CRDC

ANNUAL REPORT 2020–21

Case study

Case study: Groundbreaking trial to return cotton textile waste to cotton fields

A cotton farm just outside Goondiwindi is the site of a groundbreaking trial to test whether shredded cotton products could offer benefits to cotton soil health, and a scalable solution to textile waste.

The project is a partnership between circular economy specialists Coreo, the Queensland Government, Goondiwindi Cotton, Sheridan, Cotton Australia, Worn Up, and CRDC-supported soil scientist Dr Oliver Knox of the University of New England (UNE) and is linked to the industry's *PLANET. PEOPLE. PADDOCK* Sustainability Framework.

Around two tonnes of cotton textiles and garments have been processed at Worn Up in Sydney, transported to "Alcheringa," and spread onto a cotton field by local farmer Sam Coulton (pictured front cover).

It is hoped the fabrics will break down in the soil, increase microbial activity, lock in carbon and provide cover to improve soil moisture. Projections show 2,250 kg of carbon dioxide equivalents (CO_2e) will be mitigated through the breakdown of these garments in soil, rather than going to landfill. The trial will be completed in early 2022, with initial results shortly after.

"We need to get smarter about how we reduce and manage waste. The potential to divert clothing from landfill, reduce greenhouse gas emissions, and potentially feed our soils could help deliver more sustainable practices in multiple sectors," said Dr Oliver Knox.

Textile waste is a major problem for communities and supply chains globally, with the latest Australian estimate showing approximately 85 per cent of apparel is sent to landfill at end of life.

Farmer Sam Coulton said being part of the solution is very positive. "We grow it here and we should be able to bury it here with positive environmental and economic impact on the local community."

CRDC

CRDC ANNUAL REPORT

2020-21

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

Contents

CRDC

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If you are interested in learning more about CRDC and our investments, visit our website or subscribe to our quarterly magazine, *Spotlight.* With thanks to the photographers and organisations who contributed photos to this report: Hayden Petty, Kym Redfern, Melanie Jenson, Paul Grundy, Renee Anderson, Ruth Redfern, Warwick Waters, Cotton Australia, Country Road, John Deere, and the University of Queensland.

Front cover photo: Goondiwindi cotton grower Sam Coulton.

Published: October 2021
ISSN: 1039-3544

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. 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

A culture of innovation and impact, driven by CRDC and RD&E.

The Australian cotton industry has built a culture of innovation, driven by the industry's world-class researchers, transformational research and development (R&D) projects, and highly adaptive growers.

CRDC's role is to foster this culture and deliver tangible innovation impacts, helping to increase the productivity and profitability of Australian cotton farms, improve our sustainability and value chain competitiveness, build our adaptive capacity, strengthen our partnerships and the adoption of our research outcomes, and ultimately drive RD&E impact.

We invest in these critical areas to ensure our cotton growers, our communities, and the wider industry are well prepared for a dynamic future.

CRDC has been driving innovation for the cotton industry for 30 years. In the early years, we supported the development of the first GM cotton varieties, the industry's world-leading insect resistance management strategies, and the development of cotton's best management practice program – all were innovative for Australian agriculture at the time.

Today, CRDC-supported research and collaborations remain at the leading edge of technological advancements. We are delivering a revolutionary insect monitoring system using smartphones; sensing technology and automation using the internet of things; and transformational new products using biotechnology to allow plants to fight pests, diseases, drought and climate change.

We are also seeing long-term investments into critical research areas such as water-use efficiency paying dividends for growers, the industry and the environment. In 2020–21, CRDC-supported research has found that over the past 25 years, the industry has almost halved the amount of water needed to grow a bale of cotton. This is primarily due to improvements in irrigation infrastructure, management efficiencies and higher yielding varieties, underpinned by RD&E, which demonstrates the industry's commitment to sustainability, continuous improvement and being responsive to society's expectations.

Just as the world in which we operate is ever-changing, the way CRDC invests in innovation is evolving. For 30 years, CRDC has worked with scientists to solve cotton's greatest challenges. That hasn't changed, but we cast our net deeper and wider. There is a world of innovation waiting to be harnessed by Australian agriculture, and CRDC is embarking on new pathways to capitalise on it, like the creation of Agricultural Innovation Australia Pty Ltd, the partnership with the Australian Government's Business Research and Innovation Initiative (BRII) program and the formation of growAG.

Critically, collaboration remains at the heart of everything we do. There isn't a single research project we invest in that isn't delivered in partnership with our growers, cotton researchers and collaborators. We also partner with those outside our sector to solve issues that are bigger than cotton alone. In 2020–21, 55 per cent of CRDC's investments were in cross-sectoral RD&E.

In this report, we outline the third year of our investment under the CRDC Strategic RD&E Plan 2018–23: the halfway point in the delivery against these strategic priorities. We bring you an update on our progress towards our goals, our 2020–21 investments, innovations and impacts.

Richard Haire
CRDC Chair

Dr Ian Taylor
CRDC Executive Director

PROGRESS AGAINST CRDC STRATEGIC R&D PLAN 2018–23

Our Annual Performance Statement

The 2020–21 year marked the third 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 dry conditions during the first half of the strategic plan period, and the challenges associated with COVID-19 in the second, 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 2020–21 under this plan are helping to continue to drive the Australian cotton industry towards a future of innovation, increased commercialisation and digital transformation.

In 2020–21, Australian cotton growers and the Australian Government co-invested $16.9 million through CRDC into cotton RD&E, across 188 projects, and in collaboration with 85 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 2020–21 year.

Our progress is measured and performance is 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.

The following table provides a snapshot of CRDC's performance against the Strategic Plan measures. The targets listed here are five of 40 targets identified in the CRDC Strategic RD&E Plan. 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	2020–21 progress comments
Increase productivity and profitability on cotton farms. Improved yield and quality.		Increase in average bales per hectare (bales/ha) from 9.86 to 11.6 bales/ha for irrigated cotton, and from 4.0 to 4.7 bales/ha for dryland cotton.	The 2019–20 crop was the smallest harvest in over 30 years due to very limited water availability and a lack of in-season rainfall. Based on 2019–20 yield information, dryland yields remain below target at under 3 bales/ha, while the 5-year average irrigated yield has remained steady from last year at 10 bales/ha. The 2020–21 season had higher rainfall across most of the cotton-growing regions; however, final production figures and, therefore, yields are not yet available. At this stage, it is anticipated that the 2023 goal will not be reached due to the adverse impact of drought and water availability.
Improve cotton farming sustainability and value chain competitiveness. CRDC collaborates in global leadership for sustainability initiatives.		Participates in six global initiatives (per annum).	CRDC participates directly in six global initiatives: ICAC's 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'; Cotton2040; and the Textile Exchange. CRDC also participates indirectly in the EU's Product Environmental Footprint processes via collaboration with Australian Wool Innovation (AWI), Meat and Livestock Australia (MLA) and Grains Research & Development Corporation (GRDC).
Build adaptive capacity of the cotton industry. Science and innovation capacity is strengthened and strategically fit for a digital future.		50+ new/early career researchers supported through strategic career pathways (10 per annum).	CRDC supported CSIRO summer scholarships, which included six students focused on cotton-related research. In May 2021, 16 researchers attended the CRDC-supported Postgraduate Cotton Careers Tour. 94 per cent of attendees said the tour was helpful in informing them of career opportunities in cotton.
Strengthen partnerships and adoption. Partnerships are strengthened to engage multi-disciplinary and multi-institutional resources.		40 per cent of CRDC's annual RD&E investments are through cross-sectoral partnerships.	In 2020–21, 55 per cent of CRDC's RD&E investments were through cross-sectoral partnerships. This included strategic collaborations on water-use efficiency, nitrogen management, novel crop protection, biosecurity, the development of the cotton industry in Northern Australia, and engagement with the European Union.
Drive RD&E impact. CRDC monitors and evaluates RD&E impact.		CRDC delivers five RD&E impact reports (one per annum).	Six RD&E impact reports were completed in 2021–22: two for the Smarter Irrigation for Profit Phase 2 program, and four for the More Profit from Nitrogen program (one for each of the participating industries).

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

Certification by the Executive Director

I, Dr Ian Taylor, as the accountable authority of Cotton Research and Development Corporation (CRDC), present the 2020–21 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

8 October 2021

2020–21 investment and impact

The Australian cotton industry in 2020–21

CRDC's investment in 2020–21

$16.9 million
CRDC's investment in cotton RD&E on behalf of cotton growers and the Australian Government

188
RD&E projects

85
research partners

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;**
- **Driving RD&E impact.**

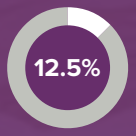
CRDC impact

100% the number of CRDC's investments in 2020–21 that have been in partnership with the cotton industry.

365 the number of stakeholders that provided feedback to the Australian cotton industry's draft sustainability targets during consultation in 2021–22.

55 per cent
the number of CRDC's investments in cross-sectoral collaborative projects.

96 per cent
the percentage of *2020 Cotton Grower Survey* respondents who agreed CRDC is a trusted information source. 91 per cent said they were supportive of CRDC's investments.



12.5 per cent
the targeted increase in irrigated cotton water-use efficiency that CRDC is helping the industry to achieve every five years under the sustainability targets.

7 **major collaborative projects**
that CRDC has led or actively participated in during 2021–22 under two government initiatives: Rural R&D for Profit, and the National Landcare Program Smart Farming Partnership.

9 the number of priority areas for the cotton industry under the industry's sustainability targets: water, carbon, biodiversity, pesticides, soil health, quality of work life, wellbeing and social capital, efficiency, and profitability.

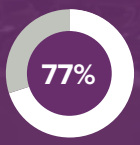
CRDC impact

(Almost) **50 per cent**

the reduction in water needed to grow a bale of cotton over the past 25 years. An analysis of available water use data shows the industry has almost halved the amount of water needed to grow a bale of cotton since 1996.

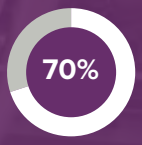
15

the number of participants in the 2021 Australian Future Cotton Leaders program.



77 per cent

the reduction in the amount of herbicide used by the new John Deere See & Spray Select™ technology, underpinned by CRDC research, compared to traditional spraying.



70 per cent

the percentage of Smarter Irrigation for Profit Phase 2 participants who intend to make management practice changes to their irrigation systems in the next 12 months.

630 students

the number of enrolments in the UNE Cotton Production Course over the past 10 years, supported by CRDC and the former Cotton Cooperative Research Centres (CRCs).

9 the number of local grower-led projects CRDC invested in through its Grassroots Grants program in 2020–21, taking the total number of projects supported since it began to 82.

6 the number of global initiatives CRDC participates in on behalf of the cotton industry.

52 the number of applications received by CRDC's challenge to revolutionise spray application through the Business Research and Innovation Initiative (BRII) program, resulting in six feasibility studies.

$600,000

the minimum contribution of Country Road to a partnership with CRDC, Cotton Australia, and Landcare Australia to improve biodiversity on Australian cotton farms.

2.3 million

the number of collective views that the 213 CRDC-supported best practice videos have amassed on the CottonInfo YouTube channel as at May 2021.

75 ha

the area of field trials established under the Cotton Landcare Tech Innovations project to trial revegetation methods: tubestock, direct and drone seeding.

14,000 ha

the area of cotton grown in Northern Australia in 2020–21, an increase from less than 1,000 hectares in 2016–17.

RD&E highlights

R&D finds industry has almost halved water use

CRDC-supported research has contributed to the Australian cotton industry almost halving the amount of water used to grow a bale of cotton over the past 25 years. Findings by NSW Department of Primary Industries (NSW DPI) researchers from in-depth water productivity benchmarking studies supported by CRDC in 2007, 2009, 2013 and 2018, combined with all other available water use data going back to 1992, showed that the amount of water needed to grow one bale of cotton has fallen by almost 50 per cent since 1996. This is primarily due to improvements in irrigation infrastructure, management efficiencies and higher yielding varieties, underpinned by RD&E. This demonstrates the Australian cotton industry's responsible use of shared natural resources and its commitment to continuous improvement in water-use efficiency.

For more, see page 44.

RDC collaboration results in Agriculture Innovation Australia

In 2019–20, CRDC worked closely with the Research and Development Corporations (RDCs) to develop a framework for collaboration across the whole of agriculture. In 2020–21, this partnership was formalised with the establishment of Agriculture Innovation Australia (AIA) Ltd: a new not-for-profit company established by the collective RDCs to drive cross-sectoral research, leverage private sector investment, and target transformational innovation. AIA Ltd is designed to prioritise and streamline co-investment to tackle difficult cross-sectoral challenges and drive greater impact for agriculture and the broader community. CRDC has been actively involved in the establishment of AIA Ltd and its first investment project, the Climate Initiative, which aims to foster thriving agriculture, fisheries and forestry industries, regardless of pressures from a variable and changing climate. For more, see page 66.

Innovative approach to revolutionise agricultural spray drift

To help solve the challenge of agricultural spray drift, CRDC took an innovative approach in 2020–21, partnering with the Australian Government's Business Research and Innovation Initiative (BRII) to approach entrepreneurs, innovators and small to medium businesses for potential solutions. BRII seeks effective ways to deal with challenges that affect the environment, while providing opportunities for startups and businesses to develop new products and technologies. Of the 52 applications received through the program, six groups were selected to test the feasibility of their ideas with CRDC, Cotton Australia, and the NSW Environmental Protection Agency (NSW EPA). Two of these applications will be selected to deliver a proof-of-concept approach.

For more, see page 47.

CRDC-supported research underpins John Deere commercialisation

New vision-based plant detection technology released by the company John Deere was developed through projects supported by CRDC with researchers from the University of Southern Queensland (USQ). The See & Spray Select™ technology, integrated into John Deere's new 400 and 600 series sprayers, is the only technology of its type available in Australia, and the industry's first factory-installed, targeted spray solution. The technology rapidly detects green plants within fallow ground and automatically triggers an application to those plants, achieving a similar hit rate to traditional broadcast spraying but using, on average, 77 per cent less herbicide. The initial experimental work to develop the vision-based plant detection technology was funded through a combination of industry research projects with CRDC, Sugar Research Australia, Hort Innovation, and USQ.

For more, see page 67.

Progress towards commercialisation: R&D on path towards commercial release

In 2020–21, several CRDC-supported R&D innovations continued their progress towards commercial release: an artificial intelligence smartphone app to help identify silverleaf whitefly (underpinned by a new silverleaf whitefly threshold also supported by CRDC and released in 2020–21); BioClay, the non-toxic, clay-based biodegradable product for crop pests and pathogens; AquaTill Injeticide, the ultra-high pressure water-cutting technology for crop termination; and VARIwise, the software that combines in-season imagery with crop production models to provide yield predictions throughout the season. Commercial development of these innovations will continue in 2021–22 with support from CRDC. For more, see page 45.

Groundbreaking trial to help soil health and solve textile waste

Reducing waste and increasing soil health are just two of the benefits expected from a ground-breaking trial, supported by CRDC, that involves spreading approximately two tonnes of shredded cotton products onto a cotton farm near Goondiwindi. It is hoped that the fabrics will break down in the soil, increasing microbial activity, locking in carbon and improving soil moisture, while also diverting cotton clothing from landfill and reducing greenhouse gas emissions. This trial is part of a partnership between circular economy specialists Coreo, the Queensland Government, Goondiwindi Cotton, Sheridan, Cotton Australia, Worn Up, and CRDC-supported soil scientist Dr Oliver Knox of the University of New England (UNE). If successful, the trial could lead to large-scale recycling of cotton textiles, helping to solve the issue of textile waste through a circular system.

For more, see inside front cover.

Country Road and cotton: helping to protect biodiversity

CRDC and Cotton Australia are supporting a partnership between iconic Australian brands Country Road and Landcare Australia to improve biodiversity on cotton farms in the Namoi Valley. Country Road will contribute a minimum $600,000 to the partnership over three years, with funds raised going to Landcare Australia to support biodiversity restoration projects. The partnership will draw on a CRDC report, published under the Australian Government's National Landcare Program Smart Farming Partnership Initiative Round 1, which mapped biodiversity in Australian

cotton landscapes, identified threatened and endangered species, and recommended ways to protect them.
For more, see page 55.

Stakeholders consulted on cotton industry sustainability targets

The *PLANET. PEOPLE. PADDOCK* Sustainability Framework has been developed by the industry to coordinate work to make Australia a global leader in sustainable cotton production. An important part of the framework is setting targets and coordinating a whole-of-industry strategy to achieve them. Draft targets and indicators of progress have been developed for each of the core focus areas under the framework. These are PLANET: water; carbon footprint, biodiversity, pesticides, soil health; PEOPLE: workplace, wellbeing; and PADDOCK: productivity, profitability. In a consultation process during July and August 2020, 356 stakeholders gave feedback on these draft indicators and targets to validate the level of ambition, to test they are the 'right' ones to use, and to elicit suggestions for partnerships and solutions to achieve targets. In addition, the industry is working with other sectors to ensure consistency; the targets will be launched when this work is finalised.
For more, see page 53.

Collaboration to tackle major cross-sectoral challenges

Of CRDC's 2020–21 investments, 100 per cent have been in partnership with the cotton industry, and 55 per cent in cross-commodity collaborative projects with fellow RDCs. CRDC led three major collaborations: Smarter Irrigation for Profit Phase 2 and More Profit from Nitrogen, under the Australian Government's 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 four other projects under the Rural R&D for Profit program, addressing cross-sectoral issues in weeds, biosecurity, energy and diseases. For more, see page 24.

Measuring RD&E performance for impact

Two monitoring and evaluation (M&E) reports released in 2020–21 show that growers value CRDC-supported RD&E from the Smarter Irrigation for Profit Phase 2 and More Profit from Nitrogen programs, delivered under the Australian Government's Rural R&D for Profit program. The Smarter Irrigation for Profit mid-term evaluation found that 70 per cent of participants intended to make management practice changes to their irrigation systems within 12 months as a result of the program. The More Profit from Nitrogen final evaluation found it was rated strongly among growers for generating knowledge and resources about improving on-farm nitrogen-use efficiency, and moderately for the extent of industry confidence in adopting key research findings.
For more, see page 73.

Building adaptive capacity: support for industry leaders

CRDC continued to invest in industry leaders during 2020–21, under the Strategic Plan goal of building adaptive capacity. These include Nuffield Scholars, supported by CRDC and Cotton Australia: 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 2021 winner, Demi Sargent of the Australian National University; and the latest cohort of Australian Rural Leadership Program participants in conjunction with Cotton Australia and Auscott Ltd: Chantal Corish and Rod Gordon (course 26), Ruth Redfern (course 27), and Justin McMillan (course 28).
For more, see page 58.

Giving back to the grassroots: investing in R&D 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, 82 projects have been supported, with $721,000 invested by CRDC. During 2020–21, these projects included on-farm evaluation of pumping telemetry; an on-farm demonstration of the internet of things (IoT) and low-power, long-range (LoRaWAN) networks; a project to promote biosecurity management and *my*BMP in northern Australia; projects to encourage the uptake of digital technology; programs to increase skill development for growers; and study tours to other cotton-growing regions. For more, see page 61.

RD&E supporting continued northern industry expansion

The Australian cotton industry continues to grow in Northern Australia, with 14,000 hectares of cotton grown in the north in 2020–21, compared to less than 1,000 hectares in 2016–17. A key focus for CRDC is to ensure this development is done sustainably, with best management practices and biosecurity as core priorities. CRDC continues to support the $2.1 million research program for Northern Australia, announced in March 2020, in partnership with the Cooperative Research Centre for Northern Australia and GRDC. In addition, 2017 Cotton Researcher of the Year Steve Yeates continues his role as cotton development and coordination leader for northern cotton with support from CRDC, delivering science leadership and coordination for current and future cotton developments and linkages for biosecurity initiatives. CRDC is also supporting grower-led initiatives, like Grassroots Grants, in Northern Australia. For more, see page 46.

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

In October 2020, CRDC welcomed the appointment of six Board Directors: Rosemary Richards and Les Copeland, who were returned for a second term on the CRDC Board; and new Directors Ross Burnett, Dr Gary Fitt, Dr Danielle Kennedy, and Peta Slack-Smith. They join CRDC Chair Richard Haire and Executive Director Dr Ian Taylor. Four Directors completed their tenures with the Board in September 2020, and CRDC recognised their contribution to the cotton industry: Kathryn Adams, Liz Alexander, Greg Kauter and Jeremy Burden. Rosemary Richards was subsequently elected as CRDC's Deputy Chair.
For more, see page 76.

Letter of transmittal

CRDC

8 October 2021

The Hon. David Littleproud MP
Minister for Agriculture and Northern Australia
Parliament House
Canberra ACT 2601

Dear Minister

It is with great pleasure that I submit the Corporation's Annual Report for 2020–21, 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 2020–21 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 7 October 2021.

Yours sincerely

Richard Haire
Chair
Cotton Research and Development Corporation

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Section 2
CRDC Business

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 and Northern Australia; the Department of Agriculture, Water and the Environment; the cotton industry's representative organisation, Cotton Australia; and cotton growers, including Cotton Grower Associations. We are funded through an industry levy and matching Commonwealth contributions. In 2020–21, we invested $16.9 million in RD&E into 188 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 2020–21, CRDC partnered with 85 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 2020–21:

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)	2020-2021 targets
GOAL 1: Increase productivity and profitability on cotton farms	Improved yield and quality	Increase in average bales/ha from 9.86 to 11.6 bales/ha for irrigated cotton, and 4.7 bales/ha for dryland cotton	Annual increase of 0.35 bales/ha for irrigated cotton, and 0.14 bales/ha 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 to participate in 6 global initiative per annum
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 per annum
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 to include cross-sectoral partnerships per annum
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 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 consult formally with Cotton Australia in the development and implementation of the Strategic RD&E Plan, including R&D investments. This engagement ensures four main actions: 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 are to:

- 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 collaborative process of deciding where to invest our annual RD&E funding involves all major stakeholders.

Each year, we work closely with the industry's peak representative body, Cotton Australia, and the Australian Government to identify and evaluate the cotton industry's requirements for RD&E. Cotton Australia provides ongoing advice 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 consult 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

In May 2019, the 2020–21 priorities forum identified key areas of focus for future RD&E investment. These key areas were prioritised for investment considering strategic research gaps, maintenance of core industry research capacity given the impact of the drought on CRDC's budget, and feedback from the advisory panels in November 2019. These key areas formed the basis of the targeted call, with expressions of interest developed on these areas to guide researchers in developing their proposals. The key focus areas included:

- tools to support disease-suppressive farming systems
- novel controls for key industry diseases
- developing novel cotton-farming systems
- towards carbon neutral cotton production
- climate, energy and business analysis for cotton growers
- identifying key issues to maintain and improve Australian cotton fibre quality
- supporting natural resource management delivery
- building digital capability in the Australian cotton industry
- undertaking the 4th Australian Cotton Industry Environmental Audit
- mitigating irrigation infrastructure impacts on aquatic biodiversity.

