CRDC

ANNUAL REPORT 2019–20

Case study

New app to stop little cotton pests flying under the radar

Near impossible to identify and count with the naked eye, silverleaf whitefly has increased in prevalence in recent years.

To make identification easier, University of Southern Queensland researchers Dr Alison McCarthy and Dr Derek Long, in collaboration with Queensland Department of Agriculture and Fisheries researcher Dr Paul Grundy, are developing a new artificial intelligence smartphone app with funding from CRDC.

“Traditionally, sampling is labour-intensive and done manually, with growers and their agronomists having to closely monitor the changes in the numbers of pests across hundreds of cotton plants on a weekly basis to determine if control action is required,” Dr McCarthy said.

“We identified that machine vision could automate the pest counting on each leaf by using infield cameras and image analysis software. We have since enabled these vision detection algorithms to be used on a smartphone device,” she said.

“Through an app, agronomists can then use real-time photo capture for pest counting which offers reduced sampling times, more precise detection and recording of pests, increased sampling consistency between field personnel and improvement for the timing of control decisions.”

The first version of the app was tested by agronomists and researchers in the 2019-20 season in two cotton growing regions. An updated version of the app will be deployed for testing during the 2020-21 cotton season after which further steps are anticipated to be undertaken towards commercial release.

For more: read the full article in the Autumn 2020 edition of CRDC’s *Spotlight* magazine www.crdc.com.au/spotlight.

CRDC ANNUAL REPORT

2019-20

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

Johnelle Rogan

Contents

Cotton Research and Development Corporation
2 Lloyd Street (PO Box 282)
Narrabri NSW 2390
Phone: 02 6792 4088
Email: crdc@crdc.com.au
Website: www.crdc.com.au
ABN: 71 054 238 316

If you are interested in learning more about CRDC and our investments, visit our website 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 researcher Dr Derek Long of the University of Southern Queensland. Image: Warwick Waters.

Published: November 2020
ISSN: 1039-3544

Melanie Jenson

About CRDC & the Australian cotton industry

The Cotton Research and Development Corporation (CRDC) leads investment in cotton research, development and extension (RD&E) for the Australian cotton industry. A partnership between the Australian Government and cotton growers, CRDC exists to invest in, and deliver outcomes from, world-leading RD&E to benefit Australia's dynamic cotton industry and the wider community.

We invest in innovation and transformative technologies to deliver impact, and as an organisation we are ambitious, agile, and adaptive.

Cotton is a major contributor to the economic, environmental and social fabric of rural Australia. The industry's national exports generate an average of $1.9 billion in annual revenue, and the industry is a major employer in rural and regional communities.

Despite prolonged dry seasonal conditions across many of the cotton-growing valleys, and the challenges associated with COVID-19, the industry continues to go through a period of geographic growth. The industry continues to expand from its predominant growing base in New South Wales (NSW) and Queensland (QLD) into northern Victoria (VIC), the Northern Territory (NT) and Western Australia (WA).

RD&E and its resulting innovations are a key driving force behind our industry's continued success, and CRDC's purpose is to power the success of Australian cotton through this world-leading RD&E.

Vision

Powering the success of Australian cotton through world-leading RD&E.

Mission

Investing in world-leading RD&E to benefit Australia's dynamic cotton industry.

Purpose

Outcome statement: Increased economic, social and environmental benefits for the Australian cotton industry and the wider community, by investing in knowledge, innovation and its adoption.

Investment, innovation, impact.

Report from the Chair and Executive Director

Adapting to change, rising to challenges, investing in innovation.

This year has thrown some unforeseen circumstances at us all, yet agriculture remains constant. Our primary producers continue to do what they do best: there are crops to plant and harvest, with some recent promising rainfall across many of our drought-affected regions. Likewise, despite the challenges and dynamic circumstances, the research conducted by our world-leading team of Australian cotton scientists and researchers also continues, through the investment provided by CRDC.

The 2019-20 year marked the second year of investment under our CRDC Strategic RD&E Plan 2018-23.

During this year, we continued to focus on our strategic priorities – increasing productivity and profitability of Australian cotton farms; improving cotton farming sustainability and value chain competitiveness; building the adaptive capacity of the Australian cotton industry; strengthening partnerships and adoption; and driving RD&E impact.

We invest in these areas to ensure our cotton growers, our communities, and the wider industry are all prepared to manage challenges and capitalise on opportunities.

If the COVID-19 pandemic has shown us anything, it is how prepared we are as an industry to adapt to change, challenges and uncertainty. Building adaptive capacity is a core part of our Strategic Plan 2018-23 as we recognise our environment is dynamic. We must be also. Through sound and innovative research and support for our research community, growers and industry, we aim to support the future success of Australian cotton.

A major component of our work during 2019-20 has been the completion and release of our industry's second Sustainability Report with Cotton Australia. This report has been five years in the making, and it reflects how important we as an industry view the impact we have: environmentally, socially and economically.

The report looks at eight critical areas for the industry – water, carbon, biodiversity, pesticides, quality of work life (safety, diversity and training), wellbeing and social capital, efficiency, and profitability – all areas that we invest in to ensure continuous improvement. It's a shared responsibility, and we pride ourselves on the strong relationships that we have with our growers, researchers, government and other core partners, and the work that we're doing to extend, adopt or commercialise our research.

Collaboration is at the very heart of everything we do. Partnerships and co-investments, both within the cotton industry and with other industries, deliver transformational outcomes. There isn't a single research project we invest in that isn't delivered in partnership with our growers, researchers and collaborators. We also partner with those outside our sector to solve issues that are bigger than cotton alone. In 2019-20, 48 per cent of CRDC's investments were in cross-sectoral RD&E.

In this report, we bring you an update on our progress towards our strategic goals – our investments, our innovations, and our intended impacts – two years into our Strategic RD&E Plan 2018–23.

Richard Haire
CRDC Chair

Dr Ian Taylor
CRDC Executive Director

PROGRESS AGAINST CRDC STRATEGIC R&D PLAN 2018–23

Our Annual Performance Statement

The 2019–20 year marked the second year under the CRDC Strategic RD&E Plan 2018–23. This plan provides an ambitious roadmap for our 2018–23 investments: through this plan, we aim to contribute to creating $2 billion in additional gross value of cotton production for the benefit of Australian cotton growers and the wider community.

Progress towards this goal has been tempered by the continued dry conditions during the strategic plan period, and the challenges associated with COVID-19, but we remain optimistic about the future of the cotton industry and focused on maximising the benefits to growers and the community.

The strategic RD&E investments that CRDC made in 2019-20 under this plan are helping to continue to drive the Australian cotton industry towards a future of innovation, increased commercialisation and digital transformation.

In 2019–20, Australian cotton growers and the Australian Government co-invested $20.0 million through CRDC into cotton RD&E, across 234 projects and in collaboration with 99 research partners.

The investments were made in the five key areas identified in the Strategic RD&E Plan:

- increasing productivity and profitability on Australian cotton farms
- improving cotton farming sustainability and value chain competitiveness
- building the adaptive capacity of the Australian cotton industry
- strengthening partnerships and adoption
- driving RD&E impact.

This Annual Report outlines progress against these areas in the 2019–20 year.

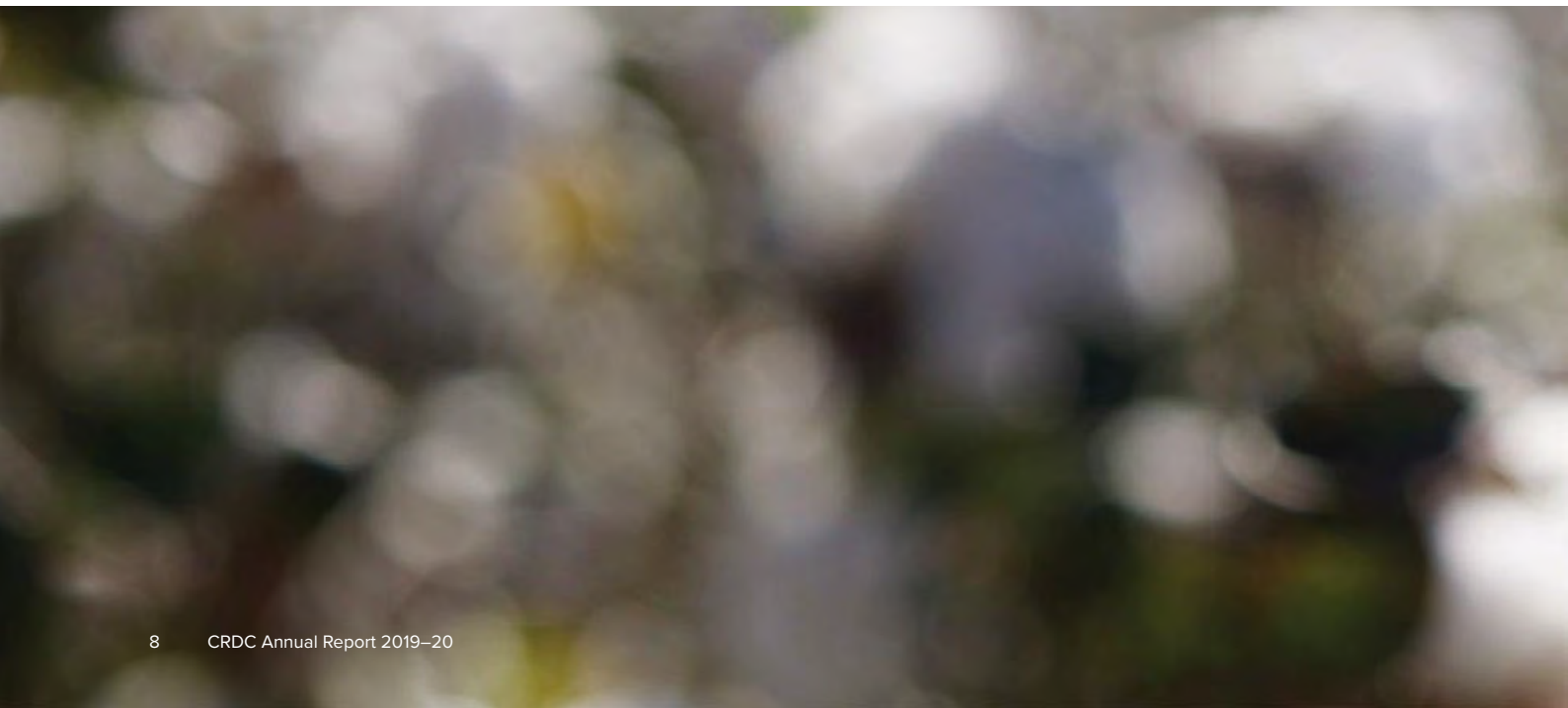
Our progress is measured, and performance analysed, through evaluation techniques outlined in the CRDC Monitoring and Evaluation Framework and targets set in the Strategic Plan. The green, amber and red traffic light system is used to track overall performance against the CRDC Strategic Plan.


The specific measure has been achieved.


On target to deliver against the measure.


Not on target to deliver against the measure.

Further details about our performance aligned with the Strategic Plan and our key focus areas are outlined in Section 4 of this Annual Report: the RD&E portfolio.



Strategic Plan Measures	Result	2023 Targets	2019–20 progress comments
Increase productivity and profitability on cotton farms. Improved yield and quality.		Annual increase of 0.35 bales per hectare for irrigated cotton and 0.14 bales per hectare for dryland cotton.	In the five years to 2019, irrigated yields have increased by 10 per cent, despite the impact of the very hot 2018-19 season on the five-year average. Dryland yields have declined 27 per cent over the same five years, which have included three of the hottest and driest years on record. Accordingly, as at 2019-20, we are on track to achieve the 2023 irrigated target, but not the dryland target.
Improve cotton farming sustainability and value chain competitiveness. CRDC collaborates in global leadership for sustainability initiatives.		Participates in six global initiatives.	CRDC continues to participate directly in five global initiatives: the International Cotton Advisory Committee (ICAC) Expert Panel on the Social, Economic and Environmental Performance of Cotton; the Sustainable Agriculture Initiative; the Sustainable Apparel Coalition; the Better Cotton Initiative 'Project Delta'; and Cotton2040. CRDC also participates indirectly in the EU's Product Environmental Footprint processes. Accordingly, we are on track to achieve the 2023 target of participating in six global initiatives.
Build adaptive capacity of the cotton industry. Science and innovation capacity is strengthened and strategically fit for a digital future.		10+ new/early career researchers supported through strategic career pathways.	In 2019-20, CRDC supported 17 PhD candidates and 16 early career researchers through strategic career pathways. Accordingly, we are on track to achieve the 2023 target.
Strengthening partnerships and adoption. Partnerships are strengthened to engage multi-disciplinary and multi-institutional resources.		40 per cent of annual RD&E investments are through cross-sectoral partnerships.	In 2019-20, 48 per cent of RD&E investments were in cross-sectoral partnerships. These included strategic collaborations on water-use efficiency, nitrogen-use efficiency, biosecurity, engagement and Northern Australia. Accordingly, we are on track to achieve or exceed the 2023 target.
Driving RD&E impact. CRDC monitors and evaluates RD&E impact.		One RD&E impact report per annum.	In 2019-20, CRDC commenced an evaluation of the phase one More Profit from Nitrogen program investments. Accordingly, we are on track to achieve the 2023 target.

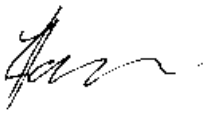
The specific measure has been achieved. On target to deliver against the measure. Not on target to deliver against the measure.

Ruth Redfern

Certification by the Executive Director

I, Dr Ian Taylor as the accountable authority of Cotton Research and Development Corporation (CRDC), present the 2019–20 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, complies with subsection 39(2) of the PGPA Act 2013, and is in accordance with 16F of the PGPA Rule 2014.



Dr Ian Taylor
Executive Director
Cotton Research and Development Corporation

15 October 2020

2019–20 investment and impact

The Australian cotton industry in 2019–20

60,000 hectares
planted into irrigated and dryland cotton.

600,000 bales
produced by the Australian cotton industry.

10 bales per hectare
the average yield for the 2019-20 crop.

(Source: Cotton Australia)

CRDC's investment in 2019–20

99
research partners

234
RD&E projects

$20 million
CRDC's investment in cotton RD&E on behalf of cotton growers and the Australian Government

5 – KEY PROGRAM AREAS

- Increasing productivity and profitability on Australian cotton farms;
- Improving cotton farming sustainability and value chain competitiveness;
- Building the adaptive capacity of the Australian cotton industry;
- Strengthening partnerships and adoption; and
- Driving RD&E impact.

CRDC impact

$2.1 million the collective investment in the potential for broadacre cropping in the Northern Territory project, involving CRDC.

48 per cent
the number of CRDC's investments in 2019-20 that have been in cross-sectoral collaborative projects.

97 per cent
the number of cotton growers adopting the industry-recommended thresholds for pest management, which are based on CRDC-supported research (97 per cent in 2019-20, compared to 90 per cent in 2016-17).

8.9 out of 10
satisfaction among partners of CRDC as an organisation to trust.

5 the number of local, grower-led projects CRDC invested in through its Grassroots Grants program in 2019-20, taking the total number of projects supported since it began to 77.

11 major collaborative projects

that CRDC has led or actively participated in during 2019-20 under two government initiatives: Rural R&D for Profit, and the National Landcare Program Smart Farming Partnership.

4000

the number of cotton, dairy, rice, grains and sugar irrigators set to benefit from the collaborative Smarter Irrigation for Profit phase 2 project, led by CRDC.

2020
the UN International Year of Plant Health, creating a focus on CRDC's RD&E investments in the area of plant health and biosecurity.

23: the number of member governments represented by the 300 attendees at the Australian ICAC Plenary Meeting in December, supported by CRDC.

36: the number of cotton-growing shires featured in CottonInfo's innovative online biodiversity management guides for growers.

100 per cent
the number of CRDC's investments in 2019-20 that have been in partnership with the cotton industry.

1.2 million
the number of collective views that the 194 CRDC-supported best practice videos have amassed on the CottonInfo YouTube channel as at May 2020.

8 the number of priority areas for the cotton industry under the *Australian Cotton Sustainability Report 2019*, co-produced by CRDC and Cotton Australia: water, carbon, biodiversity, pesticides, quality of work life (safety, diversity and training), wellbeing and social capital, efficiency, and profitability.

YEAR IN REVIEW

RD&E highlights

Collaboration to tackle major cross-sectoral challenges

100 per cent of CRDC's investments in 2019-20 have been in partnership with the cotton industry, and 48 per cent have been in cross-commodity collaborative projects with our fellow Research and Development Corporations (RDCs). CRDC has led three major collaborations: Smarter Irrigation for Profit phase 2, and More Profit from Nitrogen, under the Rural R&D for Profit program; and Cotton Landcare Tech Innovations 2021, under the National Landcare Program Smart Farming Partnership. CRDC has also partnered in eight additional projects under the Rural R&D for Profit program, addressing cross sectoral issues in climate, pests, weeds, diseases, energy, digital technologies, and natural resource management.

Team RDC working towards whole-of-agriculture collaboration

CRDC is working closely with the RDCs to develop a framework to facilitate collaboration across the whole of agriculture and promote participation of a greater diversity of actors within the Australian agro-ecosystem. This collaborative framework links to the cross-sectoral RD&E strategies and provides a mechanism for the RDCs and other participants to partner to address key issues facing agriculture, including climate variability, water-use efficiency, biosecurity and soil quality. The first initiative the collective RDCs are partnering on under the new framework is the Climate Initiative: a significant new co-investment program, led by CRDC, to foster thriving agriculture, fisheries and forestry industries regardless of pressures from a variable and changing climate.

Release of Australia's Cotton Sustainability Report

CRDC and Cotton Australia have released the highly anticipated *Australian Cotton Sustainability Report 2019*, following on from the inaugural report published in 2014. The report tells a positive story of increasing efficiency in the use of resources, including water and land. It reveals long-term trends that producing a bale of cotton now takes 48 per cent less water, 34 per cent less land, and 97 per cent less insecticide than it did in 1992. The report provides data on eight priority social, economic and environmental topics, and by comparing performance over five-year periods in these important sustainability areas, highlights areas for improvement. CRDC and Cotton Australia are now progressing the development of the industry's sustainability targets.

Bringing the world of cotton to Australia for ICAC

The International Cotton Advisory Committee's (ICAC) 78th Plenary Meeting was held in Brisbane in December 2019, hosted by the Department of Agriculture, Water and the Environment with support from CRDC as a major sponsor and organising committee member. ICAC is an association of governments from cotton-producing, consuming and trading countries, and is the only global intergovernmental group for cotton and cotton textiles. More than 300 people from 23 member governments attended the meeting, including representatives from five international organisations and five non-member countries. Ten presenters from CRDC's world-leading crop of cotton scientists shared their latest research and expertise.

Cotton and grain partnership: spray drift hazard alert and warning system

A CRDC and Grains Research and Development Corporation (GRDC) collaboration has been working to minimise the potential and impact of spray drift from cotton and grain properties since 2016. Before this, there was no reliable or accurate method to determine when inversion conditions were hazardous or not for spraying. Research supported by CRDC and GRDC developed a Spray Drift Hazard Alert and Warning System. The partners are now moving to deliver this technology to growers through establishing a network of Profiling Automatic Weather Stations (PAWS) across the cotton and grain belts of eastern Australia.

Developing cotton in Northern Australia: major collaboration announced

A $2.1 million research program for Northern Australia supported by CRDC was announced in March 2020, to trial high-value crops such as cotton with potential rotation crops. The two-year 'Potential for broadacre cropping in the Northern Territory' project is being co-funded by the Cooperative Research Centre for Developing Northern Australia (CRCNA), CRDC, GRDC and 14 industry partners. This is the largest collaboration to date for the CRCNA. This project will collate historic broadacre cropping data, natural resource information and an understanding of market opportunities to support the development of viable broadacre cropping systems in the NT, helping to de-risk broadacre agriculture in the Top End.

Artificial intelligence app to help identify problem pests

Silverleaf whitefly (SLW), mites and aphids are not easily detected in cotton, and left untreated, they can slash the value of the crop. To make identification easier, University of Southern Queensland researchers are developing a new artificial intelligence smartphone app with funding from CRDC. The app uses vision-detection algorithms, that automate pest counting on each leaf using infield cameras and image analysis software. Through the app, growers and agronomists can then use real-time photo capture, reducing sampling times and offering more precise detection and recording of pests for decision making. The app was first tested during 2019-20, and will be deployed for further testing during 2020-21 on a potential pathway towards commercial release.

CRDC support results in new tool for dryland crop destruction

AquaTill Injeticide, a new tool incorporating herbicide with ultra high-pressure water cutting, offers dryland cotton growers an alternative method of crop termination with minimal soil disturbance post-harvest. The technology was first tested on mulched cotton in 2017, through a CRDC-supported project looking at opportunities for dryland cotton with Bollgard 3®. CRDC subsequently supported AquaTill's founder as a participant in the Pollenizer start-up rural.xo microhack. He has since partnered with a machinery manufacturer and a herbicide registrant. Under a new CRDC-supported project, demonstrations are planned for cotton farms during the 2020-21 season.

Innovative online biodiversity management guides for growers

CottonInfo has launched new online biodiversity management guides for Australia's 36 cotton-growing shires, giving cotton growers detailed biodiversity information and outlining beneficial practices to support biodiversity on their farms. Growers can select their local government area (LGA) to see a snapshot of the biodiversity in their shire, along with practical tips to improve conditions for the diversity of species in that specific cotton landscape. This initiative is an outcome of the 'New technologies to improve natural resources (biodiversity) on Australian cotton farms - Cotton Landcare Tech Innovations 2021' project funded by CRDC in partnership with the Australian Government's National Landcare Smart Farming Partnership Initiative.

Focus on biosecurity: the UN International Year of Plant Health

2020 is the official UN International Year of Plant Health, providing a platform to raise awareness of the importance of plant health and biosecurity, and of CRDC's RD&E investments in this area. From a research perspective, CRDC is a member of the Plant Biosecurity Research Initiative (PBRI), which supports cross-sectoral RD&E to minimise the damage caused by biosecurity threats to Australia's plant industries. All seven plant-based RDCs are members of PBRI. From a preparedness perspective, CRDC and Plant Health Australia staged Exercise Blueprint in August 2019. This simulation exercise of a biosecurity incursion brought together key stakeholders within the cotton industry to examine a fictional scenario of the detection of cotton blue disease; only months before a response was required to the discovery of fall armyworm in Northern Australia.

Building adaptive capacity: support for industry leaders

CRDC continued to invest in industry leaders during 2019-20, under the Strategic Plan goal of building adaptive capacity. These include Nuffield scholars, supported by CRDC and Cotton Australia: Luke McKay of Kununurra, Renee Anderson of Emerald, and Richard Quigley of Trangie; the ABARES Science and Innovation Award 2020 winner, Dr Dinesh Kafle of the QLD Department of Agriculture and Fisheries; and the latest cohort of Australian Rural Leadership Program participants in conjunction with Cotton Australia and Auscott Ltd: Fleur Anderson and John Durham (course 25), Chantal Corish and Rod Gordon (course 26), and Ruth Redfern (course 27).

Giving back to the grassroots: investing in research programs with grower organisations

CRDC's annual Grassroots Grants program provides grants of up to $10,000 to cotton grower associations (CGAs) to support local projects. The grants support on-farm trials, demonstrations and workshops, and build intrinsic value, such as fostering collaboration, peer-to-peer learning, and improving research skills through on-farm and grower-led research. Since the program began in 2011, 77 projects have been supported, with $670,000 invested by CRDC. During 2019-20, these projects included the installation of weather stations; on-farm evaluation of pumping telemetry; a study tour to investigate planting times, pests and spray drift management strategies; an on-farm demonstration of the internet of things (IoT) and low-power, long-range (LoRaWAN) networks; and a project to foster cross-sectoral RD&E collaboration and leadership in Northern Australia.

Ensuring a strong relationship with RD&E partners

Every investment CRDC undertakes on behalf of the cotton industry is in partnership with a valued research provider. To assess the strength of these partnerships, and ensure continuous improvement, CRDC invited key partners to provide feedback on the health of the partnership during 2019-20. The feedback from this process demonstrated strong results across each of the three organisational performance metrics: overall satisfaction with the partnership across all partners was strong (8.4 out of 10), as was satisfaction with CRDC as an organisation to trust (8.9 out of 10), and satisfaction with the way CRDC engages (8.3 out of 10). CRDC will continue to invest in and develop these relationships because collaboration underpins the industry's RD&E success.

Enhancing commercialisation and innovation: CRDC business strategy

CRDC developed a business strategy in 2019 that specifically seeks to enhance the development of innovative solutions across the challenging issues facing Australian agriculture. The business strategy identifies the importance of strategic, national and international partnerships that can bring greater diversity to solutions creation, as well as allowing for private investment. Further, the business strategy increases the focus on developing commercial outcomes and improving management and access to intellectual property developed through RD&E, with the aim of increasing revenue into the sector.

Letter of transmittal

CRDC

15 October 2020

The Hon. David Littleproud MP
Minister for Agriculture, Drought and Emergency Management
Parliament House
Canberra ACT 2601

Dear Minister

It is with great pleasure that I submit the Corporation's Annual Report for 2019–20, 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 2020-30*.

The activities of the Corporation are reported against the objectives, strategies, outputs and outcomes of the CRDC Strategic RD&E Plan 2018–23, and are consistent with CRDC's 2019–20 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 PGPA Rule 2014. The report of operations was approved by a resolution of the Directors on 30 September 2020.

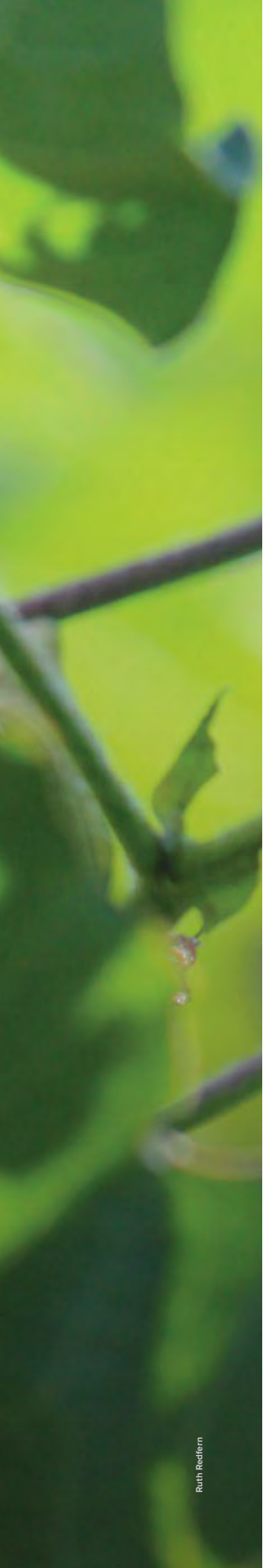
Yours sincerely

Richard Haire
Chair
Cotton Research and Development Corporation

COTTON RESEARCH AND DEVELOPMENT CORPORATION
office address 2 Lloyd Street, Narrabri NSW 2390, Australia **postal address** PO Box 282, Narrabri NSW 2390
P 02 6792 4088 **E** crdc@crdc.com.au ABN 71 054 238 316 **www.crdc.com.au**


MADE FROM
AUSTRALIAN COTTON
A natural, world class quality fibre grown by Australian farmers who care for the environment. Breathable and soft to touch, cotton is comfortable, easy to wear and easy to care for.

Section 2
CRDC Business


Ruth Redfern

Our role

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

Our corporate outcome is to achieve increased economic, social and environmental benefits for the Australian cotton industry, and the wider community, by investing in knowledge, innovation and its adoption.

We have four key stakeholders – the Australian Government through the Minister for Agriculture; the Department of Agriculture, Water and the Environment; the cotton industry's representative organisation, Cotton Australia; and cotton growers, including Cotton Grower Associations – and we are funded through an industry levy and matching Commonwealth contributions. In 2019–20, we invested $16.7 million in RD&E into 234 projects.

We recognise that collaboration is essential to the delivery of RD&E outcomes. As such, we partner with researchers, research organisations and growers to deliver RD&E projects and outcomes.

In 2019–20, CRDC partnered with 99 research partners, including:

- Department of Agriculture, Water and the Environment
- 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.

Our operations

We have five strategic outcomes that we seek to achieve under our 2018–23 Strategic RD&E Plan – these in turn are the key focus areas in which we invested during 2019–20:

GOAL 1: Increasing productivity and profitability on Australian cotton farms

GOAL 2: Improving cotton farming sustainability and value chain competitiveness

GOAL 3: Building the adaptive capacity of the Australian cotton industry

ENABLING STRATEGY 1: Strengthening partnerships and adoption

ENABLING STRATEGY 2: Driving RD&E impact

Our achievements against these outcomes are monitored, evaluated and reported annually – in the Portfolio Budget Statement and the Annual Report.

Strategic Plan Goals	Performance criteria	End of Plan targets (to achieve by 2023)	2019-2020 targets
GOAL 1: Increase productivity and profitability on cotton farms	Improved yield and quality	Increase in average bales/ha to 11.6 bales/ha for irrigated cotton, and 4.7 bales/ha for dryland cotton	Annual increase of 0.35 bales per hectare for irrigated cotton, and 0.14 bales per hectare for dryland cotton
GOAL 2: Improve cotton farming sustainability and value chain competitiveness	CRDC collaborates in global leadership for sustainability initiatives	CRDC participates in 6 global initiatives	CRDC participates in 6 global initiatives
GOAL 3: Build adaptive capacity of the cotton industry	Science and innovation capacity is strengthened and strategically fit for a digital future	50+ researchers supported through strategic career pathways	10+ new/early career researchers supported through strategic career pathways
ENABLING STRATEGY 1: Strengthening partnerships and adoption	Partnerships are strengthened to engage multi-disciplinary and multi-institutional resources (centres of excellence)	40 per cent of CRDC investments include cross-sectoral partnerships	40 per cent of CRDC investments include cross-sectoral partnerships
ENABLING STRATEGY 2: Driving RD&E impact	CRDC monitors and evaluates RD&E impact	CRDC delivers 5 RD&E impact reports	One RD&E impact report per annum

Setting the research priorities

We work with the Australian cotton industry to determine the sector's key RD&E priorities; with 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 our strategic RD&E priorities, which are formalised under the 2018–23 CRDC Strategic RD&E Plan.

Industry accountability

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

We engage with Cotton Australia in a formal process of consultation in the development and implementation of the Strategic RD&E Plan, including R&D investments. This engagement ensures industry research priorities are regularly reviewed; emerging issues are actively considered; the uptake of research in the form of best practice is facilitated; and the overall performance of the Australian industry is enhanced.

Cotton industry priorities for RD&E:

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

Our investment process

The process of deciding where to invest our annual RD&E funding is a collaborative one, involving all major stakeholders.

We work closely with the industry's peak representative body, Cotton Australia, and the Australian Government on an annual basis to identify and evaluate the cotton industry's requirements for RD&E. Cotton Australia provides ongoing advice to us on research projects and where research dollars should be invested, guided by the priorities established in the 2018–23 CRDC Strategic RD&E Plan.

In line with the plan, we hold a research priority forum annually, bringing together the Cotton Australia research and development advisory panels to identify the gaps in the existing research portfolio and opportunities for new research. We also hold a series of discipline forums with research partners to identify emerging research priorities.

From here, we issue a targeted annual call for research proposals against these identified priorities. In determining which proposals are successful, we again undertake 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 us and are delivered by our research partners. Critically, our success in delivering RD&E outcomes to growers and the industry is contingent upon strong relationships with our research partners.

RD&E priorities

The 2019–20 priorities forum, held in June 2018, identified key areas of focus for future RD&E investment. These key areas formed the basis of the targeted call, with 21 expressions of interest developed on these areas to guide researchers in developing their proposals. The key focus areas included:

- Development of disease-suppressive farming systems;
- Sustainable insect management through improved insect resistance monitoring;
- Improved management of weeds in cotton and grains farming systems;
- Sustainable management of *Helicoverpa* through pre-emptive resistance management strategies;
- Improved weed and disease management through the use of cover crops;
- Supporting southern cotton farming systems and the development of northern cotton farming systems;
- Benchmarking of water-use efficiency in irrigated and dryland cotton production systems;
- Sustainability reporting, including the development of baselines for social capital and wellbeing;
- Development of more resilient cotton production systems;
- Improving soil health;
- Cotton production course support; and
- Developing higher value uses for cottonseed oil.

