.

‘The RD&E approach proposed by this project aims to equip growers with the tools and knowledge to more successfully farm dryland cotton and contribute to the CRDC’s strategic objective of increasing farm resource-use efficiency,’ Ian said.

For more, see the Spring 2016 edition of CRDC’s Spotlight magazine: www.crdc.com.au/spotlight.



Researchers Dr Paul Grundy and Kaara Klepper of QDAF are working with dryland growers on a new five-year CRDC project.

Case study: Irrigators go south for inspiration

A group of 29 cotton growers, irrigators and consultants from Northern NSW, the Darling Downs and Kununurra in WA visited irrigated farms in Southern NSW and Northern Victoria in December 2016 to see innovations that maximise efficiencies in water use, energy and labour.

The three-day tour, hosted by CottonInfo and NSW DPI's Sustaining the Basin: Irrigation Farm Modernisation (STBIFM) program, under the *Smarter irrigation for profit* project visited irrigation farms in the Goulburn–Murray, Coleambally and Murrumbidgee irrigation areas, covering dairy, rice, and cotton production.

'The tour provided irrigators with an opportunity to look at different systems, design and structures to see what might work on their properties,' said CottonInfo's (then) water-use efficiency technical specialist (now CottonInfo regional extension officer) Janelle Montgomery, who organised and led the tour.

'The tour gave irrigators the opportunity to hear first-hand from farmers who have fully automated surface irrigation systems and have confidence in the technology,' Janelle said. 'This is important for our growers, as the cotton industry is still in its infancy in terms of automation adoption.'

The tour visited 10 farms where growers and consultants met the farmers and industry experts who have already adopted some level of automation in their surface irrigation system. Participants gained important insights into the decision-making processes when investing in these technologies and how risk is managed.

The main benefits of irrigation automation are labour savings, removing the 24-hour monitoring of conventional siphon systems, and minimising tail-water losses. Automating surface irrigation systems can improve efficiencies in labour and water use. The precise control of flows and water levels throughout a farm can also improve production and reduce costs of production, thus improving profitability.

Participant evaluation of the tour showed 93 per cent would make changes on their farms as a result of what they've learned. This includes trialling different surface irrigation designs, adopting remote monitoring, changing scheduling practices, being better informed and knowing what questions to ask when talking with irrigation designers. A similar tour in 2015 also resulted in a number of cotton growers implementing change on their farms.

Dalby cotton irrigator Ian Hayllor currently uses traditional siphons, which he finds labour-intensive. He was on the tour to learn how he could improve water-use efficiency. After visiting Noel Baxter's cotton and maize farm at Berrigan, which has a pipe-through-the-bank system, including a distribution pontoon, Ian is interested in trialling a similar system.

'The reason I like this system is it is so simple, cheap to install and easy to automate,' Ian said. 'To trial on our farm, we would grade our rotorbuck areas out, install a pontoon and put in a pipe through the bank. I can't believe such a simple system works so well.'

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



Attendees at the Irrigation Automation Tour.

RUTH REDFERN

CRDC's early-planting research changes the Central QLD cotton game

CRDC-supported research examining how to help Queensland's Central Highlands cotton growers overcome climate challenges has been put into practice commercially this season, with great success.

The project started in the 2013-14 season with trials led by Dr Paul Grundy and Dr Stephen Yeates, who identified that a key tactic may be to plant considerably earlier (August) than the traditional mid-September to October window in an effort to pull the boll-filling period forward into spring and early summer when weather conditions are most reliable.

With the wider planting window afforded by Bollgard 3® this season, growers for the first time have been able to put this research to the test and plant commercial areas during August.

There were 18,000 hectares of irrigated cotton and 1000 hectares of dryland planted in Central Queensland (CQ) this season. Approximately 4500 hectares were sown during August, and the crops responded well.

'The key objective in the trials was to complete boll filling before mid-summer monsoonal influences take hold, with either bursts of cloudy wet weather or humid heat waves that generally occur after Christmas,' Paul said.

'There is still a risk of wet picking but compared to the status quo of September–October planting, early sowing mostly avoids bad weather exposure during boll filling, and halves wet picking risks.'

The research demonstrated that August sowing is quite reliable due to Emerald's relatively warm days and good solar radiation, which heats the ground and provides an adequate buffer against cool nights. Planting with degradable film to increase ground temperature was initially investigated but found to be unnecessary, as soil temperatures over four years of the trial without film typically remain above 14°C, even during bursts of cold weather when nightly minimums drop to near 0°C.

The project has worked closely with growers on improving understanding of the climate risks for cotton in CQ, and how this fits with the new farming systems opportunities that the broader window provides.

'While it does not alleviate all the potential climate risks, August sowing has resulted in very respectable yields with very few additional input costs (beyond planting more seed and using the full complement of seed dressings), and in most years will produce excellent cotton while also avoiding boll rots and rain-related lint downgrades,' Paul said.

'We are really pleased with the reports we are getting back from growers and agronomists who have chosen to plant early. We can't do this research without the support of growers, so I'd like to thank Carlo Stangherlin and Neek Morowitz for hosting our trials, and agronomist Jamie Iker for looking after the day-to-day consulting for us.'

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



PAUL GRUNDY

Research technical officer Gail Spargo, grower Carlo Stangherlin, and consultant Jamie Iker in early-planted cotton in the Central Highlands, picked in January 2017.

**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 2016-17, CRDC's support for this important research area included the following key projects:

- *Accelerating precision agriculture to decision agriculture*, with various research partners, including all 15 RDCs, CSIRO, Australian Farm Institute, Data to Decisions CRC, UNE, Griffith University, and University of the Sunshine Coast; and
- *Agri-intelligence in cotton production systems – stage I*, with QUT.

The *Accelerating precision agriculture to decision agriculture* project is the third cross-sectoral project under the Australian Government's Rural R&D for Profit programme that is led by CRDC. The project is administered by the Department of Agriculture and Water Resources, and is the first fully cross-sectoral project, conducted in conjunction with all 15 RDCs and other research partners. The project, which commenced in 2016-17, aims to capitalise on the big data opportunities for Australian agriculture and to transition a range of agricultural industries from precision to decision agriculture.

The project will identify cases where the use of digital agricultural applications and use of data is likely to have the following effects: high-impact profitability and productivity benefits; involve a detailed analysis of the current and future economic benefits of digital agriculture in Australia, examining the projected use and benefits to farm business decision making, risk management and profitability; and evaluate the options, merits and

risks of business models to take advantage of digital technologies in the Australian agricultural sector. Importantly, the project will establish international best practice in data use to develop frameworks, policies and guidelines for Australian farmers that will remove current barriers and capitalise on the full impact of digital technology.

The project comprises a series of eight sub-projects. One such project, *Analysis of the economic benefit and strategies for delivery of decision agriculture* (Australian Farm Institute), has conducted a study of big data use in the USA, and found that there is potential for decision agriculture to significantly cut farm costs and improve outcomes to meet consumer demands and regulatory requirements. The study found that decision agriculture in the USA is using analytical platforms, accessing aggregated data from different machines and digital technologies and from multiple farms, helping farmers get a faster, cheaper or better result across such considerations as variety selection, chemical application and negotiating prices for farm inputs. Some platforms reported input cost savings of up to 50 per cent for farmers. The overarching *Accelerating precision agriculture to decision agriculture* project is due for completion in 2017-18.

The *Agri-intelligence in cotton production systems – stage I* project seeks to take the first major steps in the development of agri-intelligence for cotton production systems. Agri-intelligence refers to the seamless integration of agricultural knowledge, knowledge across the value chain, systems science and digital technologies to help farming enterprises to make best use of agronomic, environmental and economic data to improve management practices – leading to more efficient, profitable and sustainable operations.

The project will develop an understanding of the decision space and the case for agri-intelligence, and develop insight into the value of information from the value chain in relation to on-farm decision making. The research is organised into two stages: the first, the on-farm decision space and the case for agri-intelligence; the second, recommendations for the development of deployable on-farm agri-intelligence solutions. The project commenced in 2016-17, and stage I is due for completion in 2017-18.

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 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.
	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.		

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).

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 2016-17, CRDC continued its support of this important research area through key projects, including:

- *Monitoring silverleaf whitefly (SLW) insecticide resistance*, with QDAF;
- *Development of a spray drift hazard prediction system*, with MicroMeteorology Research and Educational Services (MRES); and
- *Crop protection development specialist (CottonInfo Technical Specialist and myBMP module lead)*, with QDAF.

The *Monitoring silverleaf whitefly (SLW) insecticide resistance* project continues to support the Australian cotton industry by seasonally testing silverleaf whitefly, *Bemisia tabaci* MEAM1, for insecticide resistance to registered chemistry. This data is fundamental to making informed insecticide resistance management decisions.

Following the 2015-16 season, the project reported the first detection of pyriproxyfen resistance in silverleaf whitefly sampled from a cotton region. During the 2016-17 cotton season, the project team made collections of silverleaf whitefly from 15 regional sites, covering the majority of the cotton production valleys in NSW and QLD. As a result, the project identified early indications of resistance to pyriproxyfen – a concerning trend, as pyriproxyfen is a cornerstone product for managing silverleaf whitefly populations in Australia, and has a low impact on beneficial insects. As a result, the project provided recommendations to industry, resulting in significant changes to the 2016-17 Insecticide Resistance Management Strategy (IRMS) and the threshold matrix, and an extensive engagement campaign to the industry. The project is ongoing in 2017-18 and 2018-19.

The *Development of a spray drift hazard prediction system* project is a collaborative project with GRDC to improve understanding of surface temperature inversions in cotton/grain landscapes, including a more detailed understanding of when safe-spray conditions exist. Ultimately, it aims to provide notification of a surface temperature inversion that might result in a long-distance drift, out to 36 hours ahead, as well as real-time updates for operators of spray application machinery. The project commenced in 2016-17, and the first stage, involving the installation of six research-grade Profiling Automatic Weather Station (PAWS) in the Lower Namoi, Gwydir, McIntyre/Border Rivers and Darling Downs regions, is complete. Analysis of the data is now underway. The project is due for completion in 2018-19.

The *Crop protection development specialist (CottonInfo Technical Specialist and myBMP module lead)* project provides crop protection and biosecurity extension leadership to the cotton industry. In particular, the specialist seeks to increase the control of volunteer and ratoon cotton through improved levels of farm hygiene; raise awareness of the biosecurity risks facing cotton growers and the wider industry; and improve on-farm biosecurity practices. The specialist leads the extension program in this area, providing linkages between industry and the RD&E sector for biosecurity and crop protection issues; quantifying the costs involved in control methods, as well as the actual and potential costs incurred if control measures are not implemented; and working with researchers to develop better control tactics.

Case study: Developing a hazard forecast service to minimise spray drift damage

A new three-year project to develop a spray hazard forecast service – to minimise the damage caused by chemical drift – kicked off in September 2016, co-funded by CRDC and GRDC.

Melbourne-based research team, MicroMeteorology Research and Education Services, has been commissioned to install a wireless sensor network across the Northern NSW and Southern QLD cotton-growing areas.

This project is a direct result of the extensive damage to cotton from phenoxy herbicide in late 2015. In early 2016, CRDC's Dr Ian Taylor convened a meeting with the cotton and grains industry, including GRDC, where the need to collaborate on reducing drift damage was highlighted. The need for action was then affirmed at the CRDC R&D Priority Forum in May 2016, and the temperature inversion project was introduced.

This project recognises that it is difficult for growers and regulators to know when an inversion is present or is likely to form – so it is also difficult to know when the restriction of chemical use should apply.

As a result, this project is particularly focused on understanding surface temperature inversions in cotton/grain landscapes, including more detailed understanding of when they are present. Ultimately, it aims to provide notification of a surface temperature inversion that might result in a long-distance drift, out to 36 hours ahead, as well as real-time updates for operators of spray application machinery.

The first stage of the project involves the installation of six inversion monitoring towers on cotton farms, to start the collection and analysis of data. The high-quality equipment very accurately monitors small and rapid variations (every second) in wind and temperature up to 10 metres to determine the potential for drifting pesticides to be held at high concentrations near the surface. Ultimately, the information will be converted to parameters for timely advice and warning of hazardous spray conditions.

Additionally, two CRDC Grassroots Grants – one in the Macquarie and one in the Namoi – are helping growers to build their local weather and spray condition information through the installation of local weather stations. CRDC is also funding a PhD scholar, Angélica Suárez-Cadavid, on a project to quantify and map the impact of herbicide spray drift on cotton. As part of this project, Angélica has been investigating how multispectral data from satellite imagery can be analysed to assess and monitor drift damage.

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



DAVE BOYLE

A temperature inversion research tower on cotton farm 'Waiwera' north of Wee Waa, NSW.

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 2016-17, CRDC's investment in this area included the following key projects:

- *Baselining lower Namoi groundwater and evaluating Pilliga coal seam gas developments*, with UNSW;
- *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;
- *Managing natural landscapes on Australian cotton farms to increase the provision of ecosystem services*, with Griffith University; and
- *National Cotton NRM Technical Specialist*, with Stacey Vogel Consulting.

The *Baselining lower Namoi groundwater and evaluating Pilliga coal seam gas developments* project compares geochemical versus water balance model estimates of artesian discharge into an alluvial aquifer. The study is located west of Narrabri where the Great Artesian Basin (GAB) discharges into the Lower Namoi alluvium. The geochemistry results suggest a continuum of

mixing in the alluvial aquifer between the GAB and surface recharge, and indicate that the alluvial groundwater is a mixture of groundwaters with residence times of less than 70 and approximately 900,000 years old. In some locations, an artesian contribution of up to 70 per cent is evident from the geochemical analyses, contrasting historical water balance modelling estimates of 22 per cent. The study demonstrates why multi-tracer geochemical analyses should be used as a critical component of water budget assessments for water policy and planning. The project is due for completion in 2017-18.

The *Improving the ability of the Australian cotton industry to report its sustainability performance* project aims to enhance the industry's sustainability reporting. As demonstrated through the Australian Grown Cotton Sustainability Report, released in 2014, the cotton industry is committed to improving its sustainability through tracking and reporting performance and seeking external stakeholder feedback. This project aims to enhance this: improving the industry's ability to report on its sustainability performance.

The project, which commenced in 2016-17, is developing a sustainability repository that can be used by the industry for different sustainability reporting needs, as well as visualisation tools that can be used to communicate the results to stakeholders. This will enable the cotton industry to show leadership and demonstrate global leadership in sustainable agriculture, ultimately to provide a competitive advantage for Australian cotton producers. Researchers have commenced a value-chain market analysis to better understand sustainability issues concerning relevant stakeholders, and to date, they have identified 313 sustainability initiatives along the Australian cotton value chain. This highlights the current complexity and difficulty for Australian cotton producers to demonstrate sustainability credentials. Through analysis, the project aims to better enable the industry to provide the relevant evidence to demonstrate that Australian cotton is sustainably produced. The project is due for completion in 2019-20.

The *Managing riparian corridors on cotton farms for multiple benefits* project has been developed to address the decline in health of river red gums, and the associated decline in provision of ecosystem services. Cotton growers in the Namoi, Gwydir, Macquarie, Darling Downs and Border Rivers regions have voiced concerns about the health of red gum trees and are seeking direction on how this decline can be reversed. This project aims to determine management actions that growers can take to increase riparian ecosystem health and reverse the current tree health decline.

The project involves experiments to demonstrate the impacts of different actions on tree health and riparian ecosystems, and to determine practical ecological restoration activities that can be undertaken to improve the health of river red gum trees and riparian areas generally. The project is due for completion in 2017-18.

The *Managing natural landscapes on Australian cotton farms to increase the provision of ecosystem services* project will provide a comprehensive assessment of values and management strategies relevant to natural landscapes on Australian cotton farms to protect, restore and enhance the delivery of ecosystem services. Forty per cent of Australian cotton farms have native vegetation areas (both grazed and ungrazed). The research will inform decision-making at farm and regional scales to maximise the benefits of management actions and minimise the risk of perverse outcomes to both natural and farming systems. The results will also improve the capacity of the cotton industry to record and demonstrate their environmental performance.

The project will address two major questions: what natural and human factors drive the provision of ecosystem services by natural landscapes on Australian cotton farms? And, what management strategies best promote the maintenance, restoration and enhancement of ecosystem services provided by natural landscapes of Australian cotton farms? The project will develop a range of decision tools and build capacity to support the improved management of natural ecosystems on Australian cotton farms at multiple scales. The project commenced in 2016-17 and will conclude in 2018-19.

The *National Cotton NRM Technical Specialist* sits with the industry's extension team, CottonInfo, and provides the technical natural resource management (NRM) skills and knowledge required to assist industry to meet CRDC's NRM goals.

The specialist's role under this project includes supporting and demonstrating the cotton industry's best practice management of riparian lands and floodplain vegetation; implementing an innovative approach using social networks to increase the engagement of cotton growers in NRM; and leading the continuous improvement of the industry's best practice recommendations for NRM. The technical specialist is using innovative and diverse methods to reach the target audience, such as creating engaging events like kayak trips on local rivers to help raise awareness of the importance of riverine management.

Case study: Talking trees with the Prime Minister

In December 2016, scientist and cotton industry researcher Dr Rhiannon Smith had the opportunity to discuss her CRDC project with the Australian Prime Minister, the Hon. Malcolm Turnbull MP, and Minister for Agriculture and Water Resources and Deputy Prime Minister, the Hon. Barnaby Joyce MP.

‘It was pretty exciting and a little intimidating having so many cameras focused on me!’ Rhiannon said, after the pair visited the University of New England in Armidale, where Rhiannon is now a research fellow and lecturer in the School of Environmental and Rural Science. Her area of focus is biodiversity, landscapes and ecosystem stewardship.

‘We were talking about research I’ve done as part of my CRDC-supported project, the technology I’m using to measure the health of trees, how much water a tree might use on a daily basis, and how that translates into production (in terms of carbon sequestration and wood production).’



CRDC-supported researcher, Dr Rhiannon Smith, discusses her research with the Australian Prime Minister, Malcolm Turnbull, at UNE in December 2016.

Last year was a big year for visiting dignitaries at UNE, with visits by the NSW Governor David Hurley and his wife Linda, the Parliamentary Inquiry into Innovation in Agriculture, the Agricultural Industries Advisory Committee (including Parliamentary Secretaries and Advisors), and finally the Prime Minister and Deputy Prime Minister, all of whom Rhiannon spoke to about her CRDC-funded research.

One particular visit resulted in an interesting request to put her scientific skills to the test.

‘I was invited to Government House in Sydney by the Governor and Mrs Hurley to install sap flow meters on historic Moreton Bay fig trees to measure their water use, and to the Parliamentary Secretary of the Department of Agriculture and Water Resources’ farm near Canberra to age some large river red gums,’ Rhiannon said.

Rhiannon’s recent research has been investigating carbon sequestration by river red gums in the Namoi Catchment. She has recently published a paper in a high-ranking international journal on growth rates and carbon sequestration by these trees during 2008–2012 when growth rates were high due to high rainfall conditions and prolonged flood events across semi-arid Australia.

‘My research is showing that carbon sequestration by river red gums trees in riparian zones may offset annual emissions from cotton production, and therefore allow cotton farmers to run a carbon-neutral enterprise.

‘This fact will be of particular interest to the growing number of carbon-conscious consumers who are looking to minimise their carbon footprint,’ Rhiannon said.

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

Case study: River and riparian zone research in focus

It was all down river at Warren in February 2017 to learn about the value of riparian areas on cotton farms and what research is telling us about their value to growers. CottonInfo and Central West Local Land Services, in partnership with the Australian Government, ran a riparian management field day at Warren in the Macquarie Valley in NSW.

CottonInfo Natural Resource Management technical specialist Stacey Vogel hosted the event to extend the latest CRDC riparian vegetation research, increase participants' awareness of its value and share the latest BMP guidelines. In all, 45 people representing 10 cotton farms joined in.

'The seats in the kayaks were snapped up by the cotton growers and their families,' CottonInfo Macquarie regional extension officer Amanda Thomas said. 'Given the grower participation and the great feedback, we would like to run another day in the Narromine or Trangie end of the valley.'

'The river provided the perfect backdrop for Stacey to share CRDC research, including really interesting information about which tree species can be beneficial for river bank stability such as river red gums, and how these trees, which can live for up to 1000 years, store large amounts of carbon.'

This research, undertaken by Dr Rhiannon Smith, who joined the day, has outlined ecosystem services provided by river red gums such as carbon storage and sequestration. Vertosols under river red gums have a higher total organic carbon percentage and provide a sustained input of carbon, through litter, for soil biology, providing better aggregate stability and erosion control. Rhiannon found river red gum sites stored significantly more carbon than other types of native vegetation, which is on average 200 t C/ha, and as high as 400 t C/ha.

CSIRO's Nancy Schellhorn's research found that on-farm native vegetation fills a critical temporal gap to support the life-cycle of many beneficials that provide pest control services.

'We also discussed Andrew Biggs' (QLD Department of Natural Resources) CRDC-funded research and the role river red gums and myalls play in mitigating excess recharge,' Stacey said.

'Leaf litter from native vegetation has an important role in suppressing weed establishment in riparian areas and assists germination of woody riparian vegetation, as found by Dr Sam Capon and Dr Stephen Balcombe's research.'

Cameron Downing from Central West Local Land Services provided commentary during the kayaking, while ecologist Phil Spark (who camped out for two nights prior to collect an array of local wildlife) introduced eight species of microbats as well as many frog, lizard, fish, weeds and native plant species.

'The adults and children heard about their importance, their habitat and how useful they are on cotton farms,' Stacey said.

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



STACEY VOGEL

Ecologist Phil Sparks in action at the riparian management field day.

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 2016-17, CRDC invested in the following key project to help scope and investigate critical threats and opportunities:

- *Resilience assessment of the Australian cotton industry at multiple scales, with Bel Tempo.*

The *Resilience assessment of the Australian cotton industry at multiple scales* project concluded in

2016-17, with the launch of the assessment at the Australian Cotton Conference in August 2016. CRDC commissioned the resilience assessment to better understand how to help the cotton industry best adapt to change, and to identify critical threats and opportunities in order to strategically target investment and resources at three levels – farm, region, and whole of industry.