Through the 2020–21 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 and Northern Australia. 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 in three main ways: 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:

- increase 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
- achieve the sustainable use and sustainable management of natural resources
- make more effective use of the resources and skills of the community in general and the scientific community in particular
- support the development of scientific and technical capacity
- develop the adoptive capacity of primary producers
- improve accountability for expenditure on R&D 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.*

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

The industry has also developed its own 20-year vision for the future that encompasses industry priorities around better 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 2020–21, 55 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 2020–21, CRDC partnered with 85 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 $5,500 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: Council of Rural RDCs, grants and growAG

CRDC is one of 15 Rural Research and Development Corporations (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, bringing 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 as outlined over the page.

In addition, the collective RDCs and the Department of Agriculture, Water and the Environment collaborated to form growAG in 2020-21. growAG is designed to create a global gateway into the Australian research and innovation system, with a focus on deal-flow, attracting capital investment and driving collaboration. It makes RD&E outcomes transparent for growers and the community, positions Australia as a global agrifood innovation hub, and makes it easy to explore, find and connect with potential partners and opportunities. growAG was launched by the Minister for Agriculture and Northern Australia the Hon. David Littleproud MP in April 2021. As of end June 2021, growAG had featured 2000 research projects (including 170 from CRDC) and showcased 31 commercial opportunities (including one from CRDC) to over 10,000 users from 117 countries. growAG is led by AgriFutures Australia and the steering committee includes representation from CRDC and 18 other agricultural innovation organisations.

Australian Government grants

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

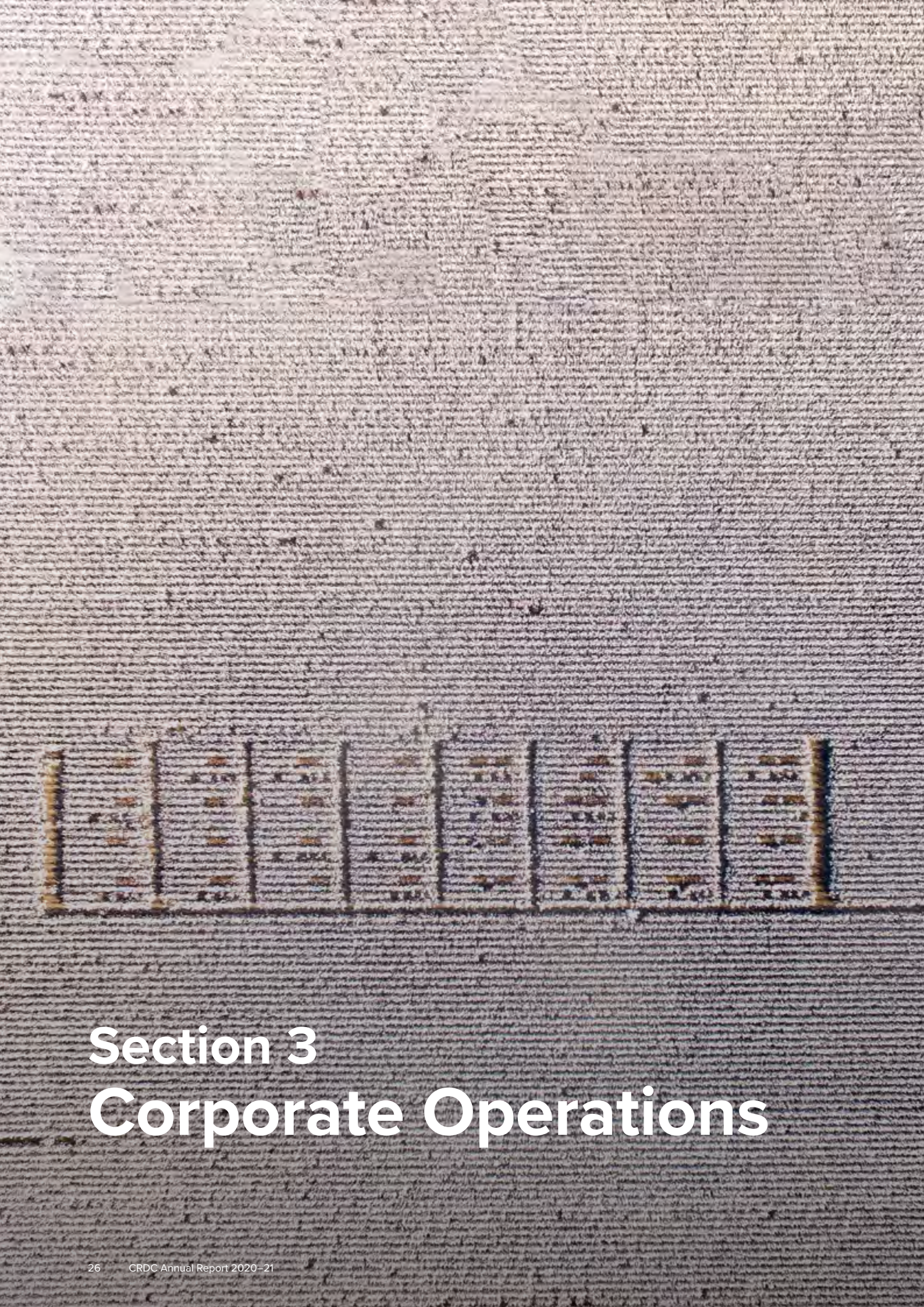
CRDC managed three programs in 2020–21 under government grants, contributing a combined $14.1 million into RD&E funding across the life of the programs, for the benefit of the Australian cotton industry, the community and other industries.

- **More Profit from Nitrogen: enhancing the nutrient-use efficiency of intensive cropping and pasture systems** *(funded 2016–21, 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, 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 four other programs through Rural R&D for Profit program grants led by other RDCs during 2020–21:

- **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).*

The Hon. Michael McCormack MP, AgriFutures Australia Chair Kay Hull AO, the Hon. David Littleproud MP and AgriFutures Australia Managing Director John Harvey pictured at the launch of growAG in April 2021.



Section 3
Corporate Operations

Business financials

Our investment in RD&E is funded through an industry levy and matching Commonwealth contributions. In 2020–21, we invested $16.9 million in cotton RD&E throughout the industry supply chain. In 2021–22, our estimated cotton RD&E expenditure will be $18.9 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.

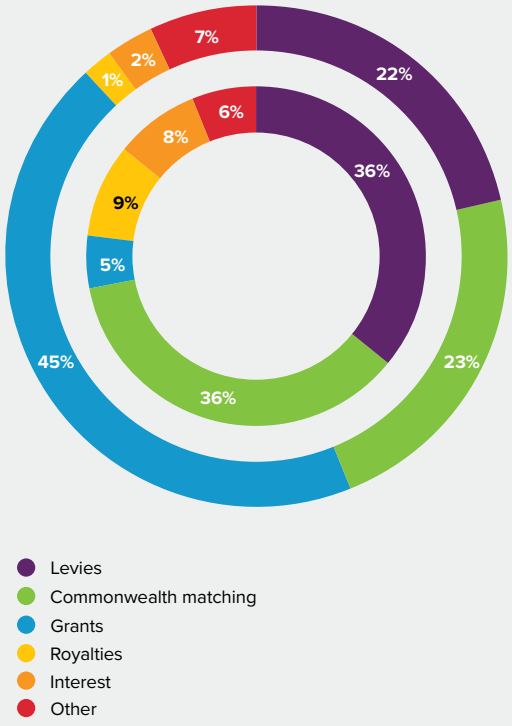
The setting and collection of the industry levy is enabled by the *Primary Industries (Excise) Levies Act 1999* and the *Primary Industries Levies and Charges Collection Act 1991*, respectively. The Australian Government's matching contributions in 2020–21 were capped at the value of levies collected because it was lower than the 0.5 per cent of the three-year average gross value of production.

Revenue (Actuals)	2020–21 ($m)
Industry levies	$2.077
Australian Government	$2.077
Royalties	$0.072
Interest	$0.191
Research Grants	$4.104
Other	$0.686
TOTAL	**$9.207**

The following graph demonstrates the change in sources of revenue over the last seven years. The proportion of grant revenue generated by partnerships with the Australian Government, RDCs and commercial enterprises has increased from five per cent to 45 per cent of total revenue.

In 2020–21, the Australian Government's Department of Agriculture, Water and the Environment contributed a total of $2.3 million in revenue to CRDC, via the Rural R&D for Profit program ($2.0 million), and the National Landcare Program's Smart Farming Partnership initiative ($0.3 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 seven years: 2014–15 (inner circle) to 2020–21 (outer circle):



Total revenue for 2020–21 of $9.207 million was $0.547 million (6 per cent) above budget of $8.660 million. Total 2020–21 revenue comprised:

- Industry levy revenue of $2.077 million, which includes $0.991 million (76 per cent) of the 2019–20 crop and $1.086 million (18 per cent) of the 2020–21 estimated crop.
- Australian Government matching contribution of $2.077 million was capped at the value of levies collected.
- $0.072 million in royalties from the commercialisation of intellectual property.
- Interest revenue of $0.191 million was 27 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 $4.104 million included Rural R&D for Profit, other Commonwealth grants and co-investments from program partners.
- Other revenue of $0.686 million, which includes project refunds.

Expenditure and investment

Actual expenditure for 2020–21 was $16.924 million, which is $2.125 million below the budgeted expenditure of $19.049 million.

Actual ($m)	2020–21
Cotton Crop Size (millions of bales)*	2.677
Total revenue	9.207
Industry levies	2.077
Australian Government	2.077
Royalties	0.072
Interest	0.191
Research grants	4.104
Other**	0.686
Expenditure total	16.924
Cotton RD&E activities	13.614
Total equity position	**23.177**

* ABARES estimate, Agricultural Commodities June 2021.
** 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 2020–21 was allocated to the following activities:

Cost Allocation Activity	2020–21
Direct R&D Expenditure (project costs)	$13,924,873
Indirect R&D Expenditure (administration costs)	$2,963,867
Grant-funded expenditure (R&D not eligible for Commonwealth Matching)	$35,366
Total Expenditure	**$16,924,106**

Portfolio Budget Statement

The CRDC Portfolio Budget Statement released in May 2021 provided an estimate of CRDC's outcomes, outputs, performance and financial position for 2021–22 to 2024–25. The statement was consistent with the CRDC Strategic R&D Plan 2018–23 and the Annual Operational Plan 2021–22.

Outcomes and outputs 2020–21

CRDC works to achieve this outcome on behalf of the Australian Government:
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	2020–21
TOTAL Budgeted Revenue	$8,659,580
TOTAL Actual Revenue	$9,207,008
TOTAL Budgeted Cost of Outputs	$19,048,964
TOTAL Actual Cost of Outputs*	$16,924,106

* 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 a $5.5 million operating deficit for 2021–22. This reflects revenue of $13.4 million and expenditure of $18.9 million. Industry levy revenue and Commonwealth contributions will continue to be drawn from two crop seasons, 2020–21 and 2021–22.

Forecast expenditure

Budgeted expenditure for 2021–22 is $18.9 million, which is $2.0 million above the 2020–21 actual expenditure. The forecast expenditure for the next two years is budgeted at $13.0 million in 2022–23 and $14.1 million in 2023–24.

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 2020–21 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.

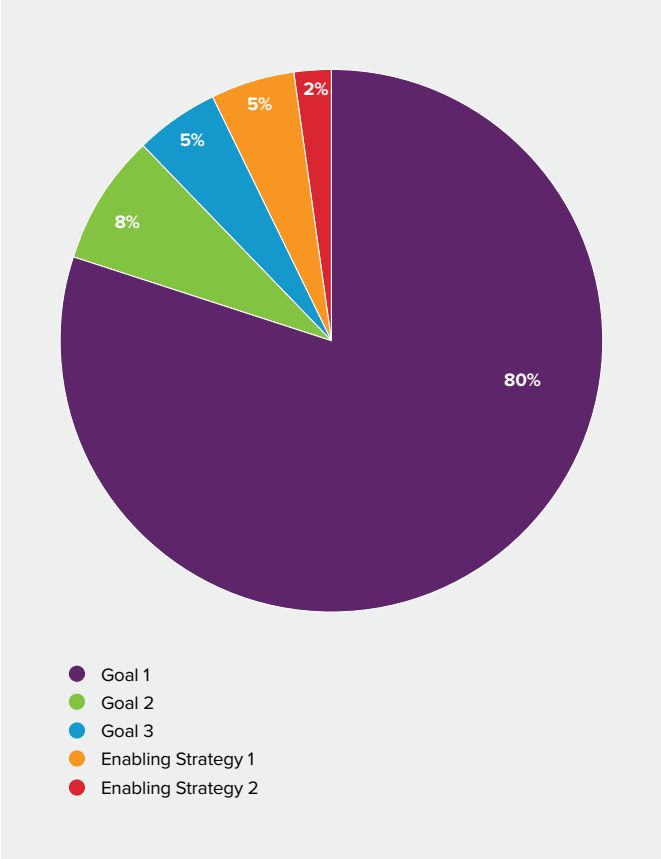
In 2020–21, we invested $13.61 million in RD&E. Of this, $2.09 million was invested in new research commencing in 2020–21.

Projects by CRDC program area

CRDC program area	Goal 1	Goal 2	Goal 3	Enabling strategy 1	Enabling strategy 2	TOTAL
Number of projects	94	29	28	30	7	188
Expenditure per program area ($m)*	$10.94	$1.05	$0.65	$0.75	$0.22	$13.61
Percentage of expenditure per program area	80%	8%	5%	5%	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 area



Total number of CRDC projects

CRDC projects	2018–19	2019–20	2020–21
Active projects	130	135	116
New projects funded	148	83	62
Projects completed	143	118	70
Continuing projects	135	116	117

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

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.

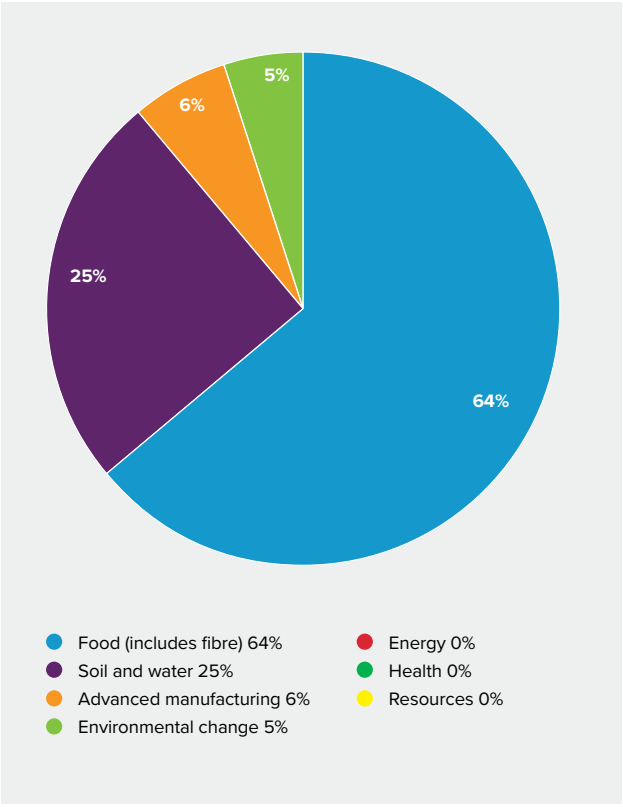
CRDC investment by Science and Research Priorities

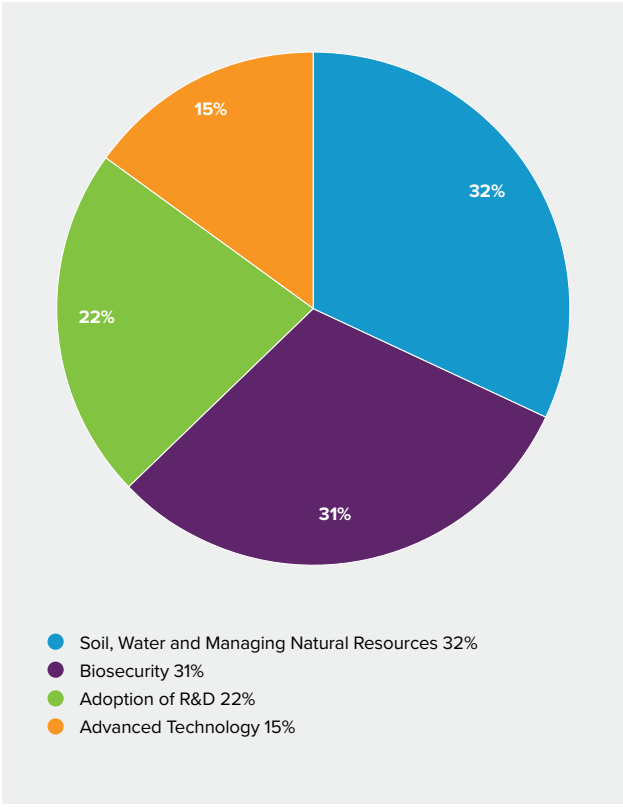
Science and Research Priorities (SRP)	CRDC investment ($'000)
Food (also includes Fibre)	$8,706
Soil and water	$3,372
Advanced manufacturing	$815
Environmental change	$701
Energy	$0
Health	$20
Resources	$0
Transport	$0
Cybersecurity	$0
Total	**$13,614**

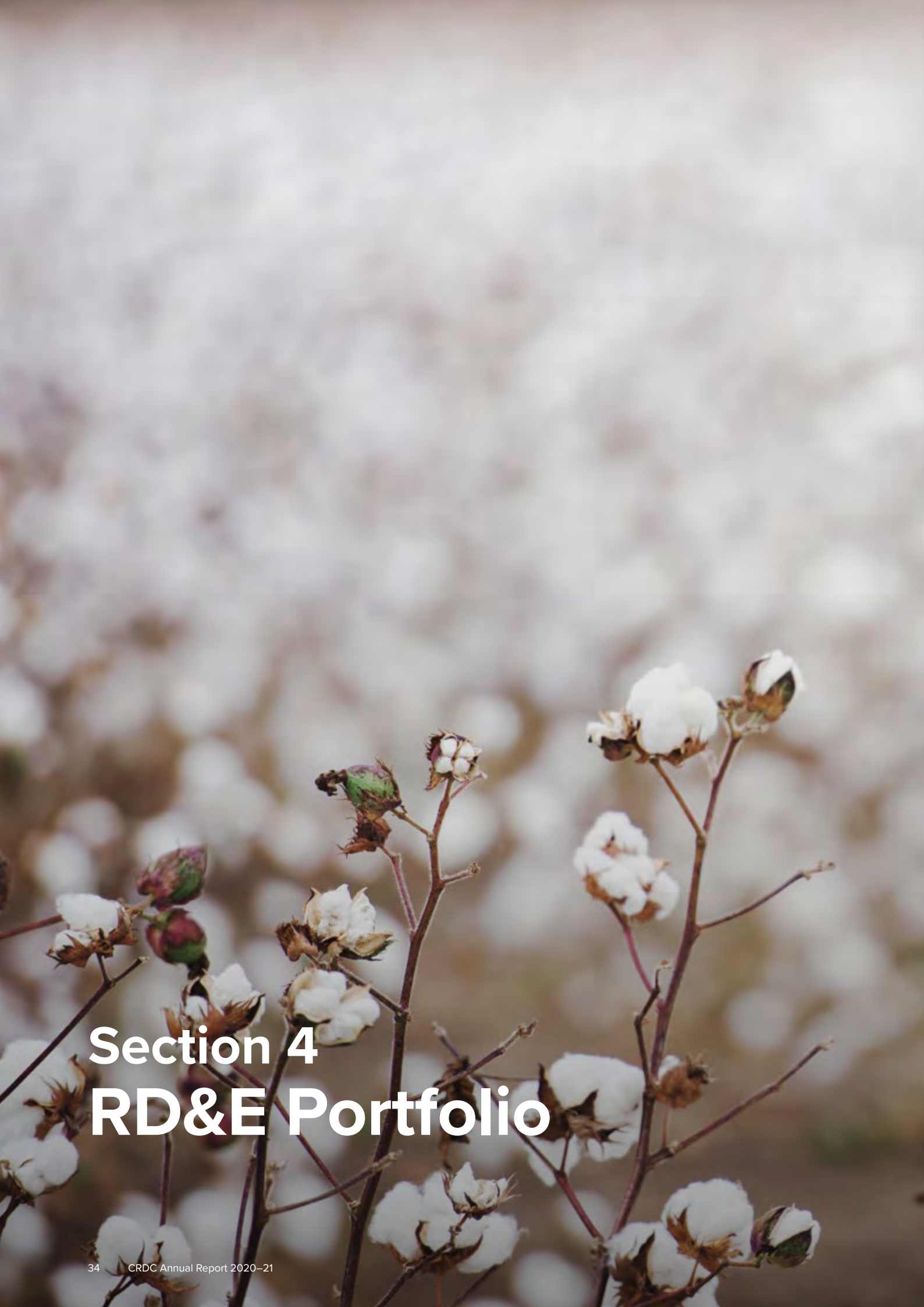
CRDC investment by Rural RD&E Priorities

Rural RD&E Priorities	CRDC investment ($'000)
Advanced Technology	$1,967
Biosecurity	$4,227
Soil, Water and Managing Natural Resources	$4,403
Adoption of R&D	$3,017
Total	**$13,614**

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

Section 4: RD&E Portfolio - Goal 1

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 2020–21, CRDC invested in 94 projects within this goal, accounting for 80 per cent of our total RD&E expenditure. This increased from 75 per cent in 2019–20, due to a focus on maintaining core capacity during investment years affected by drought.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicator	Measures	2020–21 progress
1.1 Optimised farming systems	1.1.1 Improved yield and quality	Increase in yield over 5 years	Assessment of average bales/ha	The 2019–20 crop was the smallest harvest in over 30 years due to very limited water availability and a lack of in-season rainfall. Based on 2019–20 yield information, dryland yields remain below target at under three bales/ha, while the 5-year average irrigated yield has remained steady from last year at 10 bales/ha. Although rainfall increased across most of the cotton-growing regions in the 2020–21 season, final production figures and therefore yields are not yet available.
	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)	The ongoing industry water productivity benchmarking by NSW DPI (including the 2019–20 season figures) is showing a continued improvement in the volume of water required to produce a bale of cotton, with an annual 2.5 per cent reduction in the volume of water needed per bale being maintained. The average rate of nitrogen use per bale of cotton declined in the 2019–20 season, reversing the trend from 2018–19. Nonetheless, average nitrogen use per bale over the last five years is stable rather than improving. Current nitrogen projects will be completed during the 2021–22 year, and CRDC is reassessing 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 has supported RD&E into new farming systems, such as bankless irrigation, farming systems that incorporate cover cropping and controlled traffic harvesting. Assessment of production from new systems has been included in the 2021 Grower Survey and will be reported next year. The feasibility of some systems research, such as 'winter cotton', is still being assessed. CRDC research is also supporting sustainable farming systems development in Northern Australian cotton through collaboration with the CRC for Northern Australia, GRDC, and the Northern Australia Crop Research Alliance. Interest in growing cotton in Northern Australia has increased rapidly with the areas going from <1,000 ha in 2016–17 to more than 14,000 ha in 2020–21. As well as supporting growers, CSIRO modelling from this research was used to inform production potential for cotton gin feasibility studies.