Through the 2019–20 procurement process, we have invested in projects to directly target these key needs.

Importantly, in addition to immediate cotton industry priorities, we also identify and invest in longer term priorities, specifically around ensuring a future for the industry that is profitable, sustainable and competitive.

Government accountability

We are accountable to the Australian Government through the Minister for Agriculture. The Government communicates its expectations of CRDC through Ministerial direction, enunciation of policy, administration of the *Primary Industries Research and Development (PIRD) Act 1989*, and priorities (Science and Research Priorities and Rural RD&E Priorities). We respond to government expectations through regular communication; compliance with the Funding Agreement, policy and legislated requirements; and the development of Strategic RD&E Plans, Annual Operational Plans, and Annual Reports. In addition, in 2019-20, the Auditor-General conducted a performance audit of five statutory RDCs, including CRDC. CRDC was found to manage probity across RD&E procurements, conflicts of interest, gifts, benefits and hospitality, intellectual property, and credit cards.

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
- 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

- Food*
- Cybersecurity
- Environmental change
- Soil and water
- Energy
- Health
- Transport
- Resources
- Advanced manufacturing

Rural RD&E Priorities

- Advanced technology
- Soil, water and managing natural resources
- Biosecurity
- Adoption of R&D

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

Ruth Redfern

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

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

National research, development and extension strategies have been developed across primary industry and cross-industry sectors, including cotton, 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 and updated in 2019, this Vision uses a 20-year timeframe to ensure a long-term focus. The Vision 2029 elements (differentiated, responsible, tough, successful, respected, capable and innovative) were central to the development of the CRDC Strategic RD&E Plan, and continue to play a key role in guiding CRDC's investments each year to ensure CRDC is contributing to their achievement.

Collaboration and co-investment

Cooperation and collaboration are fundamental to our operation. We work in partnership with industry bodies, commercial entities and RDCs to achieve strategic outcomes for the industry, and to leverage higher returns for our investments.

This collaborative approach underpins our investment strategy. We partner in over 80 per cent of RD&E projects conducted in the cotton sector, and in 2019–20, 48 per cent of CRDC investments were in cross-sectoral RD&E.

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

Cotton Australia

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

Research partners

All CRDC projects are delivered in partnership with key research partners. In 2019–20, CRDC partnered with 99 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 3 RD&E Portfolio of this report.

Growers

In addition to the Cotton Australia research advisory panels, cotton growers also contribute to RD&E through participation in other industry committees, such as the Cotton Australia Transgenic and Insect Management Strategy (TIMS) Committee and Technical Panels, to provide practical guidance on the implementation of stewardship practices for GM traits.

Growers are also actively involved in RD&E by conducting on-farm trials – a critical component of the RD&E process. This involves a financial contribution through direct on-farm trial costs and opportunity costs, and the provision of growers' time, knowledge and expertise. Thirty-five per cent of growers host research trials on their farms, with growers contributing an average of 19 hours and $5500 towards their on-farm trials.

Cotton industry programs: CottonInfo and *my*BMP

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

Rural Research and Development Corporations

CRDC is one of 15 Rural RDCs that come together under the banner of the Council of Rural RDCs (CRRDC) to coordinate efforts, collaborate and co-invest in projects and achieve consistency in communication. The focus is on improving efficiencies, maximising the impact of research outcomes, and avoiding duplication in research. The scale of this collaboration extends from large national research programs to small local projects and administration, to bring a national focus in dealing with climate variability, soil health, irrigation, plant biosecurity, crop protection, farm safety and human capacity. CRDC continues to work with the CRRDC to investigate administrative efficiency gains within the RDCs and the rural R&D system as a whole.

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

Australian Government grants

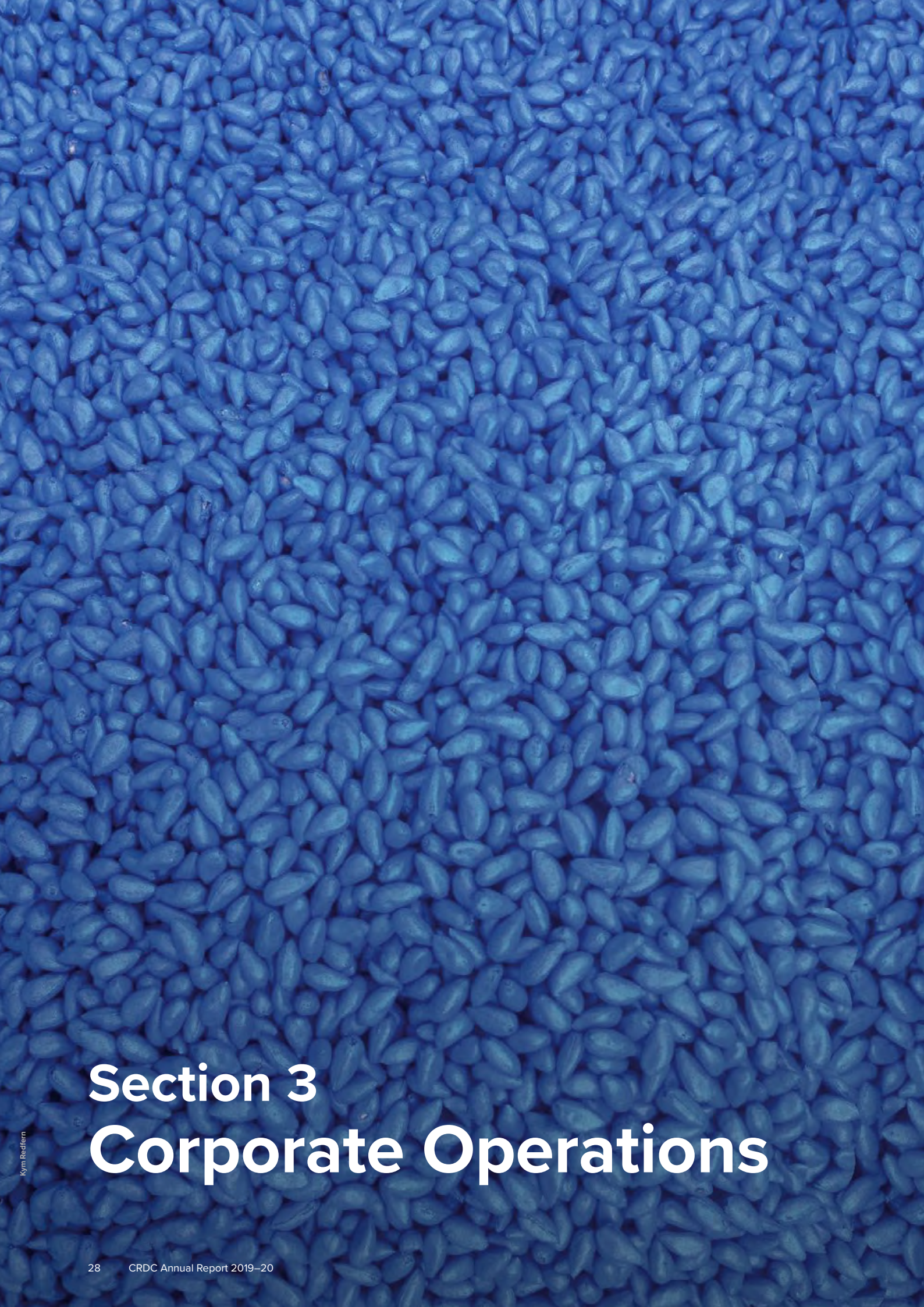
CRDC works in partnership with the Australian Government and fellow RDCs on a number of ongoing grant projects.

CRDC managed three programs in 2019–20 under Government grants, contributing a combined $14.1 million into RD&E funding across the life of the programs, for the benefit of the Australian cotton industry, the community and other industries.

- **More Profit from Nitrogen: enhancing the nutrient-use efficiency of intensive cropping and pasture systems** *(funded 2016–20, with $5.9 million from the Rural R&D for Profit program – round two).* Involves fellow RDCs Dairy Australia, Sugar Research Australia and Horticulture Innovation Australia and other research partners. Administered by the Department of Agriculture, Water and the Environment.
- **Smarter Irrigation for Profit – phase 2** *(funded 2019–22, with $7.1 million from the Rural R&D for Profit program – round four).* Involves fellow RDCs Dairy Australia, Sugar Research Australia, AgriFutures Australia, and the Grains Research and Development Corporation and other research partners. Administered by the Department of Agriculture, Water and the Environment.
- **New Technologies to Improve Natural Resources (Biodiversity) on Australian Cotton Farms – Cotton Landcare Tech Innovations 2021** *(funded 2018–22, with $1.1 million from the National Landcare Program: Smart Farming Partnerships initiative – round one).* Administered by the Department of Social Services Community Grants Hub.

CRDC was also involved in eight other programs through Rural R&D for Profit program grants led by other RDCs during 2019–20:

- **Digital Technologies for More Dynamic Management of Disease, Stress and Yield** *(funded 2016–20, led by Australian Grape and Wine Authority; $3 million from the Rural R&D for Profit program – round two).*
- **Forewarned is Forearmed: Managing the Impacts of Extreme Climate Events** *(funded 2017–20, led by Meat & Livestock Australia Limited in partnership with CRDC through the Managing Climate Variability program; $6.2 million in funding from the Rural R&D for Profit program – round three).*
- **Improving Plant Pest Management Through Cross-Industry Deployment of Smart Sensors, Diagnostics and Forecasting** *(funded 2017–20, led by Horticulture Innovation Australia in partnership with CRDC; $6.8 million in funding from the Rural R&D for Profit program – round three).*
- **Increasing Farmgate Profits, the Role of Natural Capital Accounts** *(funded 2017–20, led by Forest and Wood Products Australia in partnership with CRDC; $900,000 in funding from the Rural R&D for Profit program – round three).*
- **Area-Wide Management for Cropping Systems Weeds, Investigating the Weed Management, Social and Economic Opportunity** *(funded 2019–22, led by Grains Research and Development Corporation in partnership with CRDC; $1.9 million in funding from the Rural R&D for Profit program – round four).*
- **Underpinning agricultural productivity and biosecurity by weed biological control** *(funded 2019–22, led by AgriFutures Australia in partnership with CRDC; $7.5 million in funding from the Rural R&D for Profit program – round four).*
- **Biorefineries for Profit – phase 2** *(funded 2019–22, led by Sugar Research Australia in partnership with CRDC; $800,000 in funding from the Rural R&D for Profit program – round four).*
- **Boosting Diagnostic Capacity for Plant Production Industries** *(funded 2019–22, led by Grains Research and Development Corporation in partnership with CRDC; $4.6 million in funding from the Rural R&D for Profit program – round four).*



Section 3
Corporate Operations

Kym Redfern

Business financials

Our investment in RD&E is funded through an industry levy and matching Commonwealth contributions. In 2019–20, we invested $20.0 million in cotton RD&E throughout the industry supply chain. In 2020-21, our estimated cotton RD&E expenditure will be $18.7 million.

Revenue

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

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

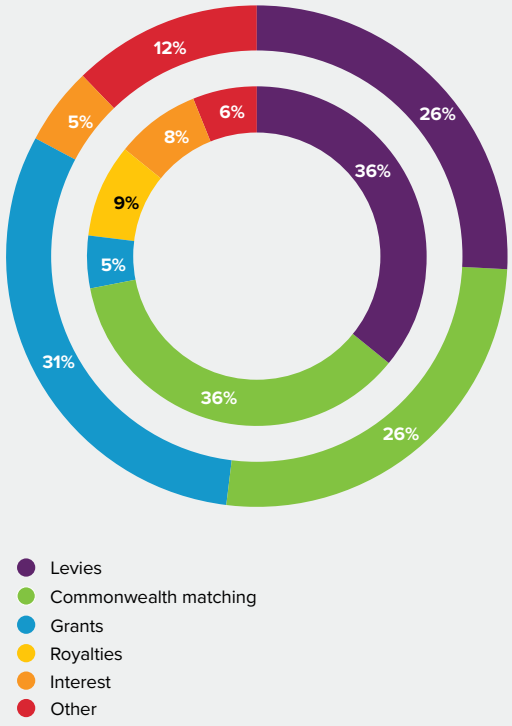
The setting and collection of the industry levy is enabled by the *Primary Industries (Excise) Levies Act 1999* and the *Primary Industries Levies and Charges Collection Act 1991*, respectively. The Australian Government's matching contributions in 2019–20 were capped at the value of levies collected because it was lower than the 0.5 per cent of the three-year average gross value of production.

Revenue (Actuals)	2019–20 ($m)
Industry levies	$3.070
Australian Government	$3.070
Royalties	$0.007
Interest	$0.620
Research Grants	$3.676
Other	$1.471
TOTAL	**$11.914**

The following graph demonstrates the change in sources of revenue over the last six years. 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.

In 2019–20, the Australian Government's Department of Agriculture, Water and the Environment contributed a total of $1.9 million in revenue to CRDC, via the Rural R&D for Profit program ($1.5 million), and the National Landcare Program's Smart Farming Partnership initiative ($0.4 million). This revenue has also attracted additional grant revenue of $1.8 million from program partners, industry and cross-sectoral partners.

Change in CRDC revenue mix over six years: 2014-15 (inner circle) to 2019-20 (outer circle)



Total revenue for 2019–20 of $11.914 million was $2.853 million (19 per cent) below budget of $14.767 million. Total 2019–20 revenue comprised:

- Industry levy revenue of $3.070 million, which includes $2.751 million (56 per cent) of the 2018-19 crop and $0.319 million (22 per cent) of the 2019-20 estimated crop.
- Australian Government's matching contribution of $3.070 million was capped at the value of levies collected.
- $0.007 million in royalties from the commercialisation of intellectual property.
- Interest revenue of $0.620 million was 3 per cent above budget, due to the higher level of cash reserves under CRDC management generated by above-budget revenues in the prior year.
- Research grants of $3.676 million included Rural R&D for Profit, other Commonwealth grants and co-investments from program partners.
- Other revenue of $1.471 million, which includes project refunds.

Expenditure and investment

Actual expenditure for 2019–20 was $20.043 million, which is $0.170 million below the budgeted expenditure of $20.213 million.

Actual ($m)	2019–20
Cotton Crop Size (millions of bales)*	0.60
Total revenue	11.914
Industry levies	3.070
Australian Government	3.070
Royalties	0.007
Interest	0.620
Research grants	3.676
Other**	1.471
Expenditure total	20.042
Cotton RD&E activities	16.666
Total equity position	**30.751**

* ABARES estimate, Agricultural Commodities June 2020.
** 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 2019–20 was allocated to the following activities:

Cost Allocation Activity	2019–20
Direct R&D Expenditure (project costs)	$16,089,008
Indirect R&D Expenditure (administration costs)	$2,951,438
Grant-funded expenditure (R&D not eligible for Commonwealth Matching)	$1,002,092
Total Expenditure	**$20,042,538**

Portfolio Budget Statement

The Commonwealth 2020-21 Portfolio Budget Statements were deferred to October 2020 due to the COVID-19 pandemic. Estimates for 2020-21 provided in this report are preliminary estimates only of CRDC's outcomes, outputs, performance and financial position for 2020–21.

Outcomes and outputs 2019–20

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	2019–20
TOTAL Budgeted Revenue	$14,767,000
TOTAL Actual Revenue	$11,913,858
TOTAL Budgeted Cost of Outputs	$20,213,000
TOTAL Actual Cost of Outputs*	$20,042,538

* 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.

Forecast revenue

Future revenue from levies and Commonwealth matching contributions are directly affected by cotton production. Commodity prices, water availability and water prices are significant factors in forthcoming cropping decisions. Below-average storage levels of public irrigation dams serving the Australian cotton-growing regions, high water prices and the impact of COVID-19 on the apparel market are expected to result in below-average cotton production in 2020-21.

CRDC has budgeted for $10.733 million operating deficit for 2020-21. This reflects revenue of $7.998 million and expenditure of $18.731 million. Industry levy revenue and Commonwealth contributions will continue to be drawn from two crop seasons, 2019-20 and 2020-21.

Forecast expenditure

Budgeted expenditure for 2020-21 is $18.731 million, which is $1.312 million below the 2019-20 actual expenditure. The forecast expenditure for the next two years is budgeted at $18.381 million in 2021-22 and $11.592 million in 2022-23.

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 may be required to seek approval from the Minister of Finance for a deficit in any year.

Our investments in RD&E

We use the CRDC Strategic RD&E Plan 2018–23 to guide our investments. Through this Strategic Plan, in 2019–20 we invested to help increase productivity and profitability on Australian cotton farms; improve cotton farming sustainability and value chain competitiveness; build the adaptive capacity of the Australian cotton industry; strengthen partnerships and adoption; and drive RD&E impact.

We achieved a balanced RD&E portfolio that considers the distribution of our investment across:

- The RD&E strategies
- The type of research, including innovation, knowledge creation, knowledge transfer and application, benchmarking, industry capacity, and education
- In-project risks
- Researcher experience and capacity
- Research providers
- Timeframe to outcomes
- The likely return on investment for projects and programs
- Expenditure on RD&E management.

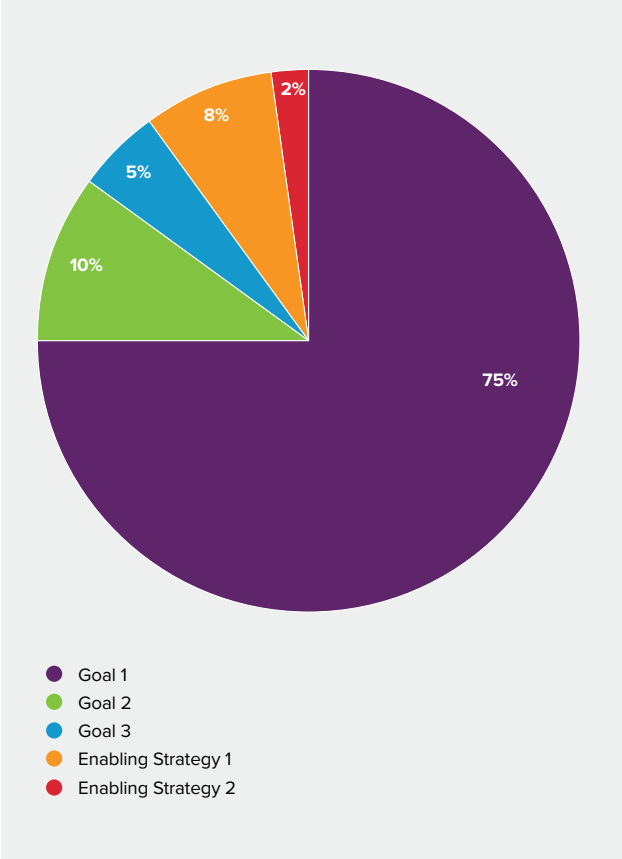
In 2019–20, we invested $16.7 million in RD&E. Of this, $7.6 million was invested in new research commencing in 2019–20.

Projects by CRDC program area

CRDC program	Goal 1	Goal 2	Goal 3	Enabling strategy 1	Enabling strategy 2	TOTAL
Number of projects	117	31	40	40	6	234
Program expenditure ($m)*	$12.5	$1.6	$0.9	$1.3	$0.4	$16.7
Program percentage (of expenditure)	75%	10%	5%	8%	2%	**100%**

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

Investment by program



Total number of CRDC projects

CRDC projects	2018–19	2019–20
Active projects	130	135
New projects funded	148	83
Projects completed	143	118
Continuing projects	135	116

Further detail on CRDC's projects can be found in Section 4: RD&E Portfolio, and in Appendix 3: RD&E Portfolio.

Melanie Jenson

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.

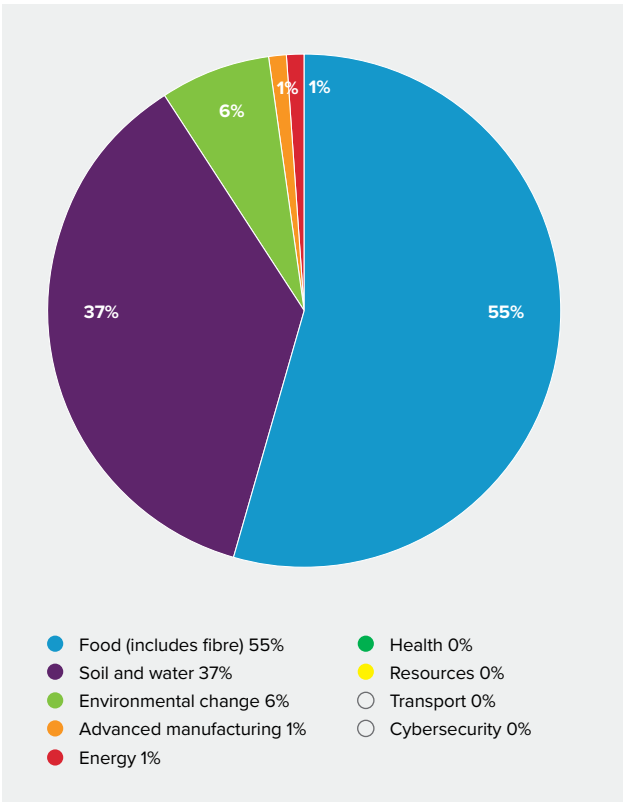
CRDC investment by Science and Research Priorities

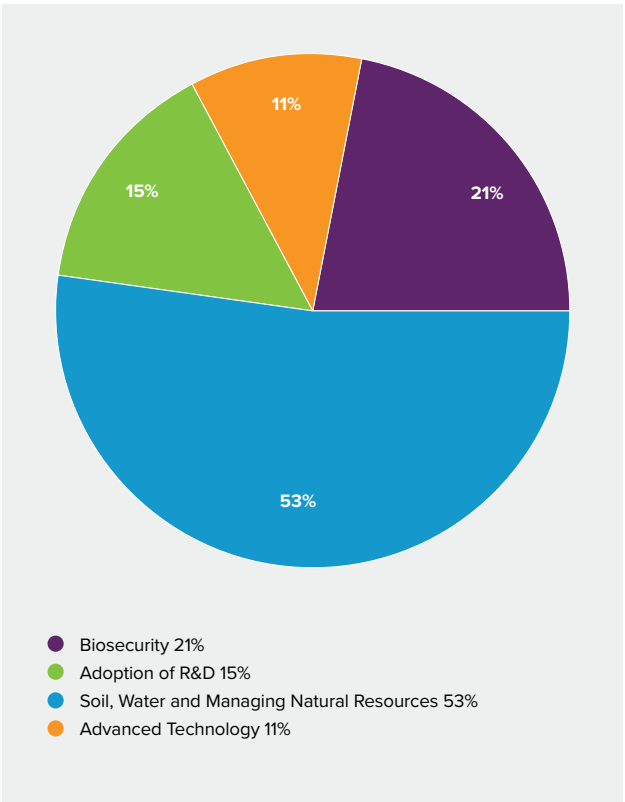
Science and Research Priorities (SRP)	CRDC investment ($'000)
Food (also includes Fibre)	$9,156
Soil and water	$6,096
Environmental change	$1,149
Advanced manufacturing	$120
Energy	$115
Health	$26
Resources	$4
Transport	$0
Cybersecurity	$0
Total	**$16,666**

CRDC investment by Rural RD&E Priorities

Rural RD&E Priorities	CRDC investment ($'000)
Advanced Technology	$1,774
Biosecurity	$3,594
Soil, Water and Managing Natural Resources	$8,802
Adoption of R&D	$2,495
Total	**$16,666**

Further detail on how CRDC's RD&E investments align with these priorities can be found in Appendix 1: Australian Government Priorities.





Section 4
RD&E Portfolio


pts
Lorem Ipsum

Section 4: RD&E Portfolio

Goal 1: Increase productivity and profitability on cotton farms

Increasing the productivity and profitability on Australian cotton farms by $1.5 billion by 2023 is CRDC's aim within this goal. To work towards this, CRDC focuses on investments in RD&E to deliver optimised farming systems, adapt transformative technologies, and protect our industry from biotic threats and environmental stresses.

In 2019–20, CRDC invested in 117 projects within this goal, accounting for 75 per cent of our total RD&E expenditure. This increased from 68 per cent in 2018-19, due to a focus on maintaining core capacity during investment years impacted by drought.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicator	Measures	2019–20 progress
1.1 Optimised farming systems	1.1.1 Improved yield and quality	Increase in yield over 5 years	Assessment of average bales/ha	Limited water combined with higher temperatures are affecting yields, especially for dryland. Nonetheless, the five-year average for irrigated yields has increased by 10 per cent, despite the impact of the very hot 2018-19 season. Quality has also been above average. Dryland yields have declined 27 per cent over the same five-year period, which included three of the hottest and driest years on record.
	1.1.2 Improved input efficiencies	Positive input/output ratios resulting from adoption of new practices	Assessment of bales per unit input for irrigated cotton (water productivity and nitrogen-use efficiency)	An updated industry water productivity benchmark and standardised measures were published by NSW DPI in October 2019. This indicated that the long-term trend of an annual 2.5 per cent reduction in the volume of water required per bale is being maintained. Benchmarking for the 2018-19 and 2019-20 seasons is currently underway. Additionally, commercialisation of R&D is in progress to enable additional technologies that improve monitoring and automation of irrigation. This is expected to lead to further improvements in water-use efficiency. Nitrogen use is increasing at a greater rate than yield, meaning that nitrogen-use efficiency is declining. Current nitrogen projects will be completed in 2020-21, and CRDC will reassess its nitrogen research investment strategy.
	1.1.3 On-farm sustainable development is supported	New farming systems are sustainable and productive	Number of bales produced on new farming systems	CRDC research is currently supporting sustainable farming systems development in Northern Australian cotton through collaboration with key partners. In addition, during 2019-20, a 'futures' workshop looking at novel farming systems was held, in conjunction with virtual workshops to consider reduced-input farming systems.
	1.1.4 Improved reliability of cotton production	Increase in five-yearly average production	Rolling annual average production (number of bales)	While new areas for cotton production are being developed, total production declined over the period as a result of extremely widespread limited irrigation water availability due to the ongoing drought. The estimated five-year rolling average production following the 2019-20 season is 2.6 million bales, down from 3.1 million after 2018-19. Improving reliability of cotton production will be a consideration for novel farming systems.

1.2 Transformative technologies	1.2.1 New technologies are adapted for use in cotton	Increased number of technologies are available for cotton growers	Number of new technologies entering commercial use	During 2019-20, CRDC undertook commercialisation activities in improved irrigation management, improved application of pesticides, improved monitoring of pests, and the development of novel pesticides.
	1.2.2 Cotton farms are digitally enabled	Increase in on-farm use of digital technology	Percentage of farms utilising digital technologies	Building on the CRDC-led, cross-sectorial *Australian Agriculture: Growing a Digital Future* project, an industry steering committee has been established to oversee the development of a digital strategy for the cotton industry, with facilitation by CRDC. Three of the projects undergoing commercialisation are focused on providing digital technologies to farmers. A CRDC Grassroots Grant to demonstrate on-farm Internet of Things (IoT) and LoRaWAN technology was supported.
1.3 Protection from biotic threats and environmental stresses	1.3.1 Increased understanding of the impact of pests, diseases and weeds, and environmental stresses	Impact information is available to inform improved management practices for growers and industry	R&D investments reflect the potential impact of biotic and environmental stresses to inform management practices	Pesticide data collected from the CRDC-supported Crop Consultants Australia survey indicates that the Environmental Toxic Load (as measured against bees) continues to decline. Projects to reassess retention and pest threshold for high yielding cotton are ongoing. Research into novel approaches to mitigate abiotic stresses, such as elevated temperatures and water deficits, is continuing.
	1.3.2 Improved identification, surveillance and management systems for pests, diseases and weeds, and environmental stresses	New management practices and systems are available for growers, consultants and industry	Economic impact of pests, weeds and diseases reduced by 40 per cent	CRDC has a number of investments to reduce the impact of pests, weeds and diseases. These include the development of new crop protection technologies (e.g. BioClay and new pesticides); adapting existing technologies for use in cotton (e.g. innovative solutions for disease and novel plant hormones to manage abiotic stress); and research to ensure recommendations such as thresholds and tactics for suppression are underpinned by strong science.
	1.3.3 Industry is prepared for a biosecurity incursion	Delivery of effective biosecurity preparedness scenarios/ exercises (undertaken by cotton industry)	Number of biosecurity preparedness activities undertaken	Exercise Blueprint, focused on a simulated incursion of cotton blue disease caused by cotton leafroll dwarf virus was successfully held in collaboration with Plant Health Australia.
			Percentage of participants reporting increased preparedness	44 per cent of cotton growers currently have a farm biosecurity plan (identifying hazards and an action plan) with a further 19 per cent currently developing a plan. Industry preparedness will be reassessed following the implementation of recommendations from Exercise Blueprint.

RD&E highlights

Smarter Irrigation for Profit phase 2 (RRDP2001-RRDP2020)

Smarter Irrigation for Profit phase 2 is tackling the challenge of reduced water availability by focusing on practical, cost-effective strategies to improve the water productivity of Australian cropping and pasture irrigators. The project is a partnership between the major irrigation industries of cotton, dairy, sugar, rice and grains, research organisations and farmer groups. The project is funded by the Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program. The project has 14 sub-projects covering three components: development of new irrigation technologies, including new sensors, advanced analytics to improve irrigation scheduling, and strategies to reduce water storage evaporation; cost-effective, practical automated irrigation systems; and a network of 36 farmer-led optimised irrigation sites located on commercial farms.

Southern cotton crop protection (including CottonInfo Disease Technical Lead and *my*BMP module lead) (DAN1903)

With new growers and consultants swelling the cotton-growing industry in southern NSW and northern VIC, the region needs capacity building in crop protection. Regional conditions and a shorter cotton-growing season require different crop management approaches in the south, and consequently, acquisition of local research data is an imperative. This project brings expertise in disease and invertebrate pest research to the region, appointing a new cotton pathologist to the south. Building on earlier projects, it analyses key pathology and entomological issues, and identifies integrated management solutions to boost productivity and profitability for southern growers.

Potential for broadacre cropping in the Northern Territory (CRCNA2001)

This project aims to support the development of viable broadacre cotton systems in the NT, through the collation of historical broadacre cropping data, natural resource information and an understanding of market opportunities. The initial focus of the project is on rainfed and irrigated systems growing cotton and peanut crops, while maize, sorghum, rice and pulse crops are being investigated as possible 'break crop' options for cotton and peanut producers. The project includes validating and calibrating modelling tools to understand short- and long-term risk profiles. Field trials and commercial on-farm demonstrations provide data for refining and validating simulation models with locally relevant data, and build local grower and agronomist cropping experience and capacity. This collaborative project builds on another CRDC-supported project, Science leadership for cotton development in Northern Australia (CSP1903).

Precision management for improved cotton quality (CMSE1802)

This project uses new sensor technology to automate the measurement of the cotton crop's status, helping growers make better on-farm management decisions. The use of sensor-collected data presents opportunities for more efficient production; improved fibre maturity, length and consistency; less trash and entanglements; and help for growers by avoiding discounts and raising profit margins. In addition, new methods are being investigated to mitigate situations where ginned cotton value is degraded by poor colour, leaf content and moisture. For example, a potential colour and leaf grade sensor in the picker to gauge the classing grade of the module at harvest, before ginning.

Minimising yield variability to maximise yield (DAN1801)

The differences in cotton yield across different fields within one farm suggest variability in soil and/or management. Using strategic soil and crop management to boost yields in low-yielding cotton paddocks would improve the average industry yield per hectare and resource-use efficiency. A systematic approach is needed to identify causes of low yield and to develop targeted solutions to overcome them. To find the many potential causes of yield variability, this project uses multidisciplinary staff from soil science (physics, chemistry, functionality and biology), plant pathology, agronomy and abiotic stress, economics and biometrics. To date, the project has used big data to produce digital soil maps to identify soil constraints at depth.