The assessment found that there are five key drivers of change acting across the Australian cotton industry: demand, policy, climate change, climate variability, and cotton price. Potential shocks, which are a sudden spike in one of these drivers, relate to climate change and variability, biosecurity, policy, price and social licence. The report identifies that industry leaders and growers need to be aware of the impact of those drivers, and of the changing nature, frequency or severity of shocks to better prepare and respond to them. The report recommends that national R&D, regional water availability and infrastructure, farm profitability, and farm-water availability thresholds should be the highest priority for interventions from a resilience perspective. The full resilience assessment is available to download from the CRDC website: www.crdc.com.au/publications.



Case study: Building resilience in the Australian cotton industry

Agricultural production, including cotton, is an increasingly complex business requiring continuous adaptation to changing circumstances. Resilience thinking is an approach designed to understand a complex and changing operating environment and maintain capacity to manage future challenges. It is now being widely adopted globally to help communities, industries and governments alike deal with uncertain futures.

The cotton industry is the first agricultural industry in Australia to apply this thinking, with the CRDC-commissioned *Resilience assessment of the Australian cotton industry at multiple scales* report, launched at the Australian Cotton Conference.

Resilience thinking takes into consideration that a cotton production system is made up of many interacting elements with links and connections between them. A change in one element affects many others and, if not managed, can lead to unintended consequences.

'Resilience thinking tries to understand the relationships between the elements of a system and how they interact so it can be managed better,' said project leader Dr Francesca Andreoni.



MELANIE JENSON

Cotton grower Juanita Hamparsum, speaking at the launch of the resilience assessment at the Australian Cotton Conference in August 2016.

'Resilience planning looks at the whole system and identifies the critical drivers of change and the potential shocks as a way of determining when it might reach a threshold beyond which a current production system is no longer possible.

'At the farm scale, the project has shown that the key drivers of change are price, climate variability and policy. They all affect the critical assets on farms, resulting in thresholds associated with water quality and quantity, soil health, profitability and proximity to native vegetation habitat.

'This understanding led to the development of a number of potential strategies that growers can implement to maintain their production systems, which are fully outlined in the report. The best way for growers to identify strategies for their farm is to conduct a resilience assessment by watching the short video that was also produced for the project,' said Francesca.

Breeza cotton grower Juanita Hamparsum believes understanding how the entire farming system works (people, financial and natural capital) allows a greater focus on the areas that will have the biggest impact on farm productivity, sustainability and profitability when challenges arise.

'We had four challenging years on our farm, with flooding, extensive 2,4-D drift, drought, severe sand blasting and hail. Using resilience thinking and mapping the relationships between all the elements of our operation, we got rid of the "noise" and focused on the actions we needed to take so we could keep our operation going and bounce back faster,' said Juanita.

'Resilience planning helps you know how things interact and work together and proactively plan for the actions you need to take to keep things humming along,' Juanita said.

For more, download the full resilience report, or watch the short video at www.crdc.com.au/publications/resilience-assessment-australian-cotton-industry.

PROGRAM 3: CUSTOMERS

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 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).

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 2016-17, CRDC continued its support of assured cotton through key projects, including:

- *Determining the shelf life of round modules and impact on cotton quality*, with CSIRO;
- *Enhancing and testing the Cotton Carbon Management Tool*, with UQ; and
- *Raising the quality of Australian cotton through post-harvest initiatives*, with CSIRO.

The *Determining the shelf life of round modules and impact on cotton quality* project aimed to address fibre quality issues in round modules that could be caused by the storage duration and conditions prior to ginning. There was a concern that the plastic wrap on round modules could create favourable conditions for microbial degradation of the cotton (as a result of solar radiation, the impermeable wrapper, and when the moisture content of the cotton is too high), which weakens the fibre and causes fibre quality deterioration, resulting in price discounts for growers.

As a result, this project aimed to establish the threshold of conditions that can cause damage, and propose potential solutions and risk-management guidelines for eliminating and reducing fibre damage during round module storage. The research found that round module storage has a

small but detectable influence on the yellowness and elongation of the cotton fibre. It also found that the industry guidelines for traditional modules in regard to moisture content at picking and module storage conditions were applicable to round modules – such as the recommendation to harvest and store seed cotton at moisture levels below 12 per cent. The project concluded in 2016-17 and the final report is available at CRDC's online library, Inside Cotton.

The *Enhancing and testing the Cotton Carbon Management Tool* project is the final stage in the development of the Cotton Carbon Management Tool (CCMT), a crop carbon footprint calculator for cotton growers. Crop greenhouse gas emissions and the need for carbon-friendly farming practices remain focus areas in agriculture in Australia. Cotton farmers globally are also coming under increased pressure to substantiate the sustainability credentials of their farming methods. As such, the tool is designed to be accessed through myBMP to allow greenhouse gas emission calculations as part of the certification process. This project involves the incorporation of a nitrogen optimisation module; a financial model; and a wheat/grains crop emissions calculator and natural vegetation calculator to enable whole-of-farm carbon assessments and scenario planning. The tool is currently being internally tested and, pending final lab results to update soil mineralisation algorithms, will be released in 2017-18, when this project will conclude.

The *Raising the quality of Australian cotton through post-harvest initiatives* project had the broad objective of providing solutions to two ongoing quality issues that affect Australia's reputation as a premium fibre producer: excessive nep generation in harvesting and ginning, and understanding the potential impact of contamination by the yellow module plastic used by the JD7760 harvester in the spinning mill. The project also sought to extend relevant technical information, through the CottonInfo extension program, to growers and service providers.

The project found that the cotton picker spindle set up and adjustment can have a significant impact on colour grade, length, elongation, micronaire and trash; and that plastic that enters the gin has a real possibility of contaminating export bales, resulting in claims. As such, it is best to prevent damage during harvesting and transporting. The project concluded in 2016-17. A subsequent project with the researcher, *Managing cotton quality to maintain Australia's premium status*, commences in 2017-18 with research in these areas continuing.

Case study: Establishing the shelf life of round modules

The use of round module builder pickers has grown very quickly in Australia and with it, uncertainty over the shelf life of the modules in the gin yard.

The advent of round bales required industry to revisit harvesting and module storage guidelines, which were developed for use with conventional modules. This brought CRDC to support research by Dr Menghe (Malcolm) Miao of CSIRO into the effect of plastic polyethylene film on module moisture and heat retention and cotton fibre quality.

The research found that, on the whole, round module storage has a small but detectable influence on the yellowness and elongation of the cotton fibre and that the industry guidelines for traditional modules in regard to moisture content at picking and module storage conditions were applicable to round modules.

‘Growers have expressed concerns about the consequences of the situation where modules may be kept in the sun and through wet weather conditions for extended periods prior to ginning,’ Malcolm said.

‘Cotton quality attributes (length uniformity, strength, elongation, and colour) displayed statistically significant changes between modules ginned at the beginning of the storage period and at the end of the storage period (some up to 10 months), however not all these changes could be assigned to the effect of storage time.

‘Two consistent trends emerged from these monitored ginning trials, which were increases

in yellowness, and decreases in elongation with module storage time.

‘Interestingly, the increased yellowness (+b) lead to a positive impact on colour grade as Australian cottons are “super-white”, while the reduction in elongation may be caused by UV exposure of the cotton at the top and ends of the round module. This hypothesis needs be confirmed by further investigation.’

Another aspect of the research included analysis of a large industrial database that contained the picking and ginning dates and HVI test results of 222,793 bales of cotton from the 2015 season, and 222,337 bales from the 2016 season. The cottons were grown in five regions including Moree, Warren, Narrabri, Trangie and Hay, and processed by six gins.

Trends between cotton quality indicators and module storage time were identified from each of the two seasons. However, the trends identified from 2015 were not repeated in the 2016 season.

‘This inconsistency is attributable to the complex nature of weather conditions, cotton growth and ginning, any of which can have a more significant effect on cotton quality than module storage time,’ Malcolm said.

For more, see the Winter 2017 edition of CRDC’s Spotlight magazine: www.crdc.com.au/spotlight, or download the final report at CRDC’s online library, Inside Cotton www.insidecotton.com.



COTTON AUSTRALIA

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 2016-17, CRDC continued its support of the differentiated products theme through key projects, including:

- *An eco-friendly treatment to improve look and handle of cotton fabric*, with Deakin University;
- *Breathable cotton for compression athletic wear*, with Deakin University; and
- *High-value bio-extractives and bioethanol from cotton gin trash*, with NSW DPI.

An eco-friendly treatment to improve look and handle of cotton fabric project builds upon earlier CRDC-supported research that found an amino acid that has the potential to replace caustic soda in the mercerisation of cotton (a process that improves lustre, strength and higher affinity for dyes). Caustic soda requires strict control in handling, disposal and recovery, making it costly and restricting its uptake. The amino acid, meanwhile, is safe and widely available. As such, in this project, the amino acid treatment will be applied and tested to maximise the lustre, strength and dye affinity effects, as well as the efficiency of the process.

The new technology will provide a competitive knowledge advantage to the Australian cotton sector on fabric innovations, particularly future market opportunities for high-value cotton products based on green technology. The project is due for completion in 2018-19.

The *Breathable cotton for compression athletic wear* project aims to develop a fabric suitable for compression garments from Australian Long Staple cotton to compete with synthetic compression athletic wear, and to demonstrate the advantage of this fabric over existing synthetic products. The project will lead to the potential development of athletic apparel with improved wearer comfort, heat and moisture transfer properties and enhanced breathability compared to the current synthetic compression athletic garments. This project aims to open up a new opportunity to develop an innovative manufacturing technology and new market for Australian cotton, which could be used in other applications outside of active wear, such as medical textiles. The project is due for completion in 2017-18.

The *High-value bio-extractives and bioethanol from cotton gin trash* project is designed to advance the research and development of converting cotton gin trash into valuable bioproducts. A current pilot study by NSW DPI has identified cotton gin trash as a novel resource for producing low-cost sugars and subsequent conversion to ethanol. However, the full spectrum and value of associated compounds that can be extracted is unknown. This project aims to fill this knowledge gap by comparing the technical and financial merits of the processes, products and market options for cotton gin trash, helping Australian cotton industry to make commercial decisions and set future research directions. The project is due for completion in 2017-18.

Case study: Unlocking the hidden value of gin trash

Agriculturally based industries, including cotton production, can generate several million tonnes of waste each year, which typically represents a burden to the industry through expensive waste management. There is, however, potential to convert this trash into treasure.

Cotton gin trash is one such promising renewable biomass feedstock that could support regional biorefineries producing a range of value-added bio-based products such as fuels, chemicals, feeds, fibre and energy.

In a CRDC-funded project, NSW DPI scientists in collaboration with a multidisciplinary team of phytochemists and pharmacologists from Southern Cross University and Western Sydney University are aiming to develop scalable, innovative and integrated processes to fractionate, refine and

convert gin trash into multiple 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 found in gin trash specifically for the production of 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, combining a number of different processes into one or maybe a few sequential steps that simplifies the overall processing, significant reductions in production costs can be realised,’ Shane said.

CRDC is also investigating the techno-economic feasibility of establishing biorefineries, and the 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 collaborative project under the Australian Government’s Rural R&D for Profit programme.

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



MELANIE JENSON

**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 2016-17, CRDC's support for the Competitive futures theme took place through key projects, including:

- *Developing renewable fine chemicals from cotton biomass*, with QUT; and
- *Exploring nanofibrous coating on cotton fabric with versatile protection and dynamic comfort*, with RMIT.

The *Developing renewable fine chemicals from cotton biomass* project investigates the production of fine chemicals that can be created from biomass, including cotton lint, mote and cotton gin trash. The project utilises existing, proven technology to convert cotton gin trash to fine chemicals, and is developing a new, economically viable process to produce the required building blocks for these fine chemicals. The process will use relatively simple reagents and investigate the potential to reduce the number of reaction steps, which will reduce the overall cost.

The project is part of the larger collaborative project, *A profitable future for Australian agriculture: biorefineries for higher-value animal feed, chemicals and fuel*, which involves CRDC and is funded by the Australian Government as part of its Rural R&D for Profit programme. The project is due for completion in 2018-19.

The *Exploring nanofibrous coating on cotton fabric with versatile protection and dynamic comfort* project aims to develop a versatile coating for cotton fabric for use in protective clothing, by adopting nanotechnology and surface engineering technology. Fabric coating is a common means of producing protective clothing, however the fluorine-based polymers traditionally used on cotton fabric have or are being banned due their environmental concerns. Nanotechnology offers an 'eco-friendly' approach to provide functional coatings for cotton fabric that protect against different liquids and oil and chemicals.

The potential is that nanotechnology can enhance coating durability through their large surface area-to-volume ratio and high surface energy, providing for better adhesion between the coating and the fabric, while maintaining the original excellent comfort characteristics of cotton such as breathability and feel. The project commenced this year and is due for completion in 2019-20.



Integrated Pest Management
"IPM"

RUTH REDFERN

Case study: Cotton goes three-dimensional with a 3D printer at Conference

CRDC's Cotton Futures program was on the agenda at the 18th Cotton Conference in August 2016, with researchers from the CRDC-supported *Cotton rapid customisation feasibility study* project, QUT's Dr Jared Donovan and Dr Rafael Gomez, presenting their findings.

The study, which concluded in 2015-16, explored the feasibility of using cotton-derived materials for rapid customisation. Rapid customisation is a way of creating physical products from digital design files through computer-controlled manufacturing. The best known is 3D printing.

The project sought to discover whether materials derived from cotton could be used for 3D printing, and if so, what the best combination of 3D printing and cotton-derived materials would be. It found that there are many different ways that cotton-derived materials could be used, and sought to answer the question: why would cotton make a compelling choice over other materials?

To address this, the researchers developed 'design visions' of products that could employ cotton-derived feedstocks in new and novel ways, and where there would be a clear advantage and market opportunity for cotton – like the on-site fabrication of cotton-based filtration products, or on-demand manufacturing of cotton bespoke furniture.

This project formed a vital first step in exploring rapid customisation – a fast-growing industry – as an area of potential for the Australian cotton industry. It recognised that if we can find new and novel ways of using cotton then we can expand the market for cotton products, and allow for innovations in supply-chain and business models.

To demonstrate 3D printing technology, CRDC and CottonInfo's stand at the Conference hosted a 3D printer from QUT, where delegates could watch cotton bolls being printed.

For more, see the *Spring 2016* edition of CRDC's *Spotlight* magazine: www.crdc.com.au/spotlight.



RUTH REDFERN

QUT's Dr Jared Donovan and Dr Rafael Gomez being interviewed in front of the 3D printer at the CRDC and CottonInfo stand at Cotton Conference.

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.
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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 2016-17, CRDC continued its investment into workforce development through a number of key projects:

- *PhD: Career motivational factors of cotton growers (attraction and retention)*, with USQ;
- *PhD: Investigating cotton farm workers' experiences of job satisfaction using social cognitive career theory*, with USQ; and
- *PhD: Skills profile and labour supply structure on cotton farms*, with UNE.

The *Career motivational factors of cotton growers (attraction and retention)* PhD project looked at the psychological drivers and characteristics that impact on cotton grower motivation and work/life satisfaction. This project investigated such factors as risk tolerance, optimism and entrepreneurship in cotton growers, and how the motivations of growers impacted on their attraction and retention strategies. Through self-assessment and a national survey, the research found growers to be agreeable, conscientious and open to experience. Insights from the project showed that growers' decision-making is influenced by factors such as 'framing' (how an event or situation is presented), 'choice overload' (finding the

balance when presented with many options), and 'defaults' (automatic decision-making). Increased understanding of these factors will improve grower decision-making, and the support options offered by the industry. The project concluded in 2016-17.

The *Investigating cotton farm workers' experiences of job satisfaction using social cognitive career theory* PhD project aimed to identify the key personal motivational factors that attract and retain farm employees of the cotton industry. The project found that up to 70 per cent of variation in farm workers' job satisfaction is explained by a combination of factors, including proactive personality, perceived organisational support, task self-efficacy, conservation values congruence, and work engagement. It also found that farm workers' confidence in their ability to do their job leads to productive behaviour if they understand and personally identify with the values and outcomes that drive best practice farming. Furthermore, productive behaviour and dedication to achieving on-farm goals was boosted by the farm workers' perceptions of support and that their efforts were recognised by their employer. The evidence identifies aspects of human resource management that may be targeted to make production gains for cotton growers. The project concluded in 2016-17.

The *Skills profile and labour supply structure on cotton farms* project is investigating the workforce needs of cotton farms and comparing them with supply sources and structures to assess the effectiveness of employee-retention practices. The project is developing an inventory of current and future labour needs, to identify the gaps and to outline the strategies to address these needs for the industry. The project has found that a coordinated approach is required to match the knowledge, skills and abilities needed in the agricultural sector to the diverse training programs available, along with an oversight program to estimate the emerging skills and knowledge needs in agriculture as a whole. With these resources in place, training suppliers could then develop appropriate learning experiences to deliver the required skills and knowledge. The project is due for completion in 2017-18.

**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 concern for cotton growers and cotton industry employers. The goal for the industry is to reduce cotton farm-related injuries by 10 per cent by 2018. CRDC contributes to the achievement of this industry goal by investing in on-farm safety, and monitoring and evaluation projects.

In 2016-17, CRDC continued its investment into workplace health and safety through two key projects:

- *People in Agriculture website*, with Dairy Australia; and

- *Primary Industries Health and Safety*, a joint partnership with RIRDC.

The *People in Agriculture website* project aimed to develop an online resource for the agricultural sector, to help employers and employees with human resource management needs. The website, which was inspired by the People in Dairy website, offers compliance support for employers, promoting agriculture as a career choice and providing a platform for employment information sharing. It provides an overarching agriculture perspective as well as sector-specific content, with resources for employers, and guides for employees via one centralised hub. The project concluded in 2016-17, with the launch of the site by the Deputy Prime Minister in December 2016.

Case study: Deputy Prime Minister launches People in Agriculture site with CRDC

People in Agriculture is a new resource for employers and employees working in agriculture.

CRDC is among one of six agricultural bodies that has led the development of the People in Agriculture website that was launched in December 2016 by Deputy Prime Minister and Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP, and CRDC Chair Richard Haire, along with representatives of the other bodies: GRDC, APL, Dairy Australia, MLA, and Food and Agribusiness Solutions.

The website offers compliance support for employers, promoting agriculture as a career choice and providing a platform for employment information sharing. It provides an overarching agriculture perspective as well as sector-specific content, with resources for employers, and guides for employees via one centralised hub.

It breaks down questions commonly asked by Australia's farmers and food producers around employment law and staff management, and provides access to information on employment

opportunities, entitlements and career management in agriculture.

In cotton, it is designed to complement the resources available in the HR and WHS modules of *myBMP*, with links to the new site from *myBMP*.

For more information on *People in Agriculture*, visit www.peopleinag.com.au.



Deputy Prime Minister and Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP, launches People in Agriculture with CRDC Chair Richard Haire, Cotton Australia's training coordinator Rebecca Fing, and CRDC's GM R&D, Dr Ian Taylor.

The ongoing *Primary Industries Health and Safety* project aims to improve the health and safety of farm workers and their families. A jointly funded project involving six of the Rural Research and Development Corporations (RDCs), it undertakes RD&E activities to improve the physical and mental health of farmers and the safety of the farm work environment. The project targets its health and safety information at business owners, managers and employees involved with farming, including cotton growers, as well as health professionals and researchers in rural health and safety. The project is due for completion in 2017-18.

**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 a number of initiatives focused on developing students at the school, undergraduate and postgraduate levels.

In 2016-17, CRDC continued its investment into educational opportunities for current and future workforces through a number of key projects:

- *Horizon Scholarship program*, with RIRDC; and
- *Primary Industries Education Foundation*, co-funded with Cotton Australia.

The ongoing *Aboriginal Employment Strategy* program, supported by CRDC and the Aboriginal Employment Strategy, is a school-based traineeship for Indigenous students. Running for 13 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 increases the skills, experience and capacity of the young Indigenous students; exposes them to range of vocations available through the cotton industry; presents a possible source of future employment; and breaks down the barriers between non-Indigenous employees and Indigenous students. In 2016-17, CRDC supported two students through this program. This program is ongoing in 2017-18.

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. As at semester one, 2017, 38 students are enrolled in the course. This program is ongoing in 2017-18.

The newly established *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 has partnered with Young Farming Champions organisers, Art4Agriculture, for the first time in 2016-17. Cotton Australia also has a relationship with Art4Agriculture, supporting the Archibull Prize. These programs form part of Cotton Australia's focus on education, and the combined CRDC and Cotton Australia focus on workforce development. The program will run until 2018-19.

- *Aboriginal Employment Strategy student scholarships*, with the Aboriginal Employment Strategy;
- *Cotton Production Course*, with UNE;
- *Cotton Young Farming Champions*, with Art for 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 specialist), with CSIRO;

PROGRAM 4: PEOPLE

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 2016-17, CRDC supported five summer/honours scholarships for students to work with existing researchers or research organisations. This program is ongoing in 2017-18.

The *CRDC PhD Scholarship* program funds researchers undertaking their PhDs. In 2016-17, CRDC helped fund 26 new or ongoing PhD scholars across all five of the CRDC's program areas. This program is ongoing in 2017-18.

The ongoing *Developing education capacity in the Australian cotton industry* project provides a full-time education officer, who implements a range of activities and programs in schools to boost knowledge of the industry and its varied career options. The officer is based at the Australian Cotton Research Institute. The project is due for completion in 2017-18.

The ongoing *Horizon Scholarship* program is an initiative of RIRDC 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. In 2016-17, CRDC supported two new Horizon Scholarships for undergraduate students: Sam Knight (2016) and Holly Chandler (2017). Overall, CRDC has supported 12 Horizon scholars throughout the 2016-17 year. CRDC's support for the Horizon program is ongoing into 2017-18.

The *Primary Industries Education Foundation* is focused on encouraging primary industries education in schools, by providing national leadership and coordination of activities; providing resources for students and teachers; and encouraging interest in primary industry careers. CRDC and Cotton Australia continue to jointly contribute to the Foundation on behalf of the cotton industry. CRDC's support for the Foundation is ongoing into 2017-18.

Case study: Cotton appoints two Young Farming Champions

Jess Lehmann and Nellie Evans have been selected as CRDC's inaugural Young Farming Champions (YFC).

Run by Art4Agriculture, the YFC program identifies youth ambassadors and future influencers working in the agriculture sector. The YFC promote positive images and perceptions of farming and engage in activities such as The Archibull Prize.

CRDC has partnered with Art4Agriculture for the first time in 2017 through its support of the YFC program. Cotton Australia also has a relationship with Art4Agriculture, supporting the Archibull Prize. These programs form part of Cotton Australia's focus on education, and the combined CRDC and Cotton Australia focus on workforce development.