	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 in Northern Australia, average total production across the industry has declined since the start of the CRDC Strategic RD&E plan as a result of extremely limited irrigation water availability. While the 2019–20 season was the lowest production year in over 30 years, seasonal conditions improved for 2020–21. The estimated five-year rolling average following the 2020–21 season is 2.8 million bales, an improvement from 2020, but still down from 3.1 million in 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	CRDC continues to undertake commercialisation activities in improved irrigation management, application of pesticides, and monitoring of pests and in the development of novel pesticides. CRDC, along with Hort Innovation, Sugar Research Australia and USQ funded the initial experimental work to develop a vision-based plant detection technology, which was further developed by John Deere, and will be available globally as factory-installed sprayers later this year.
	1.2.2 Cotton farms are digitally enabled	Increase in on-farm use of digital technology	Percentage of farms utilising digital technologies	The percentage of farms using digital technologies is being measured in the 2021 Grower Survey and will be reported on next year. A Grassroots Grant project that commenced in 2021 is seeking to better understand the needs of growers to best equip them to organise and analyse farm data so that they are 'digitally ready'.
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 annual consultants survey indicates that the five-year rolling average for Environmental Toxic Load (as measured against bees) continues to decline. Large-scale field trials on the impact of insect and environmental stress before flowering are continuing. Research into novel approaches to mitigate abiotic stresses, such as higher temperatures and water deficits, is continuing. Assessments are planned for 2021–22 to measure the economic impact of pests, disease and weeds on production. These assessments will inform evaluations on past RD&E investments.

1.3 Protection from biotic threats and environmental stresses	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 that seek to reduce the economic impact of pests, weeds and diseases through better management practice recommendations that are underpinned by strong science and able to be readily adopted. For example, research into building disease-suppressive soils is continuing, building off historical data collected in annual disease surveys. CRDC supported the development of the new silverleaf whitefly (SLW) threshold that was launched for 2020–21, and an app to automatically count SLW nymphs that is available to the industry for beta-testing. As well as better management, CRDC is also supporting new crop protection technologies, such as BioClay, soil biologicals, new pesticides, and adapting existing technologies for use in cotton, such as innovative solutions for disease, microwave for disease and weed management, AquaTill for crop destruction, and novel plant hormones to manage abiotic stress. Discussions with a chemical registrant have begun on potential label registration for early season use of a growth hormone for delay of peak resource demand. Assessments are planned for 2021–22 to measure the economic impact of pests, disease and weeds on production. These assessments will inform evaluations on past RD&E investments.
	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	Following on from the successful Exercise Blueprint biosecurity scenario activity in 2019, CRDC and CottonInfo have supported a number of biosecurity activities, including raising awareness with growers, consultants, and ginning organisations. The CottonInfo Biosecurity Tech Lead organised and facilitated the Cotton Biosecurity Reference Group's annual review of pest lists and prioritisation of RD&E gaps. CRDC has participated in a number of strategic Plant Biosecurity Research Initiative projects to support industry preparedness, including a fall armyworm podcast series and two Rural R&D for Profit cross-industry collaborations: iMapPESTS, and Building national diagnostic capability. Contingency plans for each of the exotic insect pests identified as high-priority pests for cotton have recently been completed and/or updated. CRDC is supporting Plant Health Australia to commence the five-year biosecurity plan review process in 2021.
			Percentage of participants reporting increased preparedness	In 2016–17, 44 per cent of cotton growers reported that they had a farm biosecurity plan (identifying hazards and an action plan) with a further 19 per cent currently developing a plan. Following the implementation of recommendations from Exercise Blueprint, industry preparedness is again being measured as part of the 2021 Grower Survey and will be reported next year.

RD&E highlights

AgriPest challenge workshop (CRDC2114)

The CSIRO AgriPest Challenge seeks to enable profitable agri-food and fibre production in a chemically limited future. It seeks to enact whole-of-supply chain collective action on the sustainable, durable and safe use of chemicals and alternatives to control pests, weeds and diseases. In 2020–21, CRDC supported the delivery of two facilitated virtual scoping workshops, bringing together key organisations in animal health and crop protection to discuss agripest challenges and goals, and investigate potential opportunities for collaboration with a particular focus on metrics and measures of success. These workshops are the first step towards a national conversation about sustainable agripest control.

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 to instead 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 collaborative project, led by GRDC and funded by the Australian Government 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 uses key weed species, regional landscapes and group engagement to develop an understanding of the economic and social drivers of success.

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 and NSW, best practice disease management advice that focuses on a farming system for building disease-suppressive soils, and a better understanding of defensive ability for resistance breeding.

Delivery of SataCrop crop mapping tool (CA2006)

Stewardship of all pesticide applications to prevent off-target damage is a priority across agriculture to ensure the safety of communities and environments. An industry-led policy of responsible pesticide use is crucial to agriculture being able to maintain access to products and maintain a positive social licence. This project provides support to SataCrop, an online tool designed to reduce the risk of damage to sensitive crops resulting from off-target spray drift. The tool enables operators to understand where sensitive crops are located in proximity to their spray operation. In its first year, 63 per cent of cotton crops were mapped on SataCrop, along with cotton refuges, barley, wheat, chickpeas, citrus, corn, grapes, macadamia, sorghum, and soybeans. This initiative was developed by Cotton Australia and Precision Cropping Technologies, with CRDC and GRDC becoming project partners.

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

Improved management of silverleaf whitefly on cotton farms (DAQ1903)

Near impossible to identify and count with the naked eye, silverleaf whitefly (SLW) has increased in prevalence in recent years. To make identification easier, under the 'Identifying sensors for better Integrated Pest Management in cotton' project, researchers have developed a new artificial intelligence smartphone app with support from CRDC. This clever technology will count pests and guide decision making through an in-built population model. In 2020–21, CRDC and the project partners began the process of commercialisation to help deliver the technology to growers and consultants. Meanwhile, under the 'Improved management of silverleaf whitefly on cotton farms' project, the SLW threshold matrix has been reviewed and a new decision support tool developed. This new tool will become available to growers and consultants via the smartphone app.

Identifying the trends and drivers of water productivity in Australian cotton through benchmarking (DAN2002)

As irrigation water becomes increasingly scarce, the Australian cotton industry remains committed to continuous improvements in water-use efficiency, and demonstrating responsible use of shared natural resources. This project continues the long-term monitoring of water-use efficiency in the cotton industry, and builds on this to deliver annual water productivity benchmarks. The project also delivers data to identify the current limitations in water productivity, e.g. biophysical (soil, rainfall, climatic limitations), management (irrigation system, frequency, crop rotation) or information-related (monitoring, best management),

and works with growers to navigate these barriers. The resulting data from this project shows a continued improvement in water-use efficiency, with an annual 2.5 per cent reduction in the volume of water needed to produce a cotton bale. A key target of CRDC's Strategic RD&E Plan and the wider industry Sustainability Framework is a 12.5 per cent improvement in water productivity over five years. This project confirms that the industry is on track to achieve this target.

Informing a digital strategy for the Australian cotton industry (CRDC2110; CRDC2111)

The cross-sectoral Accelerating Precision Agriculture to Decision Agriculture and Growing a Digital Future projects, led by CRDC in collaboration with fellow RDCs, found that digital technologies have the potential to fundamentally transform the food and fibre sectors, but that the full potential could not be realised until constraints are addressed. The constraints include such challenges as the availability of appropriate data, suitable data governance arrangements, availability of decision support tools and analysis capability, and clearly defined value propositions for potential technology users. Given the complexity of the issues and the involvement of multiple parts of the value chain, CRDC determined that an industry-wide strategy would be a critical component of addressing the barriers. As such, these projects are focused on delivering a digital strategy for the Australian cotton industry, developed through building the business case for potential investment in the development of a trusted, scalable, flexible data sharing solution for the supply chain.

iMapPESTS: Sentinel surveillance for Agriculture (HIA1802)

The iMapPESTS project is investigating advanced pest and disease surveillance and diagnostics technologies. This includes custom-designed mobile surveillance units (sentinels) that incorporate specialised trapping equipment and technology to capture airborne samples to identify high-priority pests and pathogens. The surveillance and identification will provide actionable information to primary producers and government on endemic, established, trade-sensitive or exotic pests. This project is supported by Hort Innovation through funding from the Australian Government as part of its Rural R&D for Profit program, and involves 16 partner organisations, including CRDC. In addition, as part of this project, cotton species-specific contingency plans for high-priority insect species are being developed, along with a boll weevil surveillance and eradication plan. This work will inform and better prepare Australia's cotton industry for the arrival of any high-priority insect species.

Managing Climate Variability program – phase five (MLA1701)

CRDC is a member of the Plant Biosecurity Research Over two decades, the Managing Climate Variability program (MCV) has been the lead R&D program in Australia for providing climate knowledge to primary producers and natural resource managers. Meat and Livestock Australia (MLA) leads it; CRDC is a partner with Sugar Research Australia (SRA), AgriFutures Australia, and the Grains Research and Development Corporation (GRDC). The program aims to help manage the risks and exploit the opportunities resulting from Australia's variable and changing climate by: improving the accuracy of forecasting; providing climate information and tools for managing climate risk; and increasing knowledge and confidence to adopt climate risk management. MCV currently has two projects underway with support from the Australian Government's Rural R&D for Profit program: the Seasonal Forecasting project (focusing on improved use of seasonal forecasting to increase farmer profitability); and the Forewarned is Forearmed project (providing forecasts of extreme climate events to help equip and prepare growers).

More Profit from Nitrogen (RRDP1711-1735; RRDP2021; RRDP2109)

More Profit from Nitrogen (MPfN) has been a five-year partnership between Australia's four most intensive users of nitrogenous fertilisers – cotton, dairy, sugar, and horticulture – led by CRDC as part of the Australian Government's Rural R&D for Profit program. Comprehensive research was conducted to increase nitrogen-use efficiency (NUE) across the four sectors while improving profitable and sustainable use. By better understanding the influence of contributing factors upon NUE in farming systems, MPfN has generated greater knowledge and understanding of: the interplay of factors to optimise nitrogen (N) formulation, rate and timing across industries, farming regions and irrigated/non-irrigated situations; the contribution (quantifying rate and timing) of mineralisation to crop or pasture N budgets; and how enhanced-efficiency fertiliser formulations can better match a crop or pasture's specific N requirements. Overall, 72 researchers were involved in the project, delivering new N fertiliser formulations, application and measurement technologies, decision support tools and best management practice guidelines. Over the program's duration, 185 extension activities were conducted, engaging with 15,500 farmers, service providers, commercial advisors, and researchers.

Novel topical vegetable, cotton virus and whitefly protection: BioClay (HIA1803); ARC Research Hub for Sustainable Crop Protection (UQ2001)

The novel topical vegetable, cotton virus and whitefly protection project involves trials of the non-toxic, clay-based, biodegradable product BioClay on cotton farms. BioClay primes the plant's own defences, helping it 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 (ARC) 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.

Optimising the management of manures in southern NSW cotton production – phase two (DU1903)

In the southern region of NSW, cotton cropping is located close to intensive cattle and chicken production; the latter, in particular, is increasing significantly. More than half the growers in the region are taking advantage of the available manure. Fertiliser prices are relatively low, and manure is mainly being applied in combination with mineral fertiliser for its perceived potential to sustain or improve long-term soil fertility. However, local knowledge of the impact is limited. This project assesses the impact of organic amendments on nutrient-use efficiency, plant development, fibre quality and yield. It evaluates a range of integrated manure and mineral fertiliser systems to provide recommendations to growers on how to integrate manure into conventional fertiliser programs. The measure of success is higher productivity and a long-term reduction in the dependence of synthetic fertiliser inputs. This research also underpins a national collaborative project developing a decision support tool to optimise organic and synthetic fertiliser strategies.

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.

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. 2020 marked the official UN International Year of Plant Health, providing a platform for PBRI and its partners to raise awareness of the importance of plant health and biosecurity, and of CRDC's RD&E investments in this area. In 2021, CRDC led the development of a fall armyworm podcast series with the PBRI partners, helping to inform growers on the impact and management of this pest.

Professor of Soil Biology (UNE2001)

Soil health is widely recognised as a critical part of our farming production systems. However, the evidence and management guidance to help growers understand and manage soil health is limited. This project adds to the existing understanding of key beneficial organisms within the soil biome, notably the arbuscular mycorrhizal fungi, while also attempting to unlock potential new control strategies for existing pathogens within cotton systems. Methodologies to achieve this are based on laboratory, glasshouse and collaborative field sampling, and the outcomes intend to deliver tangible soil health-promoting options to the Australian cotton industry. This project also involves the delivery of extension to cotton growers via the CottonInfo technical lead for soil health, the coordination of the industry citizen science project 'Soil your undies', and involvement in the collaborative project involving a trial of returning cotton textile waste to cotton fields. The trial aims to assess the impact on, and potential benefits to, soil health and the prospect of using this process as a way to recycle bulk cotton textile waste.

Potential for broadacre cropping in the Northern Territory (CRCNA2001)

Science leadership for cotton development in Northern Australia (CSP1903)

The 'Potential for broadacre cropping in the Northern Territory' project aims to support the development of viable broadacre cotton systems in the NT through the collation of historical broadacre cropping data and 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,' which delivers science leadership and coordination for current and future cotton developments in the north and linkages for biosecurity initiatives.

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. In most experiments, the best cover crop treatments recovered the 40-60 mm water deficit taken to grow them by the end of the fallow, which 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.

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. Its 14 sub-projects cover 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. The project also supported the Irricom 2021 forum, a collaboration with CottonInfo, that brought together irrigation researchers, growers, consultants, agtech and industry partners to identify current and future technologies and their fit for irrigators. The forum explored technical challenges (such as suitable evaporation mitigation technology for large storages) as well as issues with adoption of existing technologies (for example, ensuring sensor, decision-making and automation technologies can be integrated in user-friendly systems).

Using DNA diagnostics to monitor disease-suppressive cotton farming systems (CAS2101)

As the cotton growing area moves further south into cooler conditions more favourable to disease, particularly Black Root Rot and Verticillium, there is a need to understand the extent, distribution and population densities of these diseases. This project aims to reduce the impact of disease on cotton production through objective measurement of disease inoculum populations. The development of a novel, user-friendly DNA molecular diagnostics tool will provide researchers, growers and consultants with reliable disease inoculum maps, enabling identification of the spatial distribution and levels of inoculum across cotton fields and their change over time. Current pathology uses subjective field assessments (e.g. stem cut surveys) that may then require plating out of samples, taking 4-6 weeks, depending on the disease. A multi-disease DNA test has the potential to reduce this turnaround time, increase sample throughput, and better inform crop planning decisions. A key to efficiency is that only one sample is required to test for multiple diseases.

Case study

Growers cut water use by almost half

NSW DPI research combined with all other available water use data going back to 1992 confirms that over the last 25 years, the Australian cotton industry has almost halved the amount of water needed to grow a bale of cotton.

Water use has fallen from 1.43 ML/bale in 1995 to 0.74 ML/bale in 2020, primarily due to improvements in irrigation infrastructure and management efficiencies underpinned by RD&E.

With support from CRDC, researchers from the NSW DPI water productivity benchmarking project are tracking improvement in water productivity. CRDC has funded the monitoring of cotton water use for several decades, with the current benchmarking project being led by NSW DPI since 2006.

Benchmarking water productivity tracks industry's progress in the efficient use of water resources and demonstrates the cotton sector's commitment to responsible water stewardship. It also provides benchmarks for growers and a means to assess the impact of new technology and management strategies.

Researchers conducted in-depth water productivity benchmarking in 2007, 2009, 2013 and 2018. Their findings were combined with all other available water use data going back to 1992. This has found that industry has almost halved the amount of water needed to grow a bale of cotton over the last 25 years.

The benchmarking project works with growers to assess their water productivity based on a gross production water use index (GPWUI) benchmarked against the industry standard. The aim is to extract maximum profitability and production out of valuable water supplies.

"GPWUI is the gold standard for determining water productivity in the cotton industry," explained NSW DPI's benchmarking project lead, Dr David Perović. "It's the most reliable and meaningful method for measuring efficiency.

"GPWUI is a measure of how productively water is used, expressed as the ratio of cotton yield (bales per hectare) to all water potentially available to the crop (megalitres per hectare). It accounts for all water from rivers and bores, all rain falling directly on the crop as well as harvested rainfall runoff, plus all soil moisture used by the growing crop."

The GPWUI also includes all water lost through evaporation and seepage during storage and delivery to the field. As GPWUI measures all sources of water available to the crop, it is the preferred metric for comparing water productivity across regions and seasons. Implementing measurement of GPWUI across the industry through the consistent use of a standardised benchmarking calculation is critical for demonstrating progress towards ambitious water-use efficiency targets.

"It has been very pleasing to see just how well the industry is performing," David said. "Even after the significant improvements in water-use efficiency that were achieved between the mid-1990s and the mid-2000s, growers keep getting better and better production out of finite water resources."

A key target of the CRDC Strategic RD&E Plan and the cotton industry's *PLANET. PEOPLE. PADDOCK*. Sustainability Framework is to achieve a 12.5 per cent improvement in water productivity from 2018 to 2023, in order to reach the benchmark target of 1.32 bales per megalitre.

Early indications suggest the industry is well on its way to continue this trend and reach this target, with 0.74 ML per bale achieved in season 2019–20. The sustainability target uses megalitres per bale as its indicator: 0.74 ML per bale equals 1.35 bales per megalitre.

For more: read the full article in the Spring 2021 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Revolution in crop protection begins

Research is creating groundbreaking new products that can entirely change the way we think about and manage pests and diseases of cotton.

BioClay™ is a novel biological crop protection approach that is non-genetically modified, safe, and environmentally sensitive. CRDC is working with a range of partners to bring BioClay to growers. Early research targets include insects, viruses, and fungal disease in several crops, including cotton.

BioClay is a biodegradable spray solution of clay particles that works like a vaccine, stimulating the plant's immune system to fight disease. It uses technology that is precise and specific in the way it helps plants defend against pathogens.

It works by binding pathogen- or pest-specific dsRNA, which is slowly released after being applied to the plant, to fight pests with longer protection periods. dsRNA is a well understood, highly specific and targeted way to help plants protect themselves. The benign clay particles on the leaf surface degrade in the presence of natural carbon dioxide and moisture, leaving no residue.

BioClay is world-leading technology invented by scientists from the Queensland Alliance for Agriculture and Food Innovation (QAAFI) and the Australian Institute for Bioengineering and Nanotechnology (AIBN) at the University of Queensland (UQ). Nufarm Limited is the commercialisation and development partner.

Crop-specific research and trials currently include partnerships with CRDC and fellow Research and Development Corporation (RDC) Hort Innovation. These projects are looking at a range of pests, including viruses and fungal diseases such as Verticillium wilt and sucking insect pests.

CRDC R&D Manager Susan Maas says this is exciting research with potential to help sustainably address key industry threats.

"BioClay is an entirely new way to approach crop protection, acting like a type of vaccine for the plant, where we can choose what pests or diseases we want to protect the plant against," Susan said. "This product is so innovative in that it can be adapted for use on a wide range of pests, including invertebrate pests as well as root-infecting pathogens. CRDC is supporting multiple projects using the BioClay platform, including those to protect against fungal diseases."

The research isn't limited to endemic pests and diseases – it extends to exotics as well.

"In partnership with Hort Innovation, we have been able to scope the potential to apply this type of technology to cotton leaf curl virus," Susan said.

"Leaf curl virus is a high-priority pest to Australian cotton that could be devastating if an incursion were to occur. Creating capacity and readiness to quickly deal with exotic incursions are key aspects of our investments in biosecurity preparedness, as is working with other plant RDCs to protect our industries from shared threats."

Commercialisation of BioClay is anticipated for around 2026-2028.

For more: read the full article in the Winter 2021 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Fundamentals for tropical cotton published

Growing cotton in tropical regions of Australia has hinged on integral research that aims to find the 'sweet spots' in promising, yet challenging climates. Success has been about finding the balance between avoiding the highest risks and capitalising on opportunities created by the tropic's unique climate of wet and dry seasons.

The foundation for current management practices for Northern Australian cotton production that seeks to sow cotton during the wet season is largely research by QLD DAF's Dr Paul Grundy and CSIRO's Dr Steve Yeates, supported by CRDC and undertaken over five seasons in the Burdekin region of North Queensland. This study was recently published in the *Journal of Field Crops Research*.

"This work not only set up a basis for how to better grow cotton sown during the wet season in Australia's tropics, but has led to questions about how summer crops in other regions might be better grown," says CRDC R&D Manager Susan Maas.

"The knowledge that was gained about how cotton interacted with the climate in the Burdekin, and in particular, how cloudiness affected fruit set and yield potential of Bollgard varieties led to a fresh look at how cotton might be better grown in other areas. The Burdekin research has also been pivotal for supporting the industry expansion into Western Australia and the Northern Territory."

The researchers also developed novel research methods to consider how cotton might respond to the local environment. Due to differences in how cotton crop growth responds to tropical conditions, particularly during the wet season, traditional feasibility modelling around planting and yield implications proved to be unreliable.