PhD: Building climate change resilience in cotton through translational physiology (ANU1704)

Frequent heat waves and drought continue to threaten Australian cotton production, but how do they affect plants? This PhD project determines the impact of extreme climates on plant photosynthesis. It generates temperature dependency data, including biochemistry and physiology of CO_2 assimilation. The differences in photosynthesis of cotton species from different parts of the globe have been analysed under glasshouse and field conditions against climates of origin and selected modern cotton cultivars. The analysis has found differences in the optimum temperature for photosynthesis between these different cotton species. The project has helped to develop predictive models to establish the value of transforming photosynthesis, and to provide guidance on physiologically meaningful levels of transformation. This knowledge will help to build resilience into cotton systems, and indicate potential breeding and management solutions to boost productivity in variable and future climates.

PhD: Utilising novel plant growth regulators to develop resilient future cotton systems (CSP1604)

This PhD project uses plant growth regulator (PGR) applications to make cotton plants more efficient and resilient to abiotic stress, and to deliver economic improvements in yield and lint quality to Australian cotton production. It investigates relevant biochemical pathways of plant and crop responses to treatments, as well as agronomic responses. Because water availability drives production, abiotic stressors are a major limiting factor of yield and lint quality, e.g. water-deficit stress reduces production via changes in plant physiological functioning. In lower yielding (American) systems, PGRs enhance overall crop performance and yield, notably in water-deficit scenarios. In Australia, novel PGRs could be used to address water deficit, heat and cold stressors and soil abiotic constraints.

Biological-based products for improved cotton production (UWS1901)

While biocontrol agents and biological indicators can limit losses from Verticillium and Fusarium wilts, better controls are needed. This project links with commercial companies to supply bio-based products for biotic (disease-incidence) or abiotic (nutrient-deficiency) stress. It aims to: find and improve microbial strains (from cotton farms) to control Verticillium and Fusarium in glasshouse- and field-grown cotton; develop ways to harness plant-microbiome interactions to control disease; and identify next-generation (genomics and satellite-based) biological indicators of soil health, including disease incidence and farm productivity. The project uses a systems approach (pathogen, host and environment), similar to an Integrated Pest Management (IPM) system, to build disease-suppressive soils and to help nutrient acquisition and stress response of the cotton crop.

Plant Biosecurity Research Initiative (HIA1801)

CRDC is a member of the Plant Biosecurity Research Initiative (PBRI), which includes all seven plant-based Research and Development Corporations (RDCs). PBRI supports cross-sectoral RD&E to minimise the damage caused by biosecurity threats to Australia's plant industries. These threats include endemic and exotic pests, diseases and weeds. The PBRI plays a long-term role in developing RD&E and capacity building for all plant industries to protect Australia's plant biosecurity system. It provides collaborative leadership to deliver high-quality plant biosecurity research to support industry. It hosted a two-day symposium in Brisbane in August 2019 showcasing current plant biosecurity research, the first meeting of its kind in Australia to address biosecurity in this way.

A biological alternative to nitrogen fertiliser in cotton (UN1901)

Nitrogen fertiliser is a significant input cost into cotton production systems and is also a key contributor to greenhouse gas emissions. The project focuses on *Gluconacetobacter diazotrophicus*, a nitrogen-fixing bacterium capable of living within plant tissue. Once colonisation is established, the bacteria can provide up to 50 per cent of the host plant's nitrogen needs. It also boosts plant growth and protects against pathogens. So far, *G. diazotrophicus* has colonised every plant species it has been tested on, and there are hopes for use in cotton. This technology could replace up to 50 per cent of a cotton plant's nitrogen requirements, significantly reducing the quantity of nitrogen fertiliser required in production systems and decreasing losses through greenhouse gas emissions.

Novel topical vegetable, cotton virus and whitefly protection: BioClay (HIA1803)

The project involves trials of the non-toxic, clay-based, biodegradable product BioClay on cotton farms. BioClay primes the plant's own defences, helping the plant to naturally attack specific crop pests and pathogens. It's a step towards revolutionising how pests are controlled organically for increased sustainability and resilience. The work has also formed the basis of an Australian Research Council Industrial Transformation Hub for sustainable crop protection, through the Plant Biosecurity Research Initiative (PBRI). The Hub aims to develop and commercialise the innovative biological alternative to chemical fungicides targeting economically significant diseases.

Large-scale biosecurity scenario to support cotton industry preparedness (PHA1902)

Exercise Blueprint was a biosecurity incursion simulation exercise run for the cotton industry over two days in August 2019. It brought together key stakeholders from the cotton industry to examine a scenario of a fictional detection of cotton blue disease in Australia. Discussions and activities during the exercise focused on three objectives: communication/engagement structure; potential strategies for responding to cotton blue disease in a production setting and understand the consequent impacts to the cotton industry; and explore strategies to mitigate the impacts of an emergency response to cotton blue disease on cotton growers. The exercise highlighted that the existing level of preparedness in the cotton industry is overall very high, with an opportunity to build upon the existing level in a few areas. This type of activity helps to ensure the industry has systems and capacity to respond to real incursions.

Identifying sensors for better Integrated Pest Management in cotton (NEC1901)

Silverleaf whitefly (SLW), mites and aphids gathering under cotton leaves are not easily detected manually because of diurnal movement or patchy distribution. Left untreated, they can slash the value of a cotton crop through feeding damage, or by depositing honeydew, which reduces quality. Effective management relies on their accurate and timely detection and quantification to identify the need for treatment. This project has successfully developed a proof-of-concept machine-vision sensing approach able to discriminate pest infestations with a beta app now being tested in the field. The algorithm includes machine learning based on thousands of SLW nymph image samples. The sensor has the potential to further improve management of these key pests.

Improving crop establishment, termination and weed control in dryland cotton farming systems (CRDC1937)

This project examines planting tactics that may address factors affecting seedling establishment in dryland cotton farming systems, and aims to develop and test the reliability of crop destruction tactics that minimise cultivation. One such tactic is AquaTill Injeticide, which incorporates herbicide ultra high-pressure water cutting, offering an alternative method of crop termination with minimal soil disturbance post-harvest. The technology was first tested on mulched cotton in 2017, in the CRDC-supported project, Opportunities for dryland cotton with Bollgard 3® (DAQ1703). CRDC then supported AquaTill's founder, Greg Butler, as a participant in the Pollenizer start-up rural.xo microhack. Greg has since partnered with a machinery manufacturer and a herbicide registrant, and under this CRDC project, demonstrations are planned for cotton farms during the 2020-21 season.

Integrated Pest Management technical lead and pest management for high-yield research (DAQ1902)

This project investigates whether previous recommendations for fruit retention are compatible with the pursuit of very high yields. It tests the validity of assumptions about advice frequently provided for the management of early to mid-season pests, and determines the limitations or capacity for timely crop compensation when the goal is to achieve high yields. The project also includes Integrated Pest Management (IPM) leadership for the industry via the CottonInfo Technical Lead, which ensures that growers and their advisors have access to current information that enables them to effectively manage pests, best preserve non-target, species and reduce the risk of insecticide resistance. During 2019-20, following the fall armyworm (FAW) incursion, the project team also inspected a range of crops for FAW activity in North QLD, and produced identification materials for growers via CottonInfo.

Characteristics of disease-suppressive cotton farming systems and soils understood (DAQ2002)

Soil-borne diseases continue to be one of the major constraints to cotton production. An improved ability to identify and manage the soil's natural disease-suppression capability would assist in the strategic management of soil-borne disease risks. This project helps to identify soil biological and physico-chemical elements to quantify disease-suppression potential and identify management practices that promote disease-suppressive systems. The project is delivering key diagnostics, surveillance, and response capacity for cotton pathology in QLD & NSW, best practice disease management advice that focuses on a farming system for building disease-suppressive soils, and an increased understanding of defensive ability for resistance breeding.

Area-Wide Management for cropping systems weeds, investigating the weed management, social and economic opportunity (GRDC2002)

The traditional approach to tackling weeds has been at a paddock or farm scale. This project aims instead to take an area-wide approach to weed management, the theory being that if the number of weeds over the entire landscape can be reduced, everyone in the area should benefit. This project, funded by the Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program, aims to identify the benefits, key principles and practices required for successful area-wide weed management. It is using key weed species, regional landscapes and group engagement to develop an understanding of the economic and social drivers of success.

Quantifying the effectiveness of cover crops as a means of increased water infiltration and reduced evaporation in the northern region (GRDC1801)

This cross-sectoral project investigated the effectiveness of cover crops to increase infiltration, reduce evaporation, and increase plant-available water for dryland grain and cotton and irrigated cotton. Thirteen experiments were conducted on low-cover fallows around Yanco, Parkes/Canowindra and Goondiwindi. The best cover crop treatments recovered the 40-60 mm water deficit taken to grow them by the end of the fallow in most experiments, something modelling suggests may happen in up to 70 per cent of years. While some cover crops stored up to 38 mm extra plant-available water, they also lost water in some very dry seasons. The research found that cover crops can protect the soil from erosion in low-cover fallows and maintain stored water in a majority of years. Importantly, the project has demonstrated yield impacts at some dryland grain and irrigated cotton sites up to three times larger than can be explained by differences in soil water alone. These responses appear to be due to better establishment, increased in-crop infiltration, better water extraction, and perhaps improved soil biology.

Case study

Smarter irrigation goes into phase 2

Irrigation efficiency is set to take another leap forward through phase 2 of the Smarter Irrigation for Profit project.

Phase 2, led by CRDC, kicked off in late 2019. The project is a partnership between the major irrigation industries of cotton, dairy, sugar, rice and grains, plus research organisations and farmer groups. It is building on the success of the initial Smarter Irrigation for Profit project, which wound up in 2018. Phase 2 is addressing the challenges of reduced water availability by improving the water productivity of crop and pasture irrigators, through developing new precision irrigation technologies, improving existing technologies, and facilitating faster uptake through producer-led demonstration sites.

Day-to-day project activities are being overseen by Cathy Phelps, who has worked extensively in both the dairy and cotton industries.

“More than 4000 cotton, dairy, rice, grains and sugar irrigators are set to benefit from this project, along with the sustainability and efficiency of those industries,” she said.

“We’ve started the 14 sub-projects with our partners, covering three key components.”

These components are: development of new irrigation technologies, including new sensors, advanced analytics to improve irrigation scheduling and strategies to reduce water storage evaporation; cost-effective, practical, automated irrigation systems for cotton, rice, sugar and dairy; and a network of 36 farmer-led optimised irrigation sites on commercial farms across Australia.

While the learning and research undertaken across the 14 sub-projects can be shared across industries, which is a feature of the projects, there are also cotton-specific projects. These will cover areas such as:

- using plant-based sensing to optimise for irrigation strategies
- development of solutions to reduce evaporation from water storages
- increasing the adoption of automated irrigation technologies
- precise real-time automated cotton irrigation for improved water productivity
- development of a whole-of-farm scale gravity-fed irrigation management system with the aim of increasing on -arm water-use efficiency
- demonstration of the application of the latest digital technologies for precise automated irrigation in the Gwydir Valley; and improving the science of water footprinting methods to make them more applicable for Australian agriculture.

Smarter Irrigation for Profit phase 2 is funded by the Australian Government Department of Agriculture, Water and the Environment, as part of its Rural R&D for Profit program, round four, in conjunction with CRDC, Dairy Australia, Sugar Research Australia, Grains Research and Development Corporation, AgriFutures Australia, CSIRO, NSW DPI, University of Melbourne, University of Southern Queensland, Deakin University, Tasmanian Institute of Agriculture, Agriculture Victoria and the Gwydir Valley Irrigators Association. Supporting partners include farmer groups and commercial irrigation providers.

Ruth Redfern

For more: read the full article in the Winter 2020 edition of CRDC’s *Spotlight* magazine www.crdc.com.au/spotlight, or visit the project page at the CRDC website www.crdc.com.au/smarter-irrigation-phase-2

Case study

Looking to broaden acres in Northern Australia

A $2.1 million research program for Northern Australia, supported by CRDC, was announced in March 2020, to trial high-value crops such as cotton with potential rotation crops.

The two-year 'Potential for broadacre cropping in the Northern Territory' project is being co-funded by the Cooperative Research Centre for Developing Northern Australia (CRCNA), CRDC, the Grains Research and Development Corporation and 14 industry partners. It's the largest collaboration to date for the CRCNA.

This project will collate historical broadacre cropping data, natural resource information and an understanding of market opportunities to support the development of viable broadacre cropping systems in the NT, helping to de-risk broadacre agriculture in the Top End.

The Northern Territory Farmers Association believes that by 2029 the area under broadacre cropping would be extensively expanded if the NT realises its potential. The cotton industry alone is projected to grow to 35,000 hectares, up from just 80 hectares currently, generating 300 jobs.

The project will identify potential crops, the timing and length of the potential cropping windows, and the impacts of climate and soil conditions on yield and quality. These factors ultimately determine the productivity of broadacre cropping systems. For crops that can be grown based on available resources and environmental conditions, there must also be an analysis of their market opportunities to support their successful adoption. The initial focus will be on rainfed and irrigated systems growing cotton and peanut crops, while maize, sorghum, rice and pulse crops will also be investigated as possible 'break crop' options for cotton and peanut producers.

A mixture of on-field and simulation techniques will be used throughout this project. Small-scale trials will be complemented by larger, commercial demonstration trials and supported by crop simulation tools like OZCOT.

"Advances in these crop simulation models provide a powerful tool that can be used to extend learnings from past and current field research, build an understanding of the short-and long-term risk profiles, identify key management decisions, determine irrigation water demands, and incorporate producer experience while developing an overall picture of the cropping potential of a region," DPIR senior research agronomist Dr Ian Biggs said.

Data collected as part of the trials will be used to validate OZCOT under Northern Australian conditions, while the University of Southern Queensland (USQ) will contribute its cropping system modelling expertise to the project. The USQ Centre for Sustainable Agricultural Systems helps decision-makers identify system constraints and make informed, science-based decisions that improve the productivity, profitability and environmental sustainability of agricultural systems.

CRCNA CEO Jed Matz said this information will help producers decide which crops to grow, and when and where to grow them.

"This collaboration is about gathering the brightest minds in northern Australian cropping systems. It's about setting the starting points for the development of broadacre cropping systems by giving producers, investors and development decision-makers the information they need to realise the region's potential and all the economic benefits that flow from realising that potential," he said.

Steve Yeates

For more: read the full article in the Winter 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

New tool for crop termination on the way

Ultra high-pressure water cutting is making its way onto implements used in the cotton farming system.

This technology, named AquaTill Injeticide, incorporates herbicide with ultra high-pressure water cutting. It is great news for cotton growers, especially dryland growers, as it offers an alternative method of crop termination with minimal soil disturbance post-harvest.

Not only is successful crop destruction important to growers to meet the requirements of the Resistance Management Plan, it is important to the industry as a whole, as ratoon cotton is an over-winter host for pests and diseases. With more herbicide genes being commercialised, ratoon control is becoming increasingly difficult with limited herbicide options available.

The AquaTill technology was first tested on mulched cotton in 2017, in a CRDC-supported project with Sundown Pastoral Company's Darren Hart, Greg Butler from the South Australian No-Till Farmers Association and QLD DAF's Paul Grundy.

The initial trial found using ultra high-pressure water cutting had potential as an effective crop destruction method, and investigated the incorporation of herbicides for more robust control. CRDC supported this further investigation, working with Greg, Annabelle Guest, and the Dryland Cotton Research Association.

The trials (using fluroxypyr) have been successful, and the team found that 'nicking' rather than completely severing the stem was most effective in delivering the herbicide dose and killing the plant.

"We think this is because the fluroxypyr translocates in the vascular tissue that has not been severed and that is why higher control is achieved with just a nick," Annabelle said.

"We have also been working with manufacturers and towards registration of the technology as a new method of herbicide application."

AquaTill Injeticide is the name given to the technology by the manufacturers of the ground engagement rig, a machinery manufacturer in Narromine, Central Western NSW.

A registrant is on board to expand their Fluroxypyr 400 product label to include AquaTill Injeticide as a new method for controlling cotton ratoon regrowth. For interested growers, demonstrations will be set up across cotton regions in the 2020-21 season.

Melanie Jenson

For more: read the full article in the Autumn 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Section 4: RD&E Portfolio

Goal 2: Improve cotton farming sustainability and cotton value chain competitiveness

Improving value chain competitiveness and sustainability to derive $0.5 billion in greater value for Australian cotton growers – and helping Australian cotton achieve its ambition to be the highest yielding, finest, cleanest and most responsibly produced cotton in the world – are CRDC's aims within this goal. To work towards this, CRDC focuses investments in RD&E to create higher value uses for cotton, to ensure the sustainability of cotton farming, and to support measurement and reporting through the value chain.

In 2019–20, CRDC invested in 31 projects within this goal, accounting for 10 per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicator	Measures	2019–20 progress
2.1 Sustainability of cotton farming	2.1.1 Improved environmental footprint for cotton farms	Increase in sustainability metrics and improved carbon footprint	Percentage of farm native vegetation managed for conservation	The area of native vegetation not usually grazed remained steady at four per cent during 2019-20.
			Carbon footprint (kg of CO_2e per bale)	Nitrogen fertiliser is the most significant contributor to the cotton industry's carbon footprint, and CRDC maintains an extensive investment for improving nitrogen-use efficiency. Nonetheless, for the five years from 2014-2019, greenhouse emissions per bale increased by 12.5 per cent, mainly due to higher nitrogen use. However, the industry does not yet assess sequestration at the industry scale, and case studies have highlighted that individual farms can be carbon positive when carbon sequestration is taken into account. Accurately measuring sequestration at the industry level will be a focus to ensure that a complete picture of the industry's footprint can be calculated.
2.2 Create higher value uses for cotton	2.2.1 Increased value for Australian cotton	Increase in the number of new commercialised products	Number of new commercialised products	While no products were commercialised during 2019-20, three commercialisation proof-of-concept activities were supported: the use of gin trash for producing high value chemicals; the use of glycine as an alternative yarn treatment; and the use of cotton by-products to enhance the performance of sound-proofing panels.
	2.2.1 Increased understanding of market requirements and opportunities throughout the value chain	Information is publicly available on market requirements and value chain opportunities	CRDC research identifies opportunities to increase the value of cotton by 25 per cent	The commercialisation activities noted above have the potential to add value to cotton through better use of current waste streams, or allowing the production of higher value cotton fabrics.

2.3 Measurement and reporting throughout the value chain	2.3.1 CRDC collaborates in global leadership for sustainability initiatives	Evidence of involvement in global initiatives	Number of global initiatives participated in	CRDC continues to participate directly in five global initiatives: the International Cotton Advisory Committee (ICAC) Expert Panel on the Social, Economic and Environmental Performance of Cotton; the Sustainable Agriculture Initiative; the Sustainable Apparel Coalition; the Better Cotton Initiative 'Project Delta'; and Cotton2040. CRDC also participates indirectly in the EU's Product Environmental Footprint processes.
	2.3.1 The value chain is transparent and understood by participants to improve market opportunities	Economic and sustainability implications of transparency throughout the value chain are published and understood	Reports and sustainability information published	The *Australian Cotton Sustainability Report 2019* was published jointly with Cotton Australia in 2019-20, and broad consultation commenced with stakeholders on draft industry targets for nine key sustainability indicators. Projects have been established to enable reporting against those targets, including the development of appropriate social capital and wellbeing indicators. In addition, projects are continuing to investigate strategies for improving labour conditions throughout the supply chain, and the information and transparency needs of the supply chain, in particular the retail/brand sector. Terms of reference have also been drafted for the conduct of the industry's fourth Environmental Audit, to commence in 2020-21.

RD&E highlights

Synthesis of natural resource assets in the cotton-growing region of eastern Australia (FWPA1801)

This project lays a foundation for developing and reporting ecological sustainability, by creating a comprehensive database of the extent and condition of natural assets the industry uses in eastern Australia. The database, which is accessible to growers via the CottonInfo website, helps to define values and drivers of natural landscape management in cotton regions. The database includes information on biodiversity, vegetation areas, wetlands, groundwater-dependent ecosystems, corridors and connectivity. It is used to evaluate and prioritise 'relative conservation value' of native vegetation, and areas for restoration. The project is part of the Forest and Wood Products-led Rural R&D for Profit program project, Natural Capital Accounting in the Primary Industries, supported by the Department of Agriculture, Water and the Environment. The data from this project will be used in the larger Rural R&D for Profit project to account for natural capital within cotton.

PhD: Sustainable water extractions: Low-flow refugia and critical flow thresholds (UNE1406)

When inland rivers flow, biodiversity thrives. But when there is low or no flow, waterholes (refugia) become refuges for fish, animals and plants, which maintains ecosystems and riverine diversity. In-channel flows help maintain connections between waterholes by facilitating dispersal and mediating water quality. Human activities, such as vehicle and domestic stock access and water pumping, increasingly threaten refugia, especially when flows are low. This project studies the locations, features, and functions of refugia to guide decision making about irrigation, management of rivers, and neighbouring landscapes. The project will make recommendations on appropriate strategies for restoration of in-channel and riverbank areas.

New technologies to improve natural resources (biodiversity) on Australian cotton farms – Cotton Landcare Tech-Innovations 2021 (NLP1901-1903, NLP2001)

This project builds on international best practice to implement and develop cutting-edge technologies, such as drone mapping and aerial seeding, acoustic monitoring and big data, to help Australian cotton better understand, report on and improve on-farm biodiversity. It is funded under the National Landcare Program's Smart Farming Partnerships initiative. In one sub-project, the research team is deploying innovative acoustic technologies to actively monitor, manage and report on biodiversity for a subset of bird and microbat species. In another sub-project, trial sites are being established to investigate the success of tube stock plantings against direct seeding for river red gums. This research aims to improve the capacity for cost-effective revegetation on cotton farms by trialling new and improved revegetation methods using drone and tractor technology.

Strategies for improving labour conditions within the Australian cotton value chain (QUT1903)

Practices occurring downstream in the cotton value chain represent a reputational risk to the Australian cotton industry and to its valued supply chain partners, including brands and retailers. To understand how the whole Australian cotton value chain functions, this project is starting with the working conditions of key Asian and African garment industries and their relevance to the Australian industry. It looks at the networks, regulatory frameworks, social context, and the parties that are best positioned to influence change. It investigates ways through which our industry could strategically enforce external labour standards. The project will produce an evidence-based toolkit of strategies and resources that can improve compliance with labour standards along the chain. It promotes industry adoption of a pathway to ensuring decent conditions for workers.

Understanding environmental impacts and resource impacts with changing demand for Australian cotton, assessed using a change modelling life cycle assessment approach (CRDC1911)

The penultimate consumers of cotton (retailers and brands) are increasingly interested in understanding and reducing the environmental and social impact of their entire supply chain, including raw material production. The preferred methodology for developing this understanding and determining how to best reduce their impact is through the use of life cycle assessment (LCA). There is the potential that clothing could have labels with an environmental and social impact rating in the same way that electrical appliances have an energy rating.
A challenge confronting cotton is that the LCA methodology being used by the supply chain is an *attributional* LCA (aLCA), designed as a tool to identify priority sustainability hot spots in a supply chain. An aLCA, however, focuses narrowly on the product (e.g. T-shirt) in question, and does not consider the impact of any changes in a system, e.g. as a result of changing the type of raw material used to make that product. This is a significant gap: the consequences of making changes are not being taken into account, and changes informed by only an aLCA methodology may result in perverse outcomes.

For the cotton industry, it is critical therefore that a broader perspective is taken when considering changes in raw material procurement policies, such as provided through using a *consequential* LCA (cLCA) methodology. A cLCA approach considers the impact at a broader systems level; for example, reducing cotton production would also reduce the production of cottonseed oil, which would need to be replaced by another type of vegetable oil, which may well have a higher environmental impact. A cLCA would take into account this broader impact – the consequences – resulting from a reduction in cotton production. Using a cLCA analysis of changes in cotton production, this project considers impacts from greenhouse gas emissions, energy use, freshwater and stress-weighted water use.

Joint RDC Community Trust Project (RIRDC1903)

In this project, 10 Research and Development Corporations (RDCs) and two rural organisations combine to build, rebuild and maintain community trust in the Australian agriculture sector. The project aims to identify strategies, best practice approaches and interventions that are common across the sector. This information will enable the Australian agriculture sector to build a common language and collective national narrative around the community trust challenge. It will also help to develop the sector's capability to monitor, anticipate, and respond to shifts in the levels of trust the community has in Australia's rural industries. The first year of the research has found that trust in rural industries is dependent on three drivers: environmental responsibility, responsiveness to community concerns, and the importance of products produced by rural industries. It found that trust in rural industries is high and that Australians believe farmers play an important role in society, but there are areas of community concern around environmental responsibility and responsiveness.

PhD: Improving precision agriculture and climate adaptation for the Australian cotton industry (ANU1602)

This project focuses on improving precision agriculture and climate adaptation by increasing the efficiency of nitrogen application in cotton. It investigates the physicochemical behaviour of commonly used nitrogen-based fertilisers, with a specific focus on the behaviour of urea in relation to temperature, salinity, soil type and crop rotation. The resulting datasets will assist in improving precision agricultural practices, and be used as a platform to further explore the behaviour of nitrogen in irrigation pipes and classic ridge and furrow field structures, in order to determine its impact on plant nutrient uptake and runoff into adjacent ground and surface water bodies.

Sustainability metrics for the cotton industry (CRDC1944)

Australian cotton growers have been quietly and collaboratively working to improve their sustainability performance for decades. In 1991, cotton became the first Australian agricultural industry to benchmark its environmental performance, and more recently, it has worked to develop sustainability reports and targets. This project oversees the development and implementation of the cotton industry's Sustainability Strategy, and coordinates the efforts of the Sustainability Working Group (SWG), which comprises representatives from CRDC, Cotton Australia and the wider industry. In 2019-20, the SWG launched the *Australian Cotton Sustainability Report 2019*, providing data on eight priority social, economic and environmental topics. The SWG continues to progress the development of the industry's sustainability targets.

Case study

Transforming Australia's cotton industry

The cotton industry has released its highly anticipated *Australian Cotton Sustainability Report 2019*, following on from the inaugural report published in 2014.

The report, co-produced by CRDC and Cotton Australia, tells a positive story of increasing efficiency in the use of resources, including water and land. It reveals long-term trends that producing a bale of cotton now takes 48 per cent less water, 34 per cent less land, and 97 per cent less insecticide than it did in 1992.

By comparing performance over five-year periods in the industry's most important sustainability areas, the report also highlights areas for improvement, including nitrogen-use efficiency and the closely associated increase in greenhouse gas emissions per bale.

"Sustainability for the Australian cotton industry means running profitable and efficient businesses while creating environmental, economic and social value. It also means being accountable to stakeholders for the industry's actions and impacts," CRDC General Manager, R&D Investment, Allan Williams said.

"The Australian cotton industry has been actively working to do this for over 30 years.

"Now, the industry is seeking to improve even more as it works towards its vision of being a global leader in sustainable cotton production."

The report is focused on eight sustainability topics most important to the industry and its stakeholders. These topics were decided through a process involving a technical review, industry input and external stakeholder consultations.

The report is part of the industry's new PLANET. PEOPLE. PADDOCK. sustainability framework that guides the industry to set ambitious targets, coordinate a whole-of-industry strategy to achieve these targets, and engage effectively with stakeholders on actions and progress.

Allan said the industry will now use report data to set five-year targets for 2024 and 2029, along with plans to achieve those targets.

"We need to set bold targets, ensure our research and adoption program can get us to those targets, and frequently and transparently share progress with our stakeholders," Allan said.

"We will be consulting with growers and other stakeholders inside and outside the industry on setting the right level of ambition in our sustainability targets.

"The industry can point to long-term trends of significant improvement in areas it has focused on in the past, and we will draw on this experience to transform our performance in other areas in the future."

For more: read the full article in the Winter 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight, and download the Australian Cotton Sustainability Report 2019 https://www.crdc.com.au/publications/australian-cotton-sustainability-report.

Case study

CottonInfo launches online biodiversity management guides for Aussie cotton growers

CottonInfo, the cotton industry's joint extension program, has launched new online biodiversity management guides for Australia's 36 cotton-growing shires.

For the first time, the innovative resources give cotton growers detailed biodiversity information and outline beneficial practices to support biodiversity on their farms.

Growers can select their local government area (LGA) on CottonInfo's new clickable map to see a snapshot of the biodiversity in their shire, along with practical tips to improve conditions for the diversity of species in that specific cotton landscape.

The biodiversity data presented in the map was collated through CRDC research projects to help the cotton community to understand and prioritise the conservation value of areas of native vegetation within cotton landscapes (cotton farms plus a 5-km buffer).

The research looked at 315 threatened and iconic plant and animal species in the cotton landscapes of eastern Australia, from the NSW-VIC border to the Fitzroy Basin in QLD, and used that data to develop targeted biodiversity management profiles for each of Australia's 36 cotton-growing shires.

Building on previous research funded by CRDC, Forest & Wood Products Australia, CSIRO and the Australian Government's Rural R&D for Profit program, each management profile specifies the biodiversity assets, including vegetation types, wetlands, species, rivers and creek lines, and adjacent public land reserves, and recommends management actions to best suit the habitats of the species represented in each of the shires.

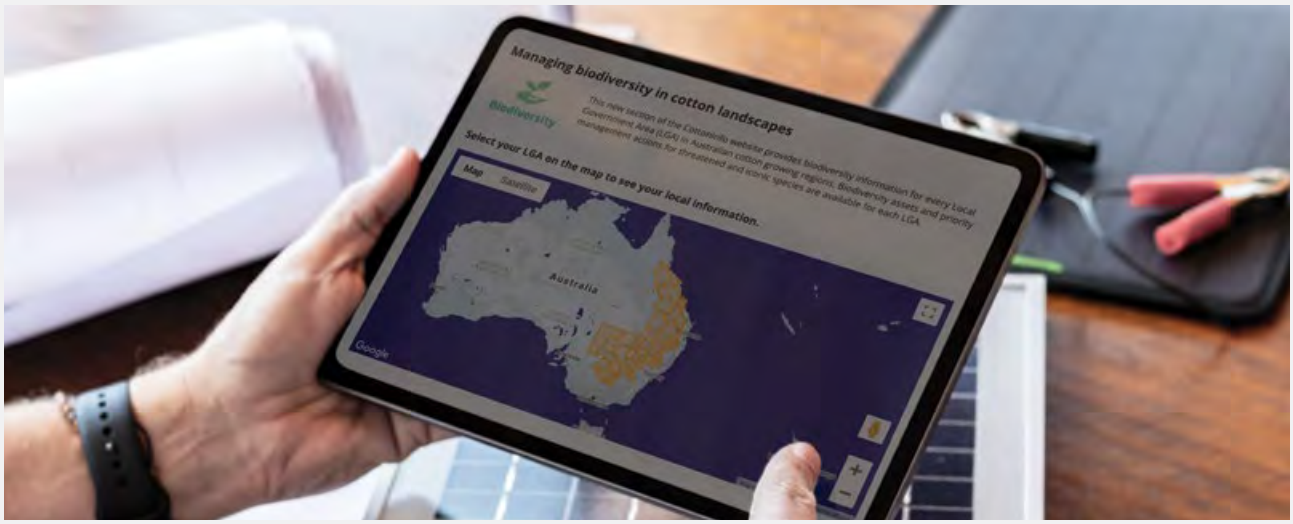
Stacey Vogel, CRDC R&D Manager, said the biodiversity management guides are based on comprehensive research that for the first time brings together valuable data to support 'boots on the ground' action to improve conditions for biodiversity in cotton landscapes.

"The cotton landscapes of eastern Australia contain an abundant diversity of native plant and animal species that occur in a mosaic of forest, woodland, wetland, grassland and cropland systems," she said.

"Growers can use the CottonInfo map to get a snapshot of the biodiversity assets and priority management actions for threatened and iconic species in their LGA, and then use that information to make decisions that support biodiversity on their farms.

"Protecting biodiversity is important for all Australian cotton-growing communities. Biodiversity delivers ecosystem services on which businesses and communities enjoy and are dependent. These new online biodiversity management guides are another useful addition to the cotton grower's toolbox for improving biodiversity."

This initiative is an outcome of the Cotton Landcare Tech Innovations 2021 project funded by CRDC in partnership with the Australian Government's National Landcare Smart Farming Partnership Initiative.