Jess Lehmann, the daughter of well-known consultant, the late Chris Lehmann, hails from the family cotton farm at Narrabri, and works in cotton research.

'I am always amazed by the various people and bodies who contribute to our agricultural sector,' she says.

'Whether it's farmers, contractors, researchers, scientists, policy developers, or agronomists,

everyone is a part of the overall equation and everyone will benefit from future agricultural research.'

After studying landscape architecture, Nellie Evans discovered cotton on the plains of Warren, Bourke and Gunnedah that changed her career direction. Currently a fourth year agricultural science student at The University of Sydney, she believes passionately in the industry.

'The cotton industry is really at the forefront of research and development as it faces a future of climate, social and market-based challenges,' she says.

CRDC's General Manager of R&D, Ian Taylor, oversees CRDC's investments in the People program and says the partnership with Art4Agriculture further broadens CRDC's support of people in the industry.

'We support a wide range of programs – from Art4Agriculture through to the Australian Rural Leadership Foundation – all focused on providing development opportunities for people in cotton.

'It's an acknowledgement that people are our most important resource,' Ian said.

For more information on the Young Farming Champions program, visit: www.art4agriculture.com.au.



SHANNA K WHAN

One of cotton's Young Farming Champions, Jess Lehmann, pictured with cotton industry researcher, Dr Robert Mensah, and Jess's grandfather, cotton grower Vic Melbourne.

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 variability in climate, competition for skilled labour, changes in land use and access to water, the industry requires a network of informed and experienced leaders that can work together to develop resilient and sustainable farming systems and communities.

In 2016-17, 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;
- *Peter Cullen Trust: Science to Policy Leadership Program*, with the Peter Cullen Trust; and
- *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 2016-17, CRDC co-sponsored two participants with Auscott and Cotton Australia: cotton merchant Matt Bradd, and marketing services manager Meagan Laidlaw. CRDC's support for the Australian Rural Leadership Program is ongoing into 2017-18.

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. In 2016-17, the two recent CRDC and Cotton Australia-supported Nuffield scholars, cotton growers Matthew McVeigh and Thomas Quigley,

graduated from the program, with the release of their respective research reports – into colour downgrades in cotton, and growing cotton under sprinkler irrigation. In this year, CRDC and Cotton Australia also commenced their support for cotton grower and Nuffield scholar Daniel Kahl, who is investigating career attraction and retention strategies for the next generation of farm managers. CRDC's support for the Nuffield Farming Scholarships is ongoing into 2017-18.

The *Peter Cullen Trust: Science to Policy Leadership Program* aims to enhance the role of science in policy development and to bring about positive change in water and catchment management in Australia. It is intended to build the leadership and communication skills of people actively involved in water systems management – be it river or catchment, rural water, or environmental science or policy. In 2016-17, CRDC supported two participants in the program: Gwydir Valley Irrigators Association executive officer Zara Lowien, and Border Rivers Food and Fibre executive officer Tim Napier. CRDC's support for the Peter Cullen Trust program is ongoing into 2017-18.

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. The 2017 recipient of the CRDC-supported cotton Science and Innovation Award is Dr Priscilla Johnston. CRDC's support for the Science and Innovation Award is ongoing into 2017-18.

Case study: Priscilla's polymers research scoops Science and Innovation pool

Postdoctoral fellow Priscilla Johnston of CSIRO Manufacturing aims to research the use of polymers to improve the efficient use of water and lower water requirements for cotton establishment.

Priscilla is the CRDC-supported awardee of the 2017 Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry.

'I'll be researching the use of a new polymer that can be sprayed onto soil to form a barrier that slows down soil-water evaporation and keeps more water in the soil for the plant to use,' Priscilla said.

'The great thing about this barrier is that water can pass through it and into the soil, which means there is also potential to capture and save water from rain or surface irrigation.'

As the polymer degrades in soil, it also means there will be no removal and disposal costs for farmers.

'I'm really interested in making new polymers that can be used to help solve real-world problems. Applying polymer technology in agriculture is leading to some really interesting material-based solutions that could help meet the future environmental and economic demands of the industry.'

'Growers have already made huge steps toward reducing their water usage, but there are a lot more improvements that could be made by adopting emerging technologies.'

This award will be used to run a glasshouse trial, with the next step being in-field trials.

Priscilla has a PhD in polymer chemistry and some experience in soil chemistry and ecology. She is part of a broader team at CSIRO developing material-based agriculture technologies, including a sprayable, biodegradable polymer membrane. This will be her first foray into the cotton industry.

'I am really looking forward to working with an industry that so clearly values research and the positive contributions it can make. I hope that my research project will help lead to a new solution for growers to reduce their water use and increase water-use efficiencies,' Priscilla said.

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



Receiving her Science and Innovation Award, Dr Priscilla Johnston with CRDC Executive Director Bruce Finney and Chair Richard Haire.

Case study: Tom's Nuffield scholarship helps to optimise overhead irrigation

Cotton grower and 2015 CRDC and Cotton Australia-supported Nuffield Scholar, Tom Quigley, says ongoing issues around water availability prompted him to look at new techniques from around the world to help grow more profitable, water-efficient and sustainable cotton crops using pressurised overhead sprinkler irrigation.

Tom and his family manage a 1200ha irrigation property, alongside dryland cropping and livestock enterprises, at Trangie, NSW. As part of the Government's incentive to modernise irrigation infrastructure, a large proportion of cotton farms in the Trangie district implemented pressurised overhead sprinkler irrigation systems.

Having invested heavily in the new infrastructure, most notably Centre Pivots and Lateral Moves (CPLM), Tom says it was clear that the new technology wasn't reaching its potential.

'The initial results were promising, however we weren't seeing the full potential of these machines using existing cotton-growing methods. We identified that we had to change our farming technique with the new infrastructure, in order to produce more, with less,' he said.

'I began researching new techniques and elements employed by other farmers around the world, which ultimately led to my Nuffield scholarship. It enabled me to see first-hand the advances being made with similar sprinkler irrigation systems in countries like the United States, Canada, Brazil, Mexico, New Zealand and Israel.

'I talked to farmers who had 30-plus years' experience utilising sprinkler irrigation and was able to bring that knowledge back home to help accelerate the change in practices on our own farm, as well as those around us,' Tom said.

His findings uncovered several areas of improvement for growers, ranging from the need to have ground cover to adopting new systems like strip tillage, which has delivered significant gains for US farmers in corn production. He also found that sprinkler selection determines how water is

delivered to the soil efficiently and will have the greatest influence in machine performance for minimal cost.

Ultimately, Tom hopes his Nuffield Scholarship report and his global experience will encourage other Australian growers to adopt new farming techniques and share these learnings with their peers.

'The cotton industry has a great history in sharing knowledge and helping each other to improve farming practices, so as to obtain greater water efficiency, yields and profitability.'

'I hope what I've seen and learnt overseas helps other growers who are already utilising – or are thinking about utilising – sprinkler irrigation to grow cotton,' he said.

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



RUTH REDFERN

Cotton grower and Nuffield scholar, Tom Quigley, with CottonInfo regional extension officer, Janelle Montgomery.

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, and CRDC's investment in this area is designed to ensure the industry continues to stay connected via dynamic networks.

In 2016-17, CRDC continued its investment into networks through a number of key projects:

- *CRDC Grassroots Grants* program, funded by CRDC;
- *Rural.XO microhacks and Cotton-X bridging program*, with Pollenizer and X-Lab;
- *Sponsorship of the 18th Australian Cotton Conference*, with Cotton Australia; and
- *Understanding and building women's participation in the cotton industry*, with Wincott.

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, it has supported 52 projects across the cotton-growing valleys, including eight projects in 2016-17. These projects include a series of weather stations, an investigation into controlled traffic farming for compaction management, and an in-field research trial comparing dryland cotton to sorghum on various row configurations. The CRDC Grassroots Grants program is ongoing in 2017-18.

The *Rural.XO microhacks* program was designed to encourage entrepreneurship in the cotton industry. Under the program, cotton industry innovators were invited to participate in a series of start-up science workshops, *Rural.XO microhacks*, in Sydney in March and May 2017 in collaboration

with CRDC's fellow RDC, Fisheries RDC. CRDC sponsored 20 cotton industry participants, from growers to researchers, to attend, with the best ideas emerging from the workshops having the opportunity to be incubated into start-up businesses through the follow-up program, the *Cotton-X bridging program* that commenced in June 2017. The *Rural.XO microhacks* program concluded in 2016-17; the *Cotton-X bridging program* is due for completion in 2017-18.

CRDC's *Sponsorship of the 18th Australian Cotton Conference* provided a platform to showcase the Australian cotton industry and enhance the outputs of CRDC-funded R&D and extension activities to the industry at large. The August 2016 conference again broke attendance records, with 1900 delegates – the largest gathering of industry participants since the event commenced. Of the 151 speakers on the program for the 2016 Conference, 52 per cent were supported in some way by CRDC, be it as a Board Director, team member or supported researcher. The Conference also formalised the continuation of the CottonInfo joint venture extension program to 2021, the launch of the CRDC 25th anniversary publication, and the launch of the CRDC-supported report *Resilience assessment of the Australian cotton industry at multiple scales*. CRDC will again be a founding sponsor of the 19th Australian Cotton Conference, to be held in August 2018.

The *Understanding and building women's participation in the cotton industry* project aimed to provide an understanding of the roles and contribution women make to all facets of the cotton industry. Four points of contact, resulting in a sample size of 298, were used to understand the role, level of engagement and interests of women working in farm-based and industry roles. The project found that women in the industry are highly educated, and juggle many concurrent roles, with a varying percentage of their professional time spent in a cotton business. The project found that women in the industry generally feel accepted and engaged, but are looking for opportunities for personal and professional development. The project concluded in 2016-17.

PROGRAM 4: PEOPLE

Case study: Start-up science – turning ideas into actions

CRDC partnered with start-up science company Pollenizer and the Fisheries RDC to run two workshops titled the *Rural.XO microhacks*, held in March and May this year.

CRDC sponsored 20 cotton industry participants to attend, from growers to researchers, with the best ideas emerging from the events now with the opportunity to be incubated into real start-up businesses. The hands-on, two-day workshops in Sydney used Pollenizer's 'Startup Science' methodology.

'XO stands for exponential opportunities; exponential opportunities for new ideas to help transform the future cotton industry,' CRDC Executive Director Bruce Finney said.

'The cotton industry was built on innovation and wouldn't be where it is today without the people who challenged the status quo, who took their big ideas and turned them into reality. It's in the spirit of this history that we see our future, albeit in a vastly different approach with new technology and start-ups.'

Cotton Grower Services business development manager Reinder Prins, of Wee Waa, said the

microhack provided a stimulating environment that encouraged participants 'to come up with solutions to problems we didn't even know we had before we started.'

'The main value I see in the microhack is fostering innovation at a grassroots level,' Reinder said.

'There are many people in cotton with valuable ideas that could benefit many. They just don't know how to get them out there, so microhacks can ensure everyone gets a chance to work on their idea and see how they might make it grow into a business venture.'

'Transforming an idea into a business venture is not easy in the best of circumstances, but with a geographically widespread industry that is located in predominantly sparsely populated areas where certain resources might be far away, it is even harder.'

'To get this kind of knowledge into our industry will benefit everyone, especially once the participants start sharing the methodology with others with good ideas as well,' Reinder said.

For more on the CRDC and Pollenizer Rural.XO microhacks, visit: www.pollenizer.com/rural-xo.



POLLENIZER

Participants at the first Rural.XO microhack in Sydney with CRDC's Bruce Finney (front left), and Cotton Australia's Adam Kay (front right) and Nicola Cottee (back left).

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 2016-17, CRDC continued its investment into communication through three 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; and
- *CRDC 25th anniversary publication*, funded by CRDC.

The *Stimulating private-sector extension in Australian agriculture to increase returns from R&D* project aims to increase the capacity of commercial and private-sector extension services in delivering R&D outputs on-farm. A review of the issues facing the commercial and private-sector extension services over the past year has identified topics for four trials, including one led by CRDC: the precision ag trial. This trial aims to increase the capacity of farm advisors to engage with digital applications based on industry RD&E to benefit growers. The project is due for completion in 2017-18.

The *Videos: Documenting the production of best practice Australian cotton* project aims to communicate 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 123 short videos have been produced over the course of the two projects, with collective views reaching over 50,000. One video, on starting a siphon pipe, has been viewed 20,000 times. The videos are accessible via the CottonInfo YouTube channel: www.youtube.com/CottonInfoAust. The project is due for completion in 2017-18.

The *CRDC 25th anniversary publication* was launched by CRDC at the Cotton Conference in August 2016, to mark 25 years of CRDC-led cotton RD&E. The publication outlined the 25 major achievements in cotton RD&E over 25 years – 25 key areas in which the co-investment into RD&E by cotton growers and the Australian Government significantly benefited the industry. The publication also featured 25 key industry people who provide their thoughts on CRDC and the contribution of cotton RD&E. The project concluded in 2016-17.

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 <i>myBMP</i> program is the primary resource for farmers accessing best practice knowledge and tools. - The cotton industry's <i>myBMP</i> 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 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).

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, *myBMP*, and the industry's joint extension program, CottonInfo. CRDC is a founding partner of both *myBMP* and CottonInfo, and provides specific investment support to both programs.

In 2016-17, CRDC continued its support of the best practice theme through key projects, including:

- *myBMP support and program coordination*, with Rachel Holloway;
- *Review of myBMP database*, with Mel Ziarno; and
- *'Science into best practice', linking research with CottonInfo*, with CSIRO.

The *myBMP support and program coordination* project aimed to review all *myBMP* 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. This project concluded in 2016-17.

The newly established *Review of myBMP database* project provides support to Cotton Australia to ensure that the software underpinning the *myBMP* program remains fit for purpose. This project will ensure the program remains easily accessible for

growers into the future. The project is due for completion in 2017-18.

The *'Science into best practice', linking research with CottonInfo* project forms part of CRDC's support for the CottonInfo program. CRDC invests in key CottonInfo personnel (including the CottonInfo program manager and communications manager), provides support for the *myBMP* program, and invests in the CottonInfo technical specialists via research projects under their specific topic areas.

This specific project is for one of the CottonInfo technical specialists. The role of the technical specialist involves the following tasks: developing new information and strategies to help the industry respond to current issues and pre-empt future issues; ensuring *myBMP* is linked to and updated with the latest best practice messages from research results; validating best practice guidelines using field experiments; supporting the development of key industry publications; and exploring opportunities for the development of new decision-making tools to support the uptake of research outcomes and best practices. This project is due for completion in 2017-18.

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 several ways: in helping the industry to continuously improve; in helping to tell the story of the industry to customers; and in helping to secure overseas markets through the demonstration of the industry's social, economic and environmental sustainability.

In 2016-17, 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;

PROGRAM 5: PERFORMANCE

- *Cotton Growing Practices Survey*, with Roth Rural and Regional, and Intuitive Solutions;
- *Measuring and reporting the value of capacity building on farms and in research*, with QualData; and
- *Longitudinal assessment of the cotton industry's People investments*, with Jennifer Moffatt.

The *Annual qualitative and quantitative surveys for the Australian cotton industry* project consists of two separate data sets/reports. The qualitative report is a survey of cotton consultants, which provides information on the practices and attitudes of consultants and their cotton grower clients. The quantitative data provides hard data as to practices on-farm, such as chemical use, and tracks how this has improved over time. The information provided by both surveys forms a critical data set for benchmarking, trending and research purposes. The 2014-15 qualitative survey report was released in December 2016. In all, 63 consultants participated, representing 444 cotton growers. The report is available at the CRDC website: www.crdc.com.au/publications. This project is ongoing in 2017-18.

The *Australian Cotton Comparative Analysis report* provides the industry benchmark for the economics of cotton growing in Australia. The 2016 crop report, published in June 2017, focuses on the economics of the 2016 crop from growers across the different cotton-growing valleys. It is based on figures from growers who produced 340,000 bales, or 12 per cent of total Australian cotton production. It found that the 'average' group of cotton growers achieved a profit per hectare of \$1706 in 2016 (compared to \$1899 in 2015, and the five-year average of \$1106) while the 'top 20 per cent' group achieved a profit of \$3159 per hectare (down on last year's profit of \$3388, but well up compared to the five-year average of \$2272). The report is available at the CRDC website: www.crdc.com.au/publications. This project is ongoing in 2017-18.

The *Cotton Growing Practices 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 2016 survey, published in May 2017, focused on nutrition, plant growth regulation, farm hygiene, chemical application management, harvesting and solar energy. The report is available at the CRDC website: www.crdc.com.au/publications. The 2017 survey was launched in June, with the resulting report set to be published in August 2017. This project is ongoing in 2017-18.

The *Measuring and reporting the value of capacity building on farms and in research* project aims to provide metrics to the industry to help measure and report the value of investments in capacity building. These metrics will help growers and the wider industry assess the value of their investments in developing the workforce, and the benefits that the upskilled workforce provides. The project will also help the industry understand how programs to develop the people contribute to attracting and retaining on-farm workers, and the value that employees place on having good working conditions. The project is due to report in 2018-19.

The *Longitudinal assessment of the cotton industry's People investments* project aims to assess the value of CRDC's investments to date in the People program. CRDC invests significant funds annually to provide educational opportunities for the industry, but there is currently incomplete knowledge of the long-term impact on the participants, and their skills and contributions to the cotton and wider communities. As such, this project will develop a longitudinal research framework to assess these impacts. This project is due to report in 2018-19.

Case study: Survey tracks grower trends

2017 marks 20 years since the first surveys of Australian cotton growers' management practices and attitudes were undertaken by CRDC. Ten surveys have been undertaken to date, with an average of 270 growers participating in each edition. Annual surveys have been commissioned since 2013 in an effort to build an ongoing picture of the industry, assess the success of RD&E and better focus future investment.

In 1997, the phrase 'pull, rake and burn' was still prominent in the cotton grower's vocabulary. That method of crop destruction was being used by 10 per cent of the 247 respondents. The use of solar as a serious energy source didn't rate a mention, yet by 2016, 37 per cent of respondents had solar energy installations.

In the disease arena, the first survey showed Verticillium wilt was a leading cause of yield reductions, albeit a different strain to those found in cotton fields today.

There have also been significant changes in terms of fertiliser use which, in irrigated cotton, has more than doubled from the average rate of 125 kg N/ha in 1995-96, to 275 kg N/ha in 2015-16. A significant increase was between the first and second surveys, to 176 kg N/ha in 1999-2000. Solid N and gas N were both used at higher rates in 2005-06 than in 2000-01.

In terms of irrigation management, irrigation scheduling was based on experience combined with crop stage and rate of growth for most

irrigators, with neutron probes used by 36 per cent of respondents, water balance models and weather data by 32 per cent, and enviroscans by nine per cent. Today growers have a much bigger toolbox to draw from, which includes IrriSAT, canopy sensors, weather stations, C probes, and modelling.

Residual herbicide use has also changed dramatically, largely due to the introduction of stacked Roundup Ready Bollgard varieties. The survey of the 1999-2000 season revealed the main changes were an increased pre-plant use of diuron and a trend toward pendimethalin, and away from trifluralin, but with an overall reduction in the use of grass herbicides. Conversely, post-plant use of diuron had reduced from 51 per cent to four per cent over the four years between the first and second surveys. Hard-to-control weeds were nutgrass, bladder ketmia, noogoora and bathurst burrs, bell vine and sesbania. While some of these weeds still pose threats, a new range of problem weeds has emerged along with resistance to glyphosate-based products.

'There is no doubt cotton growing has changed significantly in the past 20 years,' CRDC Executive Director Bruce Finney said. 'Much of this change has been supported by the new knowledge and practices generated through investment in industry RD&E.'

For more on the CRDC Cotton Growing Practices Survey, visit www.crdc.com.au/growersurvey.



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

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

In 2016-17, CRDC continued its investment into reviews through the following key projects:

- *Enhancing private sector agricultural RD&E investment in Australia*, with Australian Farm Institute; and
- *Impact assessment of selected clusters of projects – stages I, II, and 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 measures currently employed in Australia and overseas, along with a series of interviews with heads of agribusiness operating throughout the industry. This project concluded in 2016-17. The resulting report will be available at the CRDC website once released: www.crdc.com.au/publications.

The *Impact assessment of selected clusters of projects – stages I, II, and III* projects are a series of qualitative and quantitative impact assessments of CRDC investments in important project clusters. Stage I was an impact assessment of the nutrition- and water-use efficiency projects cluster; Stage II is an impact assessment of the Bt technologies projects cluster; and Stage III is an impact assessment of the sustainability projects cluster.

The purpose of the evaluations is to determine the success of CRDC's investments against the stated Strategic Plan goals, and to inform future investments.

The Stage I impact assessment of the efficient use of water and optimising crop nutrition projects, which concluded in 2016-17, found that CRDC's investments delivered major economic benefits to growers. It found that CRDC's investment of \$4.90 million on behalf of cotton growers and the Australian Government into six water-use efficiency projects from 2010-15 provided a return benefit of \$40.62 million to cotton growers, a benefit-cost ratio of 8.29 to 1. In addition, CRDC's investment of \$11.32 million of grower and Government funds into nine nutrition research projects from 2008-16 returned a benefit of \$61.15 million to growers, or 5.4 to 1. The reports will be made available at the CRDC website once released: www.crdc.com.au/publications. Stages II and III are set to report in 2017-18.

Section 5 **CRDC People and** **Governance**

CRDC Board

CRDC employees

**Governance and
accountability**

**Selection Committee
report**



CRDC People and Governance

CRDC BOARD



Dr Mary Corbett BSc PhD (FAICD, AFAIM)

Chair (to 12 August 2016)

CRDC Chair, Dr Mary Corbett, has more than 20 years' experience as a Company Director in the scientific research and development area, and in education and training. Dr Corbett has significant board and corporate governance experience gained across a range of organisations. She is currently a board member of Horticulture Innovation Australia and of DairyBio, and Adjunct Professor with the University of QLD, Faculties of Health and Behavioural Sciences and Medicine and Biomedical Sciences. Previously, Dr Corbett was Chair of the West Moreton Hospital and Health Service, a board member on the Wound Management Innovation CRC, Deputy Chair of the Southbank Institute of Technology, Deputy Chair of the Australian Agriculture College Corporation, and a board director of the Sugar Research and Development Corporation, and Food Science Australia.

Dr Corbett has extensive experience as Chair and member of a number of board committees. She is Managing Director of Australian Business Class, an organisation specialising in executive leadership development.