"The approach Steve and Paul took, to determine when a crop might be sown so that flowering, boll fill and picking occurred during periods of reduced climatic risk while at the same time maintaining the capacity to overcome periods of poor weather, was novel," Susan said. "We had to determine both the potential magnitude and likely timing of climatic risks in these environments from a cotton plant's perspective to then be able to identify the best crop production 'sweet spots'."

Steve Yeates has spent much of his life on research in the tropics. He says the North is not one homogenous place in terms of climate, soil, or pests, yet the Burdekin work provided a foundation for cotton growing there. He says this was not by chance.

"Looking to apply the benefits of the research to a wider area was inherent in this research from the outset," Steve said. "At the time we didn't know how much would be relevant, but we knew the work we were doing would have applications elsewhere, and allowed us to translate knowledge to management, then tweak management when crops were grown in new tropical regions. The Burdekin also showed us how selective we have to be when choosing the best growing locations."

Steve says the challenges posed by the North include the lack of uniformity in climate and soils.

"You can't look at North Queensland or tropical Australia as uniform; it's more diverse than all the other regions we grow cotton put together. What works at Katherine won't be exactly the same for the Ord, the Gulf or North Queensland."

CRDC-supported research for cotton's development in Northern Australia continues.

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

Case study

Is it possible to revolutionise agricultural spray application?

The Australian Government's Business Research and Innovation Initiative (BRII) is providing $12 million funding for small- and medium-sized enterprises to solve five important environmental challenges.

One of these challenges, submitted and now managed by CRDC, is 'Is it possible to revolutionise agricultural spray application?'

BRII aims to find effective ways of dealing with challenges that affect the environment, while providing opportunities for start-ups and businesses to develop new products and technologies for the global market. It offers competitive grants to encourage the development of innovative solutions to public policy and service delivery challenges as nominated by government.

The challenge CRDC submitted was one of five chosen by the government to support. It challenges applicants to find new approaches with innovative technology solutions to improve applicator capacity and reduce spray drift. CRDC R&D Manager Susan Maas developed the successful application to BRII.

"Pesticides help ensure Australian farming remains productive and maintains its reputation for high quality, but spray drift, or movement beyond the original target, is an ongoing, global issue," she said. "Spray drift onto sensitive crops results in environmental contamination and significant financial loss. Spray application is complex, with many factors needing to be considered, including chemical composition, application equipment, training, and legal requirements.

"The solution could address one or many of these factors, reduce complexity or could involve the use of a lateral-thinking technological solution that brings increased automation and insight to the process. The successful grant applicant will have the chance to work closely with government to create a product that could be commercialised locally and even globally."

The challenges are examples of how RDCs are trying new approaches to address the big issues facing agriculture. CRDC's successful project has benefits beyond the cotton industry. Spray drift is a concern for all agriculture. In particular, the grains industry is also looking on with interest as it seeks better targeting of spray droplets, thereby increasing spray efficiency and more economical use of chemical inputs.

The BRII challenge will build on existing cross-industry collaboration addressing the issue of spray drift.

One such collaboration is SataCrop, a tool designed to mitigate the risk of spray drift by allowing operators to understand where sensitive crops are in proximity to their spray operation. This industry initiative was developed by Cotton Australia and Precision Cropping Technologies, with CRDC and GRDC becoming project partners.

SataCrop can map all crop types, including cotton, grains, and tree crops, and can be used all year round. Growers can log in and plot the location of fields they have planted with different crops each season. Other farmers and spray contractors can review the site when planning spray applications to see the location of potentially sensitive neighbouring crops. Coupled with vigilance around spray conditions, wind directions, and application, this information helps to reduce adverse effects of spray drift.

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 - Goal 2

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 2020–21, CRDC invested in 29 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 Indicator	Measures	2020–21 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 current percentage of farm area set aside for native vegetation (not normally grazed) is four per cent, equivalent to the percentage recorded in 2018. This measure is being assessed in the 2021 Grower Survey and will be reported again next year.
			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. However, the industry does not yet assess sequestration at the industry scale. Case studies have shown that individual farms can be carbon positive when carbon sequestration is considered. 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. This will be done in conjunction with a collaborative project, led by Agriculture Innovation Australia, seeking to determine a common methodology for determining greenhouse gas emission baselines for Australian farms.
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	No products were commercialised in 2020–21, and one commercialisation proof-of-concept activity remains active: the use of gin trash for producing high-value chemicals.
	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	Budget constraints due to the drought limited the potential to invest in new opportunities to increase the value of cotton in 2020–21.

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 participates directly in six global initiatives: ICAC's 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'; Cotton2040; and the Textile Exchange. CRDC also participates indirectly in the European Union's Product Environmental Footprint processes via collaboration with AWI, MLA and GRDC.
	2.3.2 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	A CRDC project, supported by the National Landcare Program, that mapped biodiversity in Australian cotton landscapes is being used to support cotton farmers to regenerate riparian areas. Projects have been established to enable reporting against the industry's sustainability indicators, including the development of appropriate social capital and wellbeing indicators. Projects are continuing that are investigating strategies for improving labour conditions through the supply chain, and the information and transparency needs of the supply chain, in particular the retail/brand sector.

RD&E highlights

Cotton industry social and wellbeing sustainability indicators (UC1901)

Achieving increased social benefits for the cotton industry and the wider community requires identifying objectives related to social wellbeing (like social capital), and producing indicators that can measure and track outcomes (like the health and wellbeing of people employed in the industry, and how the industry contributes to social capital in rural communities). Monitoring these indicators will enable the industry to identify those performing optimally and those where intervention may be required to improve social outcomes. This project works with the cotton industry to identify the social objectives of the industry, agree on indicators, collect data and produce a report of baseline performance benchmarked against national and international standards, with a consistent methodology so that the measures can be repeated, and indicators tracked over time.

Feasibility study of managing aquifer recharge for improved water productivity for Australian cotton production (ANU1901)

Due to climate variability and national policy initiatives, irrigated cotton regions need to find a way to remain economically viable with a smaller and more variable water supply. The cotton industry has already adapted to a great extent through increasing water-use efficiency, but additional innovative adaptation measures may be required. Managed Aquifer Recharge (MAR) offers one possible adaptation by using surface water, when in surplus, to artificially recharge groundwater aquifers. This water is then available for subsequent irrigation during seasonal or annual dry periods, with underground storage reducing water loss from evaporation. Preliminary studies have shown that MAR can be hydrogeologically and economically feasible and socially acceptable. It may also reduce flood damage and offer environmental habitat for local species. The purpose of this project is to evaluate the feasibility of MAR across all facets: economic, technical, environmental, social and legislative.

Impacts and solutions: A scoping study on relative impacts of irrigation infrastructure on fish (DAQ2101)

In line with the cotton industry's goal to improve sustainability, this project aims to better understand and minimise the impact of irrigation infrastructure on fish populations in rivers. Under this project, researchers are evaluating how various fish species interact with different types of irrigation infrastructure. This information will enable measures to be developed to avoid fish being entrained in irrigation systems. Evaluating the relative impact of different irrigation infrastructure types will identify which are lower impact and which types should be prioritised for mitigation measures in the future. Available mitigation measures and the potential costs and benefits will also be examined. This work is an important step in developing and prioritising best management practices to reduce the direct impacts of water extraction on fish without sacrificing irrigation efficiency. The results of this work could be applied to new irrigation developments and upgrades to existing systems.

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. The first year of the research 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. The second year of the research is delivering a series of industry-specific case studies, including one focused on the cotton industry. CRDC and Cotton Australia are working collaboratively with the researchers on this project, as the results will help inform the industry's trust and social licence strategy.

Cotton Landcare Tech Innovations 2021 (NLP1901-1903, NLP2101-2104)

This project builds on international best practice to implement and develop cutting-edge technologies, such as drone mapping, aerial seeding, acoustic monitoring and big data, to help the Australian cotton industry 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.

PhD: Sustainable Value Chain Analysis of the Australian Cotton Industry (QUT1901)

Sustainable value creation refers to the need for businesses and industries to create social and environmental value as well as economic value for their stakeholders, shareholders, and the wider community. The Australian cotton industry is an important agricultural industry with a deep commitment to on-farm sustainability; however, as the raw material travels through the value-adding stages in the globalised textile and apparel industries, it is uncertain how sustainable value is transferred into the final product. Sustainable value chain analysis involves "walking the chain" to identify which activities add sustainable value and how relationships along the chain facilitate this flow of information. Under this project, a sustainable value chain analysis is being conducted. The outcome will be a framework to outline how the industry can create sustainable value to ensure both future competitiveness in the global marketplace and positive contribution to societal and natural capital.

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 investigating 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 the cotton industry could strategically enforce external labour standards. The outcomes of the research will be used to inform the Australia cotton industry on strategies to improve labour conditions in the cotton value chain, with success measured through industry adoption of a pathway towards ensuring decent work for workers.

Sustainability metrics for the cotton industry (CRDC1944)

In May 2020, the *Australian Cotton Sustainability Report* was published, providing performance metrics against eight priority social, economic and environmental sustainability topics for cotton. Following this, the industry is working to develop sustainability targets, guided by a sustainability strategy and framework *PLANET. PEOPLE. PADDOCK*. This project provides the resources to deliver this strategy, coordinate sustainability reporting, and oversee the development of the industry's sustainability targets, in conjunction with the Sustainability Working Group, which comprises representatives from CRDC, Cotton Australia, CottonInfo, *my*BMP, the Australian Cotton Shippers Association, and individual growers.

Case study

Evaluating interactions between irrigation infrastructure and fish

Research is underway to better understand and minimise the impact of irrigation infrastructure on fish populations in rivers.

Specialists from QLD DAF, with support from CRDC, will evaluate how various fish species interact with different types of irrigation infrastructure. This information will enable measures to be developed to avoid fish being entrained – or caught up – in irrigation systems. Evaluating the relative impact of different irrigation infrastructure types will identify which are lower impact and which types should be prioritised for mitigation measures in the future.

There are many variations in irrigation infrastructure systems, design, and function. Pumps vary in size, and the locations and style of the inlets also vary. For example, some inlets are close to the riverbank, others extend further out into the river, and some are positioned in short side channels perpendicular to the river. Other irrigation systems rely on gravity-fed diversion channels. Fish may also behave differently in natural flow events, compared to irrigation flow releases from dams and weirs, says QLD DAF Principal Fisheries Biologist Michael Hutchison, who is leading the research.

“All this variation means some systems are likely to have a lower impact than others when it comes to entrainment of fish,” Michael said. “The intent of this work is to build on existing international and national research and make best practice recommendations to CRDC for irrigators to minimise impacts on fish. These measures may also be beneficial to the irrigation infrastructure operating efficiency and maintenance.”

Some of Michael’s previous research evaluated movements of small and medium-sized fish in the Northern Murray-Darling Basin. Michael and fellow researcher Dr Andrew Norris also have a background in restoring fish stocks through habitat restoration and enhancement. Their award-winning work in the Condamine River near Dalby led to substantial increases in the abundance of fish at rehabilitated sites.

Much of this work involved collaboration and cooperation with landholders. All observed increases in fish numbers occurred without irrigators reducing their use of water.

“Based on our past experience, some fish species or sizes are more likely to be entrained than others,” Michael said.

“Some species, even though abundant in the river, may rarely pass through an irrigation system, whereas other less common, poorer swimming species may be over-represented. For example, juvenile catfish seem particularly susceptible to entrainment.”

CRDC Natural Resource Management R&D Manager Stacey Vogel said this project represents the commitment by the cotton industry to identify key management strategies to protect and improve riverine areas, including the condition and resilience of fish populations within cotton landscapes.

“CRDC has prioritised research relating to fish entrainment as an outcome from the industry’s 2019 fish stewardship R&D priority workshop,” Stacey said.

“Representatives from industry, universities, state and Australian Government organisations attending the forum rated fish entrainment as the highest R&D priority due to its potential impact on the resilience of native fish populations and the subsequent threat it poses to the industry’s social licence to irrigate.”

For more: read the full article in the Summer 2020–21 edition of CRDC’s *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Ensuring success now and into the future

Work to progress one of the most important programs for the Australian cotton industry has taken a big step forward with the completion of extensive stakeholder consultation on sustainability targets.

The *PLANET. PEOPLE. PADDOCK.* Sustainability Framework has been developed by the industry to coordinate work to make Australia a global leader in sustainable cotton production. An important part of the framework is setting targets and coordinating a whole-of-industry strategy to achieve them. Draft targets and indicators of progress have been developed for each of the core focus areas under the framework: PLANET: water; carbon footprint, biodiversity, pesticides, soil health; PEOPLE: workplace, wellbeing; PADDOCK: productivity, profitability.

In a consultation process during July and August 2020, 356 stakeholders gave feedback on these draft indicators and targets to validate the level of ambition, to test they are the 'right' ones to use, and to elicit suggestions for partnerships and solutions to achieve targets.

"We have consulted widely with stakeholders inside and outside the Australian cotton industry on draft targets developed by growers, scientists and industry experts," CRDC's General Manager R&D Investment Allan Williams said. "Stakeholder feedback has been used to refine some targets and indicators to ensure they meet stakeholder expectation, and are still achievable and consistent with the industry's ambition to be a global leader in sustainable cotton production."

Other primary industries, such as grains and livestock, are also developing or have in place their own sustainability frameworks. Acknowledging that most farms growing cotton are mixed cropping and grazing enterprises, the cotton industry is working with other industries to have sustainability metrics and methodologies that are as consistent as possible across broadacre industries. For some topics like carbon footprint, biodiversity and soil health, these common metrics and data collection methodologies don't yet exist and need to be agreed before targets can be set for the industry. Because these are complex areas involving several industries, this work is taking time to get right. Targets will be launched when this work is finalised, which will be several months yet.

"However, we are not waiting for targets to be launched to act," Allan said. "The industry has been improving its sustainability performance for 30 years, and this work will continue through existing industry programs, such as *my*BMP, CottonInfo and focused R&D investments."

The targets outlined in *PLANET. PEOPLE. PADDOCK*. will be a starting point, and the working group will seek to frequently engage with stakeholders on their actions and the progress towards them. Achieving these targets is not a feel-good exercise. Managing sustainability well has the potential to reduce industry risks, improve industry social licence and trust, increase farm productivity and resilience, and maintain or gain access to customers and markets.

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. The industry has created the world-leading *my*BMP cotton certification standard to establish best practice, and developed the CottonInfo program to drive grower adoption of research.

"*PLANET. PEOPLE. PADDOCK*. does not add a new layer to this proven structure," Allan said. "These existing channels will continue to drive industry's continuous improvement right across farm operations, and remain the path for researchers to connect with growers to adopt change. Growers are asked to continue to use these critical programs, and if needed, rise to the challenge of improving performance in areas to benefit them and the entire industry."

For more: read the full article in the Summer 2020–21 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Drones fly into revegetation game

In an Australian first, large drones have been used to broadcast native seed from the air as part of pioneering revegetation trials underway on cotton farms in the NSW Riverina.

Dr Rhiannon Smith from the University of New England (UNE) is leading the research to compare the effectiveness of different revegetation techniques for germination and establishment, as well as cost-effectiveness.

Approximately 37 hectares of native tree seedlings and seeds have already been planted at trial sites near Coleambally and Griffith, using three different revegetation methods: tubestock seedling planting; direct seeding with a ute or tractor; and drone seeding. As well as the Riverina sites, revegetation trials are also planned for the Namoi Valley. Overall, 75 hectares of field trials will be established, and at each location alternating rows will be planted using the three different revegetation methods.

UNE has partnered with international land rehabilitation and biodiversity restoration experts Dendra Systems for the drone plantings. The seeding trials are the first time drone technology has been used for revegetation in Australian cotton landscapes.

“Our research is comparing different technologies for native revegetation in semi-arid clay floodplains,” Rhiannon said. “It is exciting to investigate the use of drones to aerially broadcast native seed on the ground surface, given its potential to cover large areas quickly at the optimum time for planting. It is cutting-edge technology.”

Rhiannon says her research would assess the germination success and cost efficiency of this new drone technology against more traditional tubestock and direct seeding methods.

“These trials are all about assessing and evaluating revegetation options to determine the most efficient and cost-effective options,” she said. “Using drones for revegetation in these heavy clay soils may have some practical advantages over conventional direct approaches. More ground can be covered faster with a minimal ground-based footprint compared to that of seeding and planting methods using tractors or utes. Drone aerial seeding may also allow operators to access proposed revegetation sites quickly after a flood or significant rainfall event.”

UNE welcomed local cotton growers to observe and learn more about the new technology and the process of revegetation.

“There is a range of reasons growers are interested in farm revegetation, from biodiversity benefits to building their social licence and illustrating sustainability credentials. Revegetation confers broad benefits, like natural pest control, carbon sequestration, prevention of erosion, providing shade and shelter for stock, wind breaks, and improved micro-climates. Most cotton growers have areas on their farms that aren’t productive for crop production, and many are interested in making those parts available for revegetation.”

The native revegetation trials are part of the Cotton Landcare Tech Innovations 2021 project,

funded by CRDC and the National Landcare Program, aiming to help Australian cotton better report on and improve on-farm biodiversity. The information garnered across the revegetation trials will contribute to developing new and improved decision-making tools for revegetation projects, strengthening biodiversity in cotton landscapes.

For more: read the full article in the Autumn 2021 edition of CRDC’s *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Protecting biodiversity in cotton landscapes

CRDC and Cotton Australia are supporting a partnership between iconic Australian brands Country Road and Landcare Australia to improve biodiversity on cotton farms in the Namoi Valley.

Funded by a corporate contribution and funds raised via the sale of its famous Verified Australian Cotton Heritage Sweats, Country Road will contribute a minimum $600,000 to the partnership over three years, with funds raised going to Landcare Australia to support biodiversity restoration projects.

Landcare Australia CEO Dr Shane Norrish says, "Landcare Australia is very proud to launch this partnership with Country Road and the Australian cotton industry to develop projects focused on biodiversity conservation with cotton farmers.

"The projects will help to restore local ecosystems, and contribute to the sustainable management and productivity of the landscape. We are very pleased to be working with Country Road, the Australian cotton industry and cotton growers on biodiversity projects that will protect habitat for a range of native plants and animals, including threatened species."

The partnership will draw on a CRDC report that mapped biodiversity in Australian cotton landscapes, identified threatened and endangered species, and recommended ways to protect them. This was achieved with support from the Australian Government's National Landcare Program Smart Farming Partnership Initiative Round 1.

The initial project will be implemented by the Kahl family (pictured) in the Namoi Valley, NSW. Third-generation cotton farmers, the Kahl family will participate in the program by revegetating a river system that flows through their property, and by excluding stock to increase habitat and shelter for native animals, reduce erosion and improve water quality. Farmers in the area will be engaged in future rounds of funding, and all farmers and industry representatives can actively help by purchasing a Country Road Verified Australian Cotton Heritage Sweat online.

According to Cotton Australia, biodiversity is an important area of sustainability work for the industry and will be a focus in coming years following the release of industry-wide sustainability targets.

"This is an incredibly exciting opportunity and the first time a corporate partner has come on board to directly support our biodiversity work on-farm. We hope the funds from Country Road and the support of Landcare Australia will help further engage our growers in biodiversity activities," Cotton Australia CEO Adam Kay said. "We know from the research that our farms provide critical habitat for Australia's native plants and animals, and when managed well these areas also bring benefits to the farm by providing natural pest control, improving soil health and storing and sequestering carbon."

The Australian cotton industry is also adding to the launch project in other ways. This includes a five-hectare research trial by the UNE to investigate which revegetation methods have the greatest survival rates on floodplain soils, as well as the initial biodiversity mapping work that helps identify target areas for biodiversity enhancement works.

"Cotton industry research shows that while there have been some great steps forward, more needs to be done to protect and improve biodiversity on cotton farms and adjacent landscapes," said CRDC R&D Manager Stacey Vogel. "We hope this partnership with Landcare Australia and Country Road will help focus industry efforts, accelerate our biodiversity work, and provide a lasting legacy for our farmers, their communities and the natural environment."

For more: read the full article in the Summer 2020–21 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Section 4: RD&E Portfolio - Goal 3

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 2020–21, CRDC invested in 28 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	2020–21 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 seven honours, 11 PhDs and two postdoctoral researchers in 2020–21. In May 2021, CRDC supported 16 early career researchers to attend the Postgraduate Cotton Careers Tour to Narrabri. The tour aimed to provide researchers interested in a career in cotton with access to industry organisations and to enhance their understanding of the industry and career opportunities. Their knowledge of cotton-focused research careers increased from 19 to 75 per cent following the tour, and participants reported high motivation to work in the industry, recording an average of 4.2 (where one was low motivation and five high motivation).
			Number of scientific exchanges	CRDC was able to support participation in a limited number of conferences in 2020–21, including the domestic Soil Science Australia conference and the International Nitrogen Initiative conference (held virtually). Nearly all other planned conferences were cancelled or postponed due to COVID-19.
	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	A postdoctoral project developing an understanding of the needs of a future cotton workforce was finalised, and the findings from the work will be incorporated into a new project commencing in 2021–22.

	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 CSIRO summer scholarships, which included six students focused on cotton-related research. 16 researchers attended the CRDC-supported Postgraduate Cotton Careers Tour in May 2021. 94 per cent of attendees said the tour was helpful in informing them of career opportunities in cotton.
			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 are continuing their development. CRDC was a challenge agency for the Australian Government's Business Research and Innovation Initiative (BRII) in 2020–21. CRDC's challenge *'Is it possible to revolutionise agricultural spray application?'* received 52 applications from small to medium enterprises with ideas on how to address this issue. CRDC, in partnership with Cotton Australia and the NSW Environmental Protection Agency, worked with six of these groups to test the feasibility of these ideas, with two of them to be selected to deliver a proof-of-concept approach.
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 continues to support Grassroots Grants that help cotton growers adapt to change and build resilience, and has 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 over time 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	CRDC has been collaborating with CSIRO on the AgriPest Challenge, a conversation on how to transform the management of weeds, pests and diseases. CRDC has also led the development of the climate initiative with fellow Research and Development Corporations. This initiative is now being led by Agricultural Innovation Australia.
			Number and details of future opportunities to be followed up	CRDC's BRII challenge to address spray application resulted in six feasibility studies, which included interviews and small workshops that informed their problem definition and innovation co-design processes. CRDC supported the delivery of two facilitated virtual scoping workshops, bringing together animal health and crop protection researchers and organisations regarding the AgriPest Challenge. These workshops are the first step towards a national conversation about sustainable agripest control.