For more: view the biodiversity management guides on the CottonInfo website
www.cottoninfo.com.au/managing-biodiversity-cotton-landscapes

Section 4: RD&E Portfolio

Goal 3: Build adaptive capacity for the cotton industry

Building the adaptive capacity of the Australian cotton industry and enabling the industry to achieve its future vision is CRDC's aim within his goal. To work towards this, CRDC focuses investments to deliver science and innovation capability and new knowledge, and to facilitate futures thinking.

In 2019–20, CRDC invested in 40 projects within this goal, accounting for five per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicators	Measures	2019–20 progress
3.1 Science and innovation capability and new knowledge	3.1.1 Science and innovation capacity is strengthened and strategically fit for a digital future	Increase in the number of researchers supported through strategic pathways	Number of PhD, post-doctoral and early career researchers supported	CRDC supported 17 PhD candidates and 16 early career researchers in 2019–20. Sponsorship of the ABARES Science and Innovation Awards continued.
			Number of scientific exchanges	CRDC supported the biennial Australian Association of Cotton Scientists Conference, bringing together 194 cotton researchers from Australia and overseas. CRDC also supported participation by 22 international and domestic researchers in the 2019 International Cotton Advisory Committee Plenary meeting held in Brisbane.
	3.1.2 Increased understanding of and participation from the diverse human capital in regional communities	Information is available on the diversity of social networks (age, gender, roles, culture, range of service providers, occupations and skills)	Report released	During 2019-20, a post-doctoral project continued to develop an understanding of the needs of a future cotton workforce. In addition, a study was commissioned to assess the socio-economic contribution of the Australian cotton industry at a regional and national level. CRDC also worked towards the development of the cotton industry's digital strategy-building on the CRDC-led, cross-sectorial *Australian Agriculture: Growing a Digital Future* project. The digital literacy of people working in the cotton industry is a key focus of the strategy. The Growing a Digital Future project found agriculture-specific role categories had low levels of digital maturity. The project developed an agricultural workforce national digital capability framework, including recommendations to lift the digital maturity of the sector.

	3.1.3 Increased opportunities for innovation skills development	Degree to which innovation is supported by CRDC	Number of participants in innovation initiatives	CRDC supported 15 cotton growers (one from each Cotton Grower Association) to participate in AgriFutures Australia's evokeAG event. In addition, a 'futures' workshop looking at novel farming systems was held, in conjunction with virtual workshops to consider reduced-input farming systems. CRDC also continued to support the ABARES Science and Innovation Awards program.
			Number and details of new ideas generated that provide benefit for the cotton industry	Innovations in the areas of glass recycling, spray drift management, volunteer cotton control, insect control, and biodiversity monitoring continued their development in 2019-20.
3.2. Futures thinking	3.2.1 Australian cotton farmers are able to adapt to change	Growers report improved capacity to manage unknown or unexpected events (resilience)	Percentage of growers who report improved general resilience	CRDC continued to support CRDC Grassroots Grants to help cotton growers adapt to change and build resilience. In addition, CRDC invested in a project investigating resilience thresholds in regional communities. Baseline figures for levels of industry global life satisfaction, and physical and mental health have been established and were reported in the *Australian Cotton Sustainability Report 2019*. They will be tracked for change and used to inform future needs.
	3.2.2 Increased opportunities for strategic foresighting	Futures workshops lead to recommendations for future opportunities	Number of futures workshops	A 'futures' workshop looking at novel farming systems was held in 2019-20 in conjunction with virtual workshops to consider reduced-input farming systems.
			Number and details of future opportunities to be followed up	The novel farming systems workshop identified four discrete future opportunities, the first one of which – Sandbox Grants, to support farmers to try novel systems on their farms – will be trialled in 2020-21.

RD&E highlights

Improving grower decisions in complex systems: A targeted tool to assist cotton growers in appropriate technology adoption (QUT2001)

This project looks to apply behavioural economics to decision making in agriculture. The ability for growers to continually assess emerging science, adapt technologies and improve practices increasingly underpins the profitability, sustainability and competitiveness of cotton-growing businesses and the Australian cotton industry. Choices of appropriate technology and digital systems for a farm business enterprise are often difficult to make, given the array of factors that need to be considered, including financial, environmental and, just as importantly, often unrecognised personal attitudes and biases. This project seeks to develop a personalised tool to help growers identify and prioritise appropriate technologies in which to invest, ones that are suited to their unique social, environmental and economic circumstances and trajectory.

Postdoc: Understanding and planning for the future cotton workforce (USQ1801)

As farming businesses continue to adapt and innovate to meet challenges to production and improve their sustainability, the success of these efforts depend on an adequately skilled workforce. This project considers how digital agriculture changes the skills required for the next generation of workers, the implications for work adjustment, and the ongoing development of these workers. The project has identified gaps in the following skills: technical, workplace health and safety, people management, leadership, employee employability, and personal management. It aims to provide best practice performance standards for growers and employees, in conjunction with the *my*BMP human resources module.

Cotton industry social and wellbeing indicators (UC1901)

This project is focused on developing robust, practical and relevant social and wellbeing targets and indicators for the Australian cotton industry. To do so, the research team are drawing on their extensive experience in developing meaningful objectives and indicators for rural Australia through the annual Regional Wellbeing Survey, the nation's largest survey of social wellbeing in rural and regional areas. The project is developing baseline data for indicators, ensuring they can be compared to national averages and are meaningful to the cotton industry, its value chain, and key stakeholders and consumers. Key to a successful outcome is to ensure social indicators fit well within overall sustainability reporting about the cotton industry, and are relevant across the value chain of the industry.

Thresholds for resilience in regional communities (UM1902)

The resilience of cotton communities is important to the industry's performance and sustainability. Through this project, a participatory resilience assessment with regional cotton communities is being undertaken to identify adaptive responses to change and contributions the cotton sector can make. It seeks to identify critical threats, major thresholds or tipping points facing cotton communities as well as opportunities for adaptation. The relationship between specified (related to cotton sector) and general resilience (capacity to cope with uncertainty and change) is also being examined in order to establish indicators of resilience. From this, the possible management responses to reduce future risks can be identified. This process will foster social networks and train participants in the use of resilience assessment processes, providing an ongoing capacity to respond to change dynamics and to measure success for the industry and communities over time.

Nuffield Australia Farming Scholarships (CRDC1801, CRDC1901, CRDC2009)

Three cotton growers received support from CRDC and Cotton Australia under the Nuffield Australia Farming Scholarships program in 2019-20: Luke McKay of Kununurra, Renee Anderson of Emerald, and Richard Quigley of Trangie. Luke's Nuffield research, which he completed during this year, was focused on issues relevant to tropical cotton-growing systems. Renee's research, which she continued this year, focuses on highlighting better management practices to improve the social, environmental and economic sustainability of agriculture and drive broader community support. Richard's research, which he commenced this year, investigates cropping systems and methods to retain more crop residue in zero-tillage farming systems.

People in Agriculture website (DA1502)

The People in Agriculture project provides an online resource for the agricultural sector to help employers and employees with human resource management needs. Developed by a collective of Research and Development Corporations (RDCs), it provides an overarching agriculture perspective as well as sector-specific content, with resources for employers and employees on one centralised hub. Since its launch in 2017, the People in Agriculture website has delivered up-to-date employment information to over 100,000 farmers, managers and employees. The website features information on employment law, compliance and career management, and provides a platform for sharing employment stories in agricultural industries. A key feature is purpose-built templates, guides and fact sheets designed to help manage on-farm employees and guide farmers on professional workplace practices.

Travel: CGA representatives to attend evokeAG 2020 (CRDC2003)

Following the success of AgriFutures Australia's inaugural immersive agricultural technology event, evokeAG, CRDC supported cotton growers to attend the second event held in 2020. evokeAG is the largest agrifood tech event in the Asia Pacific, attracting over 1000 delegates and 115 speakers. It provides an insight into the rapidly evolving world of agricultural innovation and is of interest to growers who are passionate about RD&E, innovation, solving problems through technology and new funding models, like venture capital. As a result, CRDC supported 15 cotton growers, representing their local Cotton Grower Associations (CGAs), to attend evokeAG. The growers were empowered to share their knowledge, learnings and key insights back to their fellow growers, via their CGAs, on their return.

Australian Rural Leadership Program – Courses 25, 26 and 27 (RIR1901, RIR1902, RIR1903)

The ARLP is a 15-month leadership development program that takes place across Australia and overseas, immersing rural, regional and remote participants in a series of unique experiences to develop their leadership capabilities. Cotton industry scholarships are offered each year, with support from CRDC, Cotton Australia and Auscott Limited. During 2019-20, cotton's course 25 ARLP participants Fleur Anderson of Theodore and John Durham of Coleambally completed their program, and course 26 participants Chantal Corish of Goondiwindi (also supported by Prime Super) and Rod Gordon of Goondiwindi commenced. The course 27 participant, Ruth Redfern of Narrabri, was announced during 2019-20 and will commence the program in 2020-21.

ABARES Science and Innovation Awards for young people in agriculture (ABA1901)

The Annual ABARES Science and Innovation Awards, run by the Department of Agriculture, Water and the Environment, are a competitive grants program that provides funding for innovative research projects to benefit Australia's rural industries. CRDC is a supporter of the annual awards, and in 2019-20, supported two award recipients: the 2019 winner, Dr Dean Brookes of the University of Queensland, and the 2020 winner, Dr Dinesh Kafle of the QLD Department of Agriculture and Fisheries. Dean's innovative research project focuses on scanning irrigation water for trace amounts of DNA left behind by pests and pathogens, as a potential new way to quickly identify the presence of difficult-to-find cotton pests. Dinesh's novel project investigates whether cotton plants can be primed with silicone to boost their defences against fusarium wilt and reniform nematode.

CRDC Grassroots Grants (CGA1902-1904; CGA2001-2005)

CRDC's annual Grassroots Grants program provides grants of up to $10,000 to cotton grower associations (CGAs) to support local projects. The grants support on-farm trials, demonstrations and workshops, and build intrinsic value, such as fostering collaboration, peer-to-peer learning, and improving research skills for non-researchers through on-farm and grower-led research. Since the program began in 2011, 77 projects have been supported, with $670,000 invested by CRDC into grower organisations across the valleys. During 2019-20, these projects included the installation of weather stations in the Lower Namoi; on-farm evaluation of pumping telemetry in the Macquarie; a study tour to investigate planting times, pests and spray drift management strategies for growers in Walgett; an on-farm demonstration of the internet of things (IoT) and low-power, long-range (LoRaWAN) networks in St George; and a project to foster cross-sectoral RD&E collaboration and leadership in Northern Australia.

Rural Safety and Health Alliance (RIRDC1901)

The Rural Safety and Health Alliance is a partnership of Research and Development Corporations (RDCs) investing in a fresh approach to improve primary production's health and safety record centred on innovative research and extension. The Alliance aims to generate positive change in the Australian agriculture industry's work health and safety record, using innovative research and extension to deliver practical health and safety solutions. Key objectives include setting clear priorities to better target research, development and extension, strengthening industry leadership, and developing a 'shark tank' funding model, where applicants work together to pitch projects for funding. The Alliance is focused on six work health and safety (WHS) priority areas, including: the development of agricultural communication guidelines; identifying and prioritising cross-sectoral WHS overlaps; reviewing health and safety data capture in agriculture; creating healthy farm management cultures; understanding behavioural insights to WHS; and critical control management on farms.

Case study

Dinesh awarded cotton's 2020 Science and Innovation Award

Dr Dinesh Kafle, an agricultural scientist at Queensland's Department of Agriculture and Fisheries, is the CRDC-supported ABARES Science and Innovation Award winner for 2020.

Dinesh was presented with his award at the ABARES Outlook Conference dinner in Canberra in March 2020, attended by CRDC's Executive Director Ian Taylor and Board Director Jeremy Burdon.

Dinesh's innovative research project will investigate whether cotton plants can be primed with silicon to boost their defences against fusarium wilt and reniform nematode. His project will germinate cotton seeds in soil with added silicon, before infecting them with the diseases.

Dinesh says that while silica is present naturally in the soil, it is difficult for crops to absorb. He plans to examine if there is any priming effect when plants are given soluble silicon as seedlings. Dinesh says very little work has been done on silicon in the past.

"It's a novel approach," he says. "So, if successful, it's going to be really a great tool for growers to consider while managing the disease."

The study will trial cotton seeds grown in both seedling trays and pots, to test whether transplanting silicon-primed seedlings provides better defence than direct sowing. Dinesh says the concept of priming itself is also relatively new, having been studied mostly in ecological settings.

"I'm trying to see if the priming has any implications in agriculture, so it's really exciting," he says.

Dinesh grew up in a small village in Nepal, living next to an agricultural research station whose field trials would inspire him for life. He trained in Germany and Israel, before turning his attention to Australian cotton in 2018. Dinesh says it's been amazing to work in such a large, profitable and interesting industry.

"It's a lot of opportunities," he says. "I'm still learning so many things, and it's an exciting field of agriculture."

As the recipient of this year's award, Dinesh will receive a CRDC grant to undertake this novel research.

The Annual ABARES Science and Innovation Awards, run by the Department of Agriculture, Water and the Environment, are a competitive grants program that provide funding for innovative research projects to benefit Australia's rural industries. CRDC has been a partner in the awards for 12 years.

Steve Keough

For more: Read more about Dinesh's work with reniform nematodes in the Winter 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight

Case study

Making farms the safest of places

Over the past 20 years, there has been only a small reduction in the number of farm-related and non-intentional injury deaths across the Australian agricultural and fishing sectors.

However, these reductions, while welcome, have not been as extensive as those in other known high-risk sectors such as mining and construction, making primary production comparatively the most dangerous industry in Australia.

Recognising the need to explore different approaches to get different results, nine Rural Research and Development Corporations have come together to form the Rural Safety and Health Alliance (RSHA).

"The people who work to produce our food and fibre are the most valuable asset to this sector, so more work needs to be done," said RSHA Executive Officer, Andrew Barrett.

The partners are CRDC, AgriFutures Australia, Australian Eggs, Australian Pork, Australian Wool Innovation, Dairy Australia, Fisheries Research & Development Corporation, Grains Research and Development Corporation and Meat & Livestock Australia.

"This collaboration seeks to leverage the commitment, commonality and resources of the RDC partners to create positive health and safety impact across the sector," Andrew said.

"During 2019, the alliance partners created the RSHA Investment Strategy and Investment Plan, and this year will see a number of foundational projects commence, seeking to create impact that flows to the on-farm level, as well as addressing strategic change at the system level."

RSHA partners recognise health and safety is a complex challenge, in a sector like no other. "We are building strong relationships within the partners, including leveraging the impressive leadership and work of CRDC in the area of health and safety," Andrew said.

"We are collaborating with important stakeholders, including the National Farmers Federation, Farmsafe Australia, Safework Australia and state-based regulators."

CRDC has previously invested in RD&E aimed at improving health and safety in Australia's rural industries through the Primary Industries Health and Safety Partnership (PIHSP), the forerunner to the RSHA. The cotton industry has put strategic programs in place in collaboration with Cotton Australia via Farmsafe, *my*BMP's WHS module, and AgSkilled training program delivering WHS courses.

With the latest WHS injury and fatality data up to 2014, CRDC recently commissioned a study to update the data, which will inform the industry's sustainability reporting. Along with the dairy industry, the industries are the only two that actively collate WHS data.

The study found that while from 2014-19 the industry appears to have made progress in terms of reducing the number of injuries, fatalities are still occurring. These involved similar factors identified in previous studies: aircraft, vehicles and machinery.

"CRDC is committed to improving the safety of people working on farms," said CRDC R&D Manager Rachel Holloway, who oversees WHS investment. "We, along with dairy, have led the way in terms of data collection and action around WHS on farms, and we're looking forward to sharing our knowledge with other industries to improve the status of agriculture across the board."

Ruth Redfern

For more: read the full article in the Autumn 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Section 4: RD&E Portfolio

Enabling strategy one: Strengthening partnerships and adoption

Further strengthening our collaboration and relationships with our partners, and working together to ensure effective adoption pathways exist for research outcomes, are CRDC's aims within this enabling strategy. To work towards this, CRDC focuses investments in strengthening partnerships and collaboration, best practice through *my*BMP, and supporting innovation and commercialisation.

In 2019–20, CRDC invested in 40 projects within this goal, accounting for eight per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicators	Measures	2019–20 progress
4.1 Partnerships and collaboration	4.1.1 Growers/ consultants value CRDC farming systems research outcomes	Maintain or increase the number of growers/ consultants that value CRDC research outcomes	Percentage of growers/consultants that report valuing CRDC outcomes	81 per cent of cotton growers and 89 per cent of consultants value CRDC's outcomes. Our 2023 target is 85 per cent.
	4.1.2 CottonInfo partnership is maintained and practice change improved	R&D outcomes are demonstrated through extension and adoption activities	Number of demonstration sessions	CottonInfo organised or contributed to 78 events involving 1,188 participants in 2019-20. Of these, 25 activities were organised by CottonInfo and 53 were organised in partnership with other organisations.
			Percentage of participants that report increased knowledge, skills, and intention to change behaviour as a result	Three workshops/webinars focused on improving irrigation management were held in 2019-20. 84 per cent of the 126 participants reported increased knowledge and skills. 89 per cent reported an intention to change their behaviour.
	4.1.3 Partnerships are strengthened to engage multi-disciplinary and multi-institutional resources (centres of excellence)	Evidence of effective collaborative projects	Percentage of investments that include cross-sectoral partnerships	48 per cent of RD&E investments in 2019-20 were in cross-sectoral partnerships, including strategic collaborations on water-use efficiency, nitrogen, novel crop protection, biosecurity, engagement and Northern Australia. Collaboration was prioritised as part of managing reduced investment due to drought.
			Number of new international and national partnerships	Two new national partnerships were established looking at community trust in agriculture and ensuring an Australian perspective is provided to the European Union on their product environmental footprint policy. An existing partnership, the Plant Biosecurity Research Initiative, was renewed.
			Partner satisfaction ranking	The 2019-20 Partner Relationship Review indicated that CRDC's current overall satisfaction ranking is 8.4 out of 10, an improvement from the 2016 baseline of 8.2. Our 2023 goal is 8.5 out of 10.

4.2 Best practice (*my*BMP)	4.2.1 Best practice is based on science and measured impact	*my*BMP practice modules reflect latest R&D outcomes	Percentage of topics within *my*BMP modules (that CRDC contributes to) that have been updated with CRDC R&D outcomes	All relevant *my*BMP modules were updated during the year with research and development outcomes.
4.3 Innovation and commercialisation	4.3.1 Improved R&D innovation and commercialisation	CRDC supports researchers to innovate and become more commercially focused	Number of projects with commercialisation potential	Seven of the 17 projects that have commercialisation potential either have a commercial partner on board or have commercialisation processes underway. However, the ongoing ability to support at the desired commercial pace may be affected by the ongoing drought, depending on the level of support willing to be offered by commercial partners. CRDC has also provided support to innovation and commercialisation processes, such as the AgFrontier Regional AgTech incubator during 2019-20, and developed a CRDC Intellectual Property & Commercialisation Strategy.
		Research partners are supported through the commercialisation process (to ensure successful knowledge transfer)	Researchers report satisfaction with CRDC commercialisation support	A Commercialisation Manager (contractor) has been appointed to CRDC to review commercialisation approaches. Changes in researcher satisfaction will be assessed once the revised processes are bedded down.
		Commercialisation and knowledge transfer is accelerated	Percentage improvement in duration from conception to market entry (per product category)	A Commercialisation Manager (contractor) has been appointed to advise and enact a process to reduce time from conception to market entry. Percentage improvement will be assessed once the revised processes are bedded down.

RD&E highlights

Collaboration agreement inversion towers GRDC/CRDC (GRDC2003)

CRDC and the Grains Research and Development Corporation (GRDC) have been collaborating to minimise the potential for, and impact of, the occurrence of spray drift from cotton and grain properties since 2016. Before this collaboration, there had been no reliable and accurate method to determine when inversion conditions are hazardous or non-hazardous for agricultural spraying. The research funded by GRDC and CRDC has developed such technology – a Spray Drift Hazard Alert and Warning System – allowing growers to identify spray opportunities. The objective at this stage of the collaboration is to explore the potential options to establish, operate and maintain a network of Profiling Automatic Weather Stations (PAWS) across the cotton and grain belts of eastern Australia, to deliver this technology to growers. In June 2020, the partners opened an expression of interest call, seeking proposals from parties to deliver the technology.

Cotton industry sustainability reporting: On-farm safety incidences 2014-2019 (US2001)

Agriculture contributes disproportionately to workplace health and safety (WHS) incidents across Australia, and the cotton industry is focused on improving WHS. To monitor progress, CRDC commissioned a review of the cotton industry's injury and safety profile in 2014, and repeated this in 2019-20. The report found that six people lost their lives on cotton farms in Australia from July 2014 to June 2019. The causal factors were aeroplane, farm vehicles and farm machinery. From 2014 to 2019, the annual number of serious injuries in the cotton industry declined by 13 per cent. This data was incorporated into the *Australian Cotton Sustainability Report 2019*, and targets are currently being set to ensure continuous improvement in WHS.

Understanding motivational factors for improved spray application on farms (UNE1901)

Spray drift, the off-target movement of herbicides and pesticides, negatively impacts agricultural production across Australia. The problem is particularly acute in mixed cropping regions where a diverse range of chemicals may be applied at any given time. Although industry organisations have developed and implemented an impressive set of technologies, education programs and workshops aimed at improving spray solutions across multiple agriculture sectors, the problem persists. This project took a unique approach to the problem: using theory and practice from the behavioural sciences to: identify the main drivers and barriers to engagement in best-practice spray application; identify the number and nature of grower segments, based on their current practices; and identify the main leverage points to initiate and sustain behaviour changes to reduce spray drift. As a result of this work, the researchers have recommended targeted engagement strategies for segments that are not engaged in best-practice spraying.

2019 ICAC Plenary Meeting (ICAC1901-1907)

The International Cotton Advisory Committee's (ICAC) 78th Plenary Meeting was held in Brisbane over four days in December 2019, hosted by the Department of Agriculture, Water and the Environment with support from CRDC as a major sponsor and organising committee member. ICAC is an association of governments from cotton-producing, consuming and trading countries, and is the only global intergovernmental group for cotton and cotton textiles. More than 300 people from 23 member governments attended the meeting, including representatives from five international organisations and five non-member countries. There were a range of international guest speakers, along with a contingent of 10 presenters from Australia's world-leading crop of cotton scientists, who shared their latest research and expertise. Topics included soil health, plant breeding, energy, climate and resistance management.

WeedSmart Phase 4 (UWA1801)

WeedSmart is an Australian agricultural industry-led initiative to enhance on-farm practices and promote the long-term sustainability of herbicide use. The aim is to provide growers with tools and information to ensure weed management is at the forefront of farming practice. The 2019 WeedSmart week was held in Emerald in August 2019, and consisted of a one-day forum, a one-day bus tour to farms in the Emerald region, and a half-day tour of SwarmFarm Robotics. Cotton growers and consultants attended, with specialists discussing integrated weed management practices to minimise the impact of herbicide resistance. The event also saw the launch of the 'Summer Big 6': the six core management tactics growers should implement to manage weeds.

CottonInfo Field Demonstration Trial: Soil health workshop (CSD2001)

One of CottonInfo's key focus areas is the improvement of knowledge and awareness of soil health issues and adoption of best practices. To help achieve this, in 2019-20, CottonInfo hosted workshops in conjunction with Crop Consultants Australia to improve grower and consultant awareness of the importance of soil health, demonstrate practical techniques to assess health, and discuss options to address soil-related issues. The workshops were facilitated by CottonInfo Technical Lead for Soil Health, Dr Oliver Knox, and focused around on-farm soil pits to provide a practical focus for discussing issues. The workshops were attended by 150 growers and consultants and built upon knowledge gained from previous CRDC-supported research conducted by Dr Knox (UNE1603 and UNE2001) about constrained root growth below 60 cm, resulting in a focus on soil and sub-soil health for productive plant growth.

Communicating cotton best production practices with video (DAQ1901)

The CottonInfo YouTube channel (youtube.com/CottonInfoAust) was created in August 2013 under a previous CRDC-supported project to house the repository of short informative videos on a wide range of cotton-related topics. The videos feature CottonInfo team members, researchers, growers and other industry experts, and include how-to examples, topic overviews, research outcomes, case studies and key messages. The channel is an important conduit of research and development, extension and adoption, best practice and practice change information and for forming a critical resource for CottonInfo communications. The channel is well supported: as at May 2020, it contained a total of 194 videos, had 4,288 subscribers and 1.26 million views.


Melanie Jenson

Case study

ICAC brings world of cotton to Brisbane

The International Cotton Advisory Committee's (ICAC) 78th Plenary Meeting, with the theme Global Leadership: Pushing Cotton's Boundaries, was held in Brisbane in December 2019, with support from CRDC as a major sponsor.

The Sofitel Brisbane was a hive of multicultural activity, discussion, networking and resolutions, all aimed at strengthening the cotton industry across the globe. A trip to the Darling Downs also took delegates and ICAC staff into the field, where they met growers, visited Bayer's laboratory and saw Australian researchers and research at work. They also learned how to distinguish male and female *Helicoverpa* pupae with a hands-on demonstration of pupae-sexing.

ICAC is an association of governments from cotton-producing, consuming and trading countries, and is the only global intergovernmental group for cotton and cotton textiles. More than 300 people attended, from 23 member governments, including representatives from five international organisations and five non-member countries.

There was a range of international guest speakers, along with a contingent of 10 presenters from our world-leading crop of cotton scientists, who shared their latest research and expertise with a very attentive audience. Topics included soil health, plant breeding, energy, climate and resistance management, of which Australia is considered a leader.

"From a cotton point of view, Australia is one of the few countries in the world that is at the cutting edge of cotton research," ICAC Executive Director Kai Hughes said in his opening address.

"Therefore, it is very apt and appropriate that we should be discussing global leadership and pushing cotton's boundaries here in Australia, a country that has taken the lead in this area in so many ways."

With a mission to assist members in fostering a healthy world cotton economy, ICAC continually strives to operate internationally in the interests of the cotton industry. Its role is to raise awareness, provide information, and serve as a catalyst for cooperative action on issues of International significance.

"ICAC membership delivers tangible benefits in the form of increased access to statistics and critical technical information provided by the Secretariat, and can lead to enhanced participation in collaborative interactions in cotton research and development," Kai said.

"Perhaps most importantly, membership provides the avenue for a country's government and cotton industry to fully join with other cotton countries to discuss issues of international scope and significance."

The meeting was opened by CRDC Chair, Richard Haire, who was followed by Dr Steve Hatfield-Dodds, Executive Director of ABARES, within Australia's Department of Agriculture, Water and the Environment, who identified global megatrends in the cotton industry, along with the opportunities and challenges they would create. These trends are: growth juggernaut; empowered consumers; disruptive technologies; more from less; fractal politics; and cascading planetary risks.

"Change and constant innovation will be needed to address these trends shaping agriculture, especially climate change, geopolitical realities and consumer choices. The challenges should be seen as opportunities requiring intensive research, consumer understanding and engagement."

Melanie Jenson

For more: read the full article in the Autumn 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Spray drift warning system a step closer to implementation

Minimising spray drift is a high priority for Australian agriculture, with the grains and cotton industries joining to develop a hazardous weather warning system to provide real-time weather data and alerts to growers and spray operators.

The Grains Research and Development Corporation (GRDC) and CRDC are currently working to identify partner/s to develop and deploy the Spray Drift Hazard Alert and Warning System in NSW and QLD, with potential to expand to other states and industries.

GRDC's Manager Chemical Regulation Gordon Cumming said the aim of the investment was to create a system that would improve on-farm decision making by accurately identifying and predicting hazardous spray conditions.

"Reducing the risk of spray drift is imperative for social, environmental and financial reasons for Australian agriculture and the wider community," Gordon said.

"As research leaders, GRDC and CRDC are committed to investing in research that supports improved on-farm practices, the sustainability of agriculture and, more specifically, the enduring profitability of Australian farmers.

"This work will be a significant venture into an innovative new space that will see the development of a continuous network to mitigate spray drift across the cropping areas of eastern Australia."

Regulations currently provide strict guidelines for the application of agricultural chemicals, which do not permit spraying when hazardous surface temperature inversions are present. In this situation, droplets can remain suspended in the inversion layer in concentrated form and be carried significant distances.

Until recently, there has been no reliable and accurate method to determine when inversion conditions are hazardous for agricultural spraying using real-time data. A previous CRDC and GRDC project investigated the effect of near-surface temperature on spray operations and produced methodology and algorithms that allow accurate predictions of hazardous inversion conditions.

After the recent expression of interest (EOI) process, CRDC and GRDC are now considering proposals for the building of a tower network, and the development of software with remote sensing capability to provide information back to growers and spray contractors about weather conditions. This work involves establishing, operating and maintaining a network of Profiling Automatic Weather Stations (PAWS), initially across the grain and cotton regions of QLD and NSW, with the potential to expand nationally.

GRDC and CRDC are equal investment partners in this project to develop the technology for this spray drift hazard alert and warning system.

CRDC's Executive Director Dr Ian Taylor said the EOI and subsequent submissions represented the next step in the process of improving spray drift hazard detection by creating an effective warning system for growers.

"Spray drift is a significant issue for agriculture, and this investment represents a vital cross-industry collaboration to improve information and outcomes at a farm level," he said.

Melanie Jenson

For more: read the full article in the Spring 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Section 4: RD&E Portfolio

Enabling strategy two: Driving RD&E impact

Ensuring CRDC's investments deliver impact and effectiveness, therefore creating value for our stakeholders, is CRDC's aim within this enabling strategy. To achieve this, CRDC ensures our RD&E investments meet grower, industry and government needs and our projects align with stakeholder priorities.

In 2019–20, CRDC invested in six projects within this goal, accounting for two per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicator	Measures	2019–20 progress
5.1 Impact and effectiveness	5.1.1 CRDC investments meet grower, industry and government needs	Funded projects align with CRDC research priorities	Percentage of aligned projects	All funded projects aligned with CRDC research priorities; 90 per cent of new investments in 2019–20 were fully aligned with grower panel advice.
		Positive stakeholder feedback about the relevance and value of CRDC investments	Percentage of positive responses	89 per cent of growers and consultants have provided positive feedback about the relevance and value of CRDC's investments. Our 2023 goal is 95 per cent.
	5.1.2 CRDC monitors and evaluates RD&E impact	Monitoring and evaluation evidence demonstrates RD&E impact	RD&E impact reported	CRDC has established a Monitoring and Evaluation (M&E) Framework aligned with the Strategic RD&E Plan. During 2019-20, CRDC invested in Phase One of the evaluation of the More Profit from Nitrogen program. In addition, the *Australian Cotton Sustainability Report 2019* was published jointly with Cotton Australia during 2019-20. Notable outcomes supported by CRDC investments include a continued reduction in the amount of water required to produce a bale of cotton, an increase in irrigated cotton yields over the five-year period of 10 per cent, and a reduction in the Environmental Toxic Load for algae and bees.
	5.1.3 CRDC-funded projects demonstrate value and return on investment	Positive return on investment (ROI)	Investments demonstrate a minimum ratio of benefit/cost	CRDC is investing in independent assessments of the return on investment of selected projects. Economic case studies were commenced on selected nitrogen research investments to assess the extent to which the research outcomes have or will result in improvements in productivity and/or profitability.
	5.1.4 Growers, the cotton industry and government are informed and aware of R&D outcomes and CRDC's progress and performance	Stakeholders report that CRDC communications meet their needs	Communications satisfaction rating	The 2019-20 Partner Relationship Review indicated that CRDC's current communication satisfaction ranking is 8.3 out of 10, unchanged from the 2016 baseline. Our 2023 goal is 8.5 out of 10.

RD&E highlights

Annual consultant qualitative and quantitative survey (CCA1901)

The annual qualitative and quantitative surveys measure the performance of research, production, practices and capacity critical to the Australian cotton industry. Crop Consultants Australia (CCA) collect the quantitative and qualitative data for the industry. The data plays an important role in informing the cotton industry, wider supply chain, the community and government of practice change within the sector, helping the industry to better tell its story. During this year, this project collected data for the 2018-19 season, representing 494 cotton growers and covering 155,287 hectares: 41 per cent of the Australia cotton production area). The report is available at the CRDC website (www.crdc.com.au/publications).