Appointed: 01/10/2008 until 30/09/2011.

Reappointed: 01/10/2011 until 30/09/2014

(term ended 12/08/2013 upon Chair appointment).

Appointed Deputy Chair: 15/12/2011.

Appointed Chair: 13/08/2013 until 12/08/2016.

Appointed Chair of the Remuneration Committee.



Mr Richard Haire (FAICD, FAIM)

Chair (from 29 August 2016)

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 Chair: 29/08/2016 until 28/08/2019.

Appointed Chair of the Remuneration Committee.

Dr Mary Corbett finished her tenure as CRDC's Chair on 12 August 2016. Mary served as a Director of CRDC from 2008, and as Chair from 2013. On behalf of the CRDC Board, we thank Dr Corbett for her contribution to CRDC during this period. CRDC Director and Deputy Chair Cleave Rogan served in the role of Acting Chair until the appointment of the incoming CRDC Chair Richard Haire on 29 August 2016 by the Minister for Agriculture and Water Resources. As Mr Haire was the Chair for the majority of the 2016-17 year, he replaces Dr Corbett as a signatory to this Annual Report.



Mr Cleave Rogan (MAICD)

Deputy Chair

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.

Appointed Deputy Chair: 27/01/2015.

Appointing Acting Chair: 12/08/2016 until 29/08/2016.



Mr Bruce Finney BSCAg (MAICD)

Executive Director

Mr Finney has extensive experience in the agricultural sector. Prior to his appointment to CRDC in 2004, he worked in corporate agriculture in various corporate, management and agronomy roles in Australia and in an advisory role in Argentina. He is a member of the Cotton Innovation Network, the Advisory Board QDAF programme on Agricultural Robotics at QUT and the Agriculture Senior Officials Research and Innovation Committee.

Mr Finney is a past chair of the Australian Cotton Growers Research Association and a past 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.



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

Non-executive Director

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.

Appointed Chair of the Audit Committee.



Ms Kathryn Adams BScAgr (Hons), LL.M, MBus, MEnvStud, Grad Dip Leg Pract, Prof Cert Arbitration, Practitioners Cert Mediation & Conciliation, FAICD

Non-executive Director

Ms Adams, a microbiologist and lawyer, 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.

Appointed Chair of the Intellectual Property Committee.



Mrs Elizabeth (Liz) Alexander BA, MRurSysMgt, GAICD

Non-executive Director

As the Agribusiness Development Coordinator for the Central Highlands Development Corporation, Mrs Alexander assists business, industry, government and other stakeholders to collaborate and grow economic opportunity across the region's agricultural sectors and value chain. She has extensive knowledge of dryland and irrigated cropping industries across eastern Australia. As principal consultant for Blue Dog Agribusiness, Mrs Alexander has provided extension services for more than 15 years, supporting Central Queensland cotton growers to undertake on-ground activities that improve water quality flowing to the Great Barrier Reef, conserve and protect biodiversity, improve production, and participate in the cotton industry's Best Management Practices program.

Mrs Alexander is currently a director of Plant Health Australia, and was previously Chair of the Theodore Irrigation Local Management Arrangements (LMA) Transition Board (Stage 2 and 3), Independent Chair of the Glencore Clermont Open Cut Groundwater and Environmental Reference Group, and a director of Cotton Australia.

Appointed: 20/10/2014 until 30/09/2017.



Mr Greg Kauter BAgEc, GradCertRuSc, 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.

Composition

CRDC has a seven-member Board, consisting of a Chair (appointed by the Minister for Agriculture and Water Resources), the Executive Director (selected by the Board) and five 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 2017:

1. Mr Richard Haire, Chair
2. Mr Cleave Rogan, Deputy Chair
3. Mr Bruce Finney, Executive Director
4. Dr Michael Robinson, Non-executive Director
5. Ms Kathryn Adams, Non-executive Director
6. Mrs Elizabeth Alexander, Non-executive Director
7. Mr Greg Kauter, 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 R&D 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 2016-17, 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 2016-17. 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	Dates	Location
Meeting 5 – 2016	17 August 2016	CRDC, Narrabri NSW
Meeting 6 – 2016	27 September 2016	Teleconference
Meeting 7 – 2016	17 November 2016	Royal on the Park, Brisbane QLD
Meeting 1 – 2017	8 February 2017	SunWater, Theodore QLD
Meeting 2 – 2017	20 April 2017	QT Hotel, Canberra ACT
Meeting 3 – 2017	6 June 2017	Warren Service Club, Warren NSW

Attendances at Board meetings

Director	Board meeting attendance						TOTAL
	Meeting 5 2016	Meeting 6 2016	Meeting 7 2016	Meeting 1 2017	Meeting 2 2017	Meeting 3 2017	
Richard Haire	-	Yes	Yes	Yes	Yes	Yes	5 of 5
Bruce Finney	Yes	Yes	Yes	Yes	Yes	Yes	6 of 6
Cleave Rogan	Yes	Yes	Yes	Yes	Yes	Yes	6 of 6
Michael Robinson	Yes	Yes	Yes	Yes	Yes	No	5 of 6
Elizabeth Alexander	Yes	Yes	Yes	Yes	Yes	Yes	6 of 6
Kathryn Adams	Yes	Yes	Yes	Yes	Yes	Yes	6 of 6
Greg Kauter	Yes	Yes	Yes	Yes	Yes	Yes	6 of 6

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 is Chair of the Audit Committee, supported by members Greg Kauter, Kathryn Adams and Alex Keatinge, an additional skills-based appointee. CRDC Executive Director Bruce Finney attended meetings as an observer. The Audit Committee met four times during 2016-17, three of which were by teleconference.

Attendances at Audit Committee meetings

Member	Date of Audit Committee meeting				TOTAL
	9 August 2016	1 November 2016	25 January 2017	11 May 2017	
Michael Robinson (Chair)	Yes	Yes	Yes	Yes	4 of 4
Greg Kauter	Yes	Yes	Yes	Yes	4 of 4
Kathryn Adams	Yes	Yes	Yes	Yes	4 of 4
Alex Keatinge	Yes	Yes	Yes	Yes	4 of 4

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 is Chair of the IP Committee, supported by members Greg Kauter and Liz Alexander. CRDC Executive Director Bruce Finney attended meetings as an observer. The IP Committee met three times during 2016-17, once by video-conference.

Attendances at Intellectual Property Committee meetings

Member	Date of Intellectual Property Committee meeting			
	19 October 2016	31 January 2017	3 May 2017	TOTAL
Kathryn Adams (Chair)	Yes	Yes	Yes	3 of 3
Greg Kauter	Yes	Yes	Yes	3 of 3
Liz Alexander	Yes	Yes	Yes	3 of 3

Remuneration Committee

The Remuneration Committee advises the Board on the Executive Director's remuneration and senior staff remuneration adjustments. The Chair of the Remuneration Committee was the Chair of the Board, Mary Corbett, followed by Richard Haire, supported by members Cleave Rogan and Liz Alexander. CRDC Executive Director Bruce Finney attended meetings as an observer. The Remuneration Committee met four times by teleconference during 2016-17.

Attendances at Remuneration Committee meetings

Member	Date of Remuneration Committee meetings				
	21 July 2016	16 November 2016	5 April 2017	17 May 2017	TOTAL
Mary Corbett (former Chair)	Yes	-	-	-	1 of 1
Richard Haire (Chair)	-	Yes	Yes	Yes	3 of 3
Cleave Rogan	Yes	Yes	Yes	Yes	4 of 4
Liz Alexander	Yes	Yes	Yes	Yes	4 of 4

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 People and Governance

CRDC EMPLOYEES

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 2017

CRDC Board of Directors				
CRDC Chair Mr Richard Haire				
CRDC Executive Director Mr Bruce Finney				
R&D Investment	Business and Finance	CottonInfo	Communications	IT
General Manager R&D Investment Dr Ian Taylor R&D Managers Allan Williams Jane Trindall Susan Maas	General Manager Business and Finance Graeme Tolson Accountant Emily Luff (extended leave) Executive Assistant Dianne Purcell Project Administration Assistants Megan Baker Amy Withington Accounts Officer Melanie Moloney	CottonInfo Program Manager Warwick Waters	Communications Manager Ruth Redfern	IT Manager Peter Harvey

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 12 full-time employees, 1 part-time employee and 1 casual employee on 30 June 2017.

CRDC employees

Employee type	2012-13	2013-14	2014-15	2015-16	2016-17
Full-time employees	12	10	11	11	11
Part-time employees	2	4	1	1	1
Parental leave	1	2	2	0	1
Casual	0	0	0	1	1
TOTAL CRDC staff	15	16	14	13	14*

* The number of CRDC staff employed by CRDC on 30 June 2017.

Staff training and development

In 2016-17, CRDC spent \$33,793 on training and \$32,268 on recruitment. Areas of direct training activities were director intellectual property training, WHS, financial management, graphic design, social media, ICT, strategic planning, and support for an employee undertaking academic studies in sustainable value chains.

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. Scientists undertaking CRDC-funded research are of diverse backgrounds and cultures.

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*	\$209,258

* 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 People and Governance

GOVERNANCE AND ACCOUNTABILITY

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 were closely involved in development of the CRDC 2013-18 Strategic R&D Plan, which incorporated 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 R&D 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, <i>myBMP</i>. 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.

A new levy was introduced on 1 April 2017 for seed cotton exports of \$4.06 per tonne of exported seed cotton.

Minister

During 2016-17, CRDC was accountable to the Australian Parliament through the Deputy Prime Minister and Minister for Agriculture and Water Resources, the Hon. Barnaby Joyce MP.

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 which 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 2016-17.

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 for 2013-18 and Annual Report on the outcomes of investments, projects, operations and financials.

Policies, procedures and charters

CRDC has 38 existing 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.

During 2016-17, CRDC reviewed its policy framework and resolved to consolidate related policies into six handbooks. The Board have approved the new Charter of Corporate Governance Handbook, Finance & Administration Policy Handbook, Human Resource Management Policy Handbook and Workplace Health and Safety Policy Handbook. Directors and management conducted or commissioned reviews of all policies during 2016-17.

CRDC commissioned an external review of its human resource management policy framework and terms and conditions of employment for compliance with legislated requirements and consistency with best practice.

Corporate reporting

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

CRDC submitted its Annual Operational Plan for 2016-17 to the Minister for Agricultural and Water Resources, the Hon. Barnaby Joyce MP, on 28 June 2016 with the plan commencing from 1 July 2016. The Annual Report 2015-16 was submitted to the Minister on 14 October 2016 and the Minister tabled the report in Parliament on 29 November 2016.

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 2016-17.

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 2016-17.

Significant changes in the state of affairs

CRDC had no significant changes in its state of affairs in 2016-17.

Judicial decisions and reviews by outside bodies

CRDC had no judicial decisions or reviews by outside bodies in 2016-17.

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 2016-17, CRDC worked with NSW DPI, USQ, Deakin University and CSIRO to manage commercialisation of intellectual property. One CRDC-supported innovation was commercialised in 2016-17, Sero X by Innovate Ag, with another two innovations, Cottonspec and Module Hood Sensors, under commercialisation negotiations with CSIRO.

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 2016-17
Initiatives during 2016-17 and outcomes	▪ An internal WHS audit of first aid kits, training register, fire extinguishers, smoke detectors and incident reporting records was completed in May. No substantive matters were identified. ▪ Fire warden, evacuation, fire extinguisher, and ergonomics 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. ▪ A defibrillator was purchased and staff provided training in its operation.
Statistics of any notifiable incidents as defined by s.38 of the WHS Act	▪ CRDC had no notifiable incidents in 2016-17.
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 2016-17, CRDC had no freedom of information requests. However, in the event a request was raised the CRDC would manage the request in accordance with the provisions of its freedom of information plan, which complied with subsection 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 2016-17, CRDC spent \$617,255, 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
ACIL Allen Consulting	Strategic advice
Banki Haddock Fiora lawyers	Legal advice
Carolyn Martin	Publication content
Keo Design	Web consultant
Melanie Jenson	Publication content
Meyer Vandenberg	Legal advice
Neil Deacon Design	Publication design
Nexia Court & Co	Internal audit services
PwC (PricewaterhouseCoopers)	Governance advice
Rachel Holloway	Program management services
Revolution IT	Software consultant
Richard Whan Building Services	Building maintenance
Talent International (Qld) Pty Ltd	Recruitment services
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 2016-17, CRDC contributed \$95,401 to Cotton Australia for industry consultation, capacity building of advisory panel members and RD&E projects.

These funds included \$40,400 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 2016-17, CRDC contributed a total of \$55,001 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.
- \$25,000 support for the 2016 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.
- \$1735 co-funding for Plant Textiles 2016 conference sponsorship.
- \$766 co-funding to develop a response to Khapra beetle.

SELECTION COMMITTEE REPORT

Joe Robinson

Presiding Member

Cotton Research and Development Corporation
Board Selection Committee

22 August 2017

The Hon. Barnaby Joyce MP
Deputy Prime Minister
Minister for Agriculture and Water Resources
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) Selection Committee during the year 1 July 2016 to 30 June 2017.

The terms of the CRDC Directors, with the exception of CRDC Chair Richard Haire, are due to complete on 30 September 2017. As such, upon my reappointment as the Presiding Member of the Selection Committee from 1 April 2017, I commenced the selection process for the CRDC Director positions.

The Committee's nominations for six directors were provided to your office on 6 July 2017.

Details of the operation of the selection committee and the process conducted by the committee are outlined in the following report.

Yours sincerely



Mr Joe Robinson
Presiding Member

Establishment of Selection Committee

The CRDC Selection Committee was established under the PIRD Act for the purpose of nominating to you persons for appointment as directors of the CRDC.

On 7 May 2014, you appointed me as the Presiding Member of the CRDC Selection Committee until 31 March 2017. Subsequently, on 9 February 2017, you reappointed me to this position for the period 1 April 2017 to 31 December 2019.

On 5 May 2017, following nominations made by me, in consultation with Cotton Australia as CRDC's representative organisation, you appointed the following persons to the selection committee:

- Mr Hamish McIntyre, QLD (CA nominee)
- Mr David Anthony, NSW (CA nominee)
- Mrs Barbara Grey, QLD (CA nominee)
- Mrs Fleur Anderson, QLD (CA nominee).

Selection process

At the commencement of this process, I consulted with CRDC Chair, Mr Richard Haire, and Executive Director, Mr Bruce Finney, on the strategic direction of the organisation, current and emerging industry issues, particular challenges facing the industry, and CRDC's role in contributing to solutions or participation in resolving these issues. I also consulted with officers at the Australian Government Department of Agriculture and Water Resources. The committee discussed in detail the skills and experience that were likely to be required to deal with the organisational and industry challenges likely to emerge over the next three years.

The board positions were advertised in the national press and regional newspapers, as well as through a wide range of electronic media, industry and professional organisations. Cotton Australia was also invited to nominate candidates for consideration.

The advertisements called for written applications against the criteria specified in the PIRD Act, which included cotton production, processing or marketing, management or conservation of natural resources, science and technology or technology transfer, environmental and ecological matters, economics and finance, administration of research and development, business management, sociology and public administration.

The committee sought candidates who also had a sound understanding of corporate governance and the role and responsibilities of directors, as well as good communications skills and the capacity to represent the CRDC to its stakeholders.

In addition, it was considered important that applicants understood the research and development environment in Australia, industry structures and, importantly, the role of the Australian government as a stakeholder in the CRDC.

In total, 81 applications were received and considered by all members of the selection committee. A meeting was held on 18 May to agree on a list of suitable candidates for interview. In developing the list of candidates for interview, the selection committee took into account the core selection criteria

contained in the PIRD Act, as well as the other criteria agreed to be important, including a level of industry experience and strategic skills that would be useful in supporting and supplementing CRDC's management in dealing with the range of issues outlined above.

The selection committee unanimously agreed to interview 12 candidates, of whom five were women. Interviews were conducted on 7 and 8 June at Cotton Australia, Level 4, 247 Coward Street, Mascot, Sydney. Reference checks were carried out after the interviews in respect of the candidates selected by the Committee for nomination.

Board nominations

Upon completion of the selection process, in accordance with section 130 of the PIRD Act, the CRDC Selection Committee provided for your consideration six nominations for appointment, as requested, and a list of two other candidates considered suitable for appointment.

Expenses

The following expenses (excluding GST) were incurred in the selection process:

Item	Expense
Selection committee members' travel and related expenses	\$5,216.05
Applicants' travel expenses and other interview costs	\$1,407.59
Presiding Member fees	\$10,000.00
Secretarial, office expenses and administrative support	\$5,000.00
Advertising	\$18,115.83
Total	\$39,739.47





Section 6 *Financials*

**Independent Auditor's
Report**

**Statement by the
Accountable Authority,
Executive Director and
Financial Officer**

Financial statements

**Notes to the financial
statements**

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INDEPENDENT AUDITOR'S REPORT

To the Minister for Agriculture and Water Resources

Opinion

In my opinion, the financial statements of the Cotton Research and Development Corporation for the year ended 30 June 2017:

- (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 2017 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 2017 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* to the extent that they are not in conflict with the *Auditor-General Act 1997* (the Code). 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 Development 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 matters related to going concern as applicable 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

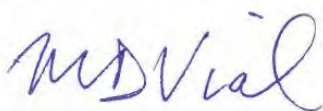
My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that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

17 August 2017

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 2017 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.

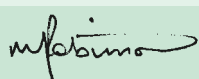
This statement is made in accordance with a resolution of the Directors.

Signed



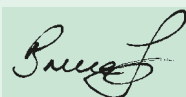
Richard Haire
Chair
17 August 2017

Signed



Dr Michael Robinson
Director
17 August 2017

Signed



Bruce Finney
Executive Director
17 August 2017

Signed



Graeme Tolson
Chief Financial Officer
17 August 2017

PRIMARY FINANCIAL STATEMENTS

STATEMENT OF COMPREHENSIVE INCOME for the period ended 30 June 2017

	Notes	2017 \$	2016 \$	Original Budget \$
NET COST OF SERVICES				
Expenses				
Employee Benefits	1.1A	2,002,847	1,881,576	1,914,000
Suppliers	1.1B	1,022,822	963,528	1,283,000
Grants	1.1C	20,875,100	17,505,758	17,047,000
Depreciation and amortisation	2.2A	188,702	131,990	157,000
Write-Down and Impairment of Assets	1.1D	-	68,544	-
Losses from asset sales		-	3,739	-
Total expenses		24,089,471	20,555,135	20,401,000
OWN-SOURCE INCOME				
Own-source revenue				
Interest	1.2A	1,077,822	1,281,822	700,000
Royalties	1.2B	584,768	745,107	656,000
Research grants	1.2C	6,718,580	4,127,088	758,000
Other revenue	1.2D	958,346	672,280	306,000
Total own-source revenue		9,339,516	6,826,297	2,420,000
GAINS				
Gains from sale of assets	1.2E	-	1,491	-
Total gains		-	1,491	-
Total own-source income		9,339,516	6,827,788	2,420,000
Net (cost of)/contribution by services		14,749,955	13,727,347	17,981,000
Revenue from Government				
PIRD Act 1989 Contribution	1.2F	6,128,948	6,053,299	5,308,000
Levies and penalties	1.2G	6,131,339	6,054,115	5,445,000
Total revenue from Government		12,260,287	12,107,414	10,753,000
Surplus/(Deficit) attributable to the Australian Government		(2,489,668)	(1,619,933)	(7,228,000)

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

PRIMARY FINANCIAL STATEMENTS

STATEMENT OF COMPREHENSIVE INCOME (CONTINUED) for the period ended 30 June 2017

Budget Variances Commentary

Statement of Comprehensive Income for not-for-profit Reporting Entities The original budget is the Corporation's 2016-17 Portfolio Budget Statements (PBS).

Suppliers expense decreased by \$0.260 million. The Corporation decreased expenditure in information and communication technology, board services and legal services.

Grants expense increased by \$3.828 million due to additional RD&E projects contracted as part of two new unbudgeted Rural R&D for Profit grants.

Interest income income increased by \$0.378 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 \$5.961 million as a result of receiving two new grants from the Rural R&D for Profit programme from the Department of Agriculture and Water Resources and contributions from the program partners.

Other revenue increased by \$0.652 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, increased by \$1.507 million as a result of an increase 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 2017

	Notes	2017 \$	2016 \$	Original Budget \$
ASSETS				
Financial assets				
Cash and cash equivalents	2.1A	15,071,075	9,212,257	1,752,000
Investments held to maturity	2.1B	20,000,000	31,000,000	27,523,000
Trade and other receivables	2.1C	4,996,053	3,837,710	2,900,000
Total financial assets		40,067,128	44,049,967	32,175,000
Non-financial assets				
Land and buildings	2.2A	721,139	697,966	860,000
Property, plant and equipment	2.2A	78,599	79,903	160,000
Intangibles	2.2A	200,892	264,072	299,000
Prepayments		-	5,487	10,000
Total non-financial assets		1,000,630	1,047,428	1,329,000
Total assets		41,067,758	45,097,395	33,504,000
LIABILITIES				
Payables				
Suppliers	2.3A	72,638	57,995	200,000
Grants	2.3B	2,986,054	4,620,209	4,000,000
Other payables	2.3C	66,650	77,173	-
Total payables		3,125,342	4,755,377	4,200,000
Provisions				
Employee provisions	3.1A	406,906	316,840	384,000
Total provisions		406,906	316,840	384,000
Total liabilities		3,532,248	5,072,217	4,584,000
Net assets		37,535,510	40,025,178	28,920,000
EQUITY				
Reserves		255,403	255,403	255,000
Retained surplus		37,280,107	39,769,775	28,665,000
Total equity		37,535,510	40,025,178	28,920,000

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

PRIMARY FINANCIAL STATEMENTS

STATEMENT OF FINANCIAL POSITION (CONTINUED)

as at 30 June 2017

Budget Variances Commentary

Statement of Financial Position for not-for-profit Reporting Entities The original budget is the Corporation's 2016-17 Portfolio Budget Statements (PBS).

Cash and cash equivalents above PBS by \$13.319 million. The Corporation holds deposits in interest-bearing short-term accounts with financial institutions when the funds will be required within three months and the interest rates are comparable with short-term deposits. Government grant income is held in interest-bearing short-term accounts with financial institutions awaiting completion of project milestones prior to payment to research organisation.

Investments held to maturity below PBS by \$7.523 million is a result of the higher proportion of cash reserves being held in at call investments accounts for Government grants.