RD&E highlights

Australian cotton industry socio-economic study (CRDC2012)

The cotton supply chain in Australia, from research and production to transport and logistics, comprises an important part of the socio-economic fabric of multiple regional communities across Australia. The industry provides employment and growth both directly and indirectly, and provides broader social and economic benefits to regional communities and the wider nation. This project provides robust, evidence-based information on cotton's direct and indirect socio-economic contribution. In addition, because cotton does more for a regional economy than what can be quantified, the project is also producing case studies, providing a broader picture of the benefits cotton delivers to regional communities: the social and community benefits, jobs and growth, innovation and capacity building, and the important contribution of women in cotton-growing communities.

CRDC Grassroots Grants (CGA2002-2004; CGA2101-2106)

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 and peer-to-peer learning, and improving research skills for non-researchers through on-farm and grower-led research. Since the program began in 2011, 82 projects have been supported, with $721,000 invested by CRDC into grower organisations across the valleys. During 2020–21, these projects included 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; a project to promote biosecurity management practice for emerging cotton regions and engaging growers in *my*BMP in the Northern Territory; projects to encourage the uptake of digital technology in southern NSW and the Macquarie; increasing skill development for growers in the Darling Downs; and tours for Central Highlands and Macintyre cotton growers to St George, the Ord and the Northern Territory.

Australian Rural Leadership Program – Courses 26, 27 and 28 (RIR1903)

The Australian Rural Leadership Program (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 2020–21, cotton's Course 26 participants Chantal Corish of Goondiwindi (also supported by Prime Super) and Rod Gordon of Goondiwindi completed their program, and Course 27 participant Ruth Redfern of Narrabri commenced. Cotton's Course 28 participant, Justin McMillan of Narrabri, was announced during 2020–21 and will commence the program in 2021–22.

Cotton Production Course (UNE2002)

The Cotton Production Course is the only university-level qualification specialising in cotton production. Over the past 10 years, 630 students have enroled in the course at the University of New England, with support from the former Cotton Cooperative Research Centres (CRCs) and CRDC. The course is delivered at undergraduate and postgraduate levels, and consists of four cotton units: applied cotton production; cotton protection; cotton and the environment; and cotton farming systems. The units are based on strong practical and scientific principles, with the latest research and farming practices incorporated into the teaching materials via close collaboration with cotton industry partners. The benefit of the Cotton Production Course to the industry is an enhanced scientific-based understanding across the workforce, assisting with the invention and adoption of improved practices.

CSIRO student vacation scholarship program 2020–21 (CSP2101)

CSIRO's undergraduate student vacation scholarship program offers research placements to students over 10 weeks of the Australian summer holidays. The program gives high-achieving students the opportunity to collaborate with CSIRO researchers and supporting industries. CRDC supported the program for the first time in 2020–21, offering six students the opportunity to work across cotton-focused research projects. The projects looked at biological controls for nematodes, pathogen suppression in cotton soils, and the impact of adding nanobubbles to irrigation water. The students presented their research to CRDC, CSIRO Agriculture and Food team members and other sponsors at a symposium at the conclusion of the program.

Future Cotton Leaders Program (CA2101)

The Future Cotton Leaders Program is a collaboration between Cotton Australia and CRDC, designed to develop emerging leaders within the cotton industry. The program is held every two years, with 2021 the seventh time it has been delivered. It covers four stages: leadership development; individual skill application; leading change; and contributing to industry. It features face-to-face forums, interactive online discussions, one-on-one coaching, and integration with industry activities. Participants also undertake an individual project related to their area of interest, which will help develop leadership skills in a real-life scenario. In the 2021 program, 15 participants were selected to participate.

Nuffield Australia Farming Scholarships (CRDC1901, CRDC2009)

The Nuffield Australia Farming Scholarships offer primary producers the opportunity to travel and study an agricultural topic of choice, courtesy of an industry scholarship. Scholars are selected annually on their commitment and passion for farming, their uptake of technology, and their potential as future leaders. Under this scholarship program in 2020–21, CRDC and Cotton Australia supported two cotton growers: Renee Anderson of Emerald, and Richard Quigley of Trangie. Renee's research, which she completed this year, focused 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 continued this year, investigates cropping systems and methods to retain more crop residue in zero-tillage farming systems.

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

With the rise of digital agriculture and the changing context of agricultural work, the cotton industry has recognised that it must develop a deeper understanding of future workforce needs, and how to unlock this capability. This involves identifying the types of workers, skills and workforce structures that will ensure cotton farm businesses are adaptable and can benefit from opportunities for improved productivity, efficiency and sustainability that technology offers. This project generated new understanding of the future of work in the cotton industry, including factors influencing the acceptance and adoption of technology; entrepreneurial behaviours and mindsets; the role of the knowledge network and consultants in influencing on-farm change; influences on attraction, retention and development of the workforce; and other factors that may shape the future of work and the workforce requirements for the cotton industry.

Postgraduate tour – Careers in cotton industry: farm to fashion 2021 (CRDA2107)

In May 2021, 16 early career researchers participated in a CRDC-supported tour of the cotton industry, gaining a greater understanding of the cotton production system and supply chain, developing industry networks, and learning about cotton career opportunities. The students visited dryland and irrigated cotton farms near Narrabri, explored the cotton seed, ginning and classing processes, and heard about the range of research underway at the Australian Cotton Research Institute. Monitoring and evaluation conducted as part of the project indicated that their knowledge of cotton-focused research careers increased from 19 to 75 per cent as a result of the tour, and that motivation to work in the industry was high, with an average ranking of 4.2 out of 5.

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 (WHS) record, using innovative research and extension to deliver practical health and safety solutions. Key objectives include setting clear priorities to better target RD&E, 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 WHS priority areas: 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.

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 2020–21 supported two award recipients: the 2020 winner, Dr Dinesh Kafle of the QLD Department of Agriculture and Fisheries, and the 2021 winner, Demi Sargent of the Australian National University. Dinesh's novel project investigates whether cotton plants can be primed with silicone to boost their defences against fusarium wilt and reniform nematode. Demi's innovative project is looking to boost a cotton plant's ability to process CO_2, greatly increasing its ability to tolerate drought and heat stress, thereby helping protect the cotton industry from the effects of climate change.

Thresholds for resilience in regional communities (UM1902)

The Australian cotton industry and communities in regions where cotton is grown will continue to experience change and challenges associated with drought and water policy, population dynamics, technology adoption and other ongoing growth and decline transitions. This research project focused on understanding what makes regional communities adaptive and resilient, and how the sector can contribute to supporting community resilience and adaptive capacity in cotton-growing regions. The project conducted three resilience assessments with community and cotton sector stakeholders in the regional towns of Goondiwindi, Warren and Walgett. The assessment process helped to define potential roles for the cotton industry, local and state government bodies, and other regional bodies in supporting community resilience.

Case study

Helping protect cotton from the effects of climate change

Cotton biologist Demi Sargent of the Australian National University was announced as the CRDC-supported ABARES Science and Innovation Award winner for 2021, with a project that could help shield the cotton industry from the effects of climate change.

Demi (pictured below) was presented with her award at the ABARES Outlook virtual conference in March, attended by CRDC's Executive Director Ian Taylor and the then Minister for Agriculture, Drought and Emergency Management, now Minister for Agriculture and Northern Australia, the Hon. David Littleproud MP.

Growing up on a small dairy farm in northern Victoria, Demi saw the impact of drought on farmers first-hand.

"My dad really struggled to grow crops that were plentiful enough and supply water to our cattle," she says. "Trying to make enough money to sustain a family of six… that was really difficult."

Now, Demi wants to help protect the cotton industry from the effects of climate change. Her Science Award project will examine a process known as 'mesophyll conductance', which is a limiting step in photosynthesis.

"It's one of the major gateways for CO_2 to enter the plant," Narrabri-based Demi explains.

"Firstly, the CO_2 will pass into little pores called stomata. Then once it's inside those pores, the CO_2 will diffuse through the cell walls. That process is called mesophyll conductance." In standard cotton cultivars, mesophyll conductance doesn't change when the temperature rises.

But a chance discovery in Demi's CRDC-supported PhD research revealed an opportunity to boost mesophyll conductance in hot weather.

"What we found is that this could be increased substantially with increasing temperature," she says.

Demi will use the award to measure the rate of mesophyll conductance under hot, dry conditions in a cotton cultivar and other species. She'll also use microscopy to study variations in the cell wall, cell membrane, and chloroplasts of the plants.

Demi believes the results of these studies could potentially supercharge a plant's ability to process CO_2, greatly increasing its ability to tolerate drought and heat stress.

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

For more: Read the full article in the Winter 2021 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Giving back to growers at grassroots

CRDC has announced nine 2020–21 Grassroots Grants recipients, with initiatives in store for cotton communities from the Northern Territory to the most southern valleys.

Included are crops tours for growers to different regions, including the Northern Territory, along with helping growers and farms become digitally ready.

Grants of up to $10,000 are available to Cotton Grower Associations (CGAs), which are designed to create and drive relevant small projects. It's been a successful initiative for CRDC, with R&D General Manager Allan Williams encouraging CGAs to continue to get on board.

"We continue to see value for growers being generated from these grants," Allan said. "Programs undertaken through the grants can help identify broader issues and needs of growers. The ability to create regionally specific value is key.

"No two growing areas are entirely the same; the topography, climate, water delivery, resistance management plans, infrastructure, insect pressure, disease status, soil type, and season length all vary, sometimes more widely than others.

"Grassroots Grants offer a way to address the regional uniqueness of issues and strengths. We've even seen grant projects lead to larger projects or successful funding applications for further research."

Southern Valley Cotton Growers Association (SVCGA), in partnership with the Irrigation Research & Extension Committee (IREC), applied to the CRDC Grassroots Grants program for funding to help members improve their digital readiness and capability across on-farm technology, computing and software.

The funding is enabling SVCGA to offer a two-part project to 25 growers, including a one-on-one farm visit from an agtech expert, and attendance at a full-day workshop. During the two-hour farm visit, the expert is making sure all software is updated and the office set-up is correct and geared for maximum efficiency. This farm visit also includes a machine audit to identify what machinery and implements are used as well as the associated screens.

During the workshop, activities include data standardisation, as well as learning and performing the steps to capture, store and share ag data collected from various sources, such as MyJohnDeere and spray rig software.

SVCGA chair Paul Cleton (pictured below) said this was also an opportunity for growers to share learnings, failures, and successes with others.

"We all create a vast amount of data from our farms, and this project will ensure we are set up to capture, store and use this data correctly," he said.

SVCGA and IREC have collaborated on several projects in the past. This is the second Grassroots Grant that SVCGA and IREC have delivered.

"These Grassroots Grants are just fantastic. They empower our CGA and enable us to implement locally relevant projects that benefit all cotton growers in our region," IREC Executive Officer Iva Quarisa said.

For more: read the full article in the Autumn 2021 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Section 4: RD&E Portfolio - Enabling strategy one

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 2020–21, CRDC invested in 30 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	2020–21 progress
4.1 Partnerships & 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	86 per cent of growers and 83 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 54 events involving 1,266 industry stakeholders (including 643 growers, 283 consultants and 75 researchers) in 2020–21. Of these, 33 activities were organised by CottonInfo, and 21 were organised in partnership with other organisations.
			Percentage of participants that report increased knowledge, skills, and intention to change behaviour as a result	The CRDC-led More Profit from Nitrogen (MPfN) project undertook an evaluation in 2020–21. Overall, stakeholders rated the extent of increased producer confidence to adopt the MPfN research findings and recommendations as moderate (average rating 3.6, on a scale of 1–5). Across the three individual research areas, stakeholders singled out the research findings on nitrogen mineralisation as being highly likely to be adopted, and 20 per cent of stakeholders involved in cotton suggested of key findings had already been adopted. A second CRDC-led cross-sectoral program, Smarter Irrigation for Profit Phase 2, completed a mid-term evaluation in 2020–21. Findings indicate 100 per cent of cotton growers rate their knowledge of irrigation scheduling at 8 or higher on a scale of 1–10, where 10 is the highest. On the same scale, 100 per cent of growers rated their skills in irrigation management at 8 or higher, and suggested they had taken steps to improve their irrigation system within the last two years.
	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	In 2020–21, 55 per cent of CRDC's RD&E investments were through cross-sectoral partnerships. This included strategic collaborations on water-use efficiency, nitrogen management, novel crop protection, biosecurity, the development of the cotton industry in Northern Australia, and engagement with the European Union. Collaboration was prioritised as part of managing the impact of lower investment due to drought.

			Number of new international and national partnerships	A number of new national partnerships were entered into in 2020–21, including membership of Agriculture Innovation Australia, and a collaboration with Landcare Australia, Cotton Australia and Country Road to improve biodiversity on cotton farms. New international partnerships included membership of Textile Exchange and participation in Cotton2040. One national partnership was renewed: the Rural Safety and Health Alliance.
			Partner satisfaction ranking	The 2019–20 Partner Relationship Review indicated that CRDC's current overall satisfaction ranking is 8.4 (on a scale of 1–10, where 1 is the lowest and 10 highest). Our 2023 goal is 8.5 out of 10. The next Partner Relationship Review is scheduled for 2022–23.
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 R&D 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	Of the 17 projects that have commercialisation potential, eight either have a commercial partner on board or have commercialisation processes underway. The ongoing ability to support them at the desired commercial pace has been affected by drought conditions.
		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 and support researchers through the commercialisation process. Changes in researcher satisfaction will be assessed towards the end of the Strategic Plan once the revised processes are bedded down and have had sufficient time to be implemented.
		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 towards the end of the Strategic Plan once the revised processes are bedded down and have had sufficient time to be implemented.

RD&E highlights

Agriculture Innovation Australia membership (AIA2101)

Agriculture Innovation Australia (AIA) Ltd is a new not-for-profit company established by the collective Research and Development Corporations (RDCs) in 2020–21 to drive cross-sectoral research, leverage private sector investment, and target transformational innovation. AIA was established to catalyse public and private sector investment and enhanced collaboration, in solving the biggest cross-sectoral challenges in Australian agriculture. As a single point of contact for cross-industry strategies, AIA will make it easier for investors from around the world to navigate and partner with the Australian agricultural system. The company aims to attract contributions from a range of sources, enabling large-scale investment on issues of national importance. CRDC has been actively involved in the establishment of AIA Ltd and its first investment project, the climate initiative, which aims to foster thriving agriculture, fisheries and forestry industries regardless of pressures from a variable and changing climate.

Climate, energy and business analysis for cotton growers (AE2101)

As farming systems become more complex, the time and effort required for cotton growers to undertake high-level climate, investment or business analysis for their cotton enterprises is increasing. To make informed decisions, these analyses are essential. This project involves agricultural economists completing analysis and providing tailored extension information to growers in climate risk management, resource-use efficiency, and business risk management – delivering an efficient solution to these knowledge gaps. Overall, the project aims to increase the capacity of cotton growers for complex on-farm decision making. As a result of this project, growers will be more informed about incorporating renewable energy to reduce irrigation extraction and transfer costs, key variables of the cotton gross margin, and climate risk due diligence.

Climate Research Strategy for Primary Industries (CRSPI) 2017-2021 (CCR1801)

The Climate Research Strategy for Primary Industries (CRSPI) is a partnership between Australian organisations, including 11 of the Research and Development Corporations (RDCs) that invest in climate RD&E for Australia's primary industries. It instigates and brings together research and knowledge the Australian agricultural sector needs to adapt to changing climate and reduce emissions. The CRSPI strategy identifies three focus areas against which the partners have aligned areas of research associated with climate change and emission reductions – adaption, business and policy, and reducing emissions. A number of CRDC-led or supported RD&E projects were included within the CRSPI categories of adaption and reducing emissions, including More Profit from Nitrogen; Accelerating Precision Agriculture to Decision Agriculture; and Managing Climate Variability.

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 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, forming a critical resource for CottonInfo communications. The channel is well supported: as at May 2021, it contained 213 videos, had 7,840 subscribers (up from 4,288 in May 2020) and 2.3 million views (up from 1.2 million views in May 2020). The current project concluded in June 2021, but videos remain a core part of a new CottonInfo multimedia project contracted from July 2021.

CottonInfo field demonstration trials (CSD2101, CSD2102, CSD2103, CSD2104)

Through their work in connecting growers with the latest in cotton research, each year the CottonInfo team run a series of in-field trials to demonstrate research outcomes to growers. In 2020–21, four trials were run: one in the southern valleys to encourage the use of cover crops for optimised farming systems; one across the Darling Downs, St George/Dirranbandi, Northern NSW and Macquarie valleys to help improve irrigation application efficiency through a series of practical on-farm demonstrations; one across all valleys to demonstrate management practice impact on riparian and floodplain ecosystems; and one across all valleys to examine the impact of different levels of fruit retention on subsequent yield potential and maturity for high-yielding cotton. The trials are directly linked to the relevant CRDC-supported research project.

Ensuring best practice is based on science (CRDC2113)

*my*BMP is the Australian cotton industry's voluntary farm and environmental management program for growers, supported by Cotton Australia and CRDC. It sets the industry's best practice performance criteria, and provides a framework by which growers can participate in, and be accredited in, best practice. Ensuring the *my*BMP modules reflect the latest R&D outcomes is a core focus of the CRDC Strategic RD&E Plan under this Enabling strategy. This project provides the linkage between the R&D outcomes and the *my*BMP program, ensuring the modules and their best practices are based on science and measured impact. It also provides strong linkages with the industry's sustainability program via the Sustainability Working Group.

Northern Queensland cotton tour (CRDA2105)

As part of the wider development of the cotton industry in Northern Australia, North Queensland is emerging as a potential cotton region. In late 2020, key industry organisations CRDC, Cotton Australia, Cotton Seed Distributors, and Bayer hosted a meeting with northern cotton researchers to discuss current research and future RD&E needs for the region. Following this meeting, in early 2021 CRDC supported a tour of the Atherton Tablelands, organised by local growers, which attracted more than 140 farmers and industry leaders. The purpose of the tour was to showcase the current cotton crop to current and potential growers, discuss the practicalities of cotton growing and the importance of best practice, and consider the region's cotton potential.

The platform for monitoring and analysis of cotton canopy nitrogen status and yield projection using calibrated aerial and satellite imagery (FLUR1801; FLUR1901)

Crop health monitoring startup, FluroSat, has been working to address the issue of nitrogen management in the Australian cotton industry since 2017. It recognises that practical, accurate and timely advice on crop fertiliser needs would help solve one of the biggest challenges facing cotton growers in seeking to improve profitability and on-farm practices. In 2017, CRDC supported FluroSat founder Anastasia Volkova through a series of startup workshops, known as Cotton X-Lab, to incubate and grow FluroSense, an online platform for crop management using remote sensing imagery. FluroSat secured $1 million in seed investment to further develop the platform, which CRDC also supported through an equity stake and research trials to validate analysis and generate recommendations. FluroSense was launched commercially in 2018, with free trial access for cotton growers in recognition of CRDC and grower community support. Following this, CRDC worked with FluroSat to integrate research previously conducted by CSIRO and CRDC, NutriLOGIC, providing actionable recommendations to cotton growers. In 2020-21, FluroSat merged with fellow startup Dagan to form Regrow Agriculture, with Anastasia as CEO. CRDC has maintained an equity stake in Regrow Agriculture, along with investors including CSIRO's Main Sequence Ventures.

Case study

RDCs create new innovation investment company

CRDC and its fellow Research and Development Corporations (RDCs) have come together to create a new not-for-profit company to drive cross-sectoral research, leverage private sector investment, and target transformational innovation.

Announced in early October by the (then) Minister for Agriculture, Drought and Emergency Management (now Minister for Agriculture and Northern Australia) the Hon. David Littleproud MP and the Council of Rural RDCs, the new company, Agricultural Innovation Australia (AIA) Ltd, marks a historic move for the 15 RDCs.

Chair of the Council of Rural RDCs Mr John Woods said the new company would target opportunities with greatest potential to deliver impact across multiple industries.

"Australia's agriculture industry is world class thanks to the efforts of the RDCs over the last three decades, but we are facing increasingly complex challenges that require new approaches, new ways of working, and new strategic responses," John said.

"This new company gives us a new tool through which we can prioritise and streamline co-investment to tackle hard-to-solve cross-sector problems and drive greater impact for industry and the broader community.

"The RDCs have a long history of effective collaborations, and I'm excited to see what we can achieve through this next iteration.

"As a single point of contact for cross-industry strategies, AIA makes it easier for investors to navigate and partner with the Australian agricultural innovation system. Its agile investment framework will attract contributions from a range of sources, enabling large-scale investment on issues of national importance.

"The Council acknowledges the strong support of Minister Littleproud for this new initiative, and welcomes the contribution of $1.3 million in seed funding from the Australian Government to fast-track action on the ground."

CRDC Executive Director Dr Ian Taylor has been part of the leadership team developing the new company, and its first investment initiative.

"AIA is a great step forward for the RDCs. It will enable greater cross-sectoral collaboration to address the major issues facing all agricultural sectors – things like climate, water-use efficiency, biosecurity and soil quality," Ian said.

"The first investment the collective RDCs are partnering on under AIA 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."

For more: read the full article in the Summer 2020–21 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight, or visit the Agricultural Innovation Australia website www.aginnovationaustralia.com.au.

Case study

Seeing a new way to spray

New vision-based plant detection technology released by John Deere in March this year was developed through projects supported by CRDC with researchers from the University of Southern Queensland (USQ). The See & Spray Select™ technology, integrated into John Deere's new 400 and 600 series sprayers, is the only technology of its type available in Australia and the industry's first factory-installed, targeted spray solution.

See & Spray Select™ camera technology rapidly detects green plants within fallow ground and automatically triggers an application to those plants. In doing so, it achieves a similar hit rate to traditional broadcast spraying but uses, on average, 77 per cent less herbicide. Operators can apply complex tank mixes more efficiently, and can switch from targeted to broadcast spraying without the need to leave the cab.

The initial experimental work to develop the vision-based plant detection technology was funded through a combination of industry research projects with CRDC, Sugar Research Australia, Hort Innovation, and USQ. Dr Cheryl McCarthy of USQ led the project.

"It's really exciting that we have a played a part in bringing new tech to a farmer's toolbox for weed control," Cheryl said. "We have helped define technology that is here and now, and industry can see R&D turning into an engineered commercial solution. We acknowledge our research partners CRDC, SRA and Hort Innovation as well as the collaboration with John Deere (USA) in achieving a successful outcome for industry."