CRDC Cotton Grower Survey (CRDC1733)

CRDC undertakes an annual survey of cotton growers to gather information about farming practices and growers' views on research, development and extension. This information helps to inform CRDC about the benefits of the research it invests in. Change in industry practice can be quantified by comparing information across the surveys conducted over the past 20 years. The 2019 Cotton Grower Survey collected data for the 2018-19 season.

A total of 219 growers participated in the survey, growing an average of 298 hectares of cotton; 80 per cent of respondents were very positive about the future of the industry, despite the challenging seasonal conditions, and 24 per cent of respondents hosted a cotton industry research trial on their farm during the season. The report is available at the CRDC website (www.crdc.com.au/publications) in PDF and interactive digital formats.

2019 CRDC Stakeholder Research Survey (CRDC2006)

To assess the health of its partnerships with stakeholders, in 2019-20 CRDC invited its key partners to provide feedback on the health of the partnership, to identify what was working effectively and to highlight the opportunities for strengthening the partnerships. The feedback from this survey demonstrated strong results across each of the three headline organisational performance metrics. Overall satisfaction with the partnership across all partners was strong (8.4 out of 10), as was satisfaction with CRDC as an organisation to trust (8.9 out of 10) and satisfaction with the way CRDC engages (8.3 out of 10). Partners valued the commitment from CRDC to invest in and develop relationships, with the review finding that continuously improving relationships will deliver dividends.

Melanie Jenson

Case study

Cotton growers remain positive and supportive

Last season (2018-19) was a tough one climatically for most cotton growers. Asked to describe the season in three words, the recurring themes were 'dry', 'hot', 'challenging' and 'tough' – only six per cent of respondents described it as good!

Planted area dropped 30 per cent on the previous season to 336,000 hectares of irrigated and dryland cotton. Yield was back to 2.2 million bales, down from 4.5 million in 2017-18, with an irrigated average of 10 bales per hectare, compared to 11.8 bales in 2017-18, which also faced high temperature and low water availability. Dryland cotton averaged 1.2 bales per hectare, down from 2.5 the previous season.

While being a trying season, growers are continually making improvements in the way they manage their farms. Water-use efficiency continues to be a focus, with growers generally adopting multiple strategies. Reductions in energy use are being achieved through a range of practices, including minimising tillage and field operations, energy benchmarking and audits, installing more energy efficient equipment and the use of solar energy. Cotton growers are also strong supporters of the communities they live and work in, with 90 per cent involved in local community activities.

These are just some of the positive messages coming out of CRDC's annual survey of cotton growers.

The surveys gather information about farming practices and growers' views on research, development and extension. This information helps inform CRDC about the benefits of the research it invests in. The 2019 Grower Survey includes baseline information about growers and their farm business, including respondents' demographics (region, farm area) and season and farm information (yields, area of cotton). Each survey contains a number of focus areas, and this year that included water, energy, nutrition and soil, *my*BMP, IPM and crop protection, natural resource management, industry research trials, community and social contribution, and industry sentiment.

In total, 219 growers completed the 2019 survey. Of those who planted a crop, the average age was 49.9.

Climate was a big driver of results. Not surprisingly, 89 per cent said limiting factors for the crop were climate related: mainly hot weather and lack of water, with an average of 115 mm of in-crop rain and low allocations.

Growers used several strategies to manage limited water. In these limited water situations, most (73 per cent) planted to water availability. Some growers planted later, while 19 per cent planted both fully and semi-irrigated crops, with some single skip-row configurations. Nearly 20 per cent stopped irrigating during the season and ploughed crops in.

Nitrogen use changed little from last season: total N (kg/ha) was 325 kg in fully irrigated and 166.7 in partially irrigated. The industry's advised rate is a total of 200 to 250 kg/ha applied.

Soil surface testing was the most popular method to determine fertiliser rates, with similar levels for semi-irrigated and dryland crops. Petiole and leaf testing were similar across all systems, at around 30 per cent of growers surveyed.

Good news is that growers are increasingly adopting industry-recommended thresholds for pest management (97 this year compared to 90 per cent in 2016-17).

The value of integrated pest management is obvious – 96 per cent of growers are preserving beneficial insects.

For more: read the full article in the Autumn 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight, and download the full Cotton Grower survey results and digital dashboard www.crdc.com.au/publications/growersurvey.

Case study

Strengthening partnerships creates unity

As an investment organisation, CRDC relies on high-quality partnerships with research providers to deliver findings and innovations that address new and existing challenges for the benefit of the industry in the long term.

For the Australian cotton industry to benefit from research investments, the outcomes need to be rapidly extended and adopted, and as applicable, commercialised. To achieve these outcomes, CRDC works with many partners: research institutions, industry groups, individual researchers, fellow research and development corporations, and state bodies of agriculture. CRDC works with about 100 different research organisations each year.

"We pride ourselves on our strong relationships with cotton growers, research providers, government and other core partners," CRDC Executive Director Dr Ian Taylor said.

"Collaboration is at the very heart of everything we do: there isn't a single research project we invest in that isn't delivered in partnership with our growers, researchers and other collaborators.

"Of all the RD&E projects in cotton, we are partners in over 80 per cent of them."

CRDC also recognises the importance of cross-sectoral collaboration in solving issues bigger than the cotton industry alone. In 2019-20, 48 per cent of CRDC's investments were in cross-sectoral RD&E, tackling issues like climate variability, soil health and nutrition, irrigation, plant biosecurity, crop protection, farm safety, and human capacity.

To assess the health of its partnerships, CRDC invited its key partners to provide feedback, to identify what was working effectively, and also highlight opportunities for strengthening the partnership. This was undertaken in late 2019 and early 2020, replicating a similar study by CRDC in 2016.

The feedback has demonstrated strong results across each of the three headline organisational performance metrics and improvement in the partner ratings across a large number of measures from 2016.

"This was particularly encouraging, given the already high benchmarks achieved in 2016, the significant organisational changes at CRDC over the past few years, along with the increasingly difficult operating conditions now faced by the industry," Ian said.

"Trust is also integral to partnerships, and with a collective rating of 8.9 out of 10 for trust (up 0.2, with no partner rating this at less than a five out of 10) points to a strong foundation for a successful partnership."

Overall satisfaction with the partnership across all partners was again strong. The ratings and feedback provided highlighted a number of perceived strengths of the current engagement and relationship with partners.

"It is very pleasing for us to receive acknowledgment that our motivation is driven by our role as an 'industry custodian'," Ian said.

Melanie Jenson

For more: read the full article in the Winter 2020 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight, and download the Partner Relationship Review www.crdc.com.au/publications/crdc-partner-relationship-review.

Section 5

CRDC People and Governance

Melanie Jenson

CRDC Board

Mr Richard Haire – Chair

FAICD, FAIM

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

Appointed: 29/08/2016 until 29/08/2019.
Reappointed: 30/08/2019 until 29/08/2022.
Chair of the Remuneration Committee.

Ms Kathryn Adams – Deputy Chair

BScAgr (Hons), LLM, MBus, MEnvStud, Grad Dip Leg Pract, Prof Cert Arbitration, Practitioners Cert Mediation & Conciliation, FAICD

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

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

Appointed: 20/10/2014 until 30/09/2017.
Reappointed: 01/10/2017 until 30/09/2020.

Mrs Elizabeth (Liz) Alexander – Non-Executive Director

BA, MRurSysMgt, FAICD

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

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

Appointed: 20/10/2014 until 30/09/2017.
Reappointed: 01/10/2017 until 30/09/2020.
Chair of the Intellectual Property and Commercialisation Committee.

Mr Greg Kauter – Non-Executive Director

BAgEc, GradCertRuSc, GAICD

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

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

Appointed: 20/10/2014 until 30/09/2017.
Reappointed: 01/10/2017 until 30/09/2020.
Chair of the Audit Committee.

Dr Jeremy Burdon – Non-Executive Director

BSc (Hons), PhD, Hon DSc, FAA, FTSE, MAICD

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

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

Appointed: 01/10/2017 until 30/09/2020.

Emeritus Professor Les Copeland AM – Non-Executive Director

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

Professor Copeland holds BSc and PhD degrees from the University of Sydney and a Graduate Diploma from the Australian Institute of Company Directors. He has held research positions at Yale University, the University of Buffalo, the University of California in Davis, and the Australian National University. He is a Fulbright Alumnus, the recipient of an Excellence in Teaching Award from the American Association of Cereal Chemists-International, and has had international experience in capacity building. Emeritus Professor Copeland was awarded a Member (AM) in the General Division in the 2019 Queen's Birthday Honours, recognising his significant service to agricultural science as an academic and researcher.

Appointed: 01/10/2017 until 30/09/2020.

Ms Rosemary Richards – Non-Executive Director

BAgEc, MBA

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

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

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

Appointed: 01/10/2017 until 30/09/2020.

Dr Ian Taylor – Executive Director

BAppSc, PhD

Dr Taylor has extensive experience across the cotton RD&E pipeline, having worked as a researcher specialising in integrated weed management before progressing to management positions within the cotton industry's extension program, CottonInfo and CRDC. Before being appointed Executive Director, Dr Taylor performed the role of CRDC's General Manager of R&D Investments for five years, overseeing CRDC's investment in cotton RD&E to deliver impact, and leading the development of the CRDC Strategic RD&E Plan 2018–23.

Dr Taylor holds BAppSc and PhD degrees from The University of Queensland, is a graduate of the Australian Rural Leadership Program, and is Deputy Chair of the Summit Community Services board. He has extensive stakeholder management, strategy development, leadership and governance experience, combined with national and international networks, in part from his time as the Technology Development Lead and Asia-Pacific Technical and Stewardship Lead with Monsanto. In his former career, Dr Taylor was an avionics technician in the Australian Defence Force, where he developed a sound understanding of digital and advanced complex systems.

Appointed: 7 March 2019 by virtue of his appointment as Executive Director of CRDC. He attends the Audit, Intellectual Property and Remuneration Committees as an observer.

Ruth Redfern

Composition

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

Board

CRDC Board at 30 June 2020

1	Mr Richard Haire, Chair
2	Ms Kathryn Adams, Deputy Chair
3	Mrs Elizabeth Alexander, Non-Executive Director
4	Mr Greg Kauter, Non-Executive Director
5	Dr Jeremy Burdon, Non-Executive Director
6	Emeritus Professor Les Copeland, Non-Executive Director
7	Ms Rosemary Richards, Non-Executive Director
8	Dr Ian Taylor, 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 among Board members.

Induction

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

The induction process is tailored to the needs of new Directors. It may include an initial visit to the 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 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 the 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 2019–20, 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 Commercialisation, and Remuneration Committees in 2019–20. In addition to face-to-face meetings, the Board and its Committees conduct much of their work via email, video-conference and telephone, supported by a secure online information portal. CRDC finds this arrangement to be effective, productive and cost-effective.

Board meeting	Date	Location
Joint board meeting with Cotton Australia	23 July 2019	Griffith, NSW
Meeting 5 – 2019	21 August 2019	Armidale, NSW
Meeting 6 – 2019	12 November 2019	Narrabri, NSW
Meeting 7 – 2019*	19 November 2019	Teleconference
Meeting 1 – 2020	8 January 2020	Teleconference
Meeting 2 – 2020	17 February 2020	Melbourne, VIC
Meeting 3 – 2020	31 March 2020	Video-conference
Meeting 4 – 2020*	24 April 2020	Video-conference
Meeting 5 – 2020	23 June 2020	Video-conference

*Out-of-session board meetings held to complete activities required between the main board meetings.

Attendances at Board meetings

Director	Meeting 4 2019	Meeting 5 2019	Meeting 6 2019	Meeting 7 2019	Meeting 1 2020	Meeting 2 2020	Meeting 3 2020	Meeting 4 2020	Meeting 5 2020	TOTAL
Richard Haire	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9
Kathryn Adams	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9
Elizabeth Alexander	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9
Greg Kauter	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9
Jeremy Burdon	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9
Les Copeland	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9
Rosemary Richards	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9
Ian Taylor	✓	✓	✓	✓	✓	✓	✓	✓	✓	9 of 9

Melanie Jenson

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. In addition to CRDC Directors, the Board has appointed a skill-based member on the Audit Committee, Sam Skelton.

Intellectual Property and Commercialisation Committee

The role of the Intellectual Property (IP) and Commercialisation Committee is to assist CRDC's Board in fulfilling its responsibilities and strategic objectives for IP management and commercialisation of project outputs to maximise the benefits to the Australian cotton industry. The Committee's specific responsibilities are to review the operation of CRDC's IP and commercialisation policy and operating principles, and to consider IP and commercialisation matters directed to it by the Board for consideration. In addition to CRDC Directors, the Board has appointed a skill-based member on the IP and Commercialisation Committee, Jarrod Ward.

Attendances at Audit Committee meetings

Member/Observer	**7 August 2019** *In person*	**12 August 2019** *Teleconference*	**23 October 2019** *Teleconference*	**4 November 2019** *Teleconference*	**6 February 2020** *In person*	**14 May 2020** *Video-conference*	**TOTAL**
Greg Kauter	✓	✓	✓	✓	✓	✓	6 of 6
Rosemary Richards	✓	✓	✓	✓	✓	✓	6 of 6
Jeremy Burdon	✓	✓	✓	✓	✓	✓	6 of 6
Sam Skelton	✓	✓	✓		✓	✓	5 of 6

Attendances at Intellectual Property and Commercialisation Committee meetings

Member/Observer	**7 August 2019** *In person*	**21 October 2019** *Video-conference*	**5 February 2020** *In person*	**22 May 2020** *Video-conference*	**TOTAL**
Elizabeth Alexander	✓	✓	✓	✓	4 of 4
Rosemary Richards	✓	✓	✓	✓	4 of 4
Les Copeland	✓	✓	✓	✓	4 of 4
Jarrod Ward	✓	✓	✓	✓	4 of 4

Remuneration Committee

The Remuneration Committee advises the Board on the Executive Director's remuneration and senior staff remuneration adjustments.

Attendances at Remuneration Committee meetings

Member/Observer	24 July 2019 *In person*	5 November 2019 *Teleconference*	13 March 2020 *Teleconference*	1 June 2020 *Video-conference*	TOTAL
Richard Haire	✓	✓	✓	✓	4 of 4
Kathryn Adams	✓	✓	✓	✓	4 of 4
Jeremy Burdon	✓	✓	✓	✓	4 of 4

Statement of principles

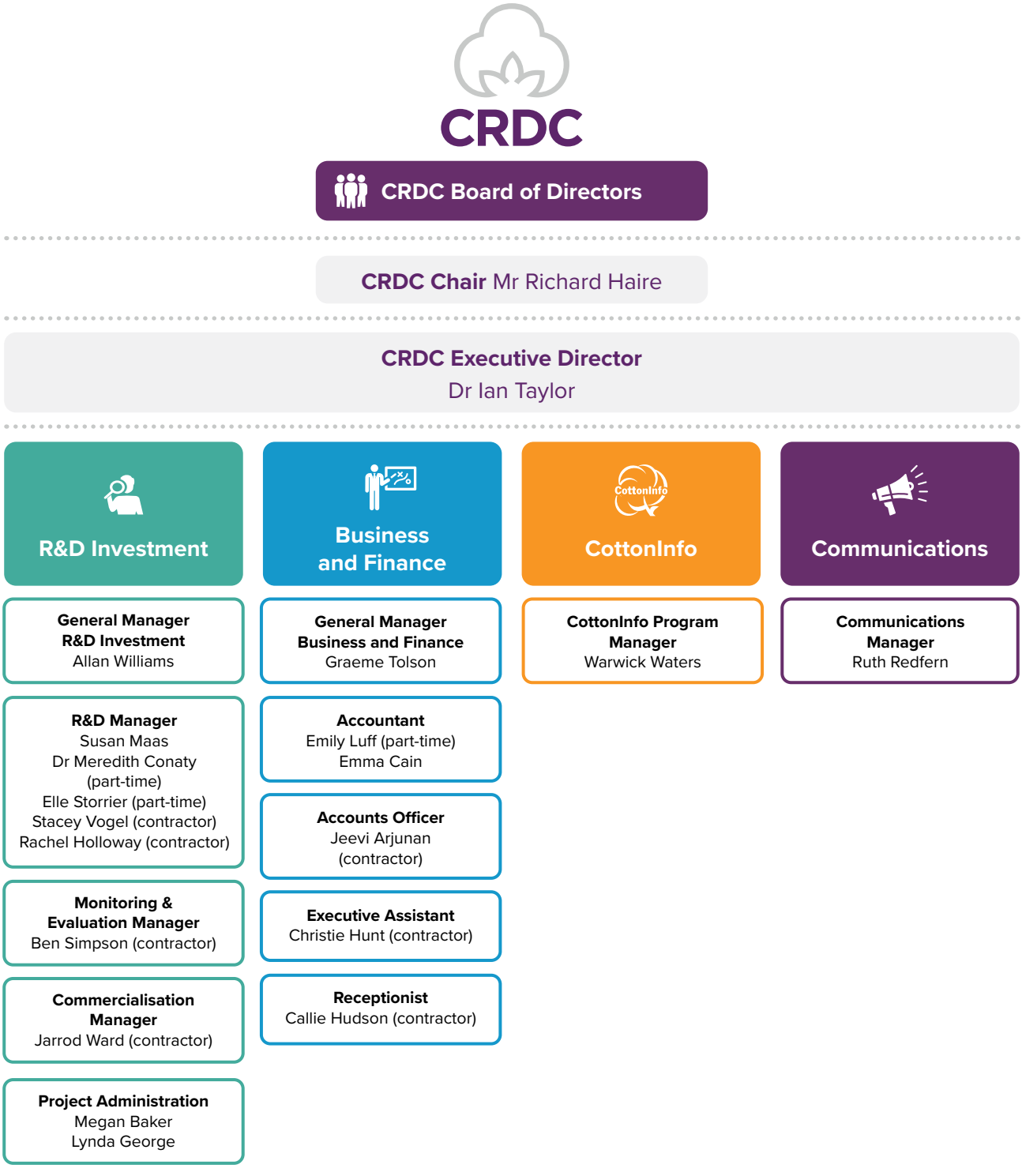
CRDC Directors and staff members are required to:

- 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 Employees

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

CRDC Organisational Structure as at 30 June 2020



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 nine full-time employees and three part-time employees as at 30 June 2020.

CRDC employees

Employee type	2015 –16	2016 –17	2017 –18	2018 –19	2019 –20
Full-time employees	11	11	11	9	9
Part-time employees	1	2	2	1	3
Casual	1	1	0	0	0
TOTAL employees*	**13**	**14**	**13**	**10**	**12**

*CRDC employees as at 30 June each year, excluding contractors.

Staff training and development

In 2019–20, CRDC spent $32,238 on training and $46,098 on recruitment. Areas of direct training activities were team values, management coaching, the Australian Institute of Company Directors (AICD) course, contract management, drone training, RD&E policies and procedures. 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. Staff members are chosen strictly according to their qualifications for the job.

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

Ruth Redfern

Key Management Personnel

During the reporting period ended 30 June 2020, CRDC had 10 key management personnel. These included seven non-executive directors, one executive director, and two senior executives who remained in their current roles for the full year.

The Chair and Non-Executive Directors' remuneration is determined by the Remuneration Tribunal, an independent statutory authority established under the *Remuneration Tribunal Act 1973*. The Executive Director and Senior Executives' remuneration is determined by the Board.

In accordance with the PGPA Rule, the Key Management Personnel information in Note 3.2 of the Financial Statements is further disaggregated in the table below:

		Short-term benefits			Post-employment benefits	Other long-term benefits		Termination benefits	Total remuneration
Name	**Position title**	**Base salary**	**Bonuses**	**Other benefits & allowances**	**Superannuation contributions**	**Long service leave**	**Other long-term benefits**		
Richard Haire	Chair	$52,680			$5,005				$57,685
Kathryn Adams	Deputy Chair	$26,340			$2,502				$28,842
Elizabeth Alexander	Non-executive Director	$26,340			$2,502				$28,842
Greg Kauter	Non-executive Director	$26,340			$2,502				$28,842
Jeremy Burdon	Non-executive Director	$26,340			$2,502				$28,842
Les Copeland	Non-executive Director	$26,340			$2,502				$28,842
Rosemary Richards	Non-executive Director	$26,340			$2,502				$28,842
Ian Taylor	Executive Director	$259,001		$18,880	$23,606	$8,062			$309,549
Allan Williams	GM R&D Invest.	$172,954			$15,852	$8,366			$197,172
Graeme Tolson	GM Business & Finance	$168,525			$15,851	$7,189			$191,565
Total		**$811,200**	**-**	**$18,880**	**$75,326**	**$23,617**	**-**	**-**	**$929,023**

CRDC does not have any other senior executive staff or highly paid staff.


CRDC

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.

Melanie Jenson

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. Cotton Australia undertakes a range of functions relating to CRDC, including an annual review to ensure the CRDC Strategic Plan remains current and relevant. The cotton industry and cotton researchers are closely involved in the development of the CRDC Strategic RD&E Plan, which incorporates Australian Government and cotton industry RD&E priorities, as well as advice from the Minister and the Department of Agriculture, Water and Environment.
Preparing an Annual Operational Plan for each financial year	An Annual Operational Plan is submitted to the Australian Government and Cotton Australia before the start 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	CRDC reports formally to the Australian Parliament through its Annual Report. In addition, CRDC informs the Minister for Agriculture 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, Water and Environment on a range of issues. Communication with the industry and Cotton Australia occurs continually on both a formal and informal basis, as outlined above. Communication with the broader community is a key focus of CRDC's communication activities. In order to ensure stringent evaluation of its RD&E activities, CRDC is committed to the ongoing Council of Rural Research and Development Corporation's Impact Evaluation process.
Facilitating the dissemination, adoption and commercialisation of research and development results in relation to the cotton industry	CRDC plays a pivotal role in facilitating fast and effective dissemination of cotton RD&E outcomes. CRDC undertakes detailed analysis and planning for determining the most appropriate adoption pathway for the results of research projects. While the majority of research results are extended as information, the CRDC actively works with its research partners to develop commercial adoption pathways where that is preferred. CRDC is a founding partner in the industry's joint extension program, CottonInfo, along with co-partners Cotton Australia and CSD Ltd. Formed in 2012, the CottonInfo team works to improve responsiveness to grower needs through improved communication and regional representation, focusing on delivering research directly to growers and consultants. The model recognises the importance of supporting adoption of RD&E through multiple delivery pathways and is underpinned by the industry's best management practices program, *my*BMP. In addition, CRDC hosts forums and on-farm events, participates in roadshows and the cotton trade show, produces publications, sponsors the biennial Australian Cotton Conference and Australian Cotton Research Conference, and has a communication strategy to extend and enhance the adoption of RD&E. CRDC also collaborates in the successful commercialisation of RD&E, where possible.

The PGPA Act

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

Other legislation

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

Cotton R&D levy

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

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

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

Minister

CRDC has been accountable to the Australian Parliament through two Ministers in 2019–20: Senator the Hon. Bridget McKenzie as Minister for Agriculture from 1 July 2019, and the Hon. David Littleproud MP as Minister for Agriculture, Drought and Emergency Management from 6 February 2020.

Minister's responsibilities

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

Ministerial directions

CRDC complies with all Ministerial directions, legislative and policy requirements of the Australian Government that it has been able to ascertain. CRDC received no Ministerial directions during 2019–20.

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 reports on investments, project outcomes, operation activities and financial statements every year via its Annual Report.
- CRDC publishes an Annual Operational Plan, Strategic R&D Plan, and Annual Report on the outcomes of investments, projects, operations and financials.

Policies, procedures and charters

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

Corporate reporting

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

CRDC submitted the Annual Operational Plan for 2019–20 to Senator the Hon. Bridget McKenzie as Minister for Agriculture on 25 June 2019, with the plan commencing 1 July 2019. The Annual Report for 2018–19 was submitted to the Minister on 11 October 2019, and the Minister tabled the report in Parliament on 27 November 2019.

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 2019–20.

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's 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 2019–20.

Significant changes in the state of affairs

CRDC had no significant changes in its state of affairs in 2019–20.

Judicial decisions

CRDC had no judicial decisions in 2019–20.

Reviews by outside bodies

Probity Management in Rural Research and Development Corporations

The Auditor-General undertook an independent performance audit across the statutory RDCs in 2019-20 noting:

"It is critical that the corporations uphold high probity standards given their often close interactions with a small number of researchers over time, and potential conflicts arising from the corporations' directors being industry representatives themselves. Total expenditure for the corporations in 2017–18 was $359 million and the audit was designed to provide assurance that RDCs are appropriately managing public funds in terms of probity risks. RDCs were last involved in a performance audit in 1998. The findings can provide lessons for future funding agreements managed by the Department of Agriculture, and the corporations can adopt examples of better practice highlighted in the audit."

The audit included AgriFutures Australia, FRDC, GRDC, Wine Australia and CRDC. The CRDC board reviewed and adopted all better practice audit recommendations.

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. Project technology that underwent commercialisation activities in 2019–20 included approaches to improved irrigation management, managing stress time thresholds, improved forecasting of inversion risk to reduce spray drift, and development of novel plant extracts.

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.

Melanie Jenson

Work Health and Safety summary

Legislative reporting requirements Schedule 2 Part 4 of the ***Work Health and Safety Act 2011***	Action undertaken 2019–20
Initiatives during 2019–20 and outcomes	• COVID-19: Changes to work practices to minimise the risk of COVID-19 in the workplace. Approved work from home arrangements, ceased travel and restricted access to the CRDC office. • Safety issues discussed at quarterly WHS staff 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.
Statistics of any notifiable incidents as defined by s38 of the WHS Act	• CRDC had no notifiable incidents in 2019–20.
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 in 2019–20.

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.

During 2019–20, CRDC had no freedom of information requests. CRDC manages requests in accordance with the provisions of its freedom of information plan, in compliance 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 2019–20, CRDC spent $999,317, 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
C&J Phelps Consulting	Program management services
Callida Consulting	Internal audit services
Computers Now Pty Ltd	ICT services
Rachel Holloway	Program management services
ICD Project Services	Program management services
Melanie Jenson	Publication content
Jobs Australia Enterprises Ltd	Contract staff
KEOwned Pty Ltd t/as KEO Design	Web consultant
Carolyn Martin	Publication content
Neil Deacon Graphic Design	Publication design
Peel HR Pty Ltd	Human resource management services
Revolution IT Pty Ltd	ICT services
Rimfire Resources Pty Ltd	Recruitment services
SapphireOne Pty Ltd	Software support
Loren Shaw	Software support
Stacey Vogel Consulting	Program management services
Universal McCann	Recruitment advertising

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 2019–20, CRDC contributed $104,767 to Cotton Australia for industry consultation, capacity building of advisory panel members and RD&E projects. These funds included $10,000 for their industry consultation role, including several specific activities:

- 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 2019–20, CRDC contributed a total of $94,767 to Cotton Australia for the following co-funded project activities:

- $55,000 support for the 2020 Australian Cotton Conference to increase awareness in the Australian cotton industry of research outcomes.
- $19,767 co-funding the National Residue Survey
- $20,000 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.

Selection Committee Report

Prof. Jim Pratley AM
Presiding Member
Cotton Research and Development Corporation
Board Selection Committee

31 July 2020

The Hon. David Littleproud MP
Minister for Agriculture, Drought and Emergency Management
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 2019 to 30 June 2020.

The terms of the CRDC Directors, with the exception of CRDC Chair Richard Haire, are due to complete on 30 September 2020. As such, upon my appointment as the Presiding Member of the Selection Committee from 30 March 2020, I commenced the selection process for the CRDC Director positions.

The Committee's nominations for six directors were provided to your office on 3 July 2020.

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

Yours sincerely

Prof. Jim Pratley AM
Presiding Member

COTTON RESEARCH AND DEVELOPMENT CORPORATION
office address 2 Lloyd Street, Narrabri NSW 2390, Australia **postal address** PO Box 282, Narrabri NSW 2390
P 02 6792 4088 **E** crdc@crdc.com.au ABN 71 054 238 316 **www.crdc.com.au**

CRDC

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 30 March 2020, you appointed me as the Presiding Member of the CRDC Selection Committee until 31 December 2022.

On 26 May 2020, 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 William Back, NSW, nominee of Cotton Australia
- Mr Nigel Burnett, QLD, nominee of Cotton Australia
- Dr Nicola Cottee, NSW, nominee of Cotton Australia
- Mrs Susan McCutcheon, NSW, nominee of Cotton Australia

Selection process

At the commencement of this process, I consulted with CRDC Chair, Mr Richard Haire, and Executive Director, Dr Ian Taylor, 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 Department of Agriculture, Water and the Environment. 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 as well as through a wide range of electronic media, industry and professional organisation, including the networks of Cotton Australia and CRDC.

The advertisements called for written applications against the criteria specified in the PIRD Act, which included:

- Data governance and application;
- Digital literacy – ability to learn, adapt and apply digital innovation;
- Science, technology and technology transfer;
- Social science and change management;
- Innovation and commercialisation;
- Cotton production and processing;
- Environmental stewardship;
- Economics or finance;
- Public administration and corporate governance; and
- International marketing and trade.

The committee sought candidates who also had a sound understanding of 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, 201 applications were received and considered by all members of the selection committee. A meeting was held on 29 May 2020 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 18 candidates, of whom seven were women. Interviews were conducted on 26 and 29 June 2020 by video-conference due to the constraints imposed by the COVID-19 pandemic. 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 six 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	nil
Applicants travel expenses and other interview costs	nil
Presiding Member fees	$9,500
Secretarial, office expenses and administrative support	$1,375
Advertising (incl.GST)	$16,169.91
Total	**$27,044.91**

Prof. Jim Pratley AM
Presiding Member

COTTON RESEARCH AND DEVELOPMENT CORPORATION
office address 2 Lloyd Street, Narrabri NSW 2390, Australia **postal address** PO Box 282, Narrabri NSW 2390
P 02 6792 4088 **E** crdc@crdc.com.au ABN 71 054 238 316 **www.crdc.com.au**

Section 6
Financials

Contents

INDEPENDENT AUDITOR'S REPORT

To the Minister for Agriculture

Opinion

In my opinion, the financial statements of the Cotton Research and Development Corporation ('the Entity') for the year ended 30 June 2020:

(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 Entity as at 30 June 2020 and its financial performance and cash flows for the year then ended.

The financial statements of the Entity, which I have audited, comprise the following statements as at 30 June 2020 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, comprising a summary of significant accounting policies and other explanatory information.

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 Entity in accordance with the relevant ethical requirements for financial statement audits conducted by the Auditor-General and his delegates. These include the relevant independence requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants (the Code) to the extent that they are not in conflict with the Auditor-General Act 1997*. I have also fulfilled my other responsibilities in accordance with the Code. I believe that the audit evidence I have obtained is sufficient and appropriate to provide a basis for my opinion.

Accountable Authority's responsibility for the financial statements

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

In preparing the financial statements, the Board is responsible for assessing the ability of the Entity 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 Board is also responsible for disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the assessment indicates that it is not appropriate.

GPO Box 707 CANBERRA ACT 2601
19 National Circuit BARTON ACT
Phone (02) 6203 7300 Fax (02) 6203 7777

Auditor's responsibilities for the audit of the financial statements

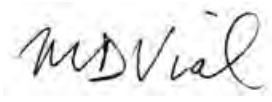
My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that 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 the Accountable Authority 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
20 August 2020

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 2020 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.

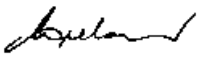
In our opinion, at the date of this statement, there are reasonable grounds to believe that the Cotton Research and Development Corporation will be able to pay its debts as and when they fall due.