Trade and other receivables above PBS by \$2.096 million is represented by increases in Commonwealth contributions and industry levies and interest receivables as a result of increased cotton production.

Land and buildings below PBS by \$0.139 million as a result of anticipated building improvements not commencing in the year.

Grants payable below PBS by \$1.014 million is represented by a decrease in accrued completed project milestones that have not been invoiced by research organisations.

STATEMENT OF CHANGES IN EQUITY
for the period ended 30 June 2017

	2017 \$	2016 \$	Original Budget \$
RETAINED EARNINGS			
Opening balance			
Balance carried forward from previous period	39,769,775	41,389,708	35,893,000
Comprehensive income			
Surplus/(Deficit) for the period	(2,489,668)	(1,619,933)	(7,228,000)
Closing balance as at 30 June	37,280,107	39,769,775	28,665,000
ASSET REVALUATION RESERVE			
Opening balance			
Balance carried forward from previous period	255,403	255,403	255,000
Comprehensive income			
Other comprehensive income	—	—	—
Closing balance as at 30 June	255,403	255,403	255,000
TOTAL EQUITY			
Opening balance			
Balance carried forward from previous period	40,025,178	41,645,111	36,148,000
Comprehensive income			
Surplus/(Deficit) for the period	(2,489,668)	(1,619,933)	(7,228,000)
Other comprehensive income	—	—	—
Total comprehensive income	(2,489,668)	(1,619,933)	(7,228,000)
Closing balance as at 30 June	37,535,510	40,025,178	28,920,000

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 2016–17 Portfolio Budget Statements (PBS).

Deficit for the period below PBS by \$4.738 million is a result of the increased revenues from industry levies, Commonwealth contributions and research grants as noted in the budget variance commentary on the Comprehensive Income Statement.

PRIMARY FINANCIAL STATEMENTS

CASH FLOW STATEMENT

for the period ended 30 June 2017

	Notes	2017 \$	2016 \$	Original Budget \$
OPERATING ACTIVITIES				
Cash received				
Industry levies and penalties		5,529,683	5,917,862	5,445,000
Commonwealth contributions		5,957,044	5,480,679	5,337,000
Royalties		627,694	798,742	722,000
Grants		7,322,192	4,487,801	834,000
Interest		1,067,430	1,511,617	700,000
Net GST received		1,284,944	1,396,772	1,693,000
Other		914,285	997,805	307,000
Total cash received		22,703,272	20,591,278	15,038,000
Cash used				
Employees		1,926,962	1,960,750	1,914,000
Grants		24,655,778	18,282,139	18,752,000
Suppliers		1,114,323	1,222,021	1,443,000
Total cash used		27,697,063	21,464,910	22,109,000
Net cash from/(used by) operating activities		(4,993,791)	(873,632)	(7,071,000)
INVESTING ACTIVITIES				
Cash received				
Proceeds from sales of property, plant and equipment		-	2,036	-
Investments		60,800,000	54,922,609	7,500,000
Total cash received		60,800,000	54,924,645	7,500,000
Cash used				
Purchase of property, plant and equipment		147,391	196,396	320,000
Investments		49,800,000	50,900,000	-
Total cash used		49,947,391	51,096,396	320,000
Net cash from/(used by) investing activities		10,852,609	3,828,249	7,180,000
Net increase/(decrease) in cash held		5,858,818	2,954,617	109,000
Cash and cash equivalents at the beginning of the reporting period		9,212,257	6,257,640	1,643,000
Cash and cash equivalents at the end of the reporting period	2.1A	15,071,075	9,212,257	1,752,000

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

CASH FLOW STATEMENT

for the period ended 30 June 2017

Budget Variances Commentary

Statement of Changes in Equity for not-for-profit Reporting Entities The original budget is the Corporation's 2016-17 Portfolio Budget Statements (PBS).

Industry levies and Commonwealth contributions increased by \$0.705 million as a result of an increase in cotton production from which levies are collected and Commonwealth contributions determined in accordance with the PIRD Act 1989.

Grant receipts increased by \$6.488 million as a result of new research grants being contracted.

Interest receipts increased by \$0.367 million as a result of increased financial reserves being invested at above budgeted interest rates.

Other receipts increased by \$0.607 million as a result of an increase in surplus project funds returned by research organisation.

Grant payments increased by \$5.904 million as a result of new RD&E projects being contracted as part of the new Government grants received during the year.

Supplier payments decreased by \$0.329 million as a result of reduction in ICT services, board services and legal services.

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.

OVERVIEW

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

No accounting assumptions or estimates have been identified that have a significant risk of causing a material adjustment to carrying amounts of assets and liabilities within the next accounting period.

1. Financial Performance

This section analyses the financial performance of the Corporation for the year ended 2017.

1.1 Expenses

	2017 \$	2016 \$
1.1A: EMPLOYEE BENEFITS		
Wages and salaries	1,645,465	1,646,198
Superannuation:		
Defined contribution plans	152,565	157,520
Defined benefit plans	20,664	12,327
Leave and other entitlements	184,153	65,531
Total employee benefits	2,002,847	1,881,576

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	163,275	195,486
Consultants	208,857	123,812
Corporate services	17,073	15,265
Information technology	233,221	218,263
Legal services	23,253	64,372
Levy management	23,876	13,251
Personnel services	78,376	80,756
Property services	87,811	63,794
General administration	49,890	47,825
Total goods and services supplied or rendered	885,632	822,824
Goods supplied	86,127	74,464
Services rendered	799,505	748,360
Total goods and services supplied or rendered	885,632	822,824
Other supplier expenses		
Operating lease rentals	111,865	116,702
Remuneration of auditors	22,000	21,000
Workers compensation expenses	3,325	3,002
Total other supplier expenses	137,190	140,704
Total supplier expenses	1,022,822	963,528

NOTES TO THE FINANCIAL STATEMENTS

1.1 Expenses

	2017	2016
	\$	\$

Leasing commitments

Operating leases consist of motor vehicle leases that do not include renewal or purchase options.

Commitments for minimum lease payments in relation to non-cancellable operating leases are payable as follows:

Within 1 year	81,484	117,225
Between 1 to 5 years	27,979	95,719
Total operating lease commitments	109,463	212,944

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	3,885,913	4,524,528
State and Territory Governments	5,806,715	4,824,839
Universities & Colleges	6,288,740	5,020,362
Corporate extension activities	557,136	454,148

Private sector:

Commercial entities	4,336,596	2,681,881
Total grants	20,875,100	17,505,758

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	15,102,277	9,259,885
Funded through research grant revenue	10,880,959	11,368,803
Total research grant commitments payable	25,983,236	20,628,688

1.2 Own-Source Revenue and Gains

	2017	2016
	\$	\$

OWN-SOURCE REVENUE**1.2A: INTEREST**

Deposits	1,077,822	1,281,822
Total interest	1,077,822	1,281,822

Accounting Policy

Interest revenue is recognised by using the effective interest method.

1.2B: ROYALTIES

Royalties	584,768	745,107
Total royalties	584,768	745,107

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	6,718,580	4,127,088
Total research grants	6,718,580	4,127,088

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.

Research grant commitments are Agreements Equally Proportionately Unperformed.

Rural R&D for Profit – Smarter irrigation for profit	477,852	477,852
Rural R&D for Profit – Accelerating precision agriculture to decision agriculture	826,561	1,397,561
Rural R&D for Profit – More profit from nitrogen: enhancing the nutrient use efficiency of intensive cropping and pasture systems	5,275,771	5,889,286
Carbon Farming Futures Extension and Outreach Program	—	461,320
Action on the Ground – Determining optimum nitrogen strategies for abatement of emissions for different irrigated cotton systems	—	135,000
Filling the Research Gap – Indirect emissions of nitrous oxide from broad-acre irrigated agriculture	—	49,664
Other research grant commitments	1,575,158	222,150
Total research grant commitments receivable	8,155,342	8,632,833

Accounting Policy**Research Grants**

Grant funding received from Industry, State or Commonwealth agencies is recognised when the funds are received from the grantor.

NOTES TO THE FINANCIAL STATEMENTS

1.2 Own-Source Revenue and Gains

	2017 \$	2016 \$
1.2D: OTHER REVENUE		
Project refunds	942,430	646,481
Rental income	5,000	5,000
Other revenue	10,916	20,799
Total other revenue	958,346	672,280
GAINS		
1.2E: GAINS FROM SALE OF ASSETS		
Property, plant and equipment		
Proceeds from sale	—	1,491
Total gains from sale of assets	—	1,491

Accounting Policy

Sale of Assets

Gains from disposal of assets are recognised when control of the asset has passed to the buyer.

REVENUE FROM GOVERNMENT

1.2F: REVENUE FROM GOVERNMENT

Department of Agriculture and Water Resources:

PIRD Act 1989 Contribution	6,128,948	6,053,299
Total revenue from Government	6,128,948	6,053,299
1.2G: LEVIES AND PENALTIES		
Industry Levies	6,128,948	6,053,299
Penalties	2,391	816
Total levies and penalties	6,131,339	6,054,115

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:

- 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*.
- 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

	2017 \$	2016 \$
2.1A: CASH AND CASH EQUIVALENTS		
Cash on hand or on deposit	15,071,075	9,212,257
Total cash and cash equivalents	15,071,075	9,212,257
2.1B: INVESTMENTS HELD TO MATURITY		
Term deposits	20,000,000	31,000,000
Total investments held to maturity	20,000,000	31,000,000

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	97,992	25,789
Total goods and services receivables	97,992	25,789
Government receivables		
Department of Agriculture and Water Resources		
— PIRD Act 1989 Contributions receivable	2,118,268	1,946,365
— Industry levies receivable	1,913,663	1,312,007
Total government receivables	4,031,931	3,258,372
Other receivables		
GST receivable from the Australian Taxation Office	523,719	221,530
Interest	342,411	332,019
Total other receivables	866,130	553,549
Total trade and other receivables	4,996,053	3,837,710

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.

NOTES TO THE FINANCIAL STATEMENTS

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	Intangibles ¹	Total
	\$	\$	\$	\$	\$
As at 1 July 2016					
Gross book value	190,000	520,942	190,662	436,518	1,338,122
Accumulated depreciation, amortisation and impairment		(12,976)	(110,759)	(172,446)	(296,181)
Net book value 1 July 2016	190,000	507,966	79,903	264,072	1,041,941
Additions – Purchases	—	37,618	36,591	73,182	147,391
Impairments recognised in net cost of services				—	—
Depreciation and amortisation		(14,445)	(37,895)	(136,362)	(188,702)
Disposals:					
Gross book value	—	—	—	—	—
Accumulated depreciation and impairment	—	—	—	—	—
Net book value 30 June 2017	190,000	531,139	78,599	200,892	1,000,630
Net book value as of 30 June 2017 represented by:					
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)
Total net book value as at 30 June 2017	190,000	531,139	78,599	200,892	1,000,630

1. The carrying amount of intangibles (computer software) included \$5,274 (2016 \$10,590) purchased software and \$195,618 (2016 \$253,482) internally generated software.

No indicators of impairment were found in 2017 (2016 impairment of \$68,544 for obsolete software).

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 30 June 2015, an independent valuer conducted the revaluation.

2.2B: Fair Value Measurement

	Fair Value	
	2017 \$	2016 \$
Non-financial assets		
Land	190,000	190,000
Buildings on freehold land	531,139	507,966
Other property, plant and equipment	78,599	79,903
Total non-financial assets	799,738	777,869
Total fair value measurements of assets in the statement of financial position	799,738	777,869

Accounting Policy**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.

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.

NOTES TO THE FINANCIAL STATEMENTS

Accounting Policy (cont.)

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:

	2017	2016
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 2017. 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 (2016: 3 to 5 years).

All software assets were assessed for indications of impairment as at 30 June 2017.

2.3 Payables

	2017	2016
	\$	\$

2.3A: SUPPLIERS

Trade creditors and accruals	72,638	57,995
Total suppliers	72,638	57,995

Settlement is usually made within 30 days.

2.3B: GRANTS**Grants****Public sector**

Australian Government entities	475,027	900,199
State and Territory Governments	626,752	1,079,813
Universities and Colleges	1,154,578	1,652,169
Other research organisations	154,400	182,426

Private sector

Other	575,297	805,602
Total grants	2,986,054	4,620,209

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

Superannuation	—	589
Statutory payable	55,875	65,444
State payroll tax	10,775	11,140
Total other payables	66,650	77,173

NOTES TO THE FINANCIAL STATEMENTS

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

	2017 \$	2016 \$
3.1A: EMPLOYEE PROVISIONS		
Leave	406,906	316,840
Total employee provisions	406,906	316,840

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.

Superannuation

Staff of the Corporation are members of Public Superannuation Funds, Self Managed Superannuation Funds, the Public Sector Superannuation Scheme (PSS) or the PSS accumulation plan (PSSap).

The PSS is a defined benefit scheme for the Australian Government. The PSSap is a defined contribution scheme.

The liability for defined benefits is recognised in the financial statements of the Australian Government and is settled by the Australian Government in due course. This liability is reported in the Department of Finance's administered schedules and notes.

The Corporation makes employer contributions to the employees' superannuation scheme at rates determined by an actuary, or by statute, sufficient to meet the current cost to the Government. The Corporation accounts for the contributions as if they were contributions to defined contribution plans.

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:

	2017 \$	2016 \$
Short-term employee benefits	715,483	711,328
Post-employment benefits	67,255	67,510
Other long-term employee benefits	64,427	62,391
Total key management personnel remuneration expenses	847,165	841,229

Notes: The total number of key management personnel that are included in the above table are 9 (2016: 9).

NOTES TO THE FINANCIAL STATEMENTS

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:

	2017 \$	2016 \$
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.	395,595	—
Elizabeth Alexander is a non-executive director of Plant Health Australia which received funding from CRDC for projects:		
PHA1502 "Provision of the independent technical, secretarial and operational services to the NWPPA 2014-15" for the project term of 7/7/2014 to 30/6/2015.	—	10,000
PHA1601 "Plant Health Australia Membership Subscription 2015-16" for the project term of 1/7/2015 to 30/6/2016.	—	2,000
PHA1602 "Plant Biosecurity RD&E Strategy 2015-16" for the project term of 1/7/2015 to 30/6/2016.	—	9,090
PHA1701 "Plant Health Australia Membership Subscription 2016-17" for the project term of 1/7/2016 to 30/6/2017.	2,000	—
PHA1702 "Facilitate 2016-17 Biosecurity scenario/training" for the project term of 1/7/2016 to 14/7/2017.	10,000	—
PHA1703 "Plant Biosecurity RD&E Strategy 2016-17" for the project term of 1/7/2016 to 30/6/2017.	9,090	—
Total transactions with related parties	416,685	21,090

4. Managing Uncertainties

This section analyses how the Corporation manages financial risks within its operating environment.

4.1 Financial Instruments

	2017 \$	2016 \$
4.1A: CATEGORIES OF FINANCIAL INSTRUMENTS		
Financial Assets		
Held-to-maturity investments		
Term deposits	20,000,000	31,000,000
Total held-to-maturity investments	20,000,000	31,000,000
Loans and receivables		
Cash and cash equivalents	15,071,075	9,212,257
Trade and other receivables	440,403	357,808
Total loans and receivables	15,511,478	9,570,065
Total Financial Assets	35,511,478	40,570,065
Financial Liabilities		
Financial liabilities measured at amortised cost		
Grants payable	2,986,054	4,620,209
Suppliers payable	72,638	57,995
Total financial liabilities measured at amortised cost	3,058,692	4,678,204

Accounting Policy

Financial assets

The entity classifies its financial assets in the following categories:

- a) held-to-maturity investments; and
- b) 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.

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.

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.

NOTES TO THE FINANCIAL STATEMENTS

Accounting Policy (cont.)

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).

	2017	2016
	\$	\$
4.1B: NET GAINS OR LOSSES ON FINANCIAL ASSETS		
Held-to-maturity investments		
Interest revenue	878,607	1,096,764
Net gain on held-to-maturity investments	878,607	1,096,764
Loans and receivables		
Interest revenue	199,215	185,058
Net gain from loans and receivables	199,215	185,058
Net gain from financial assets	1,077,822	1,281,822



Section 7

Appendices

**Appendix 1: Annual
Performance Statement**

**Appendix 2: Australian
Government priorities**

**Appendix 3: Environmental
performance**

Appendix 4: RD&E Portfolio

**Appendix 5: Glossary and
acronyms**

**Appendix 6: Annual
reporting requirements**

Appendix 7: Index

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. 2016-17 marked CRDC's fourth 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 and progress against the Strategic Plan programs as of 30 June 2017.

Certification by the Executive Director

I, Bruce Finney as the accountable authority of Cotton Research and Development Corporation (CRDC), present the 2016-17 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
13 October 2017

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 2016-17

Year	Performance criteria	Targets	Achievement against targets
2016-17	Farmers – cotton is profitable and consistently farmers' crop of choice. Industry productivity growth per hectare per annum.	3 per cent per hectare per annum.	Estimated achievement of 3.1 per cent average growth in yield per hectare per annum since 2013. CSIRO attributes these yield increases to management and the interaction of management and genetics (52 per cent); and genetic improvements (48 per cent). CRDC invests predominately in the areas of management and the interaction of management and genetics. Data from CRDC's monitoring and evaluation program has demonstrated a resulting increase in crop yield, resource-use efficiencies, and profitability. CRDC continued to invest in this area in 2016-17, with a focus on driving productivity growth through RD&E in resource efficiencies and innovative solutions.
	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. Developed in response to the industry's Third Environmental Assessment, the 2014 Australian Grown Cotton Sustainability Report developed and benchmarked 45 key sustainability indicators for the Australian cotton industry. Other agricultural industries have since followed cotton's lead, demonstrating an increased sustainability focus and encouraging collaboration. The cotton industry is committed to ongoing sustainability reporting, and CRDC continued to invest in this area in 2016-17, with a focus on enhancing the industry's sustainability performance reporting ability.
	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.	The Australian cotton industry receives a premium for its product – at times double the premium paid for cotton from other countries – however, competition with man-made fibres continues to exert downward pressure on the global market value for cotton. As a result, CRDC's RD&E investments in 2016-17 have supported quality assurance practices to successfully sustain premiums, while investigating novel uses for cotton and disruptions to the supply chain to make cotton more competitive with man-made fibres.

Performance information 2016-17

Year	Performance criteria	Targets	Achievement against targets
2016-17	People – capable and connected people driving the cotton industry. Implementation of the Cotton Industry Workforce 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, in support of the strategy in 2016-17, CRDC continued to fund 10 leadership and development programs, run two scholarship programs for emerging researchers, run the Grassroots Grants program to encourage local innovation, and support the Australian Cotton Conference and the Association of Australian Cotton Scientists Research Conference as a foundation sponsor. Educational attainment in cotton is commensurate with regional Australia, with 28 per cent of the population possessing post-school qualifications, up from 24 per cent in 2006.
	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, <i>myBMP</i> , with industry participation in the program now at 70 per cent. In addition, CRDC monitoring and evaluation (M&E) framework enables ongoing performance reporting. In 2016-17, 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. One such assessment, of CRDC's investment in early-planting research in Central QLD, found a benefit-cost ratio of approximately 17.1 to 1: hence \$17.10 in benefit to Central QLD growers for every \$1 invested by growers and the Government through CRDC into this RD&E.

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	Progress
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.	In progress. Understanding the ecology of cotton pests (insect, weed and pathogens) is the focus of 16 projects, including six PhDs and three post-doctoral positions. 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.
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 progress. Bollgard 3 was commercially grown across the Australian cotton industry for the first time in 2016-17. This significant achievement was a key outcome of CRDC and industry research to develop the resistance management plan (RMP). Research continues to evaluate the robustness of the plan and to evaluate key performance aspects of the technology across all cotton-growing geographies. Investment in a new Rural R&D for Profit project <i>Digital technologies for dynamic management of disease, stress and yield</i> , led by AGWA, has enabled the cotton industry to focus on developing improved management strategies for cotton diseases, with a particular focus on Verticillium wilt. One CRDC-supported innovation was commercialised in 2016-17 – Sero X – a cutting-edge biopesticide for growers that has been registered for use by Innovate Ag. The commercialisation of this product follows a 10-year study by Dr Robert Mensah of NSW Department of Primary Industries (NSW DPI), with support from the former Cotton CRC and CRDC, and significant further investment, research and product development by Innovate Ag. CRDC has developed a pipeline of innovative biopesticides for future commercialisation to change reliance on pesticide inputs.
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.	In progress. 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 totalling 3000. They consistently rank as the most preferred method of receiving R&D information among consultants.

Program 1: Farmers

Theme: Productive Resource Efficiencies

Outcome: Inputs for cotton production are optimised

Will be achieved by:	Measure of success	Progress
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 CO₂ emitted.	In progress. Two projects are specifically providing benchmarks of on-farm resource-use efficiencies regarding 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 and in the 2012-13 season, the GPWUI farm was 1.12 bales/ML. Commonwealth grants are being used to benchmark energy efficiency and greenhouse gas emissions on farms. Currently, 1.92 kg of cotton lint is produced for each unit of CO₂e, and 23.6 kg of nitrogen (N) is used to produce one 227-kg bale of cotton.
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 CO₂ emitted.	In progress. 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 <i>Smarter irrigation for profit</i> project aims to improve 3000 irrigation enterprises' profit by \$20,000 to \$40,000 per annum, through the adoption of technologies and practices to improve water-use efficiency. 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. 60–120cm); 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 CO₂ emitted.	In progress. Current irrigation projects have led to advances in the optimisation and automation of irrigation applications. 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. The development of a control system for variable rate irrigation application, and software that sequences irrigations and controls the communications between the system components, brings the industry close to smart automated furrow irrigation.

Program 1: Farmers		
Will be achieved by:	Measure of success	Progress
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 CO₂ emitted.	In progress. CRDC is supporting the enhancement of a crop carbon management tool, and the revision of the industry's nutrition management guide, NUTRIpak. The crop carbon management tool allows farmers to better understand the source and extent of nitrous oxide emissions from their cotton farm, and how to reduce them by improving their farming efficiency.
Theme: Profitable Futures		
Outcome: Innovations in cotton production		
Will be achieved by:	Measure of success	Progress
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.	In progress. The objective of the Cotton Futures profitable futures theme is to increase cotton producer profitability through improved productivity and certainty of production. Feasibility studies for some projects identified in the futures program have begun, while other advanced projects have been incorporated as part of the Australian Government's Rural R&D for Profit programme. With the support of all RDCs, the project <i>Accelerating precision agriculture to decision agriculture</i> aims to deliver legal guidance, consistent data systems and access to the foundational datasets to enable Australian farmers to capitalise on the data being generated on Australian farms. The targets for the profitable futures theme are: - Doubling input efficiency by 2029. - Reducing per hectare volatility of yield by half by 2029. - Reducing per bale volatility of quality grade by half by 2029.