CRDC R&D Manager Susan Maas said the technology is a good fit for managing rogue cotton in fallows and rotation crops.

"We worked with USQ on case studies that were cotton industry specific," she said. "The partnership has let us bring those lessons together and work to find a solution that has broad application."

USQ Centre for Agricultural Engineering Director Professor Craig Baillie said the technology was an excellent example of Australian research and innovation having global application, enabling Australian farmers to be at the forefront of transformative agtech.

"Industry collaborations such as this assist to sustain the development of future technologies and products which will transform agricultural industries over the years to come," he said.

USQ provided the experimental technology underlying See & Spray Select™ three years ago, which John Deere further developed and tested across farms in the United States, Canada, and Australia before its global release. John Deere Australia/New Zealand Managing Director Luke Chandler said collaborations such as this are a powerful pathway to helping farmers around the world unlock the value of targeted and applied agricultural technology.

"We are delighted to have collaborated with USQ to develop industry-leading innovation here in Australia that has potential to deliver positive and impactful changes for farmers globally," he said.

"The path to greater efficiency, profitability and sustainability begins in the paddock. It is through these types of collaborations that we can create practical, simple-to-use tools and technologies that save time and input costs, and reduce impact on the natural environment, for a higher performing farm sector."

For more: read the full article in the Winter 2021 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Section 4: RD&E Portfolio - Enabling strategy two

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 2020–21, CRDC invested in seven 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	2020–21 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 and were supported by growers.
		Positive stakeholder feedback about the relevance and value of CRDC investments	Percentage of positive responses	CRDC investments are relevant and valued by 92 per cent of growers and 89 per cent of consultants. 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	Two monitoring and evaluation reports were released in 2020–21. The Smarter Irrigation for Profit Phase 2 program mid-term evaluation highlighted that all activities are on track to achieve performance targets, despite COVID-19 implications. It also found that the project extension methodology is being implemented as designed and is appreciated by its target audience, with 70 per cent of farmers reporting being very involved or quite involved in decision making on the learning sites. Moreover, 70 per cent or more of participating producers intend to make management practice changes to their irrigation system within 12 months. Secondly, the final evaluation of the More Profit from Nitrogen program found it performed strongly, with an average of 91 per cent of planned outputs, milestones and key indicators achieved. In relation to impact, the program was rated strongly for generating knowledge and resources about improving on-farm nitrogen-use efficiency, and moderately for the extent of industry confidence in adopting key research findings.

	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	Two economic case studies completed in 2020–21 demonstrate impacts to growers of CRDC-funded projects. Smarter Irrigation for Profit Phase 2 research found that investment in automated small-pipe-through-bank systems generated a net present value of $364/ha when compared to manual siphon irrigation, and seasonal net benefits of $153/ha due to irrigation labour savings of up to 85 per cent. SIP2 also found productivity impacts for Canopy Temperate Stress (CTS) technology can increase yields while reducing labour and water costs. Incorporating CTS technology into irrigation management has the potential to generate an additional $152/ha/season.
	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. Our 2023 goal is 8.5 out of 10. The next Partner Relationship Review is scheduled for 2022–23.

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 2019–20 season, surveying 55 cotton consultants, representing 194 cotton growers and covering 38,314 hectares: 64 per cent of the Australian cotton production area for that season. The report is available at the CRDC website (www.crdc.com.au/publications).

Collaboration: Evaluation and measuring impact (SRA2002, SRA2101)

Monitoring and evaluation is crucial to ensuring the impact and effectiveness of CRDC's investments. CRDC's Monitoring and Evaluation Framework, developed in line with the 2018–23 Strategic RD&E Plan, guides the collection and analysis of information to enable the measurement, evaluation and reporting on progress towards the desired outcomes. CRDC and its fellow Research and Development Corporation Sugar Research Australia (SRA) have collectively appointed a Monitoring and Evaluation Manager to manage this process, and measure CRDC and SRA's respective success in delivering impact and value to growers, industry and government.

CRDC Cotton Grower Survey (CRDC2014)

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 2020 Cotton Grower Survey collected data for the 2019–20 season. 225 growers participated in the survey, growing an average of 184 hectares of cotton, and reporting an average irrigated yield of 10.45 bales per hectare. 96 per cent of growers agree CRDC is a trusted information source, and 91 per cent said they were supportive of CRDC's research investments and activities. The report is available at the CRDC website (www.crdc.com.au/publications) in PDF and interactive digital formats.

Case study

Survey identifies current practice and future issues

The feedback from the *2020 CRDC Grower Survey* indicates a positive level of confidence and optimism about the future of the industry among cotton growers.

The 2019–20 season was one of scarce irrigation water and rainfall, with an average of just 184 hectares under production for the 225 growers who responded to the survey. This represented 10 per cent of their total farmable area, with an average yield of 10.45 bales per hectare on fully irrigated cotton.

The 2020 survey included focus areas of water, nutrition and soil, irrigation, integrated pest management and crop protection, sustainability, workforce, community and social contribution, feedback on CRDC and CottonInfo, and industry sentiment.

Sustainability is a focus of the Australian industry right now with the release in May of the Sustainability Report 2019 and the development of sustainability targets under the *PLANET. PEOPLE. PADDOCK* Sustainability Framework.

Through the Grower Survey, respondents described what they felt are the industry's most important environmental, social, and economic opportunities and threats between now and 2024. While a range of issues was identified, two major themes emerged for the feedback provided: water; and community attitudes and perceptions.

Reference was made to a range of different aspects of water, including water-use efficiency; management of water resources; water shortage and availability to water; growers' access to water; and misinformation around water/politicising of water.

In terms of community attitudes and perceptions, growers referred to the misinformation circulating about the water issues (particularly across social channels); the poor perception the community has of the industry/growers; the need to keep the community up to date with improvements made by the industry, and a need for more community education.

Wellbeing is an important factor in sustainability. The survey of growers' time use showed that 61 per cent reported spending less or much less time with family/friends than they wanted to, with 39 per cent indicating they were spending more, or much more time working than they wanted.

CRDC undertakes an annual survey of cotton growers to gather information about farming practices and growers' views on RD&E. This information helps inform CRDC about the benefits of the research it invests in and priority areas for future research. Change in industry practice can be quantified by comparing information across the surveys conducted over the past 20 years.

The results of the survey are published annually via both a user-friendly PDF report, and an interactive digital dashboard, enabling readers to explore the data in more depth. The results from the 2020 survey are now available at the CRDC website.

For more: read the full article in the Summer 2020–21 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

Economic analyses define benefits of irrigation innovation

Economic analyses are being undertaken as part of Smarter Irrigation for Profit Phase 2 (SIP2). Three studies completed by Ag Econ suggest that while the benefits stack up, growers should undertake individual farm analysis and consider specific farm and market dynamics when considering investments.

Evaporation mitigating for cotton water storages

As part of SIP2, the University of Melbourne (UMELB) developed and demonstrated cost-effective and practical solutions to reduce evaporation from water storages. The research builds on previous large-scale field trials and subsequent lab trials to develop a unique solution to mitigate wind impacts on monolayer films, reducing water evaporation. Trials were undertaken at Yanco in southern NSW and St George in south-west Queensland. Top findings of the economic analysis:

- The greatest water losses on-farm are evaporation losses from on-farm storages, with an industry average loss of 25 per cent, and as high as 45 per cent.
- A combination of wind barriers and monolayers being developed and trialled by UMELB has shown the potential to reduce evaporation by up to 35 per cent.
- The actual benefits will be influenced by a range of factors, including the dimensions of the farm storage, seasonal water availability, and seasonal water-use patterns.

Plant-based sensing for cotton irrigation

As part of Smarter Irrigation for Profit Phase 1 (SIP1), CSIRO conducted on-farm trials of canopy temperature stress (CTS) technology in NSW and QLD. The overarching philosophy of the trials was to provide farmers the opportunity to use an irrigation scheduling tool that is based on real-time monitoring of a crop's stress levels and need for water. Top findings of the economic analysis:

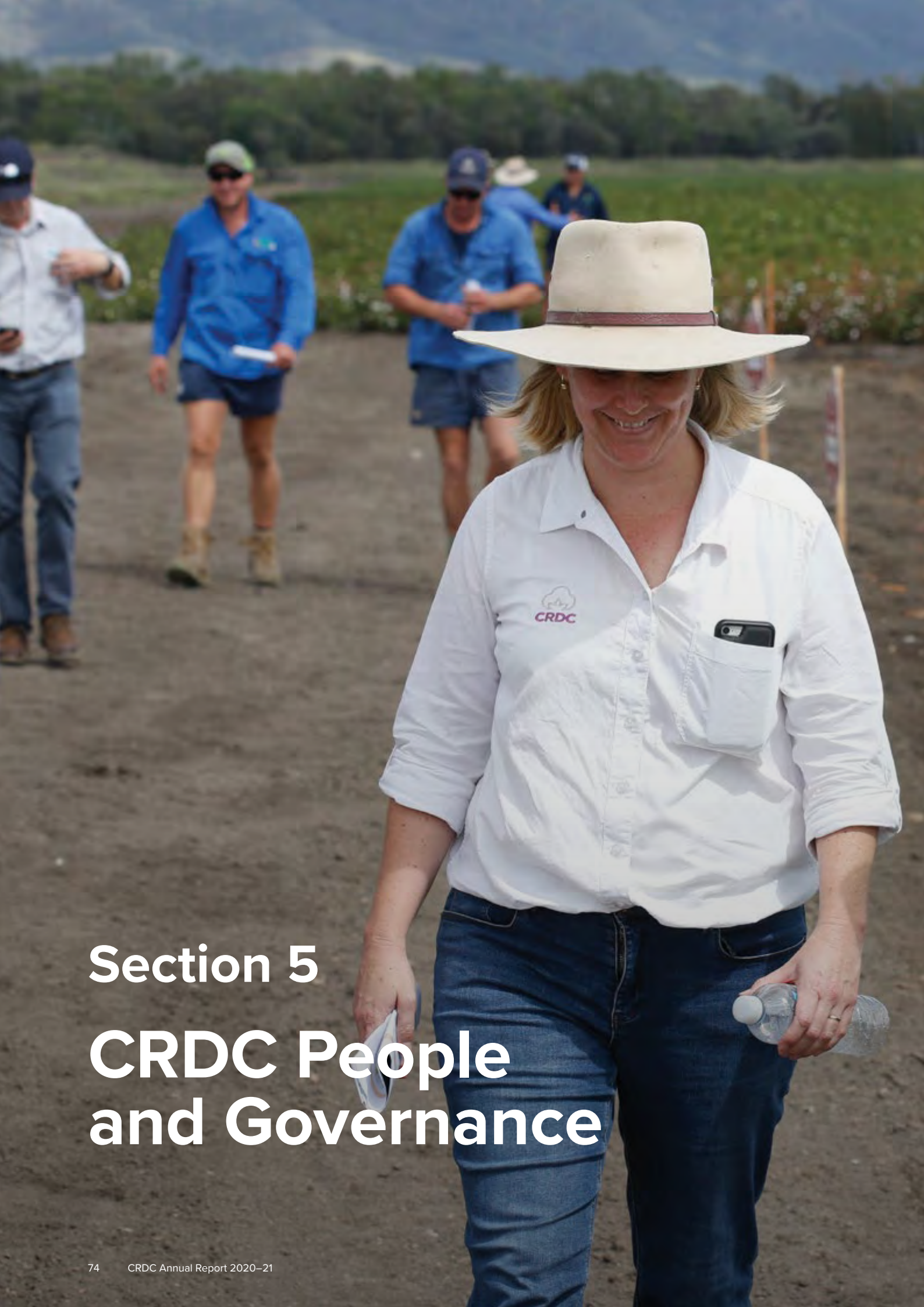
- By supporting more accurate monitoring of a crop's stress levels and need for water, CTS technology can increase cotton yields while reducing labour and water costs.
- Incorporating CTS technology into irrigation management has the potential to generate an additional $152/ha/season.
- Due to long water supply lead times, some growers may find it harder to adapt irrigation management unless there is sufficient on-farm storage or bore water supply.

Small pipe through bank irrigation system

As part of SIP1, the National Centre for Engineering in Agriculture at the University of Southern Queensland (USQ) completed successful trials of a blind head-ditch and small pipe through bank (sPTB) irrigation system at Moree, NSW, and supported early adoption of the technology at 'Waverley' near Wee Waa, NSW. Top findings of the economic analysis:

- Compared to manual siphon irrigation systems, automated sPTB reduces labour inputs and costs.
- With an upfront cost of $604/ha and net benefits of $968/ha over 25 years, investment in automated sPTB with a blind head-ditch was found to generate a net present value (NPV) of $364/ha over conventional siphons.
- Up-front investment costs can be heavily influenced by individual farm characteristics, and could range from $500/ha to $1000/ha.
- The seasonal net benefits of $153/ha were driven by labour savings of up to 85 per cent.
- In years of low water allocation, there may be insufficient irrigation water to fully use the sPTB area, leading to reduced return on investment.

For more: read the full article in the Winter 2021 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.



Section 5

CRDC People and Governance


COTTON
Growing Together

CRDC Board

Mr Richard Haire – Chair

BEc, 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 Rosemary Richards – Non-Executive Director *to 30 September 2020*
Deputy Chair *from 1 October 2020*

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.
Reappointed: 01/10/2020 until 30/09/2023.
Chair: IP & Commercialisation Committee.

Emeritus Professor Les Copeland AM – Non-Executive Director

BSc, PhD, GradDipAICD

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*.

Emeritus 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.

Emeritus 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.
Reappointed: 01/10/2020 until 30/09/2023.
Chair: Audit Committee.

Mr Ross Burnett – Non-Executive Director *from 1 October 2020*

BAgSc, GAICD

Mr Burnett has considerable experience in crop production, having successfully operated and grown his cropping business in Emerald QLD for over 16 years. Mr Burnett primarily farms cotton on his *my*BMP-certified property, and has developed extensive hands-on knowledge of cotton production over the years by being heavily involved in all areas of the process. Beyond the farmgate, he has been an active advocate for the cotton industry, representing the industry at local, state and national levels. He has a passion for sustainability and research, implementing both in his farming business and as a grower representative for the industry in these areas.

His understanding of corporate governance, business management and stakeholder engagement has been developed through operating his own business and past/current board and executive roles, including as the Vice President of the Queensland Farmers' Federation; the former President of the Central Highlands Cotton Growers and Irrigators Association; a grower representative for Cotton Australia; Director of the Local Management Arrangements Board for Emerald; and Chair of the CRDC Industry Research Advisory Panel. Mr Burnett holds a Bachelor of Agricultural Science and is a Graduate of the Australian Institute of Company Directors.

Appointed: 01/10/2020 until 30/09/2023.

Dr Gary Fitt – Non-Executive Director *from 1 October 2020*

BSc (Hons), PhD, ATSE, AICD

Dr Fitt has extensive research experience in agricultural sustainability, particularly focused on pest management and biotechnology. His in-depth research on the ecology of *Helicoverpa* species greatly assisted in the development of resistance management strategies, which provided a foundation for the successful introduction and management of transgenic cotton varieties in Australia. Dr Fitt started his career as an Experimental Scientist with CSIRO, and went on to hold leadership positions within the organisation, including Program Leader for Cotton, Deputy Chief CSIRO Entomology, Director of the CSIRO Biosecurity Flagship, and Science Director and Deputy Director for CSIRO Health and Biosecurity. He is now a CSIRO Honorary Fellow.

Dr Fitt has also held leadership positions within the wider research community, including as the Chief Executive Officer of the Australian Cotton Cooperative Research Centre (CRC), a Board Director of the Cotton Catchment Communities CRC, and Chair of the Science Advisory Body of the OECD Cooperative Research Program. Dr Fitt holds a Bachelor of Science and PhD from the University of Sydney, and has served as an Adjunct Professor at both his alma mater and the University of New England.

Appointed: 01/10/2020 until 30/09/2023.

Dr Danielle Kennedy – Non-Executive Director *from 1 October 2020*

BSc (Hons) (Chem), PhD, MAICD

Dr Kennedy is a scientist and entrepreneur with extensive experience in the R&D sector specialising in data analysis, advanced materials, chemistry and robotics. Dr Kennedy holds BSc (Hons) and PhD degrees from the University of New South Wales, and spent 12 years in R&D at CSIRO working across chemical, health, energy and agricultural applications, including in cotton processing. Dr Kennedy also has qualifications in portfolio management and change management, which she applies in her role as managing partner for Digital Agency DDSN Interactive where she works with companies large and small, not-for-profits and government agencies to craft and implement digital transformation with web-facing systems at the heart.

Dr Kennedy was previously the director of the CSIRO AIM Future Science Platform, which sought transformational research advances by bringing scientists together in the fields of materials, processing, robotics and data to address some of the nation's largest challenges. In 2017 for this work, Dr Kennedy was awarded the WALA Emerging Leader in the Public Sector and was finalist WALA Influencer of the Year. She has previously held positions as a member of the CSIRO Manufacturing Business Unit leadership team, chair of the IOT Alliance Australia Manufacturing workgroup, Vice-President of the Catalysis Society of Australia, and a member of the working group for the Decadal plan for Women in STEM delivered in 2019.

Appointed: 01/10/2020 until 30/09/2023.

Ms Peta Slack-Smith – Non-Executive Director *from 1 October 2020*

BAppSc, GAICD

Ms Slack-Smith has operated at the executive level of global businesses for over a decade. She has worked in numerous agricultural industries – cotton, grains, dairy, wool and livestock – and has extensive experience working with government and the rural Research and Development Corporation (RDC) model.

Ms Slack-Smith has advised CEOs, boards, ministers, companies and industries through threats to reputation, new operating environments, and changes to consumer and stakeholder expectations. She has managed sensitive issues including the environment, pesticide use, GMOs, food safety, Wheat for Weapons Royal Commission, and PeTA's animal welfare campaign. For over a decade, she worked closely with textile manufacturers, international fashion and apparel businesses, providing guidance on traceability and corporate social responsibility issues.

Ms Slack-Smith has worked in not-for-profits, ASX-listed corporates, industry associations, state and federal government departments, and as chief of staff to a federal minister. She holds a Bachelor of Applied Science (Wool & Pastoral Science), a Post-Grad Cert in Rural Science (Cotton Production), and is a graduate of the Australian Institute of Company Directors, Mt Eliza Business School, and Harvard Business School. She is the recipient of two prestigious awards, including a Churchill Fellowship and the Fairfax Fellowship in Ethical Leadership.

Appointed: 01/10/2020 until 30/09/2023.

Ms Kathryn Adams – Deputy Chair *until 30 September 2020*

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 previously on the Board of the Cotton CRC, a number of other CRCs, Agriculture Victoria Services Pty Ltd, and PBIP Ltd. She was 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

until 30 September 2020

BA, MRurSysMgt, GAICD

Based in Emerald QLD, Mrs Alexander is a Commercialisation Facilitator with i4 Connect, the delivery partner for the Australian Government's Entrepreneurs' Programme. She works closely with businesses in the central and south-west Queensland regions, and agtech businesses nationally to bring novel products, processes and services to market. Mrs Alexander has extensive knowledge across the value chain of dryland and irrigated cropping industries, and experience across natural resource management, agricultural extension, and water policy. In her previous role with the Central Highlands Development Corporation (CHDC), Mrs Alexander founded the AgFrontier Regional Agtech Incubator and developed the AgTeCH events held annually in Emerald and Mungindi, NSW, from 2017.

Mrs Alexander is a Non-Executive Director of Plant Health Australia, the Queensland Rural and Industry Development Authority (QRIDA), and Independent Chair of the Director Selection Committee for Sugar Research Australia (2020, 2021). Previously, she was a Director of Cotton Australia, and the Chair of Theodore Water and the Theodore Irrigation LMA Interim Board. She 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.
Former Chair of the Intellectual Property and Commercialisation Committee.

Mr Greg Kauter – Non-Executive Director *until 30 September 2020*

BAgEc GradCert Ru.Sc. 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.
Former Chair of the Audit Committee.

Dr Jeremy Burdon – Non-Executive Director *until 30 September 2020*

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.

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. Dr Taylor attends the Audit, Intellectual Property, and Remuneration Committees as an observer.

Composition

CRDC has an eight-member Board, consisting of a Chair (appointed by the Minister for Agriculture and Northern Australia), 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 2021

1	Mr Richard Haire, Chair
2	Ms Rosemary Richards, Deputy Chair
3	Emeritus Professor Les Copeland, Non-Executive Director
4	Mr Ross Burnett, Non-Executive Director
5	Dr Gary Fitt, Non-Executive Director
6	Dr Danielle Kennedy, Non-Executive Director
7	Ms Peta Slack-Smith, 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 keenly aware of its responsibilities about 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 2020–21, 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 2020–21. 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.

In 2020–21, the majority of board meetings were held via video-conference due to impact of COVID-19 on travel.

Board meeting	Date	Location
Meeting 6 – 2020	19 August 2020	Video-conference
Meeting 7 – 2020	25-26 November 2020	Video-conference
Meeting 1 – 2021	13 January 2021	Video-conference
Meeting 2 – 2021	17-18 February 2021	Video-conference
Meeting 3 – 2021	7-8 April 2021	Narrabri NSW
Meeting 4 – 2021	23 June 2021	Video-conference

Attendances at Board meetings

Director	Meeting 6 2020	Meeting 7 2020	Meeting 1 2021	Meeting 2 2021	Meeting 3 2021	Meeting 4 2021	TOTAL
Richard Haire	✓	✓	✓	✓	✓	✓	6 of 6
Les Copeland	✓	✓	✓	✓	✓	✓	6 of 6
Rosemary Richards	✓	✓	✓	✓	✓	✓	6 of 6
Kathryn Adams	✓						1 of 1
Elizabeth Alexander	✓						1 of 1
Greg Kauter	✓						1 of 1
Jeremy Burdon	✓						1 of 1
Ross Burnett		✓	✓	✓	✓	✓	5 of 5
Gary Fitt		✓	✓	✓	✓	✓	5 of 5
Danielle Kennedy		✓	✓	✓	✓	✓	5 of 5
Peta Slack-Smith		✓	✓	✓	✓	✓	5 of 5
Ian Taylor	✓		✓	✓	✓	✓	5 of 6

Audit Committee

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

The Committee also provides a forum for communication between the Directors, the senior managers of CRDC, and the internal and external auditors. It carries responsibility for identifying areas of significant business risk, and stipulating the means of managing any such risk. In addition to CRDC Directors, the Board has appointed a skill-based member on the Audit Committee, Samuel Skelton. The CRDC Charter of Corporate Governance, which includes the Audit Committee functions, is available at the CRDC website: www.crdc.com.au/content/crdc-charter-corporate-governance.