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

Signed

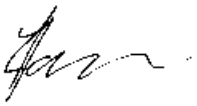
Richard Haire
Chair
19 August 2020

Signed



Les Copeland
Director
19 August 2020

Signed



Ian Taylor
Executive Director
19 August 2020

Signed

Graeme Tolson
Chief Financial Officer
19 August 2020

STATEMENT OF COMPREHENSIVE INCOME

for the period ended 30 June 2020

	Notes	2020 $	2019 $	Original Budget $
NET COST OF SERVICES				
Expenses				
Employee benefits	1.1A	**1,880,226**	1,964,199	2,446,000
Suppliers	1.1B	**916,406**	1,122,357	998,000
Grants	1.1C	**17,018,983**	20,803,322	16,510,000
Depreciation and amortisation	2.2A	**226,227**	234,060	259,000
Write-down and impairment of assets	1.1D	**-**	12,970	-
Losses from asset sales		**696**	6,081	-
Total expenses		**20,042,538**	24,142,989	20,213,000
OWN-SOURCE INCOME				
Own-source revenue				
Revenue from contracts with customers	1.2A	**3,850,461**	5,684,593	1,989,000
Interest	1.2B	**619,981**	983,475	600,000
Other revenue	1.2C	**1,303,198**	1,140,523	500,000
Total own-source revenue		**5,773,640**	7,808,591	3,089,000
Total own-source income		**5,773,640**	7,808,591	3,089,000
Net (cost of)/contribution by services		**14,268,898**	16,334,398	17,124,000
Revenue from Government				
PIRD Act 1989 Contribution	1.2D	**3,069,897**	8,679,831	5,839,000
Levies and penalties	1.2E	**3,070,321**	8,695,331	5,839,000
Total revenue from Government		**6,140,218**	17,375,162	11,678,000
Surplus/(Deficit) attributable to the Australian Government		**(8,128,680)**	1,040,764	(5,446,000)
OTHER COMPREHENSIVE INCOME				
Items subject to subsequent reclassification to net cost of services				
Gain/(Losses) on financial assets at fair value through other comprehensive income		**(26,517)**	82,476	-
Total other comprehensive income/(loss)		**(26,517)**	82,476	-
Total comprehensive income/(loss) attributable to the Australian Government		**(8,155,197)**	1,123,240	(5,446,000)

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

STATEMENT OF COMPREHENSIVE INCOME (CONTINUED)

for the period ended 30 June 2020

Budget Variances Commentary

Statement of Comprehensive Income for not-for-profit Reporting Entities

The original budget is the Corporation's 2019-20 Portfolio Budget Statements (PBS).

Employee expense decreased by $0.566 million due to the average full-time equivalent staffing being below budget during the year.

Grants expense increased by $0.509 million due to additional projects funded by external grant revenue and partly offset by reduced budgets for projects impacted by the drought.

Revenue from contracts with customers increased by $1.861 million as a result of:

- **Research Grant revenue** increased by $2.362 million as a result of receiving new grants from the Rural R&D for Profit program from the Department of Agriculture, Water and the Environment and grants from the program partners.
- **Other grants revenue** increased by $0.059 million as a result of opening revenue recognition adjustments for AASB 15 revenue from contracts with customers.
- **Royalty revenue** decreased by $0.667 million from budget as a result of the cessation of the seed trait royalty agreement.
- **Sponsorship revenue** increased by $0.107 million as a result of unbudgeted sponsorships received for the International Cotton Advisory Committee 2019 Plenary meeting in Brisbane.

Other revenue increased by $0.803 million as a result of an increase in surplus project funds returned by research organisations.

Commonwealth Contributions; and Industry Contributions, comprising of levies and penalties, decreased by $5.538 million as a result of a decrease in cotton production from which levies are collected and Commonwealth contributions are determined.

STATEMENT OF FINANCIAL POSITION

as at 30 June 2020

	Notes	**2020 $**	2019 $	Original Budget $
ASSETS				
Financial assets				
Cash and cash equivalents	2.1A	**16,025,028**	15,882,926	1,747,000
Investments	2.1B	**17,000,000**	24,500,000	28,000,000
Trade and other receivables	2.1C	**1,219,038**	3,246,974	3,809,000
Other investments	2.1D	**143,547**	170,064	88,000
Total financial assets		**34,387,613**	43,799,964	33,644,000
Non-financial assets				
Land and buildings	2.2A	**711,349**	713,497	795,000
Plant and equipment	2.2A	**354,533**	310,360	667,000
Computer software	2.2A	**37,282**	153,150	395,000
Total non-financial assets		**1,103,164**	1,177,007	1,857,000
Total assets		**35,490,777**	44,976,971	35,501,000
LIABILITIES				
Payables				
Suppliers	2.3A	**130,302**	115,180	200,000
Grants	2.3B	**4,137,341**	5,656,353	4,000,000
Other payables	2.3C	**57,833**	52,234	-
Total payables		**4,325,476**	5,823,767	4,200,000
Provisions				
Employee provisions	3.1A	**414,103**	313,106	491,000
Total provisions		**414,103**	313,106	491,000
Total liabilities		**4,739,579**	6,136,873	4,691,000
Net assets		**30,751,198**	38,840,098	30,810,000
EQUITY				
Reserves		**273,654**	273,654	251,000
Other reserves		**33,547**	60,064	-
Retained surplus		**30,443,997**	38,506,380	30,559,000
Total equity		**30,751,198**	38,840,098	30,810,000

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

STATEMENT OF FINANCIAL POSITION (CONTINUED)

as at 30 June 2020

Budget Variances Commentary

Statement of Financial Position for not-for-profit Reporting Entities

The original budget is the Corporation's 2019-20 Portfolio Budget Statements (PBS).

Cash and cash equivalents and Investments above PBS by $3.278 million as a result the cash balance at the 30 June 2019 was above budget.

Trade and other receivables below PBS by $2.590 million is represented by decreases in industry levies collected and held by the Department in June 2020 and matching Commonwealth contributions and partly offset by increases in contract assets and GST receivable.

Plant and equipment below PBS by $0.312 million as a result of delayed replacement of equipment and ICT infrastructure.

Computer Software below PBS by $0.358 million as a result of delayed upgrading of project management software.

STATEMENT OF CHANGES IN EQUITY

for the period ended 30 June 2020

	2020 $	2019 $	Original Budget $
RETAINED EARNINGS			
Opening balance			
Balance carried forward from previous period	**38,506,380**	37,465,616	36,005,000
Adjustment on initial application of AASB 15/AASB 1058	**66,297**	-	-
Adjusted opening balance	**38,572,677**	37,465,616	36,005,000
Comprehensive income			
Surplus/(Deficit) for the period	**(8,128,680)**	1,040,764	(5,446,000)
Closing balance as at 30 June	**30,443,997**	38,506,380	30,559,000
ASSET REVALUATION RESERVE			
Opening balance			
Balance carried forward from previous period	**273,654**	273,654	251,000
Closing balance as at 30 June	**273,654**	273,654	251,000
OTHER RESERVES			
Opening balance			
Balance carried forward from previous period	**60,064**	(22,412)	-
Comprehensive income			
Other comprehensive income	**(26,517)**	82,476	-
Closing balance as at 30 June	**33,547**	60,064	-
TOTAL EQUITY			
Opening balance			
Balance carried forward from previous period	**38,840,098**	37,716,858	36,256,000
Adjustment on initial application of AASB 15/AASB 1058	**66,297**	-	-
Adjusted opening balance	**38,906,395**	37,716,858	36,256,000
Comprehensive income			
Surplus/(Deficit) for the period	**(8,128,680)**	1,040,764	(5,446,000)
Other comprehensive income	**(26,517)**	82,476	-
Total comprehensive income	**(8,155,197)**	1,123,240	(5,446,000)
Closing balance as at 30 June	**30,751,198**	38,840,098	30,810,000

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

STATEMENT OF CHANGES IN EQUITY (CONTINUED)

Budget Variances Commentary

Statement of Changes in Equity for not-for-profit Reporting Entities

The original budget is the Corporation's 2019-20 Portfolio Budget Statements (PBS).

Adjustment on initial recognition of AASB 15 for the nett revenue and expenses of $0.066 million recognised as contract liabilities $(0.231) million and contract assets $0.297 million under the new accounting standards.

Deficit for the period above PBS deficit by $2.683 million is a result of the decrease in levies and Commonwealth matching and partly offset by increased grant revenues, as noted in the budget variance commentary on the Comprehensive Income Statement.

CASH FLOW STATEMENT

for the period ended 30 June 2020

	Notes	2020 $	2019 $	Original Budget $
OPERATING ACTIVITIES				
Cash received				
Industry levies and penalties		**4,164,162**	9,690,360	5,839,000
Commonwealth contributions		**4,334,628**	9,541,298	5,839,000
Royalties		**8,048**	222,435	675,000
Grants		**4,138,699**	5,955,770	1,314,000
Interest		**713,043**	928,195	600,000
Net GST received		**1,288,816**	1,487,759	-
Other		**1,215,903**	1,111,684	500,000
Total cash received		**15,863,299**	28,937,501	14,767,000
Cash used				
Employees		**1,781,492**	2,100,064	2,446,000
Grants		**20,272,529**	20,048,495	16,510,000
Suppliers		**1,014,096**	1,281,136	998,000
Total cash used		**23,068,117**	23,429,695	19,954,000
Net cash from/(used by) operating activities		**(7,204,818)**	5,507,806	(5,187,000)
INVESTING ACTIVITIES				
Cash received				
Proceeds from sales of property, plant and equipment		**21,818**	93,909	-
Investments		**52,500,000**	66,500,000	30,000,000
Total cash received		**52,521,818**	66,593,909	30,000,000
Cash used				
Purchase of property, plant and equipment		**174,898**	256,314	270,000
Investments		**45,000,000**	63,000,000	25,000,000
Total cash used		**45,174,898**	63,256,314	25,270,000
Net cash from/(used by) investing activities		**7,346,920**	3,337,595	4,730,000
Net increase/(decrease) in cash held		**142,102**	8,845,401	(457,000)
Cash and cash equivalents at the beginning of the reporting period		**15,882,926**	7,037,525	2,204,000
Cash and cash equivalents at the end of the reporting period	2.1A	**16,025,028**	15,882,926	1,747,000

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

CASH FLOW STATEMENT (CONTINUED)

for the period ended 30 June 2020

Budget Variances Commentary

Cash Flow Statement for not-for-profit Reporting Entities

The original budget is the Corporation's 2019-20 Portfolio Budget Statements (PBS).

Industry levies and Commonwealth contributions decreased by $3.179 million as a result of a decrease in industry levies collected and matching Commonwealth contribution determined in accordance with the PIRD Act 1989.

Royalty receipts decreased by $0.667 million as a result of the cessation of the seed trait royalty agreement.

Grant receipts increased by $2.825 million as a result of new research grants being contracted.

Net GST receipts increased by $1.289 million as a result of an increase in project milestones payable to research organisations.

Other receipts increased by $0.716 million as a result of an increase in surplus project funds returned by research organisations.

Employee payments decreased by $0.665 million as a result of reduction in the average full-time equivalent staffing during the year.

Grant payments increased by $3.763 million as a result of new RD&E projects being contracted as part of the new Government grants received during the year and reduction in grants payable at the end of year.

Investments cash received, net of cash used, increased above PBS as a result of an increase in the cash available for investment at the beginning of the year.

OVERVIEW

Notes to the Financial Statements

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);* 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 except for AASB 15 and AASB 1058 described below.

Standard / Interpretation	Nature of change in accounting policy, transitional provisions, and adjustment to financial statements
AASB 15 *Revenue from Contracts with Customers* / AASB 2016-8 *Amendments to Australian Accounting Standards – Australian Implementation Guidance for Not-for-Profit Entities* and AASB 1058 *Income of Not-For-Profit Entities*	AASB 15, AASB 2016-8 and AASB 1058 became effective 1 July 2019. AASB 15 establishes a comprehensive framework for determining whether, how much and when revenue is recognised. It replaces existing revenue recognition guidance, including AASB 118 Revenue, AASB 111 Construction Contracts and Interpretation 13 Customer Loyalty Programmes. The core principle of AASB 15 is that an entity recognises revenue to depict the transfer of promised goods or services to customers in an amount that reflects the consideration to which the entity expects to be entitled in exchange for those goods or services. AASB 1058 is relevant in circumstances where AASB 15 does not apply. AASB 1058 replaces most of the not-for-profit (NFP) provisions of AASB 1004 Contributions and applies to transactions where the consideration to acquire an asset is significantly less than fair value principally to enable the entity to further its objectives, and where volunteer services are received. The details of the changes in accounting policies, transitional provisions and adjustments are disclosed below and in the relevant notes to the financial statements.
AASB 16 *Leases*	The Corporation does not have any current lease arrangements.

Application of AASB 15 Revenue from Contracts with Customers/AASB 1058 Income of Not-For-Profit Entities

The Entity adopted AASB 15 and AASB 1058 using the modified retrospective approach, under which the cumulative effect of initial application is recognised in retained earnings at 1 July 2019. Accordingly, the comparative information presented for 2019 is not restated, that is, it is presented as previously reported under the various applicable AASBs and related interpretations.

Under the new income recognition model, the Corporation shall first determine whether an enforceable agreement exists and whether the promises to transfer goods or services to the customer are 'sufficiently specific'. If an enforceable agreement exists and the promises are 'sufficiently specific' (to a transaction or part of a transaction), the Corporation applies the general AASB 15 principles to determine the appropriate revenue recognition. If these criteria are not met, the Corporation shall consider whether AASB 1058 applies.

In relation to AASB 15, the Corporation elected to apply the new standard to all new and uncompleted contracts from the date of initial application. The Corporation is required to aggregate the effect of all of the contract modifications that occur before the date of initial application.

Impact on transition

The impact on transition is summarised below:

	1 July 2019
Assets	
Contract assets	297,010
Total Assets	**297,010**
Liabilities	
Contract liabilities	230,713
Total Liabilities	**230,713**
Total adjustment recognised in retained earnings	**66,297**

OVERVIEW (CONTINUED)

Set out below are the amounts by which each financial statement line item is affected as at and for the year ended 30 June 2020 as a result of the adoption of AASB 15 and AASB 1058. The first column shows amounts prepared under AASB 15 and AASB 1058 and the second column shows what the amounts would have been had AASB 15 and AASB 1058 not been adopted:

	AASB 15 / AASB 1058 $	Previous AASB $	Increase / (Decrease $
TRANSITIONAL DISCLOSURE			
Expenses			
Grants	17,018,983	17,091,100	(72,117)
Total Expenses	**17,018,983**	**17,091,100**	**(72,117)**
Revenue			
Grants	3,850,461	3,706,542	143,919
Total Revenue	**3,850,461**	**3,706,542**	**143,919**
Net (cost of)/contribution by services	**(13,168,522)**	**(13,384,558)**	**216,036**
Assets			
Contract assets	369,127	0	369,127
Total Assets	**369,127**	**0**	**369,127**
Liabilities			
Contract liabilities	86,794	0	86,794
Total Liabilities	**86,794**	**0**	**86,794**
Net Assets	**282,333**	**0**	**282,333**
Equity			
Adjustment on initial application of AASB 15/AASB 1058	66,297	0	66,297
Surplus/(Deficit) for the period	(8,128,680)	(8,344,716)	216,036
Retained earnings	**(8,062,383)**	**(8,344,716)**	**282,333**

Initial recognition of *AASB 15 Revenue from contracts with customers* requires revenue received for future performance obligations to be transferred to contract liabilities and expenses incurred for partially performed obligations that are not yet recoverable from the customer to be transferred to contract assets.

Taxation

The Corporation is exempt from all forms of taxation except Fringe Benefits Tax (FBT), the Goods and Services Tax (GST) and State payroll taxes.

Events after the Reporting Period

There was no subsequent event that had the potential to significantly affect the ongoing structure and financial activities of the Corporation.

Accounting Judgements and Estimates

In the process of applying the Corporation's accounting policies, management has made a number of judgements and applied estimates and assumptions to future events. Information around judgements and estimates which are material to the financial statements are found in the following notes:

- Note 4.1 Available-for-sale financial assets

1. FINANCIAL PERFORMANCE

This section analyses the financial performance of the Corporation for the year ended 2020.

1.1 EXPENSES

	2020 $	2019 $
1.1A: EMPLOYEE BENEFITS		
Wages and salaries	**1,599,669**	1,841,437
Superannuation:		
Defined contribution plans	**153,281**	145,911
Defined benefit plans	**4,278**	31,115
Leave and other entitlements	**122,998**	(54,264)
Total employee benefits	**1,880,226**	1,964,199

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	**119,113**	206,760
Consultants	**215,202**	173,094
Corporate services	**21,325**	29,399
Information technology	**300,259**	300,401
Legal services	**6,377**	59,084
Levy management	**12,818**	20,061
Personnel services	**83,877**	172,689
Property services	**86,425**	72,563
General administration	**42,036**	59,196
Total goods and services supplied or rendered	**887,432**	1,093,247
Goods supplied	**139,069**	120,488
Services rendered	**748,363**	972,759
Total goods and services supplied or rendered	**887,432**	1,093,247
Other suppliers		
Remuneration of auditors	**26,000**	26,000
Workers compensation expenses	**2,974**	3,110
Total other suppliers	**28,974**	29,110
Total suppliers	**916,406**	1,122,357

Lease commitments

The Corporation does not have any current lease arrangements.

1.1 EXPENSES (CONT)

	2020 $	2019 $
1.1C: GRANTS		
Public sector:		
Australian Government entities	**2,718,825**	3,578,286
State and Territory Governments	**4,748,076**	5,861,671
Universities and Colleges	**5,240,832**	5,424,842
Corporate extension activities	**425,517**	577,059
Private sector:		
Commercial entities	**3,957,850**	4,967,534
Total contracted grant programs	**17,091,100**	20,409,392
Grant acquittal	**-**	393,930
Transfer from (to) contract asset	**(72,117)**	-
Total grants	**17,018,983**	20,803,322
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	**14,279,807**	14,116,506
Funded through research grant revenue	**8,952,854**	13,754,308
Total research grant commitments payable	**23,232,661**	27,870,814
Note 1.1D: Write-down and Impairment of Other Assets		
Impairment of property, plant and equipment	**-**	12,970
Total write-down and impairment of other assets	**-**	12,970

1.2 OWN-SOURCE REVENUE AND GAINS

OWN-SOURCE REVENUE	2020 $	2019 $
1.2A: REVENUE FROM CONTRACTS WITH CUSTOMERS		
Sale of goods	**700**	-
Rendering of services		
Research grants	**3,676,324**	5,180,197
Other grant	**59,485**	300,000
Royalties	**7,316**	204,396
Sponsorships	**106,636**	-
Total revenue from rendering of services	**3,849,761**	5,684,593
Total revenue from contracts with customers	**3,850,461**	5,684,593

Accounting Policy

Revenue from the sale of goods or services is recognised when control has been transferred to the customer.

The following is a description of principal activities from which the Corporation generates its revenue:

Research grants received from the Commonwealth require the Corporation to generate and deliver knowledge, technologies, products or processes that will benefit primary producers. AASB 1058 is applied as the performance obligation is not sufficiently specific. Revenue is recognised when received.

- Research grant revenue recognised - AASB 1058	**1,927,281**

Research grants received from program partners require the Corporation to generate and deliver knowledge, technologies, products or processes that will benefit primary producers. The service is the management of the program for the partners and the intellectual property licence for reporting and activity materials that is granted at the commencement of the contracts. Revenue is recognised against performance of the obligation over the time of each grant. Progress towards complete satisfaction of the performance obligation is based on an input method, payment of sub-contract project milestones.

- Research grant revenue recognised over time - AASB 15	**1,749,043**
Total research grants	**3,676,324**

Other grant received from the Commonwealth requires the Corporation to manage and procure goods and services for the International Cotton Advisory Committee 2019 Plenary meeting. The performance obligation is to manage the event and procure the venue and services required to host the event. Revenue is recognised against performance of the obligation over time as the goods and services are procured.

- Other grant revenue recognised over time - AASB 15	**59,485**

Royalties received from intellectual property licences collected by the co-licensors are paid within 30 days after receiving an invoice from the Corporation. The royalties are sales-based or usage-based and are recognised as revenue when received or receivable.

- Royalties - usage-based	**5,000**
- Royalties - donation	**2,316**
- Royalties recognised at point in time - AASB 15	**7,316**

Sponsorships received from organisations for providing a service allowing the organisation to promote themselves to participants at events. Sponsorship revenue is recognised at a point in time being when the event is held.

- Sponsorships recognised at point in time - AASB 15	**106,636**

1.2 OWN-SOURCE REVENUE AND GAINS (CONT.)

The transaction price is the total amount of consideration to which the Corporation expects to be entitled in exchange for transferring promised goods or services to a customer. The consideration promised in a contract with a customer may include fixed amounts, variable amounts, or both.
Receivables for goods and services, which have 30-day terms, are recognised at the nominal amounts due less any impairment allowance account. Collectability of debts is reviewed at the end of the reporting period. Allowances are made when collectability of the debt is no longer probable.

Research grant commitments receivable

The Corporation in its capacity as grantee has agreements for research grants receivable that are commitments tied to the future performance of research, development and extension activities and project milestones.

Rural R&D for Profit - More Profit from Nitrogen: enhancing the nutrient-use efficiency of intensive cropping and pasture systems	**300,354**	1,187,215
Rural R&D for Profit - Smarter Irrigation for Profit phase 2	**6,999,289**	9,210,664
National Landcare Program Smart Farming Partnerships - New technologies to improve nature resources (biodiversity) on Australian cotton farms	**329,866**	706,552
Other research grant commitments	**327,000**	327,000
Total research grant commitments receivable	**7,956,509**	11,431,431

1.2 OWN-SOURCE REVENUE AND GAINS (CONT)

	2020 $	2019 $
1.2B: INTEREST		
Deposits	**619,981**	983,475
Total interest	**619,981**	983,475

Accounting Policy

Interest revenue is recognised by using the effective interest method.

1.2C: OTHER REVENUE		
Project refunds	**1,286,531**	1,140,523
Other revenue	**16,667**	-
Total other revenue	**1,303,198**	1,140,523
REVENUE FROM GOVERNMENT		
1.2D: REVENUE FROM GOVERNMENT		
Department of Agriculture, Water and the Environment:		
PIRD Act 1989 Contribution	**3,069,897**	8,679,831
Total revenue from Government	**3,069,897**	8,679,831
1.2E: LEVIES AND PENALTIES		
Industry Levies	**3,069,897**	8,679,831
Penalties	**424**	15,500
Total levies and penalties	**3,070,321**	8,695,331

Accounting Policy

Revenue from Government

Funding received or receivable from non-corporate Commonwealth entities (appropriated to the Department of Agriculture, Water and the Environment 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, Water and the Environment is recognised on an accrual basis from the date that the Department of Agriculture, Water and the Environment notifies the Corporation of the amount receivable. Revenue from Government includes:

a) Industry Levies: Under section 30(1)(a) of the *Primary Industries Research and Development 1989 Act* (PIRD Act), CRDC received cotton industry levies. This contribution to the Corporation is collected and distributed by the Australian Government under the *Primary Industries (Excise) Levies 1999 Act.*

b) PIRD Act 1989 Contributions: Under section 30(1)(b) of the PIRD Act, the Australian Government provides matching payments, within certain parameters, equal to one half of the amount expended by the Corporation. Matching payments are recognised as Revenue from Government when the necessary expenditure is recognised.

2. FINANCIAL POSITION

This section analyses the Corporation's assets used to conduct its operations and the operating liabilities incurred as a result. Employee related information is disclosed in the People and Relationships section.

2.1 FINANCIAL ASSETS

	2020 $	2019 $
2.1A: CASH AND CASH EQUIVALENTS		
Cash on hand or on deposit	**16,025,028**	15,882,926
Total cash and cash equivalents	**16,025,028**	15,882,926

Accounting Policy

Cash is recognised at its nominal amount. Cash and cash equivalents includes:
a) cash on hand; and
b) demand deposits in bank accounts with an original maturity of 3 months or less that are readily convertible to known amounts of cash and subject to insignificant risk of changes in value.

2.1B: INVESTMENTS		
Term deposits	**17,000,000**	24,500,000
Total investments	**17,000,000**	24,500,000

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 are classified as investments. 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	**36,631**	157,068
Contract assets	**369,127**	-
Total goods and services receivables	**405,758**	157,068

The contract assets are associated with recognition of *AASB 15 Revenue from contracts with customers* for expenses incurred for partially performed obligations that are not yet recoverable under grant agreements.

Refer Note 2.3A for information relating to contract liabilities.

Government receivables		
Department of Agriculture		
- PIRD Act 1989 Contributions receivable	**203,002**	1,467,734
- Industry levies receivable	**203,002**	1,296,843
Total government receivables	**406,004**	2,764,577
Other receivables:		
GST receivable from the Australian Taxation Office	**360,616**	185,607
Interest	**46,660**	139,722
Total other receivables	**407,276**	325,329
Total trade and other receivables	**1,219,038**	3,246,974

No indicators of impairment were found for trade and other receivables.

2.1 FINANCIAL ASSETS (CONT)

	2020 $	2019 $
2.1D: OTHER INVESTMENTS		
Shares in listed companies		
Shares in unlisted companies	**143,547**	170,064
Net other investments	**143,547**	170,064

Accounting Policy

The Corporation has invested in seed preference shares in an unlisted start-up company over which it does not have significant influence or control. The company has been established for the purpose of commercialisation of intellectual property that may benefit the Australian cotton industry and other agriculture sectors in Australia and worldwide.

Investments in unlisted companies are accounted for in accordance with AASB 9 *Financial Instruments,* and have been designated as 'investments in equity instruments at fair value through other comprehensive income' financial assets and are expected to be recovered in more than 12 months. (See note 4.1 for further information.)

2.2 NON-FINANCIAL ASSETS

2.2A: RECONCILIATION OF THE OPENING AND CLOSING BALANCES OF PROPERTY, PLANT, EQUIPMENT AND INTANGIBLES

	Land $	**Buildings $**	Material plant and equipment $	Minor plant and equipment $	**Total plant and equipment $**	**Computer software[1] $**	**Total $**
As at 1 July 2019							
Gross book value	**190,000**	**537,080**	244,382	225,273	**469,655**	**833,397**	**2,030,132**
Accumulated depreciation, amortisation and impairment		**(13,583)**	(19,128)	(140,167)	**(159,295)**	**(680,247)**	**(853,125)**
Net book value 1 July 2019	**190,000**	**523,497**	225,254	85,106	**310,360**	**153,150**	**1,177,007**
Additions – Purchases	**-**	**11,923**	90,161	72,814	**162,975**	**-**	**174,898**
Depreciation and amortisation		**(14,071)**	(45,955)	(50,333)	**(96,288)**	**(115,868)**	**(226,227)**
Disposals:							**-**
Gross book value	**-**	**-**	(25,893)	-	**(25,893)**	**-**	**(25,893)**
Accumulated depreciation and impairment	**-**	**-**	3,379	-	3,379	**-**	**3,379**
Net book value 30 June 2020	**190,000**	**521,349**	246,946	107,587	**354,533**	**37,282**	**1,103,164**
Net book value as of 30 June 2020 represented by:							
Gross book value	**190,000**	**549,003**	308,651	298,087	**606,738**	**833,397**	**2,179,138**
Accumulated depreciation, amortisation and impairment		**(27,654)**	(61,705)	(190,500)	**(252,205)**	**(796,115)**	**(1,075,974)**
Total net book value as at 30 June 2020	**190,000**	**521,349**	246,946	107,587	**354,533**	**37,282**	**1,103,164**

1. The carrying amount of computer software included $16,504 (2019: $71,698) purchased software and $20,778 (2019: $81,452) internally generated software.

No indicators of impairment were found in 2020 (2019: $nil).

No non-financial assets are expected to be sold or disposed of within the next 12 months.

Revaluations of non-financial assets

All revaluations were conducted in accordance with the revaluation policy stated below. On 30 June 2018, an independent valuer conducted the revaluation of land and buildings.

Land valuation has not changed.

A revaluation increment of $nil for buildings on freehold land (2019: $nil) was credited to the asset revaluation surplus by asset class and included in the equity section of the Statement of Financial Position.

Accounting Policy

Fair value measurement of non-financial assets are based on Level 2 inputs that are observable for the asset either directly or indirectly. The fair value of these assets do not have quoted prices in active markets (Level 1 inputs).

Land is assessed using market comparables being the sale prices of comparable land for similar land size and long-term land appreciation rates.

Buildings on freehold land are assessed using the discounted cash flow of future potential rental income adjusted for the market rate of interest.

Motor vehicles in material plant and equipment is assessed using quoted prices for similar motor vehicles.

Other material plant and equipment is assessed using the depreciated replacement cost based on market prices of similar assets less depreciation.

2.2 NON-FINANCIAL ASSETS (CONT)

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 of land and buildings depended upon the volatility of movements in market values for the relevant assets.

Revaluation adjustments are made on a class basis. Any revaluation increment is credited to equity under the heading of asset revaluation reserve except to the extent that it reversed a previous revaluation decrement of the same asset class that was previously recognised in the surplus/deficit. Revaluation decrements for a class of assets are recognised directly in the surplus/deficit except to the extent that they reversed a previous revaluation increment for that class.

Any accumulated depreciation as at the revaluation date is eliminated against the gross carrying amount of the asset and the asset was restated to the revalued amount.

Depreciation

Depreciable property, plant and equipment assets are written-off to their estimated residual values over their estimated useful lives to the Corporation using, in all cases, the straight-line method of depreciation.

Depreciation rates (useful lives), residual values and methods are reviewed at each reporting date, and necessary adjustments are recognised in the current, or current and future reporting periods, as appropriate.

Depreciation rates applying to each class of depreciable asset are based on the following useful lives:

	2020	2019
Buildings on freehold land	**40 years**	40 years
Plant and equipment	**3 to 10 years**	3 to 10 years

Impairment

All assets were assessed for impairment at 30 June 2020. 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 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 (2019: 3 to 5 years).

All software assets were assessed for indications of impairment as at 30 June 2020.

2.3 PAYABLES

	2020 $	2019 $
2.3A: SUPPLIERS		
Trade creditors and accruals	**43,508**	115,180
Contract liabilities	**86,794**	-
Total suppliers	**130,302**	115,180

Settlement is usually made within 30 days.

The contract liabilities are associated with recognition of *AASB 15 Revenue from contracts with customers* for revenue received for future performance obligations under grant agreements.

Refer Note 2.1C for information relating to contract assets.

2.3B: GRANTS		
Grants:		
Public sector:		
Australian Government entities	**597,659**	887,575
State and Territory Governments	**1,510,664**	681,109
Universities and Colleges	**985,547**	1,526,947
Other research organisations	**43,500**	307,500
Private sector:		
Other	**999,971**	2,253,222
Total grants	**4,137,341**	5,656,353

All grants payable are expected to be settled within 12 months.
Settlement is usually within 30 days of completion of milestones and receipt of a tax invoice.

2.3C: OTHER PAYABLES		
PAYG & FBT payable	**57,833**	52,234
Total other payables	**57,833**	52,234

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

	2020 $	2019 $
3.1A: EMPLOYEE PROVISIONS		
Leave	**414,103**	313,106
Total employee provisions	**414,103**	313,106

Accounting Policy

Liabilities for short-term employee benefits and termination benefits expected within 12 months of the end of the reporting period are measured at their nominal amounts.

Leave

The liability for employee benefits includes provision for annual leave and long service leave.

The leave liabilities are calculated on the basis of employees' remuneration at the estimated salary rates that will be applied at the time the leave is taken, including the Corporation's employer superannuation contribution rates to the extent that the leave is likely to be taken during service rather than paid out on termination.

The liability for long service leave has been determined by reference to the Department of Finance standard parameters for the Long Service Leave Shorthand Method set out in the Financial Reporting Rule. The estimate of the present value of the liability takes into account attrition rates and pay increases through promotion and inflation.

Separation and Redundancy

Provision is made for separation and redundancy benefit payments. The Corporation recognises a provision for termination when it has developed a detailed formal plan for the terminations and has informed those employees affected that it will carry out the terminations.

3.2 KEY MANAGEMENT PERSONNEL REMUNERATION

Key management personnel are those persons having authority and responsibility for planning, directing and controlling the activities of the Corporation, directly or indirectly, including any director (whether executive or otherwise) of the Corporation. The Corporation has determined the key management personnel to be the Directors, Executive Director and General Managers. Key management personnel remuneration is reported in the table below:

	2020 $	2019 $
Short-term employee benefits	**830,080**	811,109
Post-employment benefits	**75,326**	75,495
Other long-term employee benefits	**23,617**	53,044
Total key management personnel remuneration expenses	**929,023**	939,648

Notes: The total number of key management personnel that are included in the above table is 10 (2019: 11).