Program 2: Industry

Theme: Respected Stewardship

Outcome: Industry protects its production technologies and its biosecurity

Will be achieved by:	Measure of success	Progress
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.	<i>In progress.</i> 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 programs are pre-emptive and enable industry to respond effectively and early should a change in the resistance frequency of pest population be detected. The Australian cotton industry was identified as the leading industry worldwide in its approach to Bt stewardship.
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.	<i>In progress.</i> There is a high level of awareness of the risks of trait and agricultural chemical resistance. The 2013 Cotton Grower Practices Survey found 83 per cent of growers agreed that all their insecticide-use decisions were consistent with the IRMS. Joint CRDC and GRDC research began on the development of a system to better enable growers and applicators to know when conditions are safe to apply agricultural chemicals. This research aims to minimise the likelihood of off-target movement of crop protection chemistries to reduce environmental impacts and impacts on other cropping systems. Herbicide resistance has been identified as a significant emerging issue. Investments have been made in identifying practices to reduce the risk of herbicide resistance, including development of a herbicide resistance management strategy.
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.	<i>In progress.</i> Research investment continues to support the evaluation of the effectiveness of the new RMP for third-generation transgenic cotton introduced to the market in 2016-17, and includes: ▪ Efficacy and expression characteristics of the toxins contained in Bollgard 3®. ▪ Reviewing the effectiveness of key tactics in the current RMP, <i>Helicoverpa</i> spp. ecology.

Program 2: Industry		
Will be achieved by:	Measure of success	Progress
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.	In progress. The plant biosecurity research initiative involving all of the plant-based RDCs was formed during 2016-17. This initiative will enable 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 should an incursion be detected.
Theme: Responsible Landscape Management		
Outcome: Industry leads in managing natural assets		
Will be achieved by:	Measure of success	Progress
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.	In progress. The resilience assessment of the Australian cotton industry project is assisting the cotton industry to develop a whole-of-system perspective that incorporates the economic, social and ecological dimensions of the industry, and how these interact with, influence each other and change over time. Of particular importance is how the industry copes in the face of major expected and unexpected future changes and events (or shocks) such as droughts or market fluctuations.
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.	In progress. The first Australian Grown Cotton Sustainability Report has documented the progress and status of the industry against 45 environmental indicators. The report, launched in 2014, is a significant step for the cotton industry to more proactively manage its environmental credentials, and has identified more opportunities for the industry to further enhance its standing as a world leader in sustainability.
Identifying and proving integrated management strategies which deliver environmental and productivity gains.	Recognition by national and global initiatives for biodiversity management.	In progress. Current investments will provide knowledge to use trees to value natural capital, arrest lateral saline water movement, boost the carbon footprint of cotton farms, and keep pest thresholds lower for longer. The NRM technical specialist will deliver these innovative management strategies through myBMP and the CottonInfo platforms.

Program 2: Industry		
Will be achieved by:	Measure of success	Progress
Researching the connectivity between cotton farms and natural systems in the landscape.	One million hectares of floodplain vegetation managed under best practice.	<i>In progress.</i> The current investments provide 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.	<i>In progress.</i> Science partnerships remain a work in progress as research and NRM funding programs are uncertain at a state and national level. Groundwater research in the Namoi catchment has been utilised recently for evidence-based planning recommendations.
Theme: Sustainable Futures		
Outcome: An industry achieving its vision		
Will be achieved by:	Measure of success	Progress
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.	<i>In progress.</i> The objective of the Cotton Futures sustainable futures theme is to achieve an increasingly resilient and responsible cotton industry. The targets for the sustainable theme program are: ▪ The cotton industry is an innovative, low-impact irrigator by 2029. ▪ The Australian cotton industry is carbon neutral by 2029. ▪ The Australian cotton industry is recognised as the leader in sustainable agriculture by 2029.
Supporting innovative approaches to solve traditional industry issues and drive future sustainability.	Innovations and partnerships established to drive cotton industry sustainability.	<i>In progress.</i> 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 achieve the following every five years: 1. Increase crop yields by 15 per cent. 2. Increase farm profitability by 15 per cent. 3. Increase water-use productivity by 20 per cent, and water-use efficiency by 20 per cent by 2029. 4. Reduce the carbon footprint by 15 per cent. 5. Improve biodiversity and ecosystem services by 10 per cent, including no loss of species. 6. Increase workforce diversity and capability to ensure they exceed national averages. 7. Provide a safe and desirable work environment for all workers, with zero fatalities and a 30 per cent reduction in injuries and lost worktime. 8. Improve the prosperity of rural communities.

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	Progress
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.	<i>In progress.</i> 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. CRDC and research partner CSIRO have identified a commercial partner to commercialise plans for instruments developed to measure fibre specifications that better enable spinning mills to match fibre quality to yarn specifications.
Supporting the development and implementation of post-farmgate BMPs.	Customers recognise and use Australia's BMP standards as their guarantee of quality assurance.	<i>In progress.</i> CRDC continues to support the training of cotton ginners and the investigation of how farm management and ginning practices influence fibre quality. The <i>myBMP</i> program has been recognised by the Better Cotton Initiative, enabling certified <i>myBMP</i> cotton to be sold as Better Cotton.
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.	<i>In progress.</i> Sustainability indicators 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 <i>myBMP</i> program now enables Australian growers to be accredited under the Better Cotton Initiative program, returning a premium to growers for the supply of <i>myBMP</i> -accredited cotton lint.

Program 3: Customers

Theme: Differentiated Products

Outcome: Customers recognise the differentiated value of Australian cotton products

Will be achieved by:	Measure of success	Progress
Identifying opportunities for improvements in fibre quality and cotton products.	Customers value the qualities of Australian cotton.	<i>In progress.</i> A number of research projects that aim to add functionality to cotton fabrics have been initiated. These include enhancing the moisture management properties of cotton fabrics, adding anti-microbial activity and enhancing the dyeability of cotton.
Demonstrating the value of different fibre classes and defining fibre quality parameters that secure a premium market.	New fibre classification systems established.	<i>In progress.</i> A project investigating novel spinning technologies to produce fine and high-quality yarns from Australian cotton is about to lodge a patent application for a device that improves the yarn quality of cotton, and which would enhance the ability of spinning mills to use more Australian cotton when producing high-quality, fine-count yarns. Research has demonstrated that Australian long-staple cotton is a viable replacement for a proportion of extra-long staple yarn in high-quality fabrics.
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.	<i>In progress.</i> A collaborative project with the integrated spinning mill Esquel Limited is developing novel cotton/wool fabrics. Research projects that aim to add functionality to cotton fabrics, such as enhancing the moisture management properties of cotton fabrics, adding anti-microbial activity and enhancing the dyeability of cotton, will aim to develop commercial partnerships once proof-of-concept has been established.

Theme: Competitive Futures

Outcome: The demand for Australian cotton products is positively transformed

Will be achieved by:	Measure of success	Progress
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.	<i>In progress.</i> The objective of the Cotton Futures competitive futures theme is to capture increased value through supply chain transformation and development of new products and markets. The targets for the competitive futures theme are: - 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.	<i>In progress.</i> Research has been commissioned that is investigating the potential for cotton to be an alternative raw material for the production of carbon fibre.

Program 4: People

Theme: Workforce Capacity

Outcome: A skilled educated and progressive industry workforce

Will be achieved by:	Measure of success	Progress
Investigating effective strategies for attracting, developing and retaining people in cotton.	Opportunities for workforce development are demanded by industry.	<i>In progress.</i> CRDC and Cotton Australia have 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. CRDC also has three investment projects further supporting this objective.
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.	<i>In progress.</i> CRDC currently invests in the RIRDC-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 myBMP 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.	<i>In progress.</i> CRDC supports student workplace scholarships through the Aboriginal Employment Strategy and is currently supporting the placement of an Indigenous student in the cotton industry.

Program 4: People

Theme: Workforce Capacity

Outcome: A skilled educated and progressive industry workforce

Will be achieved by:	Measure of success	Progress
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 progress. CRDC and Cotton Australia have developed the first on-farm Workforce Strategy. The development of this strategy helped Cotton Australia attract \$14.7 million toward the development of the AgSkilled program. The program administered under the NSW State Training Services Smart and Skilled program will provide key training and upskilling initiatives for the cotton and grains industries. In 2016-17, CRDC supported five CRDC Summer and Honours Scholarships, and 12 RIRDC Horizon Scholarships supporting the development of undergraduate agricultural students. CRDC also invested in eight new PhD Scholarships during the 2016-17 year, taking the total number of PhD scholars supported by CRDC to 26.
Creating opportunities for, and supporting the development of leadership skills.	Participation in leadership programs.	In progress. CRDC supported three Nuffield scholars, two participants in the Australian Rural Leadership Program, and two participants in the Peter Cullen Trust program in 2016-17.

Program 4: People

Theme: Networks

Outcome: A skilled educated and progressive industry workforce

Will be achieved by:	Measure of success	Progress
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.	In progress. CRDC provided support for the Australian Association of Cotton Scientists conference and provided nine travel scholarships for industry researchers to attend the conference 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 2016-17.
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.	In progress. 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.	In progress. CRDC supported nine travel scholarships and scientific exchanges during 2016-17 to enable growers, advisors and researchers to participate in key industry, national and international forums. Additionally, CRDC has established relations with its US counterpart (CottonInc) and the first scientific exchange under this program commenced in June 2016.
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.	In progress. CRDC supported the activities of the Cotton Australia research advisory panels, which provide advice on RD&E. 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 inform 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	Progress
Providing information for demand-driven communication strategies and performance reporting.	Communications systems for all CRDC stakeholders are meeting their communication needs.	<i>In progress.</i> CRDC invested \$1.5 million in the CottonInfo joint venture during 2016-17 to assist in the development and extension of research outcomes. Studies conducted in 2016-17 have shown that 90 per cent of growers and 98 per cent of consultants are aware of CottonInfo; 86 per cent of growers and 87 per cent of consultants source information from CottonInfo; and 86 per cent of growers and 100 per cent of consultants believe CottonInfo has helped to improve practices.
Applying innovative communication methods.	The information and services derived from CRDC investments are in demand and the technologies adopted.	<i>In progress.</i> CRDC is continuously applying innovative communication methods to communicate the outcomes of investments to the core stakeholders and target audiences. This has included an overhaul of all CRDC and CottonInfo communications.

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	Progress
Supporting a best practice framework as the primary integrated planning, risk management, benchmarking, knowledge development and delivery system.	The cotton industry's <i>myBMP</i> program is the primary resource for farmers accessing best practice knowledge and tools.	<i>In progress.</i> CRDC invests in two projects to support the achievement of this objective. Firstly, the development of a centralised information repository, Inside Cotton, for the storage of all extension materials and CRDC reports. Secondly, CRDC has invested in the review of all of the <i>myBMP</i> modules to ensure consistency within and between modules and their applicability for implementation on-farm. This has resulted in greater alignment with on-farm needs.
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 <i>myBMP</i> program is nationally recognised and integrated with other agricultural sector best management practice programs.	<i>In progress.</i> CRDC's RD&E underpins the industry's best management practices program, <i>myBMP</i> , with industry participation in the program now at 70 per cent. CRDC invests in a number of Technical Specialists within CottonInfo, who are charged with extending information to growers and updating <i>myBMP</i> modules to ensure they reflect the latest in research findings and outcomes.

Program 5: Performance

Theme: Monitoring and Evaluation

Outcome: Industry and RD&E performance is captured

Will be achieved by:	Measure of success	Progress
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 which measures and reports on the performance of CRDC's research and development investments.	In progress. 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.	In progress. CRDC invests in two projects to assess industry performance: an annual Cotton Growing Practices Survey and a survey of consultants conducted by Crop Consultants Australia. These two 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.	Achieved. 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	Progress
Undertaking scientific discipline reviews of the industry's RD&E.	Independent reviews of the CRDC's research and development performance.	Achieved. CRDC has undertaken a review of soil science in cotton. CRDC has completed a review of its leadership and capacity-building investments, nutrition and water investments, and currently has reviews underway for its sustainability investments, <i>myBMP</i> program and Bt resistance management projects.
Commissioning and participating in independent reviews of CRDC's RD&E and organisational performance.	Independent reviews of the CRDC's research and development performance.	In progress. CRDC's M&E framework enables performance monitoring of the R&D portfolio, and CRDC has participated in an external review its organisational performance during the 2016-17 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.	In progress. CRDC and Cotton Australia have developed 45 sustainability indicators to enable the industry to benchmark and monitor its performance against these indicators.
Participating in cross-sectoral RD&E impact evaluations and reviews.	Independent reviews of the social, environmental and economic performance of the industry's performance.	In progress. CRDC is working with the Council of RDCs 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 the 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 2016-17 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 2016-17
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, CRDC through discrete investments and through the Rural R&D for Profit programme has invested in eight projects to address these outcomes, including: - Digital technologies for dynamic management of disease stress and yield - New materials and options for reducing water losses from evaporation and seepage - Irrigation scheduling using canopy temperature sensing - Smart autonomous irrigation - Irrigation systems comparison - Future farm - Machine vision spot sprayer - Robotics to improve weed control.
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 other plant-based RDCs, formed the Plant Biosecurity Research Initiative. This initiative will enable the plant-based RDCs to more effectively collaborate and co-invest in biosecurity issues common to these industries, and to develop the required capacity to support biosecurity research in Australia. - The TIMS Technical Panel functions effectively to inform Resistance Management Plans for Bollgard 3® and for next-generation herbicide-tolerant traits that are finalised/underway. - The industry has achieved a 90 per cent decline in active ingredient per hectare (ai/ha) insecticide use. - The latest CRDC-supported Crop Consultants Australia (CCA) survey has found that: 91 per cent of spray recommendations consider impact on bees 17 per cent of growers' cotton crops were significantly affected by spray drift 87 per cent of farm advisors aim to conserve beneficial insects wherever possible 84 per cent of spray recommendations are based on established industry thresholds 79 per cent of farm advisors follow the insect resistance management strategy - glyphosate resistance affects 34 per cent of irrigated cotton hectares and 38 per cent of dryland cotton hectares.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2016-17
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: - Yields increased by 2.5 per cent per annum between 1990 and 2015. In 2013-2016, this is estimated to be an increase of 3.2 per cent - Nitrogen Fertiliser-Use Efficiency (NFUE) is 23.6 kg N/bale - Gross production water-use efficiency (GPWUE) is 1.12 bales/ML 1.92 kg cotton lint is produced per unit of CO₂e. - CRDC is investing in research to provide knowledge to use trees to value natural capital, arrest lateral saline water movement, boost the carbon footprint of cotton farms, keep pest thresholds lower for longer and develop adaptive farming systems that are able to with stand abiotic stresses.
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	- The CottonInfo joint venture is delivering extension to growers and industry, resulting in adoption and practice change. In 2016-17, CottonInfo engaged with growers, consultants and the wider industry at 145 events, with 2300 cotton industry personnel in attendance: 1200 growers and farm workers; 400 consultants; 300 agribusiness personnel; and 400 representing the wider industry, including supply chain, government, and natural resource management bodies. - 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. 70 per cent of growers estimated to now be participating in myBMP. - Three new CottonInfo Technical Specialists were appointed in 2016-17, in the areas of irrigation, nutrition and weed management. 327 growers and consultants attended CRDC, CottonInfo and ICAN regional weed management workshops about the impact of increasing levels of glyphosate resistance, and the strategies to delay or manage its onset. 100 per cent of those who provided feedback said the information learned would help with decisions in the field. 130 growers and consultants attended a series of Integrated Pest Management (IPM) workshops across five valleys. 75 per cent of participants reported higher levels of confidence about growing high-yielding crops using IPM after the workshop. 93 per cent of participants in the 2016 Smarter Irrigation Technology Tour said they would do something differently on their farm as a result of the tour. - Support for ongoing R&D cross-sector partnerships addressing climate change, natural resource management, irrigation and biodiversity, and encouraging the development of new scientists in these areas.

Science and Research Priorities per CRDC RD&E program 2016-17 (\$'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	6,778	5,535	—	—	—	565	—	394	27	13,299
Program 2: Industry	1,667	360	—	—	—	263	—	865	—	3,155
Program 3: Customers	1,188	136	—	—	—	—	381	—	—	1,705
Program 4: People	1,289	112	—	—	—	—	—	—	25	1,426
Program 5: Performance	730	3	—	—	—	—	—	—	—	733
TOTAL*	11,652	6,146	—	—	—	828	381	1,259	52	20,318

* Excludes budgeted employee and supplier expenditure, contingency provisions for research 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 2016-17 (\$'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	4,082	3,183	4,822	1,212	13,299
Program 2: Industry	535	1,571	930	119	3,155
Program 3: Customers	1,197	97	282	129	1,705
Program 4: People	189	75	183	979	1,426
Program 5: Performance	1	79	101	552	733
TOTAL*	6,004	5,005	6,318	2,991	20,318

* Excludes budgeted employee and supplier expenditure, contingency provisions for research 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

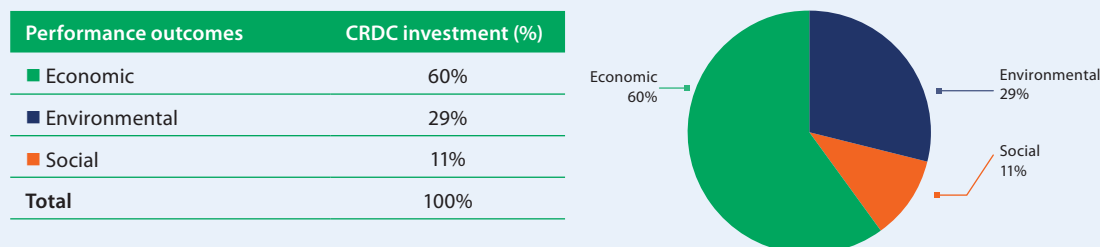
CRDC has integrated the principles of ecologically sustainable development under section 516A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) into its planning framework. As such, each of the measures of success within the CRDC program areas (outlined in the Strategic Plan) consider triple bottom line outputs.

In line with this, the Annual Operational Plan 2016-17 was designed to ensure RD&E investments provide measurable environmental, economic 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. This information is analysed by CRDC and provides valuable guidance for researchers for future RD&E directions.

CRDC RD&E investments across economic, environmental and social performance outcomes 2016-17



CRDC program contributions to economic, environmental and social outcomes 2016-17

Contributions	Economic	Environmental	Social	Total
CRDC programs	Investment total	Investment total	Investment total	Investment total
Program 1: Farmers	\$8,881,494	\$3,758,410	\$656,795	\$13,296,698
Program 2: Industry	\$1,443,098	\$1,259,685	\$452,878	\$3,155,662
Program 3: Customers	\$1,288,533	\$406,282	\$9,699	\$1,704,514
Program 4: People	\$256,076	\$119,834	\$1,050,547	\$1,426,457
Program 5: Performance	\$291,611	\$310,142	\$132,880	\$734,632
Total	\$12,160,811	\$5,854,353	\$2,302,799	\$20,317,963
Percentage	60%	29%	11%	100%