Mr Samuel Skelton (non-board member) BBus, BComm, GAICD, Grad Dip Fraud & Financial Investigation, ASSI Cert III Investigative Services, Cert IV Govt Investigations

Consultant for assurance, integrity, investigation, risk management, internal audit, compliance frameworks, and audit committee advisory, training and support services. Experience includes Director of Fraud Investigation & Dispute Services with EY, and Assistant Secretary, Governance Audit & Reporting Branch for Department of the Prime Minister and Cabinet.

Appointed: 01/12/2018 (reviewed annually)
Non-board member total consultancy for 2020–21 $7,414 ex. GST

Intellectual Property and Commercialisation Committee

The role of the Intellectual Property (IP) and Commercialisation Committee is to help CRDC's Board fulfil 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.

Attendances at Audit Committee meetings

Member	11 Aug 2020 *Video-conference*	4 Feb 2021 *Video-conference*	19 May 2021 *Video-conference*	TOTAL
Les Copeland	✓	✓	✓	3 of 3
Rosemary Richards	✓	✓	✓	3 of 3
Greg Kauter	✓			1 of 1
Jeremy Burdon	✓			1 of 1
Peta Slack-Smith		✓	✓	2 of 2
Ross Burnett		✓	✓	2 of 2
Samuel Skelton	✓	✓	✓	3 of 3

Attendances at Intellectual Property and Commercialisation Committee meetings

Member	22 July 2020 *Video-conference*	3 Feb 2021 *Video-conference*	20 May 2021 *Video-conference*	TOTAL
Elizabeth Alexander	✓			1 of 1
Rosemary Richards	✓	✓	✓	3 of 3
Les Copeland	✓	✓	✓	3 of 3
Danielle Kennedy		✓	✓	2 of 2
Gary Fitt		✓	✓	2 of 2

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	11 Aug 2020 *Video-conference*	9 Feb 2021 *Video-conference*	9 June 2021 *Video-conference*	TOTAL
Richard Haire	✓	✓	✓	3 of 3
Kathryn Adams	✓			1 of 1
Jeremy Burdon	✓			1 of 1
Les Copeland		✓	✓	2 of 2
Rosemary Richards		✓	✓	2 of 2

Statement of principles

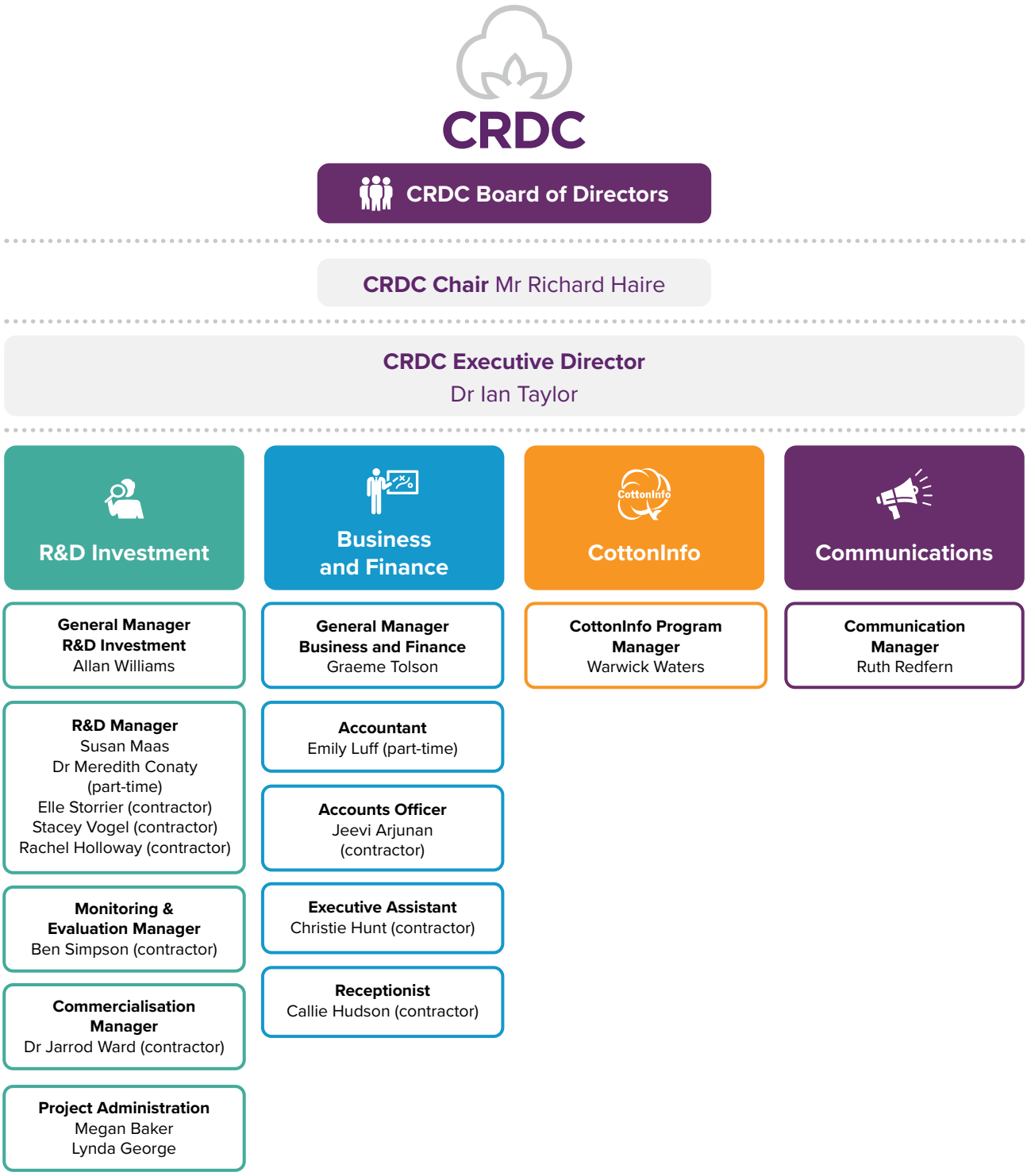
CRDC Directors and staff members are required to:

- 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 2021:



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 eight full-time employees and two part-time employees as at 30 June 2021.

CRDC employees

Employee type	2016 –17	2017 –18	2018 –19	2019 –20	2020 –21
Full-time employees	11	11	9	9	8
Part-time employees	2	2	1	3	2
Casual	1	0	0	0	0
TOTAL employees*	**14**	**13**	**10**	**12**	**10**

*CRDC employees as at 30 June each year, excluding contractors. For 2020-21, contractors equalled 3.9 full time equivalents (FTE).

Staff training and development

In 2020–21, CRDC spent $13,337 on training and $7,166 on recruitment. Areas of direct training activities were first aid training, fire warden training, employee and executive coaching, a climate essentials short course, a women in leadership masterclass, drone training, a UTS data analytics short course, and policies and procedures training. 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).

Key Management Personnel

During the reporting period ended 30 June 2021, CRDC had 10 key management personnel. These included seven non-executive directors, and 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 *(to 30 Sept 2020)*	$6,585			$626				$7,211
Elizabeth Alexander	Non-executive Director *(to 30 Sept 2020)*	$6,585			$626				$7,211
Greg Kauter	Non-executive Director *(to 30 Sept 2020)*	$6,585			$626				$7,211
Jeremy Burdon	Non-executive Director *(to 30 Sept 2020)*	$6,585			$626				$7,211
Les Copeland	Non-executive Director	$26,340			$2,502				$28,842
Rosemary Richards	Non-executive Director	$26,340			$2,502				$28,842
Ross Burnett	Non-executive Director *(from 1 Oct 2020)*	$19,755			$1,877				$21,632
Gary Fitt	Non-executive Director *(from 1 Oct 2020)*	$19,755			$1,877				$21,632
Danielle Kennedy	Non-executive Director *(from 1 Oct 2020)*	$19,755			$1,877				$21,632
Peta Slack-Smith	Non-executive Director *(from 1 Oct 2020)*	$19,755			$1,877				$21,632
Ian Taylor	Executive Director	$265,691		$18,079	$23,606	$6,662			$314,038
Allan Williams	GM R&D Invest.	$175,201			$15,851	$4,480			$195,532
Graeme Tolson	GM Business & Finance	$168,891			$16,166	$4,307			$189,365
Total		**$820,503**	**-**	**$18,079**	**$75,645**	**$15,449**	**-**	**-**	**$929,676**

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

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 RD&E 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 R&D 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.

Executive Director of CRDC, Dr Ian Taylor, with Secretary of the Department of Agriculture, Water and the Environment, Andrew Metcalfe AO.

Functions

Function	Application
Investigating and evaluating the cotton industry's requirements for R&D, 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, which 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 the 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 and Northern Australia 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 the Environment on a range of issues. Communication with the industry and Cotton Australia occurs continually both formally and informally, as outlined above. Communication with the broader community is a key focus of CRDC's communication activities. 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 R&D 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, 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

During 2020–21, CRDC has been accountable to the Australian Parliament through the Minister for Agriculture and Northern Australia (formerly the Minister for Agriculture, Drought and Emergency Management), the Hon. David Littleproud MP.

Minister's responsibilities

The Minister's powers and responsibilities, as outlined under various sections of the PIRD Act, include appointing CRDC's Chair and Directors and, under certain conditions, terminating these appointments; approving CRDC's Strategic R&D Plan and any variations to it; appointing a person as Presiding Member of CRDC's Selection Committee, as well as other members of that Committee; and transferring to CRDC any assets held by the Commonwealth that the Minister considers appropriate and 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 2020–21.

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 2020–21 to Minister Littleproud 25 June 2020, with the plan commencing 1 July 2020. The Annual Report for 2019–20 was submitted to the Minister on 1 October 2020, and the Minister tabled the report in Parliament on 11 November 2020.

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 2020–21.

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 2020–21.

Significant changes in the state of affairs

CRDC had no significant changes in its state of affairs in 2020–21.

Judicial decisions

CRDC had no judicial decisions in 2020–21.

Reviews by outside bodies

CRDC had no reviews by outside bodies in 2020–21.

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 2020–21 included improved irrigation management, improved application of pesticides, improved monitoring of pests, and the development of novel pesticides.

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.

Work Health and Safety summary

Legislative reporting requirements Schedule 2 Part 4 of the ***Work Health and Safety Act 2011***	Action undertaken 2020–21
Initiatives during 2020–21 and outcomes	• COVID-19: CRDC instigated a Crisis Management Team that met regularly to update the COVID-19 management plan as risks increased or decreased. CRDC continued supporting work-from-home arrangements. • First aid training. • Warden and fire training. • Safety issues discussed at quarterly Work Health and Safety (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 2020–21.
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 2020–21.

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 2020–21, 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 Operational 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 2020–21, CRDC spent $1,065,614 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
Callida Consulting	Internal audit services
C&J Phelps Consulting	Program management services
Computers Now Pty Ltd	Information and communication technology (ICT) services
Rachel Holloway	Program management services
ICD Project Services	Program management services
Melanie Jenson	Publication content
Jobs Australia Enterprises Ltd	Hire staff
KEOwned Pty Ltd t/as KEO Design	Web consultant
Carolyn Martin	Publication content
Macpherson Agronomy Services Pty Ltd	Program management services
Cleave Rogan	Stipend fees
Neil Deacon Graphic Design	Publication design
Peel HR Pty Ltd	Human resource management services
Revolution IT Pty Ltd	ICT services
Ionize Pty Ltd	Cybersecurity services
The Strategic Directions Group Pty Ltd	Grant management software consultancy
Loren Shaw	Software support
Stacey Vogel Consulting	Program management services

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 2020–21, CRDC contributed $117,435 to Cotton Australia for industry consultation, capacity building of advisory panel members, and RD&E projects. These funds included $1,685 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 2020–21, CRDC contributed a total of $115,722 to Cotton Australia for the following co-funded project activities:

- $71,500 towards the Australian Future Cotton Leaders Program
- $44,222 towards a project to understand perceptions, issues and opportunities for the Australian cotton industry.

Selection Committee Report

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

21 July 2020

The Hon. David Littleproud MP
Minister for Agriculture and Northern Australia
Parliament House
Canberra ACT 2600

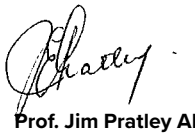
Dear Minister

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 2020 to 30 June 2021.

The Selection Committee's recommendation for the new CRDC Board were the subject of advice to you in the previous year. You subsequently approved of the nominations and so the only activity for this current year was for me to advise the supplementary list of alternate nominees that were unsuccessful.

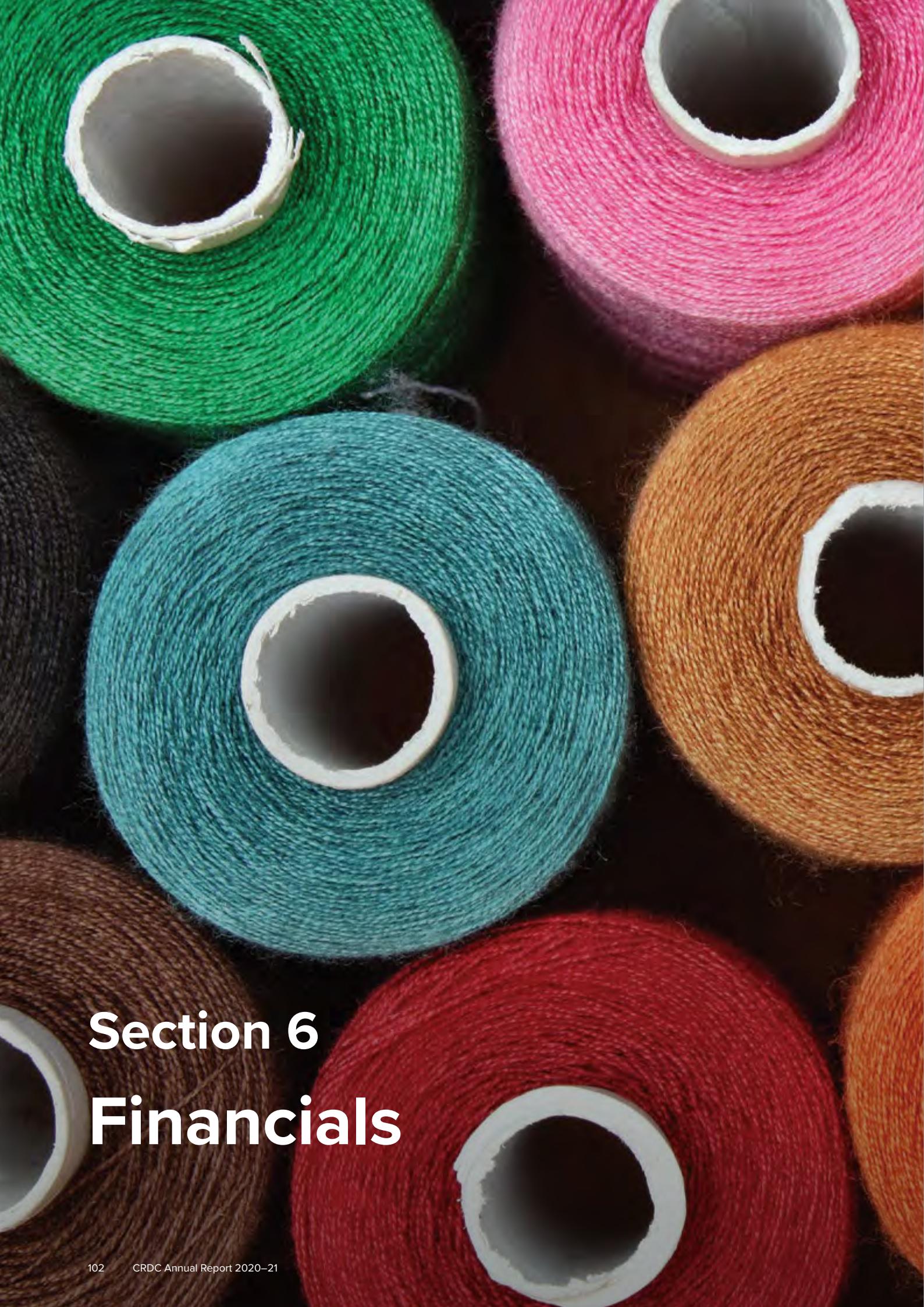
There were no further actions required during this year.

Yours sincerely



Prof. Jim Pratley AM
Chair
CRDC Board Selection Committee

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 and Northern Australia

Opinion

In my opinion, the financial statements of the Cotton Research and Development Corporation ('the Entity') for the year ended 30 June 2021:

(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 2021 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 2021 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 (including Independence Standards)* (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

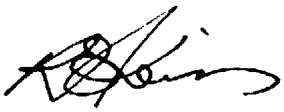
My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that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

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



Racheal Kris
Senior Director
Delegate of the Auditor-General

Canberra
23 August 2021

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 2021 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
20th August 2021

Les Copeland
Director
20th August 2021

Ian Taylor
Executive Director
20th August 2021

Graeme Tolson
Chief Financial Officer
20th August 2021

STATEMENT OF COMPREHENSIVE INCOME

for the period ended 30 June 2021

	Notes	2021 $	2020 $	Original Budget $
NET COST OF SERVICES				
Expenses				
Employee benefits	1.1A	**1,849,622**	1,880,226	1,979,000
Suppliers	1.1B	**803,980**	916,406	1,363,000
Grants	1.1C	**14,116,033**	17,018,983	15,541,000
Depreciation and amortisation	2.2A	**152,821**	226,227	166,000
Losses from asset sales		**1,650**	696	-
Total expenses		**16,924,106**	20,042,538	19,049,000
OWN-SOURCE INCOME				
Own-source revenue				
Revenue from contracts with customers	1.2A	**4,176,115**	3,850,461	4,246,000
Interest	1.2B	**190,616**	619,981	150,000
Project refunds	1.2C	**685,772**	1,286,531	250,000
Other revenue		**-**	16,667	-
Total own-source revenue		**5,052,503**	5,773,640	4,646,000
Total own-source income		**5,052,503**	5,773,640	4,646,000
Net (cost of)/contribution by services		**11,871,603**	14,268,898	14,403,000
Revenue from Government				
PIRD Act 1989 Contribution	1.2D	**2,077,224**	3,069,897	2,007,000
Levies and penalties	1.2E	**2,077,281**	3,070,321	2,007,000
Total revenue from Government		**4,154,505**	6,140,218	4,014,000
Surplus/(Deficit) attributable to the Australian Government		**(7,717,098)**	(8,128,680)	(10,389,000)
OTHER COMPREHENSIVE INCOME				
Items not subject to subsequent reclassification to net cost of services				
Changes in asset revaluation surplus		**73,427**	-	-
Items subject to subsequent reclassification to net cost of services				
Gain/(Losses) on financial assets at fair value through other comprehensive income		**69,865**	(26,517)	-
Total other comprehensive income/(loss)		**143,292**	(26,517)	-
Total comprehensive income/(loss) attributable to the Australian Government		**(7,573,806)**	(8,155,197)	(10,389,000)

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

STATEMENT OF COMPREHENSIVE INCOME (CONTINUED)

for the period ended 30 June 2021

Budget Variances Commentary

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

The original budget is the Corporation's 2020-21 Portfolio Budget Statements (PBS).

Employee expense decreased by $0.129 million due to the average full-time equivalent staffing being below budget during the year.

Supplier's expense decreased by $0.559 million due to impact of COVID-19 reducing travel and delaying ICT grant management system enhancements.

Grants expense decreased by $1.425 million due to projects delayed during COVID-19 and reduced budgets for projects impacted by the drought.

Project refunds increased by $0.436 million as a result of an increase in surplus project funds returned by research organisations.

Commonwealth Contributions and Industry Contributions, comprising of levies and penalties, increased by $0.140 million as a result of an increase in rainfall increasing cotton production from which levies are collected and Commonwealth contributions are determined.

STATEMENT OF FINANCIAL POSITION

as at 30 June 2021

	Notes	2021 $	2020 $	Original Budget $
ASSETS				
Financial assets				
Cash and cash equivalents	2.1A	**15,129,908**	16,025,028	6,196,000
Investments	2.1B	**7,000,000**	17,000,000	16,500,000
Trade and other receivables	2.1C	**2,413,513**	1,219,038	913,000
Other investments	2.1D	**213,412**	143,547	144,000
Total financial assets		**24,756,833**	34,387,613	23,753,000
Non-financial assets				
Land and buildings	2.2A	**770,000**	711,349	746,000
Plant and equipment	2.2A	**267,316**	354,533	373,000
Computer software	2.2A	**27,879**	37,282	144,000
Total non-financial assets		**1,065,195**	1,103,164	1,263,000
Total assets		**25,822,028**	35,490,777	25,016,000
LIABILITIES				
Payables				
Suppliers	2.3A	**56,715**	130,302	200,000
Grants	2.3B	**2,049,349**	4,137,341	4,000,000
Other payables	2.3C	**52,503**	57,833	-
Total payables		**2,158,567**	4,325,476	4,200,000
Provisions				
Employee provisions	3.1A	**486,069**	414,103	454,000
Total provisions		**486,069**	414,103	454,000
Total liabilities		**2,644,636**	4,739,579	4,654,000
Net assets		**23,177,392**	30,751,198	20,362,000
EQUITY				
Reserves		**347,081**	273,654	273,000
Other reserves		**103,412**	33,547	34,000
Retained surplus		**22,726,899**	30,443,997	20,055,000
Total equity		**23,177,392**	30,751,198	20,362,000

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

STATEMENT OF FINANCIAL POSITION (CONTINUED)

as at 30 June 2021

Budget Variances Commentary

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

The original budget is the Corporation's 2020-21 Portfolio Budget Statements (PBS).

Cash and cash equivalents and Investments below PBS by $0.566 million was a result of decrease in grants payable and partly offset by reduced expenditure.

Trade and other receivables above PBS by $1.501 million is represented by increases in industry levies collected and held by the Department in June 2021 and matching Commonwealth contributions.