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:

	2020 $	2019 $
TRANSACTIONS WITH RELATED PARTIES		
Elizabeth Alexander is a non-executive director of Plant Health Australia (PHA), which received funding from CRDC for membership to PHA and collaborative plant biosecurity projects.	**42,166**	90,934
Elizabeth Alexander is employed as an Agribusiness Development Coordinator of Central Highlands development Corporation (CHDC), which received funding from CRDC for sponsorship of the AgFrontier new regional Agtech incubator.	**-**	30,000
Total transactions with related parties	**42,166**	120,934

4. MANAGING UNCERTAINTIES

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

4.1 FINANCIAL INSTRUMENTS

	2020 $	2019 $
4.1A: CATEGORIES OF FINANCIAL INSTRUMENTS		
Financial assets at amortised cost		
Cash and cash equivalents	**16,025,028**	15,882,926
Term deposits	**17,000,000**	24,500,000
Trade and other receivables	**452,418**	296,790
Total financial assets at amortised cost	**33,477,446**	40,679,716
Financial assets at fair value through other comprehensive income (investments in equity instruments)		
Shares in unlisted companies	**143,547**	170,064
Total financial assets at fair value through other comprehensive income (investments in equity instruments)	**143,547**	170,064
Total financial assets	**33,620,993**	40,849,780
Financial Liabilities		
Financial liabilities measured at amortised cost		
Grants payable	**4,137,341**	5,656,353
Suppliers payable	**130,302**	115,180
Total financial liabilities measured at amortised cost	**4,267,643**	5,771,533

Available-for-sale financial assets have been valued under the following fair value hierarchy: • Level 3: inputs that are not observable and involve significant judgement.	2020 $	2019 $
Movements in available-for-sale financial assets		
Opening balance	**170,064**	87,588
Fair value gains/(losses) through other comprehensive income	**(26,517)**	82,476
Closing balance of available-for-sale financial assets	**143,547**	170,064

Accounting Policy

Financial assets

With the implementation of AASB 9 *Financial Instruments* for the first time in 2019, the entity classifies its financial assets in the following categories:

a) financial assets at fair value through profit and loss;
b) financial assets at fair value through other comprehensive income; and
c) financial assets measured at amortised cost.

The classification depends on both the entity's business model for managing the financial assets and contractual cash flow characteristics at the time of initial recognition. Financial assets are recognised when the entity becomes a party to the contract and, as a consequence, has a legal right to receive or a legal obligation to pay cash and derecognised when the contractual rights to the cash flows from the financial asset expire or are transferred upon trade date.

Comparatives have not been restated on initial application.

4.1 FINANCIAL INSTRUMENTS

Financial Assets at Amortised Cost

Financial assets included in this category need to meet two criteria:

1. the financial asset is held in order to collect the contractual cash flows; and
2. the cash flows are solely payments of principal and interest (SPPI) on the principal outstanding amount.

Amortised cost is determined using the effective interest method.

Effective Interest Method

Income is recognised on an effective interest rate basis for financial assets that are recognised at amortised cost.

Financial Assets at Fair Value Through Profit or Loss (FVTPL)

Financial assets are classified as financial assets at fair value through profit or loss where the financial assets either doesn't meet the criteria of financial assets held at amortised cost or at FVOCI (i.e. mandatorily held at FVTPL) or may be designated.

Financial assets at FVTPL are stated at fair value, with any resultant gain or loss recognised in profit or loss. The net gain or loss recognised in profit or loss incorporates any interest earned on the financial asset.

Financial Assets at Fair Value Through Other Comprehensive Income (FVOCI)

Financial assets measured at fair value through other comprehensive income are held with the objective of both collecting contractual cash flows and selling the financial assets, and the cash flows meet the SPPI test.

Any gains or losses as a result of fair value measurement or the recognition of an impairment loss allowance are recognised in other comprehensive income.

Significant accounting judgements and estimates for unlisted companies

The shares in the unlisted companies are valued on earnings before interest and tax (EBIT) basis of management's view of potential cash flow outcomes. The estimates are based on the best information available (Level 3 inputs) due to the start-up phase nature and that future cash flows are uncertain.

Impairment of Financial Assets

Financial assets are assessed for impairment at the end of each reporting period based on Expected Credit Losses, using the general approach which measures the loss allowance based on an amount equal to lifetime expected credit losses where risk has significantly increased, or an amount equal to 12-month expected credit losses if risk has not increased.

The simplified approach for trade, contract and lease receivables is used. This approach always measures the loss allowance as the amount equal to the lifetime expected credit losses.

A write-off constitutes a derecognition event where the write-off directly reduces the gross carrying amount of the financial asset.

Financial Liabilities

Financial liabilities are classified as either financial liabilities 'at fair value through profit or loss' or other financial liabilities. Financial liabilities are recognised and derecognised upon 'trade date'.

Financial Liabilities at Fair Value Through Profit or Loss

Financial liabilities at fair value through profit or loss are initially measured at fair value. Subsequent fair value adjustments are recognised in profit or loss. The net gain or loss recognised in profit or loss incorporates any interest paid on the financial liability.

Financial Liabilities at Amortised Cost

Financial liabilities, including borrowings, are initially measured at fair value, net of transaction costs. These liabilities are subsequently measured at amortised cost using the effective interest method, with interest expense recognised on an effective interest basis.

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).

4.1 FINANCIAL INSTRUMENTS

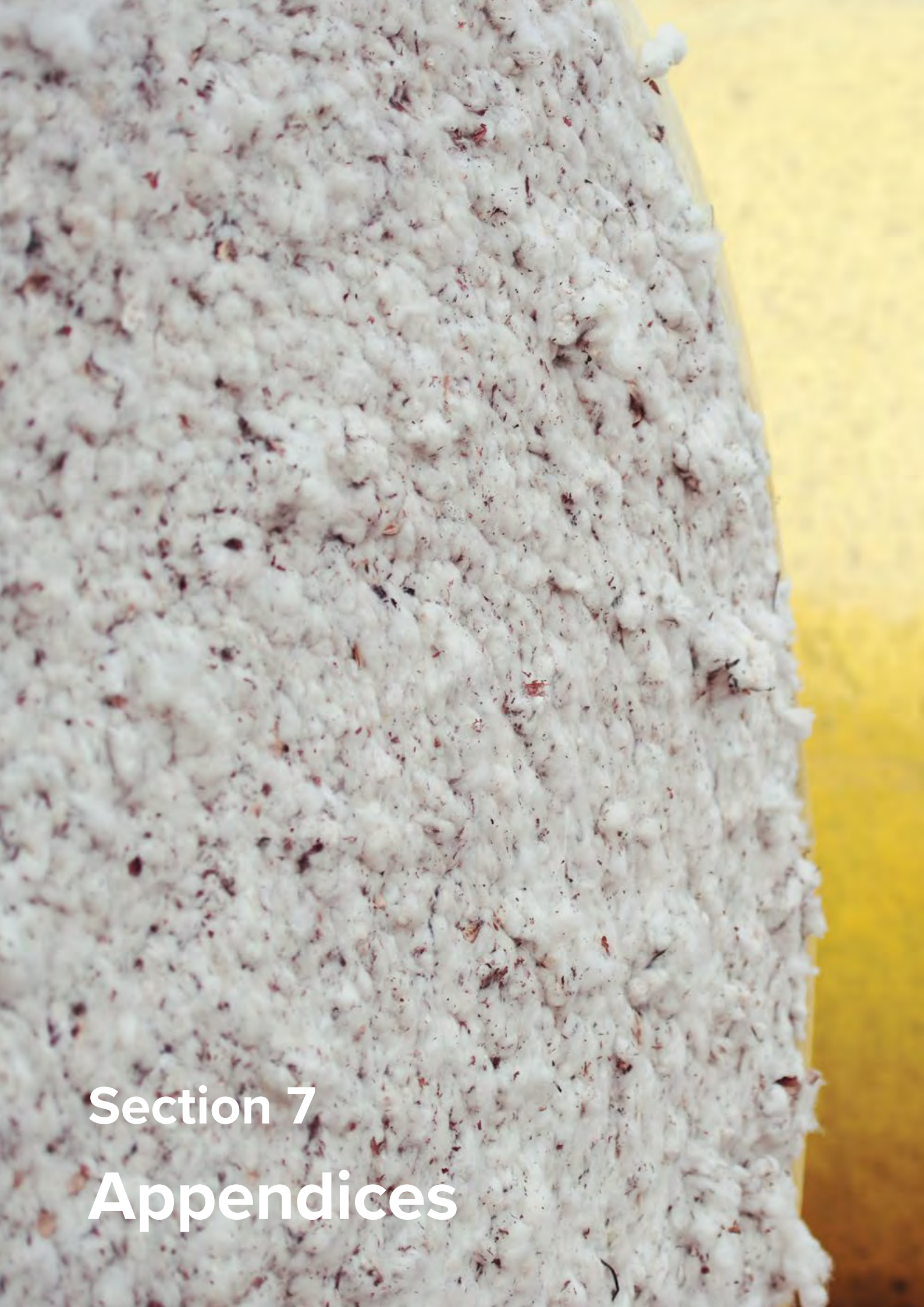
4.1C: NET GAINS OR LOSSES ON FINANCIAL ASSETS

	2020 $	2019 $
Financial assets at amortised costs		
Interest revenue	**619,981**	983,475
Net gain on financial assets at amortised cost	**619,981**	983,475
Investments in equity instruments at fair value through other comprehensive income		
Gain/(Losses) recognised in equity	**(26,517)**	82,476
Net gains/(losses) on investments in equity instruments at fair value through other comprehensive income	**(26,517)**	82,476
Net gain from financial assets	**593,464**	1,065,951

5. OTHER INFORMATION

5.1 AGGREGATE ASSETS AND LIABILITIES

	2020 $	2019 $
5.1A: AGGREGATE ASSETS AND LIABILITIES		
Assets expected to be recovered in:		
No more than 12 months	**34,244,066**	43,629,900
More than 12 months	**1,246,711**	1,347,071
Total assets	**35,490,777**	44,976,971
Liabilities expected to be settled in:		
No more than 12 months	**4,572,944**	5,967,092
More than 12 months	**166,635**	169,781
Total liabilities	**4,739,579**	6,136,873



Section 7
Appendices

Appendix 1: Australian Government Priorities

CRDC's investments in RD&E during 2019–20 supported the achievement of the Australian Government's Science and Research Priorities and Rural RD&E Priorities, as outlined below.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2019–20
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	• Building on the CRDC-led, cross-sectoral Australian Agriculture: Growing a Digital Future project, an industry steering committee has been established and facilitated by CRDC that will oversee the development of a digital strategy for the cotton industry. • Three of the projects now undergoing commercialisation activities are focused on providing digital technologies to farmers, improving management of spray drift, irrigation and insect management. • A CRDC Grassroots Grant to demonstrate on-farm internet of things (IoT) and LoRaWAN technology was supported. • CRDC sponsored the AgFrontier Regional Agtech Incubator, which provides start-ups the opportunity to work and grow in a dedicated program designed specifically for rural businesses and individuals in regional QLD and northern NSW who have practical understanding of agriculture. Ten agricultural innovators were selected from more than 30 applications received from across northern NSW and regional QLD, including SwarmFarm Robotics.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2019–20
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 other plant-based RDCs, have continued their partnership with Plant Health Australia, and the Department of Agriculture, Water and the Environment in the Plant Biosecurity Research Initiative (PBRI). PBRI coordinates funding for biosecurity research, development and extension and attracts further co-investment. It focuses on biosecurity threats to plant-based industries and developing better preparedness, diagnostics, surveillance and management capabilities in addition to improving industry resilience. PBRI has coordinated approximately $50 million cash and in-kind into biosecurity research, development and extension (RD&E) in the last three years (Phase I). Phase 1 also delivered the two-day PBRI Symposium 2019 and International Year of Plant Health 2020 events. This coordinated approach helps ensure that this effort is aligned to broader national goals and delivered with increased efficiency, avoiding duplication of effort. In addition to identifying co-investments, the initiative is also improving RDC collaboration, for example, coordination of an across-industry response to the fall armyworm incursion, including application for chemical use permits, testing for insecticide resistance and combined communications to primary producers. • CRDC is also collaborating with Hort Innovation on applying a novel technology, BioClay, to support management of exotic and endemic pests. • Development in Northern Australia presents new risks in terms of biosecurity, and CRDC is supporting crop protection research in Northern Australia as well as virus and vector surveillance linked to Northern Australia Quarantine Strategy activities. • In collaboration with Plant Health Australia, CRDC conducted a successful biosecurity simulation, Exercise Blueprint. It examined the response by the industry to a detection of cotton blue disease, a high-priority pest of the cotton industry. Exercise Blueprint brought together key stakeholders from the cotton industry to examine a scenario of a fictional detection of cotton blue disease in Australia. The exercise highlighted that the existing level of preparedness in the cotton industry is overall very high, with an opportunity to build upon the existing level in a few areas.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2019–20
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 continues to invest in projects seeking to improve the environmental footprint of Australian cotton, with a particular focus on soil health, nitrogen use and water efficiency. The water productivity of Australian cotton production continues to improve, with a long-term trend of 2.5 per cent per annum increase in water-use efficiency being maintained. • CRDC continues to invest in the cross-sectoral Managing Climate Variability program, and provides fortnightly climate information to growers to help them manage climate risk. In addition, ongoing research investigates the potential management strategies for coping with higher temperatures and carbon dioxide levels. • A collaborative project co-funded by the CRC for Northern Australia, GRDC and CRDC aims to support development of a viable broadacre cropping system in the NT. The project includes validating and calibrating modelling tools to understand short- and long-term risk profiles and collating broadacre cropping data, natural resource information and an understanding of market opportunities to provide strategic information to de-risk industry development. • In collaboration with Cotton Australia, CRDC published the *Australian Cotton Sustainability Report 2019*.
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	• CottonInfo organised or contributed to 78 events involving 1,188 participants. Of these, 25 activities were organised by CottonInfo and 53 were organised in partnership with other organisations. • The CottonInfo team provided support for regional sampling and data collection for CRDC research projects that were affected by travel restrictions due to COVID-19. • The CottonInfo team continued to support private industry activities, including Cotton Seed Distributor's Crop Management Tours, the Crop Consultants Australia seminars and the Bayer Grower of the Year Field Day. • Work has commenced to ensure that *my*BMP is relevant to northern (tropical) cotton production, given the potential expansion of the industry.

Science and Research Priorities per CRDC RD&E program 2019–20 ($'000)

Science and Research Priorities	Food	Soil and Water	Transport	Cyber security	Energy	Resources	Advanced Manufacturing	Environmental Change	Health	Total
Goal 1	$6,738	$5,560	$0	$0	$0	$4	$0	$213	$0	**$12,515**
Goal 2	$476	$284	$0	$0	$0	$0	$0	$809	$0	**$1,569**
Goal 3	$654	$90	$0	$0	$0	$0	$120	$2	$20	**$886**
Enabling Strategy 1	$921	$162	$0	$0	$115	$0	$0	$125	$6	**$1,328**
Enabling Strategy 2	$366	$0	$0	$0	$0	$0	$0	$0	$0	**$366**
TOTAL*	$9,156	$6,096	$0	$0	$115	$4	$120	$1,149	$26	**$16,666**

* Excludes budgeted employee and supplier expenditure, and corporate research activities that support R&D planning and adoption. Some funding totals have been rounded up or down to the closest whole number.

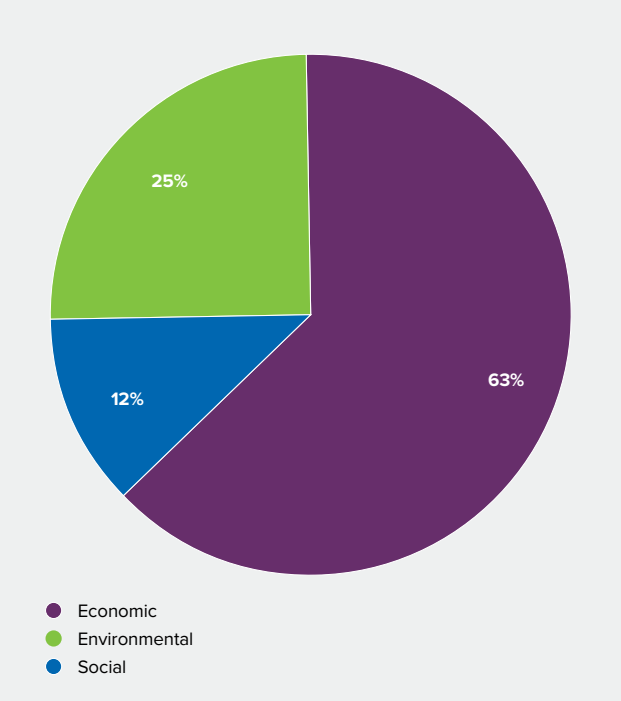
Rural RD&E Priorities per CRDC RD&E Program 2019–20 ($'000)

Rural RD&E Priorities	Advanced Technology	Biosecurity	Soil, Water, and Managing Natural Resources	Adoption of R&D	Total
Goal 1	$1,062	$3,351	$7,358	$744	**$12,515**
Goal 2	$290	$0	$1,202	$78	**$1,569**
Goal 3	$110	$5	$196	$575	**$886**
Enabling Strategy 1	$312	$212	$20	$784	**$1,328**
Enabling Strategy 2	$0	$26	$26	$315	**$366**
TOTAL*	$1,774	$3,594	$8,802	$2,495	**$16,666**

* Excludes budgeted employee and supplier expenditure, and corporate research activities that support R&D planning and adoption. Some funding totals have been rounded up or down to the closest whole number.

Appendix 2: 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 RD&E Plan) consider triple bottom line outputs. In line with this, the Annual Operational Plan 2019–20 was designed to ensure RD&E investments provide measurable economic, environmental and social benefits to the cotton industry and the wider community.



CRDC RD&E investments across economic, environmental and social performance outcomes 2019–20

Performance outcomes	CRDC investment
Economic	$10,458
Environmental	$4,148
Social	$2,060
TOTAL	**$16,666**

CRDC program contribution to economic, environmental and social outcomes 2019–20 ($'000)

Contributions	Economic	Environmental	Social	Total
CRDC programs	**Investment total**	**Investment total**	**Investment total**	**Investment total**
Goal 1	$8,363	$3,266	$887	**$12,515**
Goal 2	$710	$403	$456	**$1,569**
Goal 3	$356	$145	$385	**$886**
Enabling Strategy 1	$864	$230	$234	**$1,328**
Enabling Strategy 2	$165	$103	$99	**$366**
TOTAL*	$10,458	$4,148	$2,060	**$16,666**
Percentage	63%	25%	12%	100%

* Excludes budgeted employee and supplier expenditure, and corporate research activities that support R&D planning and adoption.

Appendix 3: RD&E Portfolio

CRDC 2019-20 Project List (as at 30 June 2020)

GOAL 1: INCREASED PRODUCTIVITY AND PROFITABILITY ON COTTON FARMS

Project title	Project code	Researcher	Organisation	Start date	Cease date
1.1 Optimised farming systems					
1.1.1 Improved yield and quality					
Improving crop establishment, termination and weed control in dryland cotton farming systems	CRDC1937	Annabelle Guest	DCRA	Jan-19	Jun-22
Increased yield through improved management of soil constraints in cotton farming systems	USQ1903	John Bennett	USQ	Jun-19	Jun-22
Managing cotton quality to maintain Australia's premium status (includes CottonInfo technical lead and *my*BMP module lead)	CRDC1924	Rene van der Sluijs	Textile Technical Services	Oct-18	Sep-20
Precision management for improved cotton quality	CMSE1802	Robert Long	CSIRO	Jul-17	Jun-20
1.1.2 Improved input efficiencies					
A biological alternative to nitrogen fertiliser in cotton	UN1901	Grace Scott	University of Nottingham & Azotic	Sep-18	Sep-19
Identifying the trends and drivers of water productivity in Australian cotton through benchmarking (includes CottonInfo technical lead)	DAN2002	David Perovic	NSW DPI	Jul-19	Jul-22
Improving the nitrogen use efficiency of cotton crops through better understanding the role of dissolved organic N	CSP1904	Bennett Macdonald	CSIRO	Jul-18	Jun-21
Improving water use efficiency in a changing climate	CSP1804	Katrina Broughton	CSIRO	Jul-17	Jun-20
Major Capital Item: IREC Field Station automated irrigation	IREC1801	Emma Ayliffe	IREC	Apr-17	Apr-20
More Profit from Nitrogen Enhancing nutrient-use efficiency in cotton	RRDP1712	Graeme Schwenke	NSW DPI	Jul-16	Jun-21
More Profit from Nitrogen: Final evaluation and economic case studies	RRDP2021	Jon Welsh	AgEcon	Mar-20	Jun-21
More Profit from Nitrogen: Improved nitrogen-use efficiency through accounting for deep soil and mineralisable N supply, and deployment of enhanced efficiency fertilisers to better match crop N demand	RRDP1717	Lukas Van Zwieten	NSW DPI	Jul-16	May-20
More Profit from Nitrogen: Improving dairy farm nitrogen efficiency using advanced technologies	RRDP1715	Helen Suter	UMELB	Jul-16	May-20
More Profit from Nitrogen: Increasing nitrogen-use efficiency in dairy pastures	RRDP1714	David Rowlings	QUT	Jul-16	Nov-19
More Profit from Nitrogen: New technologies and managements: transforming nitrogen use efficiency in cane production.	RRDP1719	Matt Redding	QDAF	Sep-16	Jun-21
More Profit from Nitrogen: Nitrogen-use efficiency indicators for the Australian cotton, sugar, dairy & horticulture industries	RRDP1901	Dio Antille	CSIRO	Mar-19	Sep-19
More Profit from Nitrogen: Optimising nutrient management for improved productivity and fruit quality in cherries	RRDP1721	Nigel Swarts	UTAS	Aug-16	Jun-21

More Profit from Nitrogen: Optimising nutrient management for improved productivity and fruit quality in mangoes	RRDP1720	Constancio (Tony) Asis	NTDPIR	Aug-16	Jun-21
More Profit from Nitrogen: Project Management Committee meetings	RRDP1722	Allan Williams	CRDC	Jul-16	Jun-21
More Profit from Nitrogen: Project communications	RRDP1735	Allan Williams	CRDC	Jul-16	Jun-21
More Profit from Nitrogen: Quantifying the whole farm systems impact of nitrogen best practice on dairy farms	RRDP1716	Richard Eckard	UMELB	Jul-16	Nov-20
More Profit from Nitrogen: Smart blended use of enhanced efficiency fertilisers to maximise sugarcane profitability	RRDP1718	Weijin Wang	QDES	Jul-16	Apr-20
More Profit from Nitrogen: YourData platform	RRDP1727	Jeff Coutts	Coutts J&R	Feb-17	Jun-21
More Profit from Nitrogen: Science leadership and project coordination	RRDP1711	Marguerite White	ICD Project Services	Nov-16	Sep-21
Optimising the management of manures in southern NSW cotton production II	DU1903	Wendy Quayle	DU	Jul-18	Jun-21
PhD: Electrophysiological and molecular identification of novel biopesticides	UWS1601	Michelle Mak	UWS	Jul-15	Jun-20
PhD: Monitoring soil water dynamics for improving water-use efficiency	UNSW1801	Ehsan Zare	UNSW	Jul-17	Dec-20
PhD: Next-generation fertilisers for nutrient stewardship in cotton production	UQ1702	Rhys Pirie	UQ	Jan-17	Jan-20
PhD: The impact of irrigation methods and management strategies on nitrogen fertiliser recovery in cotton in southern QLD	UQ1502	John Smith	UQ	Jul-14	Dec-20
Professor of Soil Biology (includes CottonInfo technical lead and *my*BMP module lead)	UNE2001	Oliver Knox	UNE	Jul-19	Jun-24
Where does water go? Visualising irrigation efficiency by time-lapse water monitoring	UNSW1802	John Triantafilis	UNSW	Jul-17	Dec-20
1.1.3 On-farm sustainable development is supported					
FUSCOM Meeting 2019	CRDA2001	Susan Maas	CRDC	Nov-19	Nov-19
National RD&E Water Use in Agriculture cross-sector strategy	DA2001		DAWE	Jul-19	Jun-21
Novel Systems Workshop	CRDA2002	Warwick Waters Susan Maas	CRDC	Mar-20	Mar-20
PhD: Classifying the suitability of Murrumbidgee Valley soils for cotton production	US2002	Jonathon Moore	USYD	Mar-20	Mar-23
Potential for broadacre cropping in the Northern Territory	CRCNA2001	Jed Matz	CRCNA	Jun-19	Dec-22
SataCrop	CA2006	Sally Ceeney	CA	Jul-19	Jun-21
Science leadership for cotton development in Northern Australia	CSP1903	Steve Yeates	CSIRO	Oct-18	Sep-21
1.1.4 Improved reliability of cotton production					
Minimising yield variability to maximise yield in a cotton farming system	DAN1801	Guna Nachimuthu	NSW DPI	Jul-17	Jun-22
PhD: Utilising novel plant growth regulators to develop resilient future cotton systems	CSP1604	Claire Welsh	CSIRO	Apr-16	Sep-19
Quantifying the effectiveness of cover crops as a means of increased water infiltration and reduced evaporation in the northern region	GRDC1801	David Lawrence	QDAF/GRDC	May-17	Oct-20
Supporting southern cotton production systems: Cotton research officer	DAN2001	Hayden Petty	NSW DPI	Jul-19	Jun-22

1.2 Transformative technologies					
1.2.1 New technologies are adapted for use in cotton					
Agri-innovation: Driving productivity for Australian cotton growers through partnerships and digital technologies	JT1901	Jane Trindall	Jane Trindall Consulting	May-19	Apr-20
Application of molecular tools to monitoring for resistance alleles in *Helicoverpa spp.*	CSE1801	Tom Walsh	CSIRO	Jul-17	Apr-21
Future Farm Phase 2: Improving farmer confidence in targeted N management through automated sensing and decision support	QUT1902	Peter Grace	QUT	Jul-18	Jun-22
Identifying sensors for better Integrated Pest Management in cotton	NEC1901	Alison McCarthy	USQ	Jul-18	Dec-21
Major Capital Item: ACRI cotton picker and precision-variable rate fertiliser technology to support cotton R&D in northern and southern NSW	DAN1905	Rod Jackson	NSW DPI	Nov-18	Dec-19
PhD: Characterisation of brassinosteroid effects and brassinosteroid-responsive genes in cotton for growth and stress-tolerance enhancement	UNE1605	Anahid A Essa Al-Amery	UNE	Sep-15	Mar-20
Precise real-time automated cotton irrigation for improved water productivity	DU1902	John Hornbuckle	DU	Jul-18	Dec-19
Smarter Irrigation 2: Beyond water smart – Advancing dairy irrigation system performance	RRDP2012	James Hills	UTAS	Jul-19	May-22
Smarter Irrigation 2: Cross-sectoral integration and extension	RRDP2005	Louise Gall	GVIA	Jul-19	May-22
Smarter Irrigation 2: Evaporation mitigating solution for Australian cotton water storages	RRDP2007	Greg Qiao	UMELB	Jul-19	May-22
Smarter Irrigation 2: Graphic design services	RRDP2016	Kristy Fielder	Black Canvas	Nov-19	Feb-20
Smarter Irrigation 2: Gwydir demonstration of latest digital technologies for precise automated irrigation	RRDP2004	Louise Gall	GVIA	Jul-19	May-22
Smarter Irrigation 2: Improved irrigation system selection and operation for increased sugarcane productivity and profitability	RRDP2013	Michael Scobie	USQ	Jul-19	May-22
Smarter Irrigation 2: Key learning sites Southern NSW (making the most of water)	RRDP2014	Alex Schultze	NSW DPI	Jul-19	May-22
Smarter Irrigation 2: Monitoring and evaluation	RRDP2020	Adam McNeill	KG2	Jun-20	Mar-22
Smarter Irrigation 2: New tech integrated smart sensing & automation for cotton	RRDP2003	John Hornbuckle	DU	Jul-19	May-22
Smarter Irrigation 2: Plant-based sensing for cotton irrigation	RRDP2006	Hizbullah Jamali	CSIRO	Jul-19	May-22
Smarter Irrigation 2: Precise real-time automated cotton & dairy irrigation for improved water productivity	RRDP2002	Joseph Foley	USQ	Jul-19	May-22
Smarter Irrigation 2: Precision automated furrow irrigation for the Australian sugar industry	RRDP2009	Malcolm Gillies	USQ	Jul-19	Jun-21
Smarter Irrigation 2: Project leadership and coordination	RRDP2001	Cathy Phelps	C&J Phelps Consulting	Jul-19	Jun-22
Smarter Irrigation 2: Project Management Committee meetings & forums	RRDP2015	Cathy Phelps	CRDC	Nov-19	May-22
Smarter Irrigation 2: Scaling irrigation management to support whole farm operations	RRDP2011	Andy McAllister	DJPR	Jul-19	May-22
Smarter Irrigation 2: Smart irrigation control for water and labour savings in rice-growing systems	RRDP2008	John Hornbuckle	DU	Jul-19	May-22
Smarter Irrigation 2: Video production	RRDP2019	Cathy Phelps	CRDC	Feb-20	Feb-20
Smarter Irrigation 2: What is my yield gap? Maximising water productivity	RRDP2010	Cath Lescun	Dairy Australia	Jul-19	May-22

Smarter Irrigation 2: YourDATA monitoring and evaluation database	RRDP2017	Jeff Coutts	Coutts J&R	Nov-19	May-22
Spray decision systems and resources grower testing	MRES2001	Graeme Tepper	MRES	Dec-19	Mar-20
Technical review of operating standards for autonomous systems in Australian broadacre cropping systems	GRDC2004	Liam Ryan	GRDC	Jun-20	Jan-21
Travel: World Agri-Tech Innovation Summit, San Francisco	JT2001	Jane Trindall	Jane Trindall Consulting	Sep-19	Mar-20
1.2.2 Cotton farms are digitally enabled					
Australian agriculture: Growing a digital future – communications	GDF1908	Melanie Jenson	Consultant	Jun-19	Sep-19
Australian agriculture: Growing a digital future - Digital capability framework for the Australian agriculture sector	GDF1906	Georgie Aley	KPMG	May-19	Sep-19
Australian agriculture: Growing a digital future - Meeting assistance	GDF1904	Julia Skinner	Consultant	Mar-19	Nov-19
Australian agriculture: Growing a digital future - National Forum	GDF1907	Jane Trindall	CRDC	Jun-19	Sep-19
Australian agriculture: Growing a digital future - Summary report	GDF1909	Sarah Nolet	AgThentic	Nov-19	Nov-19
Australian agriculture: Growing a digital future – Developing digital agriculture maturity index and assessing digital maturity levels across all agricultural sectors	GDF1901	Airong Zhang	CSIRO	Jan-19	Sep-19
Australian agriculture: Growing a digital future – Developing transparency and trust for producers through Australian agricultural data governance framework and action plan	GDF1902	Leanne Wiseman	GU	Jan-19	Sep-19
Australian agriculture: Growing a digital future – Developing transparency and trust for producers through Australian agricultural data governance principles	GDF1903	Jay Sanderson	USC	Jan-19	Sep-19
Major capital item: Sundown Smart Farm Development	CRDC1928	Nick Gillingham	Sundown Pastoral	Nov-18	Oct-20
1.3 Protection from biotic threats and environmental stresses					
1.3.1 Increased understanding of the impact of pests, diseases and weeds, and environmental stresses					
Grassroots Grant: Additional Support – Fullbright Scholarship to study Verticillium wilt	CGA1911	Karen Kirkby	Lower Namoi CGA	Jun-19	May-20
Integrated Pest Management to support the management of emerging pests	CSP1905	Simone Heimoana	CSIRO	Jul-18	Jun-21
Integrated Weed Management options for weed control in cotton farming systems	DAN1901	Eric Koetz	NSW DPI	Jul-18	Sep-19
PhD: Biology of *Amarathus retroflexus* and *Amaranthus viridis*	UQ1703	Asad Khan	UQ	Jan-17	Jun-20
Podcasts for fall armyworm management in Northern farming systems	PHA2003	Stuart Parsons	PHA	Apr-20	Aug-20
Transformation of *Verticillium dahliae*, causal agent of Verticillium wilt of cotton, with the GFP gene	DAN1809	Aphrika Gregson	NSW DPI/UQ	Dec-17	Dec-20
1.3.2 Improved identification, surveillance and management systems for pests, diseases and weeds, and environmental stresses					
ARC Research Hub for Sustainable Crop Protection	UQ2001	Neena Mitter	HIA/UQ	Jul-19	Jun-24
Area-Wide Management for cropping systems weeds, investigating the weed management, social and economic opportunity	GRDC2002	Rick Llewellyn	GRDC	Aug-19	Jun-22
Biological-based products for improved cotton production	UWS1901	Brajesh Singh	UWS	Jul-18	Mar-22
Characteristics of disease-suppressive cotton farming systems and soils understood	DAQ2002	Linda Smith	QDAF	Sep-19	Jun-22