* Excludes budgeted employee and supplier expenditure, contingency provisions for research 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					
2016-17 Pest management workshops	CRDA1706	CottonInfo	Warwick Waters	18/10/16	1/12/16
2016-17 Silverleaf Whitefly review	CRDA1709	CSIRO	Lewis Wilson	7/12/16	7/12/16
A predictive diagnostic test for black root rot in cotton soils	CRDC1624	Microbiology Laboratories Australia	Maria Manjarrez	30/04/16	31/10/16
Best practice management for weeds and herbicide resistance across farming systems	CRDC1722	Andreas Betzner	Andreas Betzner	14/11/16	31/01/18
Biology of <i>Amaranthus hybridus</i> , <i>A. mitchellii</i> , and <i>A. powellii</i> : emerging weeds of cotton systems	UQ1703	UQ	Asad Khan	1/01/17	31/12/19
Black root rot diagnostics	CRDA1707	CottonInfo	Warwick Waters	10/11/16	10/04/17
Capital item: Autoclave (ACRI Cotton Pathology Laboratory)	DAN1704	NSW DPI	Rod Jackson	1/03/17	30/09/17
Centre for Biopesticides & Semiochemicals: Development of new tools & strategies for IPM	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	30/06/18
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 machine vision weed spot sprayer	NEC1402	NCEA	Steven Rees	1/07/13	30/03/18
Crop protection development specialist (CottonInfo Technical Specialist and myBMP module lead)	DAQ1502	QDAF	Sharna Holman	1/07/14	30/06/17
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 (IPM) in cotton systems	CSP1401	CSIRO	Lewis Wilson	1/07/13	30/06/18
Establishing southern cotton – IPM	DAN1501	NSW DPI	Sandra McDougall	1/07/14	15/11/17
Hard-to-control weeds in northern farming systems – understanding key processes to improve control methods (CottonInfo Technical Specialist and myBMP module lead)	DAN1402	NSW DPI	Eric Koetz	1/07/13	30/06/17
Herbicide spray management workshop	CRDA1705	CottonInfo	Warwick Waters	21/09/16	21/09/16
Herbicide technical panel meeting	CRDA1708	CRDC	Susan Maas	31/1/17	1/2/17
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
Management of Solenopsis mealybug in Bollgard® cotton	DAQ1501	QDAF	Richard Sequeira	1/07/14	30/06/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Management options enhancing beneficial microbial functions in cotton soils	CSE1401	CSIRO	Gupta Vadakattu	1/07/13	30/08/16
Managing Verticillium risk for cotton	RRDP1723	NSW DPI	Karen Kirkby	1/07/16	30/06/19
Mealybug workshop	CSD1703	CSD	Janelle Montgomery	23/03/17	23/03/17
Northern Australia cotton development & coordination leader	CSP1602	CSIRO	Stephen Yeates	1/10/15	30/06/18
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	30/06/18
PhD: Host plant relationships of green mirids – is alternative control possible?	UQ1402	UQ	Justin Cappadonna	18/11/13	18/05/17
PhD: Multiple host use and gene-flow in green vegetable bug relative to cotton crop	UQ1403	UQ	Dean Brookes	1/03/13	1/04/17
PhD: Quantifying and mapping the impacts of herbicide drift on cotton (non-target crop)	USQ1404	USQ	Luz Angelica Suarez Cadavid	25/11/13	30/06/17
PhD: Understanding the ecology of reniform nematodes in cotton	UNE1703	UNE	Bernard Walker	1/01/17	31/12/20
Regional weed management workshops for growers and advisors	CRDC1621	ICAN	John Cameron	1/03/16	30/09/17
Review of technologies that can be enabled by robotics to improve weed control in Australian cotton farming systems	CRDC1615	SwarmFarm Robotics	Andrew Bate	26/10/15	30/07/16
Staying ahead of weed evolution in changing cotton systems	UQ1501	UQ	Jeff Werth and Bhagirath Chauhan	1/07/14	30/06/19
Travel: Attending the 49th Annual Society for Invertebrate Pathology Conference	QUT1604	QUT	Christopher Nouné	1/05/16	31/07/16
Verticillium wilt assessment using drones	CRDC1729	WA Aerial Mapping	Jerome Leray	30/01/17	30/06/17
Viruses, vectors and endosymbionts: Exploring interactions for control	UQ1305	UQ	Daisy Stainton	1/04/13	31/08/17
FARMERS: Productive Resource Efficiencies					
ACRI field 6 (Rochester trial site) maintenance	CSP1705	CSIRO	Michael Bange	1/07/16	30/06/17
Agronomy for resilient future cotton systems	CSP1601	CSIRO	Michael Bange	1/07/15	30/06/18
Benchmarking water-use efficiency and crop productivity in the Australian cotton industry (CottonInfo Technical Specialist and myBMP module lead)	DAN1505	NSW DPI	Ali McCarthy	1/07/14	30/06/19
BestWeather climate consultancy	CRDC1736	BestWeather	Matt Davey	21/03/17	31/03/18
Canopy temperature monitoring IP review	CRDC1714	Davies Collison Cave		25/8/16	30/8/16
Capital item: Drive on load cells	DAQ1604	QDAF	Paul Grundy	1/06/16	31/08/16
Capital Item: Precision planter	DAN1706	NSW DPI	John Smith	14/06/17	14/06/18
Capital item: Southern connected systems trial picker	DAN1603	NSW DPI	John Smith	8/04/16	30/06/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Carbon farming in the Australian cotton industry (CottonInfo Technical Specialist and myBMP module lead)	CFEO1401	CSD	Jon Welsh	1/07/13	30/06/17
Carbon farming in the Australian cotton industry: Climate tool – website development, maintenance & site hosting fees	CFEO1710	Keo Design	Mark Hetherington	18/04/17	30/04/17
Carbon farming in the Australian cotton industry: Data input	CFEO1702	Warrenbri Farming Partnership	Sally Knight	1/07/16	12/07/16
Carbon farming in the Australian cotton industry: Economic assessment of implementing potential mitigation/ sequestration options in cotton	CFEO1603	Janine Powell	Janine Powell	1/05/16	31/03/17
Carbon farming in the Australian cotton industry: Energy efficiency information sessions	CFEO1704	Phillip Szabo	Phillip Szabo	24/11/16	15/12/16
Carbon farming in the Australian cotton industry: Extension & outreach project placement	CFEO1601	CSIRO	Trudy Staines	11/12/15	3/02/16
Carbon farming in the Australian cotton industry: Grant communications support	CFEO1501	Seedbed Media Pty Ltd	Rachel Bowman	28/10/14	10/01/17
Carbon farming in the Australian cotton industry: Impact assessment	CFEO1703	Coutts J&R	Jeff Coutts	10/11/16	15/02/17
Carbon farming in the Australian cotton industry: Monitoring and evaluation support system	CFEO1705	Coutts J&R	Jeff Coutts	1/07/16	30/06/17
Carbon farming in the Australian cotton industry: N trial booklet	CFEO1711	Black Canvas Pty Ltd	Lindsey Brightwell	28/04/17	26/05/17
Carbon farming in the Australian cotton industry: Nitrogen fact sheets	CFEO1709	David Hall	David Hall	12/04/17	26/04/17
Carbon farming in the Australian cotton industry: Nitrogen-use efficiency trials and extension 2016	CFEO1701	Back Paddock Pty Ltd	Chris Dowling	15/07/16	30/09/16
Carbon farming in the Australian cotton industry: NRM and soil carbon workshops	CFEO1707	CSD	Jon Welsh	17/02/17	4/03/17
Carbon farming in the Australian cotton industry: NUTRIpak design	CFEO1712	Black Canvas Pty Ltd	Lindsey Brightwell	28/04/17	26/05/17
Carbon farming in the Australian cotton industry: Present at NRM and soil carbon workshops	CFEO1708	UNE	Rhiannon Smith	17/02/17	20/02/17
Carbon farming in the Australian cotton industry: Soil nitrogen status – Namoi	CFEO1706	Back Paddock Pty Ltd	Chris Dowling	21/12/16	11/01/17
Consolidating targeted and practical extension services for Australian Farmers and Fishers	RIRDC1604	RIRDC	Jamie Allnutt	1/07/15	31/12/16
Determining optimum nitrogen strategies for abatement of emissions for different irrigated cotton systems	AOTG1401	NSW DPI	Steve Kimber	1/07/13	30/06/17
Development of revolutionary float actuated, fully automatic, flow-regulating valves	CRDC1514	Cocky Valves	Peter Cocciardi	1/07/14	31/05/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Improved use of seasonal forecasting to increase farmer profitability	RIRDC1603	RIRDC	Michael Beer	1/07/15	30/06/18
Improving cotton productivity with crop nutrition	CSP1403	CSIRO	Michael Bange	1/07/13	30/09/16
Increasing profitability through improved nitrogen-use efficiency (NUE) and reducing gaseous losses of nitrogen (N)	AOTG1601	QUT	Peter Grace	1/07/15	30/06/18
International student exchange: Texas A&M Bt susceptibility influenced by diet	CLW1602	CSIRO	Ashley Tessnow	10/06/16	31/08/16
Mitigating and managing soil compaction for sustainable cotton production	CSP1701	CSIRO	Michael Braunack	1/07/16	30/06/17
Monitoring greenhouse gas emissions from irrigated cropping systems	CLW1401	CSIRO	Ben Macdonald	1/07/13	30/06/17
More Profit from Nitrogen: Enhancing nutrient-use efficiency in cotton	RRDP1712	NSW DPI	Graeme Schwenke	1/07/16	30/04/20
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	31/05/19
More Profit from Nitrogen: Improving dairy farm nitrogen efficiency using advanced technologies	RRDP1715	UMELB	Helen Suter	1/07/16	30/06/19
More Profit from Nitrogen: Increasing nitrogen-use efficiency in dairy pastures	RRDP1714	QUT	David Rowlings	1/07/16	31/05/19
More Profit from Nitrogen: New technologies and managements: transforming nitrogen-use efficiency in cane production	RRDP1719	QDAF	Matt Redding	1/09/16	1/02/21
More Profit from Nitrogen: Optimising nitrogen and water interactions in cotton	RRDP1713	NCEA	Alice Melland	1/07/16	30/06/18
More Profit from Nitrogen: Optimising nutrient management for improved productivity and fruit quality in cherries	RRDP1721	UTAS	Nigel Swarts	1/08/16	30/04/20
More Profit from Nitrogen: Optimising nutrient management for improved productivity and fruit quality in mangoes	RRDP1720	NTDPIR	Mila Bristow	1/08/16	30/04/20
More Profit from Nitrogen: Program Management Agreement meetings	RRDP1722	CRDC	Allan Williams	1/07/16	30/06/20
More Profit from Nitrogen: Project communications	RRDP1735	CRDC	Allan Williams	1/07/16	30/04/20
More Profit from Nitrogen: Project monitoring and evaluation	RRDP1736			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

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
New materials and options for reducing water losses from evaporation and seepage	NEO1701	NeoTop Water Systems	Andrew Hamilton	1/07/16	30/06/18
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: Next-generation fertilisers for nutrient stewardship in cotton production	UQ1702	UQ	Rhys Pirie	15/1/17	15/1/20
PhD: Self-guided drones for tracking irrigation in a cotton field	USQ1402	USQ	Derek Long	1/03/14	1/03/17
PhD: Soil-specific strategic irrigation – identifying saline-sodic water as a resource	NEC1403	NCEA	Aaditi Dang	3/03/14	3/03/17
PhD: The impact of irrigation methods and management strategies on nitrogen fertiliser recovery in cotton (CottonInfo Technical Specialist and myBMP module lead)	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	1/01/16	31/03/18
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
Resilient cotton-farming systems in irrigated vertosols: soil quality, carbon and nutrient losses, cotton growth & yield in long-term studies	DAN1503	NSW DPI	Guna Nachimuthu	1/07/14	30/06/17
Season benchmarking with canopy temperature sensors	CSD1701	CottonInfo	Amanda Thomas	1/12/16	1/12/17
Smarter Irrigation for Profit: 2016 Irrigation Automation Tour	RRDP1710	NSW DPI	Janelle Montgomery	30/11/16	3/12/16
Smarter Irrigation for Profit: 2017 IREC cross-sectoral Northern Tour	RRDP1728	IREC	Iva Quarisa	7/02/17	9/02/17
Smarter Irrigation for Profit: Dairy and cotton tours	RRDP1729	RRR	Guy Roth	8/02/17	8/02/17
Smarter Irrigation for Profit: Develop precise and automated control systems for a range of irrigation systems	RRDP1603	NCEA	Joseph Foley	1/07/15	30/04/18
Smarter Irrigation for Profit: Educating growers in innovative on-farm water management and scheduling practices	RRDP1734	SRA	Andres Jaramillo	1/07/15	30/04/18
Smarter Irrigation for Profit: Evaluation of scheduling tools for the sugar industry	RRDP1609	SRA	Andres Jaramillo	31/05/16	30/04/18
Smarter Irrigation for Profit: Grower-led cotton automation integration trial	RRDP1730	GVIA	Louise Gall	15/04/17	30/04/18
Smarter Irrigation for Profit: Grower-led irrigation system comparison in the Gwydir Valley	RRDP1606	GVIA	Louise Gall	1/07/15	30/04/18
Smarter Irrigation for Profit: Increasing farm profit through efficient use of irrigation for dairy farms	RRDP1604	UTAS	James Hills	1/07/15	30/04/18

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Smarter Irrigation for Profit: Integrated irrigation for dairy	RRDP1732	DA	Monique White	1/03/17	30/04/18
Smarter Irrigation for Profit: Irrigation agronomy for tailored and responsive management with limited water	RRDP1602	CSIRO	Hizbullah Jamali	1/07/15	30/04/18
Smarter Irrigation for Profit: Maximising on-farm irrigation profitability – southern connected systems	RRDP1605	NSW DPI	Peter Regan	1/07/15	30/04/18
Smarter Irrigation for Profit: NCEA technical support for technology integration & scheduling projects	RRDP1731	USQ	Joseph Foley	1/03/17	30/04/18
Smarter Irrigation for Profit: Optimised dairy irrigation farms	RRDP1607	DA	Monique White	1/07/15	30/04/18
Smarter Irrigation for Profit: Project Leadership and Coordination	RRDP1501	RRR	Guy Roth	1/07/15	30/05/18
Smarter Irrigation for Profit: Scheduling technology matrix	RRDP1733	ICD Project Services	Marguerite White	1/05/17	28/02/18
Smarter Irrigation for Profit: When and how much	RRDP1601	DEDJTR	Mike Morris	1/07/15	30/04/18
Soil constraint workshop	CRDA1607	CottonInfo	Alice Devlin	1/06/16	31/07/16
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	31/01/19
SOILpak and NUTRIpak review	CRDC1628	Soil Management Designs	David McKenzie	1/06/16	31/07/16
Southern research update	CRDA1704	CottonInfo	Warwick Waters	8/9/16	8/9/16
Strengthening the Central Highlands cotton production system	DAQ1401	QDAF	Paul Grundy	1/07/13	30/06/17
Travel: 18th Australian Cotton Conference, 2016 – Dr Walter Baethgen, Climate Risk Management Presentation	CRDC1629	CottonInfo	Jon Welsh	6/06/16	8/08/16
Travel: Attend Agriculture and Climate Change Conference 2017	CSP1707	CSIRO	Katie Broughton	20/01/17	3/04/17
Travel: Attend Australian Energy Storage Conference	CSD1702	CSD	Jon Welsh	24/03/17	15/06/17
Travel: Attend Australia and New Zealand Soil Society Conference	UNE1702	UNE	Yui Osanai	10/12/16	16/12/16

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
FARMERS: Profitable Futures					
Agri-intelligence in cotton production systems: Stage 1	QUT1701	QUT	Tristan Perez	1/01/17	31/12/18
Future Farm: Intelligent decisions – Improving farmer confidence in targeted N management	GRDC1601	GRDC		1/02/16	30/06/17
PhD: A national regulatory framework governing big data in primary production	UNE1606	UNE	Gina Wood	1/02/16	28/02/19
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	30/08/18
Precision to Decision Agriculture: Agribusiness Linkage	RRDP1702	AFI	Richard Heath	1/07/16	28/02/18
Precision to Decision Agriculture: 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 Agriculture: Data communications	RRDP1703	UNE	David Lamb	1/07/16	30/12/17
Precision to Decision Agriculture: Data rules	RRDP1704	Griffith	Leanne Wiseman	1/07/16	30/12/17
Precision to Decision Agriculture: Data rules II	RRDP1706	USC	Jay Sanderson	1/07/16	30/12/17
Precision to Decision Agriculture: Data sources	RRDP1707	CSIRO	Simon Barry	1/07/16	30/12/17
Precision to Decision Agriculture: Data systems	RRDP1705	D2D CRC	Brenton Cooper	1/07/16	30/12/17
Precision to Decision Agriculture: Producer survey to identify P2D needs and issues	RRDP1725	CSIRO	Emma Jakku	15/12/16	31/07/17
Precision to Decision Agriculture: Project leadership and coordination	RRDP1701	Rainbow & Associates Pty Ltd	Rohan Rainbow	1/07/16	28/02/18
Precision to Decision Agriculture: Project Management Agreement, Project Management Committee, agribusiness forums & regional workshops	RRDP1708	CRDC	Rohan Rainbow	1/07/16	28/02/18
Precision to Decision Agriculture: Regional workshops facilitation	RRDP1709	Speigare Pty Ltd	Cameron Begley	17/10/16	31/05/17
OUTCOME 1: FARMERS PROGRAM TOTAL: \$13,296,698					

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 2: INDUSTRY: Respected Stewardship					
2016-17 Biosecurity scenario/training	CRDA1711	CRDC	Susan Maas	3/04/17	14/07/17
Conventional insecticide resistance in <i>Helicoverpa</i> – monitoring, management and novel mitigation strategies in Bollgard 3®	DAN1506	NSW DPI	Lisa Bird	1/07/14	30/06/19
Cotton Map 2016-17	CA1701	CA	Nicola Cottee	1/07/16	30/06/17
Development of a spray drift hazard prediction system	MRES1701	MRES	Graeme Tepper	1/07/16	30/06/19
<i>Helicoverpa punctigera</i> in inland Australia: what has changed?	UNE1502	UNE	Peter Gregg	1/07/14	31/12/17
Investigating the risk of mycotoxin contamination in Australian cotton production systems	DAN1406	NSW DPI	Kathy Schneebeli	1/01/14	31/12/16
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 (SLW) insecticide resistance	DAQ1701	QDAF	Jamie Hopkinson	1/07/16	30/06/19
National residue survey for cotton	CA1705	CA	Nicola Cottee	9/02/17	9/02/19
PhD: Evolution of viral diversity and virus ecology in the management of resistance to biopesticides	QUT1402	QUT	Christopher Nouné	12/01/14	30/06/17
Plant Biosecurity RD&E Strategy 2015-16	PHA1602	PHA	Rodney Turner	30/05/16	30/05/17
Plant Biosecurity RD&E Strategy 2016-17	PHA1703	PHA	Rodney Turner	1/06/17	1/06/18
Provision of the independent technical, secretarial and operational services to the National Working Party of Pesticide Application (NWPPA)	PHA1502	PHA	Nicholas Woods	20/07/14	30/06/17
Resistance research and monitoring to enhance stewardship of Bt cotton and management of <i>Helicoverpa</i> spp.	CSE1701	CSIRO	Sharon Downes	1/07/16	30/06/19
Southern IPM review and REFCOM	CRDA1710	CRDC	Susan Maas	21/3/17	22/3/17
Sponsorship: Science Protecting Plant Health Conference 2017	CRDC1738	QAAFI	Jenny Lawler	3/04/17	28/09/17
Stewardship of biotechnologies and crop protection (CottonInfo Technical Specialist and myBMP module lead)	SC1601	Ceeney Agricultural Consultants	Sally Ceeney	1/07/15	30/06/18
Surveillance and studies for endemic and exotic virus diseases of cotton	DAQ1601	QDAF	Murray Sharman	1/07/15	30/06/19
Sustainability stakeholder reference forum	CRDC1715	Step Communications	Brooke Summers	1/7/16	30/9/16
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
Travel: Facilitate 2016-17 Biosecurity scenario/training	PHA1702	PHA	Stephen Dibley	3/04/17	14/07/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Travel: 2016-17 Biosecurity scenario/training	CA1707	CA	Nicola Cottee	22/05/17	14/07/17
Travel: Attend and Present at REFCOM Meeting	CSE1702	CSIRO	Geoff Baker	31/7/16	1/8/16
Travel: Facilitate Southern IPM Review and REFCOM	CRDC1734	Michael Williams & Assoc	Michael Williams	21/3/17	22/3/17
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 CSG Developments	UNSW1601	UNSW	Bryce Kelly and Charlotte Iverach	1/07/15	30/06/18
Cotton NRM Technical Specialist (CottonInfo Technical Specialist and myBMP module lead)	CRDC1501	Stacey Vogel Consulting	Stacey Vogel	1/07/14	30/06/17
Cotton Rivercare Champion	CRDC1602	Capricorn North Pty Ltd	Mark Palfreyman	1/09/15	30/06/18
Developing the groundwater health index (GHI) as an industry-wide monitoring tool	MQ1501	Macquarie	Grant Hose	1/07/14	31/12/17
Fauna survey and wildlife workshop field day	CRDC1725	Phil Spark	Phil Spark	18/10/16	22/10/16
Improving the ability of the Australian cotton industry to report its sustainability performance	QUT1705	QUT	Erin Peterson	1/10/16	30/09/19
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
National Facility for Cotton Climate Change Research	CSP1402	CSIRO	Michael Bange	1/07/13	31/12/16
PhD: Effects of climatic fluctuation and land use change on soil condition in the Lower Lachlan	US1403	USYD	Patrick Filippi	3/03/14	2/09/17
PhD: Spatial & temporal importance of diffuse & stream recharge in semiarid environments: Implications for integrated water management	UNSW1403	UNSW	Calvin Li	1/03/14	28/02/17
PhD: Sustainable water extractions: Low flow regia and critical flow thresholds	UNE1406	UNE	Marita Pearson	1/01/14	30/12/19
Resilience assessment of the Australian cotton industry at multiple scales	CRDC1502	Bel Tempo	Francesca Andreoni	1/07/14	31/01/17
Resilience assessment of the Australian cotton industry at multiple scales: graphic design	CRDA1702	GD Studio	Dougall Binns	1/7/16	6/9/16
The impact of improved water-use efficiency on paddock and catchment health	DNRM1401	DNRM	Mark Silburn	1/07/13	30/04/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
INDUSTRY: Sustainable Futures					
Bio-degradation of dyed cotton fabrics	NCSU1701	NCSU	Nelson Vinueza	1/01/16	31/12/17
Capital Item: GenesisERT hydro turbine	QUT1704	QUT	Stephen Hughes	1/09/16	30/08/17
Capital Item: Redflow 8 kWh battery	QUT1703	QUT	Stephen Hughes	1/09/16	30/08/17
Cross RDC meeting: Life cycle assessment and water use in agriculture	CRDA1712	CRDC	Allan Williams	3/03/17	3/03/17
Development of automatic siphons for cotton irrigation and use of hydro to recover energy from storage dams	QUT1702	QUT	Stephen Hughes	1/09/16	30/08/17
Microparticles generated from laundering of cotton and other fabrics	NCSU1702	NCSU	Richard Venditti	1/01/17	31/12/17
OUTCOME 2: INDUSTRY PROGRAM TOTAL: \$3,155,662					

PROGRAM 3: CUSTOMERS: Assured Cotton					
Determining the shelf life of round modules and impact on cotton quality	CMSE1501	CSIRO	Menghe Miao	1/07/14	30/11/16
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
Raising the quality of Australian cotton through post-harvest initiatives (CottonInfo Technical Specialist and myBMP module lead)	CMSE1503	CSIRO	Rene Van der Sluijs	1/07/14	30/06/17
Sustainable Apparel Coalition Membership 2015 and 2016	CRDC1608	SAC	Scott Miller	18/08/15	31/07/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
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	31/12/17
Breathable cotton for compression athletic wear	DU1601	Deakin	Maryam Naebe	1/07/15	30/12/17
Improved thermal management performance of bedding systems	RMIT1701	RMIT	Olga Troynikov	1/1/17	31/12/17
Literature review: the impact of the use phase of cotton (and wool) textiles	CRDC1721	Beverley Henry	Beverley Henry	18/10/16	15/2/17
Measuring and managing fibre elongation for the Australian cotton industry	CMSE1504	CSIRO	Shouren Yang	1/07/14	31/12/16
Novel anti-wetting & self-sterilising cotton fabrics	DU1501	Deakin	Xin Liu and Yun Zhau	1/07/14	30/09/17
Novel spinning technologies for fine and high-quality Australian cotton yarns	DU1502	Deakin	Xungai Wang	1/07/14	30/06/17
PhD: Effects of cotton cellulose structure and interactions on dye uptake	CMSE1308	CSIRO	Genevieve Crowle	1/07/12	31/12/16
PhD: High-value bio-extractives and bioethanol from cotton gin trash	DAN1504	NSW DPI	Mary Egbuta	1/07/14	31/08/17
PhD: Improving length, strength and fineness of cotton fibre	DU1401	Deakin	Rechana Remadevi	1/07/13	31/12/16
PhD: Low-wax Australian cotton – reducing the scouring requirements of cotton fabric	CMSE1403	CSIRO	Katherine Birrer	1/04/14	30/09/17
Smart cotton/carbon fabrics for electromagnetic interference shielding	DU1602	Deakin	Jin Zhang	1/07/15	30/06/18
CUSTOMERS: Competitive Futures					
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	01/04/19
Identifying technical benefits in producing regenerated cellulose fibres from cotton for carbon fibre production	DU1702	Deakin	Nolene Byrne	1/10/16	13/01/17
Exploring nanofibrous coating on cotton fabric with versatile protection and dynamic comfort	RMIT1702	RMIT	Olga Gavrilenko	1/02/17	31/01/20
OUTCOME 3: CUSTOMERS PROGRAM TOTAL: \$1,704,514					

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 4: PEOPLE: Workforce Capacity					
AES & PIHSP program lead, final report summaries	CRDC1723	Warrenbri Farming Partnership	Sally Knight	21/11/16	30/06/17
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
Co-Investment in PIEFA membership for the cotton industry 2016-17 & 2017-18	CA1706	CA	Adam Kay	1/07/16	30/06/18
Cotton Young Farming Champions program 2017	CRDC1728	Art4Agriculture	Lynne Strong	1/12/16	30/01/19
CottonInfo human resources workshop	CRDA1703	CottonInfo	Warwick Waters	31/8/16	31/8/16
Developing education capacity for the Australian cotton industry	CSE1602	CSIRO	Trudy Staines	1/07/15	30/06/18
Effects of application uniformity change on energy requirement for Australian lateral move irrigation machines	USQ1701	USQ	Benton Munro	30/11/16	12/10/17
Grower RD&E advisory panels: Capacity building	CA1702	CA	Nicola Cottee	1/07/16	30/06/17
Horizon Scholarship: Alana Martin	RIRDC1404	RIRDC	Alana Martin	31/03/14	31/12/16
Horizon Scholarship: Camilla a'Beckett	RIRDC1504	RIRDC	Camilla a'Beckett	31/03/15	31/12/17
Horizon Scholarship: Emily Miller	RIRDC1306	RIRDC	Emily Miller	30/04/13	31/12/16
Horizon Scholarship: Felicity Taylor	RIRDC1401	RIRDC	Felicity Taylor	31/03/14	31/12/17
Horizon Scholarship: Grace Scott	RIRDC1402	RIRDC	Grace Scott	31/03/14	31/12/16
Horizon Scholarship: Holly Chandler	RIRDC1702	RIRDC	Holly Chandler	1/07/16	30/06/19
Horizon Scholarship: Jessica Kirkpatrick	RIRDC1302	RIRDC	Jessica Kirkpatrick	30/04/13	31/12/16
Horizon Scholarship: Michael Wellington	RIRDC1405	RIRDC	Michael Wellington	31/03/14	31/12/17
Horizon Scholarship: Paul Sanderson	RIRDC1304	RIRDC	Paul Sanderson	30/04/13	31/12/16
Horizon Scholarship: Sam Johnston	RIRDC1403	RIRDC	Sam Johnston	31/03/14	31/12/17
Horizon Scholarship: Sam Knight	RIRDC1602	RIRDC	Sam Knight	1/07/15	31/12/19
Horizon Scholarship: Scott Nevison	RIRDC1503	RIRDC	Scott Nevison	31/03/15	31/12/18
Longitudinal Evaluation Study: Australian Rural Leadership Program	RIR1602	ARLF	Matt Linnegar	1/06/16	30/03/17
Nuffield Scholarship: Matthew McVeigh	CRDC1413	Nuffield	Matthew McVeigh	1/06/14	30/09/16
Nuffield Scholarship: Daniel Kahl	CRDC1711	Nuffield	Daniel Kahl	1/07/16	30/09/18
Nuffield Scholarship: Thomas Quigley	CRDC1516	Nuffield	Thomas Quigley	1/10/14	30/09/16
People in Agriculture: employment starter kit (ESKi) website	DA1502	DA	Shane Hellwege	1/07/14	30/06/17
Peter Cullen Trust Science to Policy Leadership Program: Tim Napier	PCT1702	PCT	Tim Napier	12/09/16	17/11/16
Peter Cullen Trust Science to Policy Leadership Program: Zara Lowien	PCT1701	PCT	Zara Lowien	12/09/16	17/11/16

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PhD: Career motivational factors of cotton growers' attraction to and retention in the cotton industry	USQ1401	USQ	Geraldine Wunsch	1/07/13	30/06/17
PhD: Human capacity needs and management on cotton farms	UNE1402	UNE	Will Winter	1/07/13	29/08/17
PhD: Investigating cotton farm workers' experiences of job satisfaction using social cognitive career theory	USQ1403	USQ	Nicole McDonald	28/01/14	19/05/17
Scholarship: Explore leadership development capacity	CRDC1614	FRDC	Eric Perez	1/09/15	1/12/16
Science & Innovation Award 2016: Yvonne Chang	ABA1501	ABARES	Yvonne Change	1/07/14	30/06/17
Science & Innovation Awards 2017: Priscilla Johnston	ABA1701	ABARES	Priscilla Johnston	1/07/16	30/06/18
Sponsorship of AES Student 2016	AES1601	Merced Farming	Montana Jones	4/02/16	1/12/17
Sponsorship of AES students	CRDC1613	AES	Natalie Tighe	1/12/14	30/11/16
Sponsorship of Narrabri High School: 2017 FIRST Robotics Competition	CRDC1737	Narrabri High School	Dinos Charalambous	28/02/17	30/06/17
Sponsorship of Wee Waa High School: 2017 FIRST Robotics Competition	CRDC1718	Wee Waa High School	Annabelle Doust	24/9/16	30/6/17
Sponsorship: Diploma in Human Resources	CRDC1726	Back Paddock Consulting	Bec Fing	1/12/16	30/12/16
Sponsorship: GrowAg Summit 2016	RIRDC1703	RIRDC	Jennifer Medway	21/09/16	23/09/16
Summer/Honours Scholarship: Determining emission factors for cotton residue-induced N ₂ O emissions using 15N isotope tracers	QUT1603	QUT	Stephen Leo	1/02/16	30/11/16
Summer/Honours Scholarship: Developing versatile protective coating on cotton fabric	CRDC1724	RMIT	Zhaowei Xu	1/02/17	30/11/17
Summer/Honours Scholarship: Efficacy of robotic methods for the detection and treatment of herbicide-resistant cotton weeds	QUT1602	QUT	Simon Thomas	22/02/16	16/11/16
Summer/Honours Scholarship: Identifying and testing commercial root endophytes in cotton	QUT1601	QUT	Nathaniel Crane	29/02/16	18/11/16
Summer/Honours Scholarship: Inhibiting larval movement between refuges and Bt cotton	CSE1703	CSIRO	Zoe and Lisa Paisley	2/01/17	31/03/17
Summer/Honours Scholarship: Tracking sediment, carbon and nutrients using environmental tracers for enhanced cotton production	CRDC1727	Newcastle	Sean Brennan	1/12/16	30/06/17
Summer/Honours Scholarship: Watering requirements of floodplain vegetation asset species of the northern Murray-Darling Basin	DNRM1701	DNRM	Madelyn Harp	1/12/16	19/02/17
UNE Cotton Production Course	UNE1604	UNE	Brendan Griffiths	1/07/15	30/06/18

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PEOPLE: Networks					
18th Australian Cotton Conference foundation sponsorship	CA1601	CA	Stuart Armitage	1/07/15	30/09/16
AgVet collaborative forum	RIRDC1601	RIRDC	Kylie Brettschneider	11/11/15	1/11/16
AgVet collaborative forum: Plant industries	RIRDC1701	RIRDC		1/07/16	1/12/19
Australian Cotton Shippers export market development tour seminars in India	ACSA1701	ACSA	Stuart Gordon	26/02/17	4/03/17
Automation of recycle system at IREC Field Station	IREC1701	IREC	Rob Houghton	1/03/17	30/10/17
BoardEffect governance platform hosting 2016-17	CRDC1631	BoardEffect LLC	BoardEffect LLC	28/06/16	7/07/17
Capacity and capability mapping	CRDC1739	Lynda George	Lynda George	4/04/17	30/06/17
Capital Item: Planter bar and trailer	CGA1703	DCRA	Ian Gourley	1/09/16	30/10/17
CCRSPI	CCR1201	RIRDC	Heather Hemphill	1/07/13	30/06/17
Collaborative Partnership Primary Industries Health & Safety	RIRDC1301	Joint Partnership RIRDC	Simon Winter	28/8/12	30/6/17
Cotton Innovation Network: A vision for future cotton RD&E capability	CRDC1719	ACIL Allen Pty Ltd	JP van Moort	14/10/16	28/11/16
Cottonspec commercialisation	CMSE1701	CSIRO	Stuart Gordon	5/9/16	30/9/16
Emerging Futures analysis workshop	CRDC1735	Robert Burke	Robert Burke	22/03/17	5/04/17
Grassroots Grant: Assessing the benefits to growers by transitioning to Controlled Traffic Farming for compaction management in a cotton rotation system	CGA1707	Southern Valley CGA	Emma Ayliffe	1/10/16	30/06/17
Grassroots Grant: Counteract high sodium uptake and nitrogen efficiency by stimulating soil health	CGA1706	Gwydir Valley CGA	Craig Estens	1/10/16	1/05/17
Grassroots Grant: Gwydir Valley dryland planting date row configuration trial	CGA1602	Gwydir Valley CGA	Ben Dawson	1/07/15	31/12/16
Grassroots Grant: In-field research trial comparing dryland cotton to dryland sorghum on various row configurations	CGA1702	Mungindi CGA	Jo Weier	1/08/16	30/06/17
Grassroots Grant: In-field trials to address local barriers to cotton growing and exposure to the cotton industry (Binnia Valley Growers Group)	CGA1605	Upper Namoi CGA	Jon Welsh	1/10/15	30/06/17
Grassroots Grant: Irrigation scheduling training using canopy sensors	CGA1607	Lower Namoi CGA	Geoff Hunter and Steve Madden	15/10/16	30/06/17
Grassroots Grant: Local weather data access	CGA1604	Dawson Valley CGA	Damien Erbacher	31/10/15	30/09/16
Grassroots Grant: Seasonal benchmarking with canopy temperature sensors	CGA1609	CottonInfo	Amanda Thomas	1/11/15	31/08/16

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Grassroots Grant: Strengthening CGA policy and procedures	CGA1608	CHCGIA	Emma McCullagh	1/10/15	30/09/17
Grassroots Grant: Upgrade to Darling Downs weather station network	CGA1708	Darling Downs CGA	Adam McVeigh	13/12/16	1/9/17
Grassroots Grant: Upgrade to Darling Downs weather station network and chemical application days	CGA1606	Darling Downs CGA	Chris Barry	1/01/16	30/09/16
Grassroots Grant: Weather station access to minimise the spray drift in the Macquarie	CGA1704	Macquarie CGA	Amanda Thomas	1/09/16	1/05/18
Grassroots Grant: Weather station project	CGA1701	Dirranbandi CGA	Brent Scott	30/07/16	31/10/16
Grassroots Grant: Weather stations	CGA1705	Walgett CGA	Jack Harris	1/10/16	31/05/17
Grassroots Grant: Weigh trailer for Southern NSW cotton trials	CGA1611	Southern Valley CGA	Kate O'Callaghan	1/01/16	28/02/17
Grower RD&E advisory panels: Board Portal subscription	CRDC1745	CRDC	Nicola Cottee	1/07/16	30/06/17
Grower RD&E advisory panels: Meeting travel	CA1703	CA	Nicola Cottee	1/07/16	30/06/17
Identification and analysis of non-tariff measures and quantification of their impact on Australian export commodities	FRDC1701	FRDC	Jim Fitzgerald	27/03/17	30/06/17
IREC Field Station upgrade (jointly funded with CSD)	IREC1501	IREC	Rob Houghton	1/07/14	30/06/17
National RD&E water use in agriculture cross-sector strategy	DA1701	DA	Cathy Phelps	3/11/16	30/6/18
National Soil RD&E Implementation Committee membership and contribution to soils cross-sectoral strategy	DAFF1401	CSIRO	Mike Grundy	1/06/14	30/06/17
National soils RD&E strategy	CSP1708	CSIRO	Mike Grundy	1/07/16	30/06/17
Plant Health Australia membership 2016-17	PHA1701	PHA		1/07/16	30/06/17
Pollenizer Rural.XO Microhack	POL1701	Pollenizer Pty Ltd	Tim Parsons	15/12/16	30/06/17
Pollenizer Start-Up Science bootcamp	CRDA1701	CRDC	Bruce Finney	12/07/16	13/07/16
Sponsorship: Restore, Regenerate, Revegetate Conference	UNE1701	UNE	Rhiannon Smith	5/2/17	9/2/17
Sponsorship: 2016 RIRDC Rural Women's Award National Dinner	RIRDC1605	RIRDC	John Harvey	17/05/16	14/09/16
Sponsorship: 2017 RIRDC Rural Women's Award National Dinner	RIRDC1704	CRDC	Jennifer Medway	19/05/17	13/09/17
Sponsorship: AACS 2017 Australian Cotton Researcher Conference	CRDC1720	AACS	Danny Llewellyn	5/09/17	7/09/17
Sponsorship: AgCatalyst Conference	CSP1704	CSIRO		5/12/16	6/12/16
Sponsorship: AgFutures Innovation and Investment Conference 2016	DAQ1705	QDAF	Brett de Hayr	25/08/16	23/11/16
Sponsorship: APEN International Conference 2017	CRDC1707	APEN	Jeanette Long	5/07/16	15/09/17
Sponsorship: Australian Cotton Fibre Expo	CRDC1713	Australian Cotton Fibre Expo	Melanie Moloney	20/7/16	6/8/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
Sponsorship: Central Highlands AgTech Forum	CRDC1742	CHDC	Sharna Holman	6/06/17	8/12/17
Sponsorship: CRDC Horizon Scholar attendance at the 18th Australian Cotton Conference 2016	RIRDC1606	CRDC	Trudy Staines	2/08/16	4/08/16
Sponsorship: Harvesting the Benefits of Digital Agriculture Conference 2017	AFI1701	AFI	Mick Keogh	1/03/17	16/06/17
Sponsorship: Planet Textiles 2016	CA1704	CA	Nicola Cottee	12/7/16	12/7/16
Travel: Attend 18th Australian Cotton Conference	ANU1701	ANU	Katie McPherson	1/8/16	4/8/16
Travel: Attend American Phytopathological Society annual meeting & scientific exchange	DAN1705	NSW DPI	Karen Kirkby	26/05/17	26/08/17
Travel: Attend International Congress of Entomology	DAN1602	NSW DPI	Robert Mensah	16/12/15	2/10/16
Travel: Attend International Congress of Entomology	CSP1603	CSIRO	Lewis Wilson and Simone Heimoana	4/01/14	2/10/16
Travel: Attend RIRDC Rural Women's Award National Dinner 2016	CRDC1712	CRDC	Jennifer Medway	24/08/16	14/09/16
Travel: Attend the cotton industry resilience workshop 2016	CRDC1717	Stacey Vogel Consulting	Stacey Vogel	30/08/16	7/09/16
Travel: Attendance at Pollenizer Rural.XO Microhack 1	POL1702	CRDC	Various	9/03/17	10/03/17
Travel: Attendance at Pollenizer Rural.XO Microhack 2	POL1703	CRDC	Various	4/05/17	5/05/17
Travel: American Societies of Agronomy, Soil Science and Crop Science Conference: Using saline and sodic soils research	ANU1702	ANU	Nilantha Hulugalle	1/8/16	17/11/16
Travel: Farrer High School attendance at the 18th Australian Cotton Conference 2016	CRDC1709	Farrer	John Drenkhahn	1/08/16	5/08/16
Travel: Participate in the 12th International Verticillium Symposium	DAQ1704	QDAF	Linda Smith	18/07/16	12/10/16
Travel: Participate in the 12th International Verticillium Symposium	DAN1702	NSW DPI	Karen Kirkby	18/7/16	12/10/16
Travel: Soils constraints forum	CRDC1706	CottonInfo	Kieran O'Keeffe	13/07/16	14/07/16
Travel: US Cotton industry tour & precision ag work experience	CRDC1740	Landmark	Casey Onus	1/05/17	31/07/17
Travel: Visit to ACRI by Dr Steven Naranjo, USDA, Arizona	CSP1702	CSIRO	Lewis Wilson	3/12/16	9/12/16
Understanding and building women's participation in the cotton industry	WIN1701	Wincott	Sally Dickinson	1/07/16	30/11/16
X-Lab cotton bridging program	XL1701	X-Lab	Allen Haroutonian	19/06/17	7/08/17

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PEOPLE: Communication					
Australian Cotton Production Manual: proofreading	CRDC1732	Helen Wheels HR	Helen Dugdale	21/04/17	28/04/17
Communications support projects	CRDC1744	House of Communications	Bernadette Pilling	1/06/17	28/02/18
Cotton industry database management	CRDC1704	Making Data Easy Pty Ltd	Lee Armson	1/07/16	30/06/17
Cotton Pest Management Guide: proofreading	CRDC1708	Helen Wheels HR	Helen Dugdale	1/7/16	15/7/16
CottonInfo: Central Queensland planting date and research update workshop	CSD1704	CottonInfo	Sharna Holman	29/06/17	11/07/17
CRDC 25th anniversary publication	CRDC1625	Seftons	Robbie Sefton	3/05/16	31/07/16
PAK publication infrastructure	CRDC1627	Keo Design	Nic Hinwood	1/06/16	31/08/16
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 through	DAQ1702	QDAF	Paul Grundy	1/07/16	30/06/18
OUTCOME 4: PEOPLE PROGRAM TOTAL: \$1,426,457					

Project title	Project Code	Research Organisation	Principal Researcher	Start Date	Cease Date
PROGRAM 5: PERFORMANCE: Best Practice					
'Science into best practice', linking research with CottonInfo (CottonInfo Technical Specialist and myBMP module lead)	CSP1504	CSIRO	Sandra Williams	1/07/14	30/06/17
myBMP support and program coordination	CRDC1703	Rachel Holloway	Rachel Holloway	1/07/16	30/06/17
PERFORMANCE: Monitoring and Evaluation					
CRDC Cotton Grower Practices surveys: 2014, 2015 & 2016	RRR1501	RRR	Ingrid Roth	1/07/14	31/05/17
CRDC Cotton Grower Survey: 2017	CRDC1733	Intuitive Solutions	Michael Sparks	1/02/17	1/12/19
Annual qualitative and quantitative surveys for Australian cotton industry	CCA1601	CCA	Liz Todd	1/07/15	30/06/18
Integrated economic environmental & social performance reporting of cotton industry	RRR1403	RRR	Guy Roth	1/07/13	30/10/16
Stakeholder survey	CRDC1630	Intuitive Solutions	Michael Sparks	6/06/16	30/08/16
Measuring and reporting the value of capacity building on farms and in research	CRDC1701	QualData	Gordon Stone	1/07/16	30/06/19
Longitudinal assessment for the cotton industry's People investments	CRDC1710	Jennifer Moffatt	Jennifer Moffatt	1/07/16	31/12/18
Boyce Cotton Comparative Analysis	BCA1701	BCA	Phil Alchin	1/07/16	30/06/17
PERFORMANCE: Reviews					
Enhancing private sector agricultural RD&E investment in Australia	CRDC1705	AFI	Mick Keogh	1/07/16	30/06/17
Impact Assessment of Selected Clusters of Projects – Stage I: Water-use efficiency and nutrition cluster	CRDC1623	Agtrans	Peter Chudleigh	2/05/16	2/12/16
Impact Assessment of Selected Clusters of Projects – Stage II: Bt technologies cluster	CRDC1730	Agtrans	Peter Chudleigh	27/02/17	18/08/17
Impact Assessment of Selected Clusters of Projects – Stage III: Sustainability and myBMP cluster	CRDC1731	Agtrans	Peter Chudleigh	27/02/17	18/08/17
Strategic R&D Plan: Horizon scan	CRDC1741	CRDC	Paul Barnett	31/03/17	9/05/17
OUTCOME 5: PERFORMANCE PROGRAM TOTAL: \$734,632					
TOTAL CRDC RD&E INVESTMENT \$20,317,963					

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 <i>Public Governance, Performance and Accountability Act 2013</i> , section 28 of the <i>Primary Industries Research and Development Act 1989</i> 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 <i>Helicoverpa</i> spp.
Bollgard 3®	Cotton varieties contain three genes resistant to <i>Helicoverpa</i> spp.
Bt	<i>Bacillus thuringiensis</i> (crystal protein gene expressed in Bollgard II® and Bollgard 3® cotton varieties, resistant to <i>Helicoverpa</i> spp.)
BS	Budget Statements
BYGUM	BarnYard Grass Understanding and Management
C	carbon
CA	Cotton Australia

Term	Description
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 (<i>Bemisia tabaci</i>).
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 specialists and myBMP 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	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
EPI	Environmental Performance Indicator
ESD	Ecologically sustainable development
F1	F1 screens involve testing the offspring of single-pair matings between moths from Cry2Ab-resistant strains maintained in the laboratory (sP15 for <i>H. armigera</i> and Hp4-13 for <i>H. punctigera</i>) and moths raised from eggs collected from field populations

Term	Description
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
GPWUlfarm	Gross Production Water Use Index farm
GRDC	Grains Research and Development Corporation
Griffith	Griffith University
GVIA	Gwydir Valley Irrigators Association
ha	hectare
<i>Helicoverpa</i> spp.	Cotton's major insect pests (<i>H. armigera</i> and <i>H. punctigera</i>)
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	MicroMeteorology Research and Education Services
myBMP	Best Management Practices Program
N	nitrogen
NAQS	Northern Australia Quarantine Strategy

Term	Description
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	<i>Public Governance, Performance and Accountability Act 2013</i>
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	<i>Gossypium barbadense</i> . Related to Egyptian cotton, having extra-long and fine staples. Limited Australian production.
PIRD Act	<i>Primary Industries Research and Development Act 1989</i>
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.
REO	Regional Extension Officers
RH	relative humidity
RIC	Research and Innovation Committee

Term	Description
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	<i>Gossypium hirsutum</i> . 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 <i>Verticillium dahliae</i> .
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 2016-17.

- (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 2016-17.

- (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.

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Constructed in the interests of users	all pages	all pages
Freedom from ambiguity and jargon	all pages	all pages
Appropriate tables, graphs etc.	all pages	all pages
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NOTES





Australian Government

Cotton Research and
Development Corporation

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