Digital technologies for dynamic management of disease, stress and yield program	AGWA1701	Liz Waters	AGWA	Aug-16	Dec-19
Improved management of silverleaf whitefly on cotton farms	DAQ1903	Richard Sequeira	QDAF	Jul-18	Jun-21
Improved management of weeds in cotton and grains farming systems	DAN2004	Graham Charles	NSW DPI	Nov-19	Jun-22
Improving plant pest management through cross-industry deployment of smart sensor, diagnostics and forecasting	HIA1802	Wee tek Tay Dean Brooks	HIA	Feb-18	May-22
Improving the management of cotton diseases in Australian cotton farming systems	RRDP1724	Linda Smith	QDAF	Jul-16	Dec-19
Innovative solutions to cotton diseases	DAN1703	Duy Le	NSW DPI	Jul-16	Jun-20
Integrated Pest Management technical lead and pest management for high-yield research	DAQ1902	Paul Grundy	QDAF	Jul-18	Jun-21
Managing Climate Variability Program – Phase 5	MLA1701	Doug McNicholl	MLA	Jul-16	Jun-21
Managing verticillium risk for cotton	RRDP1723	Karen Kirkby	NSW DPI	Jul-16	Dec-19
Mirid and mealybug best practice management	DAQ1802	Richard Sequeira	QDAF	Jul-17	Oct-19
Modern systems agronomy for resilient cotton production	CSP2001	Claire Welsh	CSIRO	Jan-20	Jun-22
National Working Party on Pesticide Applications stakeholder contribution for 2019-20	PHA2002	Greg Fraser	PHA	Jul-19	Jun-20
Novel topical vegetable, cotton virus and whitefly protection: BioClay	HIA1803	Neena Mitter	HIA/UQ	Feb-18	Feb-21
PhD: Building climate change resilience in cotton through translational physiology	ANU1704	Demi Gamble	ANU	Feb-17	Aug-20
Plant Health Australia membership subscription 2019-20	PHA2001	Greg Fraser	PHA	Jul-19	Jun-20
Ready-to-use soil test to manage black root rot risks	MLAB1901	Maria Manjarrez	Microbiology Labs Aust	Jul-18	Jun-20
Reducing the impact of weather, insects and microbes on cotton colour	CSP1901	Simone Heimoana	CSIRO	Jul-18	Jun-21
Southern cotton crop protection (including CottonInfo Disease Technical Lead and *my*BMP module lead)	DAN1903		NSW DPI	Jul-18	Oct-21
Staying ahead of weed evolution in changing cotton systems	UQ1501	Jeff Werth and Bhagirath Chauhan	UQ	Jul-14	Dec-19
Sustainable insect management through improved insect resistance monitoring	DAN2003	Lisa Bird	NSW DPI	Jul-19	Jun-22
Sustainable SLW management through improved insect resistance monitoring	DAQ2001	Jamie Hopkinson	QDAF	Jul-19	Jun-22
1.3.3 Industry is prepared for a biosecurity incursion					
2020 International Year of Plant Health	HIA2001	Jo Luck	HIA	Sep-19	Sep-20
Boosting diagnostic capacity for plant production industries	GRDC2001	K'trie Coster	GRDC	Jul-19	Dec-22
Fall armyworm bioassay: partnership with GRDC	GRDC2005	Wee tek Tay Tom Walsh	GRDC/ CSIRO	Jun-20	Jun-21
Khapra beetle response	CA1708	Sally Ceeney	CA	Jan-17	Dec-19
Large-scale biosecurity scenario to support cotton industry preparedness	PHA1902	Lucy Aukett	PHA	Jul-18	Dec-19
Plant Biosecurity Research Initiative (PBRI)	HIA1801	Jo Luck	HIA	Jun-17	Jun-20
GOAL 1 TOTAL: $12.5 MILLION					

GOAL 2: IMPROVE COTTON FARMING SUSTAINABILITY AND VALUE CHAIN COMPETITIVENESS

Project title	Project code	Researcher	Organisation	Start date	Cease date
2.1 Sustainability of cotton farming					
2.1.1 Improved environmental footprint for cotton farms					
Appropriate land-use methodology for Australian cotton LCA assessments	UQ1701	Francois Visser	UQ	Jul-16	Oct-19
Cotton Landcare Tech Innovations: Communications support	NLP1903	Bernadette Pilling	HOC	Nov-18	Mar-22
Cotton Landcare Tech Innovations: Drone training	NLP2001	Meg Kummerow	Fly the Farm	Oct-19	Dec-19
Cotton Landcare Tech Innovations: Improved natural capital (biodiversity) on Australian cotton farms	NLP1901	Stuart Parsons	QUT	Jan-19	Nov-21
Cotton Landcare Tech Innovations: Improved natural capital (biodiversity) on Australian cotton farms	NLP1902	Rhiannon Smith	UNE	Jul-18	Nov-21
Feasibility study of managed aquifer recharge for improved water productivity for Australian cotton production	ANU1901	Anthony Jakeman	ANU	Aug-18	Aug-21
Improving the ability of the Australian cotton industry to report its sustainability performance	QUT1705	Erin Peterson	QUT	Oct-16	Oct-19
PhD: Farm-wide microgrid decision support system for the Australian cotton industry	UTS1901	Yunfeng (Forrest) Lin	UTS	Aug-18	Jun-21
PhD: Improving precision agriculture and climate adaptation for the Australian cotton industry	ANU1602	James Latimer	ANU	Feb-16	Oct-19
PhD: Sustainable water extractions: Low-flow refugia and critical flow thresholds	UNE1406	Marita Pearson	UNE	Jan-14	Mar-21
Quantifying the nitrogen cycle: from farmgate to catchments, groundwater and atmosphere	ANSTO1801	Dioni Cendon	ANTSO	Jul-17	Jun-21
Quantifying the potential environmental impacts of pesticides used on cotton farms	DAN1803	Mick Rose	NSW DPI	Jul-17	Jun-21
Review of international water footprints and their assessment of Australian agriculture	CRDC1923	Tim Grant	Life Cycles Strategies	Oct-18	Jul-19
Synthesis of natural resource assets in the cotton-growing region of eastern Australia	FWPA1801	Julian Wall	Eco Logical Aust	Jan-18	Jul-20
Understanding environmental impacts and resource impacts with changing demand for Australian cotton, assessed using a change modelling life cycle assessment approach	CRDC1911	Stephen Wiedemann	Integrity Ag and Environment	Aug-18	Feb-20
2.2 Create higher value uses for cotton					
2.2.1 Increased value for Australian cotton					
Breathable cotton for compression fabrics phase 2: performance testing	DU1905	Maryam Naebe	DU	Jan-19	Dec-19
Developing renewable fine chemicals from cotton biomass (A profitable future for Australian agriculture: Biorefineries for higher value animal feeds, chemicals and fuels) Phase 2	SRA2001	William Doherty	QUT	Jul-19	Jun-21
High sound-absorbing composites from recycled cotton	DU1901	Christopher Hurren	DU	Oct-18	Sep-19
PhD: Exploring nanofibrous coating on cotton fabric with versatile protection and dynamic comfort	RMIT1702	Olga Gavrilenko	RMIT	Feb-17	Oct-20

2.2.2 Increased understanding of market requirements and opportunities throughout the value chain					
Bio-degradation of dyed cotton fabrics	NCSU1701	Nelson Vinueza	NCSU	Jan-16	Dec-19
Joint RDC Community Trust Project	RIRDC1903	Jennifer Medway	AgriFutures	Jun-19	May-21
Microparticles generated from laundering of cotton and other fabrics	NCSU1702	Richard Venditti	NCSU	Jan-17	Dec-19
Strategies for improving labour conditions within the Australian cotton value chain	QUT1903	Alice Payne	QUT	Jun-19	Jun-22
2.3 Measurement and reporting throughout the value chain					
2.3.1 CRDC collaborates in global leadership for sustainability initiatives					
Australian participation in the European Union product environmental footprint technical advisory board	CRDC2008	Angus Ireland	AWI	Sep-19	Dec-22
Cotton industry social and wellbeing sustainability indicators	UC1901	Jacki Schirmer	University of Canberra	Jun-19	Jun-22
Membership of the Sustainable Agriculture Initiative (SAI) platform, Australian chapter	CRDC1902	Selwyn Heilbron	SAI Platform (Aust) Inc	Jul-18	Jun-20
PhD: Textile supply chain transparency and accountability	UL1901	Mark Sumner	UL	Oct-18	Sep-21
Sustainability metrics for the cotton industry	CRDC1944	Chris Cosgrove	Sustenance Asia	Jun-19	Jun-22
Sustainable Apparel Coalition membership	CRDC1817	Glenn Robinson	SAC	Aug-17	Jun-21
2.3.2 The value chain is transparent and understood by participants					
Engagement for Australian cotton industry contribution and perception scan report	CRDC1948	Robert Poole	KPMG	Jun-19	Jul-19
PhD: Sustainable value chain analysis of the Australian cotton industry	QUT1901	Zoe Mellick	QUT	Jul-18	Jul-21
GOAL 2 TOTAL: $1.6 MILLION					

GOAL 3: BUILD ADAPTIVE CAPACITY OF THE COTTON INDUSTRY

Project title	Project code	Researcher	Organisation	Start date	Cease date
3.1 Science and innovation capability, and new knowledge					
3.1.1 Science and innovation capacity is strengthened and strategically fit for a digital future					
2016 Horizon Scholarship: Sam Knight	RIRDC1602	Sam Knight	AgriFutures	Feb-16	Dec-19
2017 Horizon Scholarship: Holly Chandler	RIRDC1702	Holly Chandler	AgriFutures	Feb-17	Dec-19
2019 and 2020 Science and Innovation Awards for young people in agriculture: Dean Brooks and Dinesh Kafle	ABA1901	Maree Finnegan	ABARES	Jul-18	Jun-21
Australian Rural Leadership Program: Course 25	RIR1901	Fleur Anderson	ARLF	Jul-18	Oct-19
Australian Rural Leadership Program: Course 25	RIR1902	John Durham	ARLF	Jul-18	Oct-19
Australian Rural Leadership Program: Course 26, Course 27, Course 28, Trail 2020, Trail 2021	RIR1903	Matt Linnegar	ARLF	May-19	Dec-21
Coordination services in the building adaptive capacity goal and *my*BMP module reviews	CRDC2013	Rachel Holloway	Consultant	Jul-19	Jun-20
Cotton Production Course	UNE2002	Oliver Knox	UNE	Jan-20	Jun-23
Honours scholarship: Baselining river water nitrogen compounds in the Murrumbidgee irrigation district	UNSW1901	Jessica Watson	UNSW	Feb-19	Dec-19
Honours scholarship: Evaluation of relative damage caused by two-spotted mite, bean spider mite and strawberry mite in cotton	DAN1808	Chris Shafto	UTAS	Jan-18	Dec-19
Honours scholarship: Soil coalescence & compaction in southern NSW	US1903	Jonathon Moore	USYD	Jan-19	Dec-19
Improving grower decision in complex systems: A targeted tool to assist cotton growers in appropriate technology adoption	QUT2001	Geraldine Wunsch	QUT	Jul-19	Mar-22
*my*BMP support and program coordination	CRDC1815	Rachel Holloway	Consultant	Jul-17	Apr-20
Nuffield Australia Farming Scholarship 2018: Luke McKay	CRDC1801	Luke McKay	Nuffield Aust	Jul-17	Sep-19
Summer scholarship: Can insects spread cotton plant diseases in Australia?	CSP2003	Roisin Concannon	CSIRO	Jan-20	Mar-20
Summer scholarship: HydraSpectra – turning passive to active: economic thresholds for nitrogen deficiency	CSP2002	Strath Yeo	CSIRO	Nov-19	Jan-20
Summer scholarship: Understanding capacity of aerial seed banks in revegetation of abandoned farming areas in an agroecological landscape	GU2001	Jaiden Johnson-Bates	GU	Dec-19	Mar-20

3.1.2 Increased understanding of the diverse human capital in regional communities					
2019 AgriFutures Rural Women's Award Gala Dinner	RIRDC1904	Belinda Allitt	AgriFutures	Jul-18	Dec-19
2019 AgriFutures Rural Women's Award Gala Dinner: travel support for cotton women to attend	CRDC2007	Ruth Redfern	CRDC	Sep-19	Oct-19
AACS 2019 Australian Cotton Research Conference	CRDC1939	Oliver Knox	AACS	Apr-19	Dec-19
Australian cotton industry socio-economic study	CRDC2012	JP Van Moort	ACIL Allen Consulting	Feb-20	Jun-20
People in Agriculture website	DA1502	Shane Hellwege	Dairy Australia	Jul-14	Jun-21
Post Doc: Understanding and planning for the future cotton workforce	USQ1801	Nicole McDonald	USQ	Oct-17	Sep-20
Present: Sustainable Economic Growth for Regional Australia (SEGRA) Conference 2019	CRDC1942	Jennifer Moffatt	Jennifer Moffatt	Jun-19	Sep-19
3.1.3 Increased opportunities for innovation skills development					
AgFrontier new regional agtech incubator	CRDC1943	Sonya Comiskey	CHDC	Jun-19	Dec-19
3.2 Futures thinking					
3.2.1 Australian cotton growers are able to adapt to change					
Grassroots Grant: 2019 grower development and extension programs and off-target spray drift mitigation	CGA1903	John Durham	Southern Valleys CGA	Nov-18	Sep-19
Grassroots Grant: Climate change – planting times, pests and spray drift	CGA2003	Alec Macintosh	Walgett CGA	Dec-19	Jan-21
Grassroots Grant: Demonstration farm of IoT and LoRaWAN technology	CGA2004	Tom Crothers	St George CGA	Nov-19	Aug-20
Grassroots Grant: Field assessment of the impact of late season thrip infestations	CGA1902	Lou Gall	Gwydir Valley CGA	Oct-18	May-20
Grassroots Grant: Fostering crop RD&E collaboration and leadership in Northern Australia	CGA2005	Mian Rosos	Nth Aust Crop Alliance	Nov-16	Apr-20
Grassroots Grant: On-farm evaluation of pumping telemetry	CGA2002	Amanda Thomas	Macquarie CGA	Sep-17	Aug-21
Grassroots Grant: Weather stations	CGA2001	Jeff Hamblin	Lower Namoi CGA	Jul-19	Jun-20
Joint RDC Rural Safety and Health Alliance 2018-2021	RIRDC1901	Jennifer Medway	AgriFutures	Jul-18	Jun-21
Nuffield Australia Farming Scholarship 2019: Renee Anderson	CRDC1901	Renee Anderson	Nuffield Aust	Apr-18	Sep-20
Nuffield Australia Farming Scholarship 2020: Richard Quigley	CRDC2009	Richard Quigley	Nuffield Aust	Apr-19	Sep-21
Thresholds for resilience in regional communities	UM1902	Ruth Nettle	UMELB	Sep-18	Jul-20
3.2.2 Increased opportunities for strategic foresight					
BoardEffect governance platform hosting	CRDC1949	Sally Ceeney	CA	Jul-19	Jun-20
Grower RD&E Advisory Panels R&D Consultation 2019-20	CA2002	Sally Ceeney	CA	Jul-19	Jun-20
Sponsorship: CSIRO AgCatalyst 2020	CSP2004	Mark Peoples	CSIRO	May-20	Oct-20
Travel: CGAs representatives to attend evokeAG 2020	CRDC2003	Ruth Redfern	CRDC	Jul-19	Feb-20
GOAL 3 TOTAL: $0.9 MILLION					

Ruth Redfern

GOAL 4 (ENABLING STRATEGY 1): STRENGTHENING PARTNERSHIPS AND ADOPTION

Project title	Project code	Researcher	Organisation	Start date	Cease date
4.1. Partnerships and collaboration					
4.1.1 Growers/consultants value CRDC farming systems research outcomes					
Collaboration agreement Inversion Towers GRDC/ CRDC	GRDC2003	Gordon Cumming	GRDC	Jul-18	Jun-21
Sponsorship: 20th Australian Cotton Conference Foundation	CA2004	Tracey Byrne-Morrison	CA	Dec-19	Nov-21
4.1.2 CottonInfo partnership is maintained and practice change improved					
Climate and energy for cotton farming businesses (including CottonInfo technical lead and *my*BMP project lead)	AE1801	Jon Welsh	AgEcon	Jul-17	Jun-20
Communicating cotton best production practices with video	DAQ1901	Tonia Grundy	QDAF	Jul-18	Jun-21
Cotton industry database management	CRDC1804	Lee Armson	Making Data Easy	Jul-17	Jun-20
CottonInfo Field Demonstration Trial: APEN Membership 2019-20	CRDA2003	Warwick Waters	CottonInfo	Jul-19	Jun-20
CottonInfo Field Demonstration Trial: Autumn cover crop trial	CSD2002	Kieran O'Keeffe	CSD	Mar-20	Jun-20
CottonInfo Field Demonstration Trial: Investigation of the impact of last irrigations on profit and quality in the MIA region	CGA2006	Emma Ayliffe	Southern Valleys CGA	Jan-20	Aug-20
CottonInfo Field Demonstration Trial: Soil health workshops – Upper Lachlan and Upper Namoi	CSD2001	Andrew Mckay	CSD	Feb-20	May-20
CottonInfo irrigation field days	CSD1901	Kieran O'Keeffe	CSD	Dec-18	Mar-20
CottonInfo technical lead for nutrition (includes *my*BMP module lead)	DAN1906	Jon Baird	NSW DPI	Jan-19	Jun-21
Extension coaching and external review for CottonInfo	CRDC1946	Sean Kenny	Rural Consulting Group	Jun-19	Jun-20
Grassroots Grant: Assessing black root rot treatments in the Lachlan and Murrumbidgee valleys	CGA1904	John Durham	Southern Valleys CGA	Nov-18	Aug-19
National biosecurity and disease extension and coordination and CQ regional extension	DAQ1801	Paul Grundy	QDAF	Jul-17	Jun-21
NRM Technical Specialist, extension campaigns (CottonInfo Technical Lead) & Biodiversity R&D Manager	CRDC1805	Stacey Vogel	Stacey Vogel Consulting	Jul-17	Jun-20
Proofreading Cotton Pest Management Guide 2019	CRDC2004	Helen Dugdale	Helen Wheels HR	Jul-19	Jul-19
Proofreading: Australia Cotton Production Manual (ACPM) 2020 and Cotton Pest Management Guide (CPMG) 2020	CRDC2010	Helen Dugdale	Helen Wheels HR	Apr-20	Jul-20
4.1.3 Partnerships are strengthened to engage multi-disciplinary and multi-institutional resources					
2019 ICAC Plenary Meeting: Conference speaker	ICAC1905	DAWE	Sofitel Brisbane	Dec-19	Dec-19
2019 ICAC Plenary Meeting: Conference support services (audio visual)	ICAC1906	Kate Nicols	Sofitel Brisbane	Dec-18	Dec-19
2019 ICAC Plenary Meeting: Conference venue	ICAC1903	Kate Nicols	Sofitel Brisbane	Oct-18	Dec-19
2019 ICAC Plenary Meeting: Event management	ICAC1901	Jann George	By George Consulting	Oct-18	Dec-19

2019 ICAC Plenary Meeting: Sofitel accommodation ICAC/CRDC	ICAC1907	Allan Williams	CRDC	Dec-19	Dec-19
2019 ICAC Plenary Meeting: Supporting activities	ICAC1902	Jann George	By George Consulting	Oct-18	Dec-19
2019 ICAC Plenary Meeting: Welcome reception venue and catering	ICAC1904	Jann George	QAGOMA	May-19	Dec-19
AgVet collaborative forum: plant industries Phase 3	RIRDC1701	Jennifer Medway	AgriFutures	Jul-16	Dec-19
Consulting climate change	CRDC2015	Xavier Rizos	Consultant	Mar-20	Jun-20
CRSPI 2017-2020	CCR1801	Anwen Lovett	CRSPI	Jul-17	Jun-20
Sponsorship: APEN Conference 2019	CRDC1933	Graham Harris	APEN	Nov-18	Sep-19
Sponsorship: Joint RDC Representation for Innovation Futures (Phase 1 and 2)	RDC2002	Council of Rural RDCs	CRRDC	Oct-19	Feb-20
WeedSmart Phase 4	UWA1801	Lisa Mayer	UWA	Jul-17	Jun-20
4.2 Best practice (*my*BMP)					
4.2.1 Best practice is based on science and measured impact					
2019 Cotton Comparative Analysis	BCA2001	Hamish Cullenward	BCA	Jul-19	Jun-20
Cotton industry sustainability reporting: On-farm safety incidences 2014-2019	US2001	Kerri Lyn Peachy	USYD	Sep-19	Nov-19
Major capital item: Review of *my*BMP database: Caspio set up	CA1807	Rick Kowitz	CA	Jun-18	Mar-20
Review of 2016 Cotton Comparative Analysis	BCA2002	Hamish Cullenward	BCA	Jul-19	Jun-20
Review of *my*BMP database: Phase 2	CRDC1830	Mel Ziarno	Ardrossi	Jun-18	Mar-20
Understanding motivational factors for improved spray application on farms	UNE1901	Don Hine	UNE	Jun-18	Feb-20
4.3 Innovation and commercialisation					
4.3.1 Improved R&D innovation and commercialisation					
Commercialisation management tasks	CRDC2002	Jarrod Ward	Ahurei	Jul-19	Jun-21
CRDC business strategy	CRDC2005	Bernadette Pilling	HOC	Jul-19	Nov-19
CRDC innovation blueprint and implementation	CRDC2011	Paul Barnett	Asymmetric Innovation	Mar-20	Jun-20
Sponsorship: Joint RDC representation at evokeAG 2020	RDC2001	Tim Lester	CRRDC	Oct-19	Feb-20
GOAL 4 TOTAL: $1.3 MILLION					

GOAL 5 (ENABLING STRATEGY 2): DRIVING RD&E IMPACT

Project title	Project code	Researcher	Organisation	Start date	Cease date
5.1 Impact and effectiveness					
5.1.1 CRDC investments meet grower, industry and government needs					
2019 CRDC Stakeholder Research Survey	CRDC2006	Michael Sparks	Intuitive Solutions	Aug-19	Dec-19
5.1.2 CRDC monitors and evaluates RD&E impact					
2017, 2018 & 2019 Cotton Grower Survey	CRDC1733	Michael Sparks	Intuitive Solutions	Mar-17	Dec-19
Annual consultant qualitative and quantitative surveys	CCA1901	Laura Causer	CCA	Mar-18	Dec-20
Collaboration: Evaluation and Measuring impact	SRA2002	Leigh Clement	SRA	Oct-19	Sep-20
Summaries of CRDC Research	CRDC1945	Bernadette Pilling	HOC	Jun-19	Jun-21
5.1.4 Growers, the cotton industry and government are informed and aware of RD&E outcomes					
Final report summaries and M&E database	CRDC1920	Sally Knight	Sally Knight	Jul-18	Dec-19
GOAL 5 TOTAL: $0.4 MILLION					

TOTAL INVESTMENT IN RD&E: $16.7 million

Appendix 4: Glossary and acronyms

Term	Description
AACS	Association of Australian Cotton Scientists
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACRI	Australian Cotton Research Institute
AFI	Australian Farm Institute
AgriFutures	AgriFutures Australia Ltd
AGWA	Australian Grape and Wine Authority (Wine Australia)
ANTSO	Australia's Nuclear Science and Technology Organisation
ANU	Australian National University
APEN	Australasia-Pacific Extension Network
APVMA	Australian Pesticides and Veterinary Medicines Authority
ARLF	Australian Rural Leadership Foundation
ARLP	Australian Rural Leadership Program
AWI	Australian Wool Innovation
BCA	Boyce Chartered Accountants
BMP	Best Management Practices program
Bollgard 3®	Cotton varieties contain three genes resistant to *Helicoverpa* spp.
Bollgard II®	Cotton varieties contain two genes resistant to *Helicoverpa* spp.
Bt	*Bacillus thuringiensis* (crystal protein gene expressed in Bollgard II® and Bollgard 3® cotton varieties, resistant to *Helicoverpa* spp.)
CA	Cotton Australia
CCA	Crop Consultants Australia Inc.
CGA	Cotton Grower Association
CHDC	Central Highlands Development Corporation
CMSE	CSIRO Materials Science and Engineering
CottonInfo team	Team of regional extension officers, technical leads and *my*BMP specialists, formed under a joint venture between CRDC, Cotton Australia and CSD
CottonLEADS	Australian and United States program to lead responsible cotton production sustainably
CQ	Central Queensland
CRC	Cooperative Research Centre
CRCNA	Cooperative Research Centre for Northern Australia
CRDC	Cotton Research and Development Corporation
CRRDC	Council of Rural Research and Development Corporations
CRSPI	Climate Research Strategy for Primary Industries
CSD	Cotton Seed Distributors Ltd (a grower-owned cooperative)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Department of Agriculture, Water and the Environment (Commonwealth)

DCRA	Dryland Cotton Research Association
DJPR	Department of Jobs, Precincts and Regions (Victoria)
DU	Deakin University
Fusarium wilt	A disease caused by the soil-borne fungal pathogen *Fusarium oxysporum f. sp. vasinfectum* (FOV).
FAW	Fall armyworm
GM	Genetically Modified
GRDC	Grains Research and Development Corporation
GU	Griffith University
GVIA	Gwydir Valley Irrigators Association
ha	hectare
Helicoverpa spp.	Cotton's major insect pests *(H. armigera* and *H. punctigera)*
HIA	Horticulture Innovation Australia (Hort Innovation)
HOC	House of Communications
HRMS	Herbicide Resistance Management Strategy
IoT	Internet of Things
IDM	Integrated Disease Management
IP	Intellectual Property
IPM	Integrated Pest Management
IREC	Irrigation Research and Extension Committee
IRMS	Insecticide Resistance Management Strategy
IWM	Integrated Weed Management
KPI	Key Performance Indicator (measure of success)
LCA	Life cycle assessment
LoRaWAN	Low-power long-range network
M&E	Monitoring and Evaluation
MDB	Murray-Darling Basin
ML	megalitre
MLA	Meat and Livestock Australia
MP	Member of Parliament
MRES	Micro Meteorology Research and Education Services
NCSU	North Carolina State University
NFF	National Farmers' Federation
NPIRDEF	National Primary Industries RD&E Framework
NRM	Natural Resource Management
NSW DPI	NSW Department of Primary Industries
NTDPIR	Northern Territory Department of Primary Industry and Resources
PBS	Portfolio Budget Statements
PGPA Act	*Public Governance, Performance and Accountability Act 2013*
PHA	Plant Health Australia

PhD	Doctor of Philosophy
PIEFA	Primary Industries Education Foundation Australia
PIRD Act	*Primary Industries Research and Development Act 1989*
Postdoc	Post-Doctorate
PYIA	Picture You in Agriculture
QAAFI	Queensland Alliance for Agricultural and Food Innovation
QAGOMA	Queensland Art Gallery and Gallery of Modern Art
QDAF	Queensland Department of Agriculture and Fisheries
QDES	Queensland Department of Environment and Science
QUT	Queensland University of Technology
R&D	Research and development
RD&E	Research, development and extension
RDC	Rural Research and Development Corporation
REO	Regional Extension Officers
RMIT	Royal Melbourne Institute of Technology
RMP	Resistance Management Plan
RRDP grants	Rural R&D for Profit grants
SAC	Sustainable Apparel Coalition
spp.	species
SRA	Sugar Research Australia
TIMS	Transgenic and Insect Management Strategy Committee
UC	University of Canberra
UL	University of Leeds
UM	University of Melbourne
UNE	University of New England
UNSW	University of New South Wales
UQ	University of Queensland
USC	University of the Sunshine Coast
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
Verticillium wilt	A disease caused by the soil-borne fungal pathogen *Verticillium dahliae*
WHS	Work Health and Safety

Appendix 5: Annual reporting requirements

The following table details the contents of the CRDC Annual Report and the associated requirements under the PIRD Act, the PGPA Act and the CRDC Funding Agreement.

Annual Report item	PIRD Act	PGPA Act	Funding Agreement
SECTION 1: EXECUTIVE SUMMARY			
About CRDC and the Australian cotton industry	s28(a)(vii)	s17BE (k) & (l) (and s17BE (s))	Clause 8.1-8.5
Report from Chair & Executive Director	s28(a)(iii)	s17BE (p)	
Progress against Strategic RD&E Plan 2018–23: Our Annual Performance Statement	s28(a)(i) s28(a)(iii) s28(a)(iib) s28(b)	s39(1) (b) s17BE (a) & (b) s17BE (g)	Clause 9.2(a-d) Clause 9.4(a-b)
2019-20 investment & impact		s39(1)(b) s17BE (g)	Clause 9.2(a-d)
Year in review: RD&E highlights	s28(a)(iv)	s39(1)(b) s17BE (g)	Clause 9.2(a-d)
Letter of transmittal		s17BB	
SECTION 2: CRDC BUSINESS			
CRDC role	s28(a)(vii)	s17BE (k) & (l) (and s17BE (s))	Clause 8.1-8.5
CRDC operations		s17BE (n) & (o)	Clause 14.1
Setting the research priorities	s28(d)	s17BE (n) & (o)	Clause 9.2(a-d)
Collaboration & co-investment	s28(a)(iv) s28(a)(vi)	s17BE (n) & (o)	Clause 9.2(a-d) Clause 11
SECTION 3: CORPORATE OPERATIONS			
Business financials	s28(d)		Clause 14.1
Investments in RD&E	s28(d) s28(a)(iib)		Clause 9.2(a-d) Clause 14.1
Investments against Government priorities	s28(a)(iib)		Clause 9.2(a-d)
SECTION 4: RD&E PORTFOLIO			
Investments, innovations & impacts: Goals 1-3, Enabling Strategies 1&2	s28(a)(i)	s39(1)(b)	Clause 9.2(a-d)

SECTION 5: CRDC PEOPLE AND GOVERNANCE			
CRDC Board		s17BB s17BE (j) s17BE (m)	
CRDC Employees		s17BE (k) & (l) (and s17BE (s))	
Governance & accountability	s28(a)(iv) s28(a)(v) s28(a)(vi) s28(c)	s17BB s17BE (a), (b), (c), (d), (e)	Clause 2.6 (a-b) Clause 7.1 Clause 9.7 Clause 12
Selection Committee Report	s141(1A)		
SECTION 6: FINANCIALS			
Independent Auditor's Report		s17BB s43(4) s17BE (r)	
Statement by the Accountable Authority, ED & Finance Officer		s17BB	
Financial statements	s28(a) (viii) s28(d)	s43(4) RMG 138/139 *	Clause 14.1 Clause 12
Notes of the financial statements	s28(a) (viii) s28(d)	s43(4)	
SECTION 7: APPENDICES			
Appendix 1: Australian Government priorities	s28(a)(i)	s17BB	Clause 9.2(a-d)
Appendix 2: Environmental performance			Clause 9.2(a-d)
Appendix 3: RD&E Portfolio list	s28(a)(i)		
Appendix 4: Glossary & acronyms		s17BD	
Appendix 5: Annual reporting requirements		S46(3) s17BD s17BE (u)	Clause 9.2(a-d)

CRDC

www.crdc.com.au