STATEMENT OF CHANGES IN EQUITY

for the period ended 30 June 2021

	2021 $	2020 $	Original Budget $
RETAINED EARNINGS			
Opening balance			
Balance carried forward from previous period	**30,443,997**	38,506,380	30,444,000
Adjustment on initial application of AASB 15/AASB 1058	**-**	66,297	-
Adjusted opening balance	**30,443,997**	38,572,677	30,444,000
Comprehensive income			
Surplus/(Deficit) for the period	**(7,717,098)**	(8,128,680)	(10,389,000)
Total comprehensive income	**(7,717,098)**	(8,128,680)	(10,389,000)
Closing balance as at 30 June	**22,726,899**	30,443,997	20,055,000
ASSET REVALUATION RESERVE			
Opening balance			
Balance carried forward from previous period	**273,654**	273,654	273,000
Adjusted opening balance	**273,654**	273,654	273,000
Comprehensive income			
Other comprehensive income	**73,427**	-	-
Total comprehensive income	**73,427**	-	-
Closing balance as at 30 June	**347,081**	273,654	273,000
OTHER RESERVES			
Opening balance			
Balance carried forward from previous period	**33,547**	60,064	34,000
Adjusted opening balance	**33,547**	60,064	34,000
Comprehensive income			
Other comprehensive income	**69,865**	(26,517)	-
Total comprehensive income	**69,865**	(26,517)	
Closing balance as at 30 June	**103,412**	33,547	34,000

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

STATEMENT OF CHANGES IN EQUITY (CONTINUED)

for the period ended 30 June 2021

TOTAL EQUITY			
Opening balance			
Balance carried forward from previous period	**30,751,198**	38,840,098	30,751,000
Adjustment on initial application of AASB 15/AASB 1058	**-**	66,297	-
Adjusted opening balance	**30,751,198**	38,906,395	30,751,000
Comprehensive income			
Surplus/(Deficit) for the period	**(7,717,098)**	(8,128,680)	(10,389,000)
Other comprehensive income	**143,292**	(26,517)	-
Total comprehensive income	**(7,573,806)**	(8,155,197)	(10,389,000)
Closing balance as at 30 June	**23,177,392**	30,751,198	20,362,000

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

Budget Variances Commentary

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

The original budget is the Corporation's 2020-21 Portfolio Budget Statements (PBS).

Deficit for the period below PBS deficit by $2.672 million is a result of the decrease in grant expenditure as noted in the budget variance commentary on the Comprehensive Income Statement.

CASH FLOW STATEMENT

for the period ended 30 June 2021

	Notes	2021 $	2020 $	Original Budget $
OPERATING ACTIVITIES				
Cash received				
Industry levies and penalties		**1,326,243**	4,164,162	2,007,000
Commonwealth contributions		**1,326,185**	4,334,628	2,010,000
Royalties		**68,834**	8,048	5,000
Grants		**4,481,880**	4,138,699	4,241,000
Interest		**229,329**	713,043	97,000
Net GST received		**1,307,998**	1,288,816	1,747,000
Other		**868,252**	1,215,903	596,000
Total cash received		**9,608,721**	15,863,299	10,703,000
Cash used				
Employees		**1,793,924**	1,781,492	1,939,000
Grants		**17,714,277**	20,272,529	17,415,000
Suppliers		**952,565**	1,014,096	1,352,000
Total cash used		**20,460,766**	23,068,117	20,706,000
Net cash from/(used by) operating activities		**(10,852,045)**	(7,204,818)	(10,003,000)
INVESTING ACTIVITIES				
Cash received				
Proceeds from sales of property, plant and equipment		**991**	21,818	-
Investments		**33,000,000**	52,500,000	30,000,000
Total cash received		**33,000,991**	52,521,818	30,000,000
Cash used				
Purchase of property, plant and equipment		**44,066**	174,898	326,000
Investments		**23,000,000**	45,000,000	29,500,000
Total cash used		**23,044,066**	45,174,898	29,826,000
Net cash from/(used by) investing activities		**9,956,925**	7,346,920	174,000
Net increase/(decrease) in cash held		**(895,120)**	142,102	(9,829,000)
Cash and cash equivalents at the beginning of the reporting period		**16,025,028**	15,882,926	16,025,000
Cash and cash equivalents at the end of the reporting period	2.1A	**15,129,908**	16,025,028	6,196,000

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

CASH FLOW STATEMENT (CONTINUED)

for the period ended 30 June 2021

Budget Variances Commentary

Cash Flow Statement for not-for-profit Reporting Entities

The original budget is the Corporation's 2020-21 Portfolio Budget Statements (PBS).

Industry levies and Commonwealth contributions decreased by $1.365 million as a result of a decrease in industry levies collected, and matching Commonwealth contribution determined in accordance with the PIRD Act 1989.

Grant receipts increased by $0.241 million as a result of new research grants being contracted.

Net GST receipts decreased by $0.439 million as a result of a decrease in project milestones payable to research organisations.

Other receipts increased by $0.272 million as a result of an increase in surplus project funds returned by research organisations.

Employee payments decreased by $0.145 million as a result of a reduction in the average full-time equivalent staffing during the year.

Grant payments increased by $0.299 million as a result of a reduction in grants payable at the end of year partly offset by a decrease in new RD&E projects being contracted during the year.

Supplier payments decreased by $0.399 million as a result of a decrease in supplier expenses during the year as noted under the Income Statement.

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.

References to 'Corporation' or 'CRDC' are references to the "Cotton Research and Development Corporation".

New Australian Accounting Standards

All new standards, amendments to standards or interpretations that were issued prior to the sign-off date and are applicable to the current reporting period did not have a material effect, and are not expected to have a future material effect, on the Corporation's financial statements.

Taxation

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

Events after the Reporting Period

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

Accounting Judgements and Estimates

In the process of applying the Corporation's accounting policies, management has made a number of judgements and applied estimates and assumptions to future events. Information around judgements and estimates that 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 2021.

1.1 EXPENSES

	2021 $	2020 $
1.1A: EMPLOYEE BENEFITS		
Wages and salaries	**1,602,869**	1,599,669
Superannuation:		
Defined contribution plans	**157,497**	153,281
Defined benefit plans	**-**	4,278
Leave and other entitlements	**89,256**	122,998
Total employee benefits	**1,849,622**	1,880,226

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	**56,250**	119,113
Consultants	**305,895**	215,202
Corporate services	**17,840**	21,325
Information technology	**241,810**	300,259
Legal services	**9,700**	6,377
Levy management	**10,057**	12,818
Personnel services	**32,749**	83,877
Property services	**68,213**	86,425
General administration	**31,700**	42,036
Total goods and services supplied or rendered	**774,214**	887,432
Goods supplied	**94,605**	139,069
Services rendered	**679,609**	748,363
Total goods and services supplied or rendered	**774,214**	887,432
Other suppliers		
Remuneration of auditors	**27,000**	26,000
Workers compensation expenses	**2,766**	2,974
Total other suppliers	**29,766**	28,974
Total suppliers	**803,980**	916,406

Lease commitments

The Corporation does not have any current lease arrangements.

1.1 EXPENSES (CONT)

	2021 $	2020 $
1.1C: GRANTS		
Public sector:		
Australian Government entities	**2,157,364**	2,718,825
State and Territory Governments	**3,847,179**	4,748,076
Universities and Colleges	**4,692,858**	5,240,832
Corporate extension activities	**346,449**	425,517
Private sector:		
Commercial entities	**2,916,389**	3,957,850
Total contracted grant programs	**13,960,239**	17,091,100
Transfer from (to) contract asset	**155,794**	(72,117)
Total grants	**14,116,033**	17,018,983
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	**8,320,028**	14,279,807
Funded through research grant revenue	**5,135,245**	8,952,854
Total research grant commitments payable	**13,455,273**	23,232,661

1.2 OWN-SOURCE REVENUE AND GAINS

OWN-SOURCE REVENUE	2021 $	2020 $
1.2A: REVENUE FROM CONTRACTS WITH CUSTOMERS		
Sale of goods	-	700
Rendering of services		
Research grants	**4,104,424**	3,676,324
Other grants	-	59,485
Royalties	**71,691**	7,316
Sponsorships	-	106,636
Total revenue from rendering of services	**4,176,115**	3,849,761
Total revenue from contracts with customers	**4,176,115**	3,850,461

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	**2,354,435**

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	**1,697,021**

Research grants received from other partners require the Corporation to generate and deliver media that will benefit primary producers. The service is the intellectual property licence for podcasts that is granted at the commencement of the contracts. Revenue is recognised against performance of the obligation at a point in time when the podcasts have been delivered to the customer.

- Research grant revenue recognised at point in time - AASB 15	**52,968**
Total research grants	**4,104,424**

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 - sales based	**3,864**
- Royalties - usage-based	**55,500**
- Royalties - donation	**12,327**
- Royalties recognised at point in time - AASB 15	**71,691**

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.

1.2 OWN-SOURCE REVENUE AND GAINS (CONT.)

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**	300,354
Rural R&D for Profit - Smarter Irrigation for Profit phase 2	**3,740,927**	6,999,289
National Landcare Program Smart Farming Partnerships - New technologies to improve nature resources (biodiversity) on Australian cotton farms	**-**	329,866
Other research grant commitments	**122,619**	352,000
Total research grant commitments receivable	**4,163,900**	7,981,509

1.2 OWN-SOURCE REVENUE AND GAINS (CONT)

	2021 $	2020 $
1.2B: INTEREST		
Deposits	**190,616**	619,981
Total interest	**190,616**	619,981

Accounting Policy

Interest revenue is recognised by using the effective interest method.

1.2C: PROJECT REFUNDS		
Project refunds	**685,772**	1,286,531
Total Project Refunds	**685,772**	1,286,531

Accounting Policy

Project refunds are surplus or unused research grants returned to CRDC.

REVENUE FROM GOVERNMENT

1.2D: REVENUE FROM GOVERNMENT		
Department of Agriculture, Water and the Environment:		
PIRD Act 1989 Contribution	**2,077,224**	3,069,897
Total revenue from Government	**2,077,224**	3,069,897

1.2E: LEVIES AND PENALTIES		
Industry Levies	**2,077,207**	3,069,897
Penalties	**74**	424
Total levies and penalties	**2,077,281**	3,070,321

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

	2021 $	2020 $
2.1A: CASH AND CASH EQUIVALENTS		
Cash on hand or on deposit	**15,129,908**	16,025,028
Total cash and cash equivalents	**15,129,908**	16,025,028

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	**7,000,000**	17,000,000
Total investments	**7,000,000**	17,000,000

Accounting Policy

Non-derivative financial assets with fixed or determinable payments and fixed maturity dates that the Corporation has the positive intent and ability to hold to maturity are classified as 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	**32,178**	36,631
Contract assets	**213,333**	369,127
Total goods and services receivables	**245,511**	405,758

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 to Note 2.3A for information relating to contract liabilities.

Government receivables		
Department of Agriculture, Water and the Environment		
- PIRD Act 1989 Contributions receivable	**954,041**	203,002
- Industry levies receivable	**954,041**	203,002
Total government receivables	**1,908,082**	406,004
Other receivables:		
GST receivable from the Australian Taxation Office	**251,973**	360,616
Interest	**7,947**	46,660
Total other receivables	**259,920**	407,276
Total trade and other receivables	**2,413,513**	1,219,038

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

2.1 FINANCIAL ASSETS (CONT)

	2021 $	2020 $
2.1D: OTHER INVESTMENTS		
Shares in unlisted companies	**213,412**	143,547
Net other investments	**213,412**	143,547

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 2020							
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 as at 1 July 2020	**190,000**	**521,349**	246,946	107,587	**354,533**	**37,282**	**1,103,164**
Additions – Purchases	**-**	**-**	-	15,816	**15,816**	**28,250**	**44,066**
Revaluations recognised in other comprehensive income	**20,000**	**53,427**					**73,427**
Depreciation and amortisation		**(14,776)**	(47,938)	(52,454)	**(100,392)**	**(37,653)**	**(152,821)**
Disposals:							**-**
Gross book value	**-**	**-**	-	(5,467)	**(5,467)**	**-**	**(5,467)**
Accumulated depreciation and impairment	**-**	**-**	-	2,826	2,826	**-**	**2,826**
Total as at 30 June 2021	**210,000**	**560,000**	199,008	68,308	**267,316**	**27,879**	**1,065,195**
Total as at 30 June 2021 represented by:							
Gross book value	**210,000**	**560,000**	308,651	308,436	**617,087**	**861,647**	**2,248,734**
Accumulated depreciation, amortisation and impairment		**-**	(109,643)	(240,128)	**(349,771)**	**(833,768)**	**(1,183,539)**
Total as at 30 June 2021	**210,000**	**560,000**	199,008	68,308	**267,316**	**27,879**	**1,065,195**

1. The carrying amount of computer software included $2,417 (2020: $16,504) purchased software and $25,462 (2020: $20,778) internally generated software.

No indicators of impairment were found in 2021 (2020: $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 2021, an independent valuer conducted the revaluation of land and buildings.

A revaluation increment of $20,000 for freehold land (2020: $nil) was credited to the asset revaluation surplus by asset class and included in the equity section of the Statement of Financial Position.

A revaluation increment of $53,427 for buildings on freehold land (2020: $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 are 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:

	2021	2020
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 2021. Where indications of impairment exist, the asset's recoverable amount is estimated and an impairment adjustment made if the asset's recoverable amount is less than its carrying amount.

The recoverable amount of an asset is the higher of its fair value less costs of disposal and its value in use. Value in use is the present value of the future cash flows expected to be derived from the asset. Where the future economic benefit of an asset is not primarily dependent on the asset's ability to generate future cash flows, and the asset would be replaced if the Corporation were deprived of the asset, its value in use is taken to be its depreciated replacement cost.

Derecognition

An item of property, plant and equipment is derecognised upon disposal or when no further future economic benefits are expected from its use or disposal.

Intangibles

The Corporation's intangibles comprise of purchased and internally developed software for internal use. These assets are carried at cost less accumulated amortisation and accumulated impairment losses.

Software is amortised on a straight-line basis over its anticipated useful life. The useful lives of the Corporation's software are 3 to 5 years (2020: 3 to 5 years).

All software assets were assessed for indications of impairment as at 30 June 2021.

2.3 PAYABLES

	2021 $	2020 $
2.3A: SUPPLIERS		
Trade creditors and accruals	**56,715**	43,508
Contract liabilities	**-**	86,794
Total suppliers	**56,715**	130,302

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 to Note 2.1C for information relating to contract assets.

2.3B: GRANTS		
Grants:		
Public sector:		
Australian Government entities	**316,634**	597,659
State and Territory Governments	**441,980**	1,510,664
Universities and Colleges	**472,768**	985,547
Other research organisations	**76,000**	43,500
Private sector:		
RD&E service providers	**741,967**	999,971
Total grants	**2,049,349**	4,137,341

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	**52,503**	57,833
Total other payables	**52,503**	57,833

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

	2021 $	2020 $
3.1A: EMPLOYEE PROVISIONS		
Leave	**486,069**	414,103
Total employee provisions	**486,069**	414,103

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.

Superannuation

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

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

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

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

3.2 KEY MANAGEMENT PERSONNEL REMUNERATION

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

	2021 $	2020 $
Short-term employee benefits	**838,582**	830,080
Post-employment benefits	**75,645**	75,326
Other long-term employee benefits	**15,449**	23,617
Total key management personnel remuneration expenses	**929,676**	929,023

Notes: The total number of key management personnel that are included in the above table is 14 (2020: 10).

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:

	2021 $	2020 $
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.	**23,210**	42,166
Total transactions with related parties	**23,210**	42,166

4. MANAGING UNCERTAINTIES

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

4.1 FINANCIAL INSTRUMENTS

	2021 $	2020 $
4.1A: CATEGORIES OF FINANCIAL INSTRUMENTS		
Financial Assets		
Financial assets at amortised cost		
Cash and cash equivalents	**15,129,908**	16,025,028
Term deposits	**7,000,000**	17,000,000
Trade and other receivables	**253,458**	452,418
Total financial assets at amortised cost	**22,383,366**	33,477,446
Financial assets at fair value through other comprehensive income (investments in equity instruments)		
Shares in unlisted companies	**213,412**	143,547
Total financial assets at fair value through other comprehensive income (investments in equity instruments)	**213,412**	143,547
Total financial assets	**22,596,778**	33,620,993
Financial Liabilities		
Financial liabilities measured at amortised cost		
Grants payable	**2,049,349**	4,137,341
Suppliers payable	**56,715**	130,302
Total financial liabilities measured at amortised cost	**2,106,064**	4,267,643

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.	2021 $	2020 $
Movements in available-for-sale financial assets		
Opening balance	**143,547**	170,064
Fair value gains/(losses) through other comprehensive income	**69,865**	(26,517)
Closing balance of available-for-sale financial assets	**213,412**	143,547

Accounting Policy

Financial assets

In accordance with AASB 9 *Financial Instruments*, the Corporation 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 Corporation 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 (CONT)

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 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 is 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.

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).

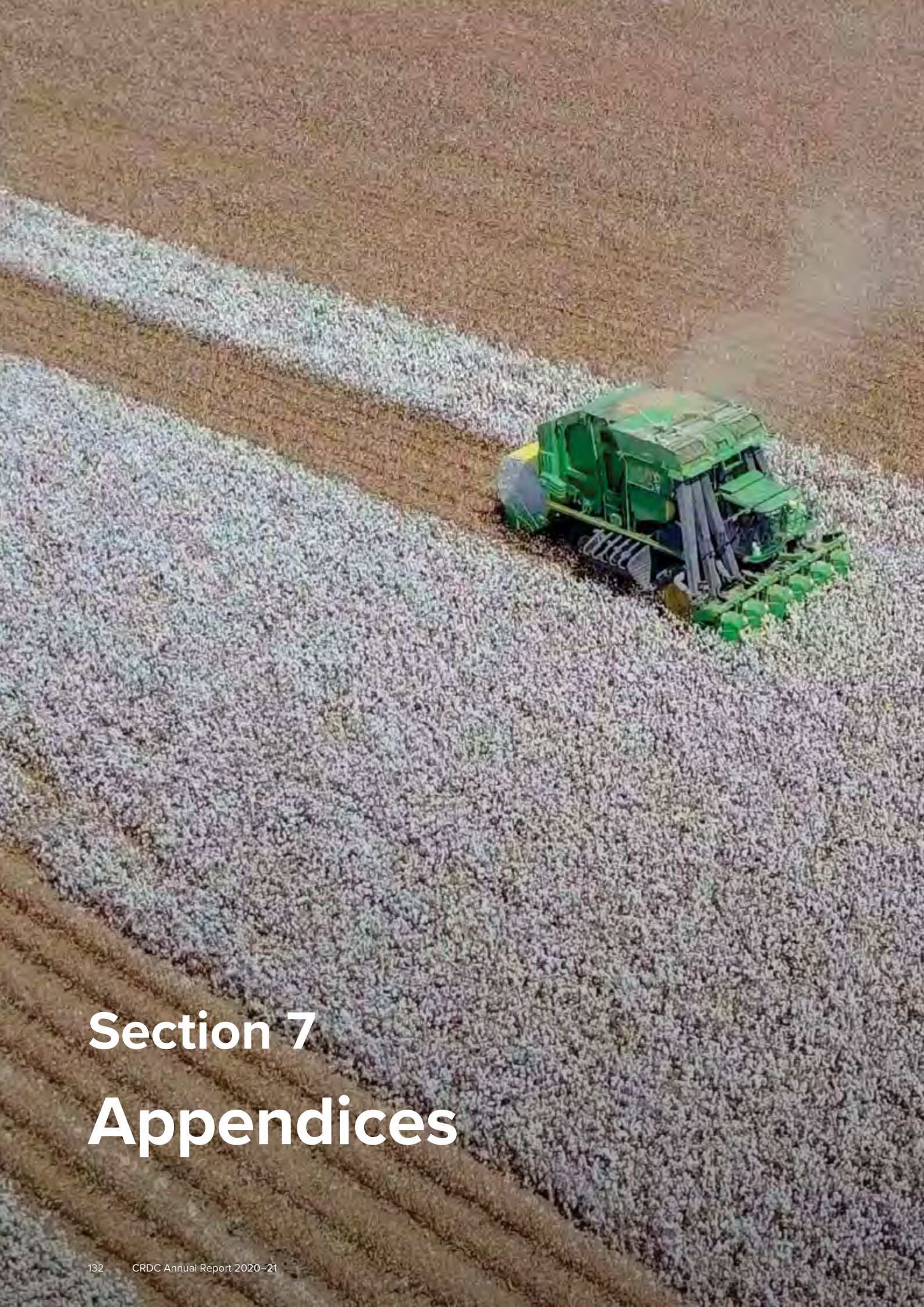
4.1C: NET GAINS OR LOSSES ON FINANCIAL ASSETS

	2021 **$**	2020 $
Financial assets at amortised costs		
Interest revenue	**190,616**	619,981
Net gain on financial assets at amortised cost	**190,616**	619,981
Investments in equity instruments at fair value through other comprehensive income		
Gain/(Losses) recognised in equity	**69,865**	(26,517)
Net gains/(losses) on investments in equity instruments at fair value through other comprehensive income	**69,865**	(26,517)
Net gain from financial assets	**260,481**	593,464

5. OTHER INFORMATION

5.1 CURRENT/NON-CURRENT DISTINCTION FOR ASSETS AND LIABILITIES

	2021 $	2020 $
5.1A: CURRENT/NON-CURRENT DISTINCTION FOR ASSETS AND LIABILITIES		
Assets expected to be recovered in:		
No more than 12 months		
Cash and cash equivalents	**15,129,908**	16,025,028
Term deposits	**7,000,000**	17,000,000
Trade and other receivables	**2,413,513**	1,219,038
Total no more than 12 months	**24,543,421**	34,244,066
No more than 12 months		
Other investments	**213,412**	143,547
Land and buildings	**770,000**	711,349
Plant and equipment	**267,316**	354,533
Computer software	**27,879**	37,282
Total no more than 12 months	**1,278,607**	1,246,711
Total assets	**25,822,028**	35,490,777
Liabilities expected to be settled in:		
No more than 12 months		
Suppliers	**56,715**	130,302
Grants	**2,049,349**	4,137,341
Other payables	**52,503**	57,833
Employee provisions	**293,798**	247,468
Total no more than 12 months	**2,452,365**	4,572,944
More than 12 months		
Employee provisions	**192,271**	166,635
Total more than 12 months	**192,271**	166,635
Total liabilities	**2,644,636**	4,739,579



Section 7
Appendices

Appendix 1: Australian Government priorities

CRDC's investments in RD&E during 2020–21 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 2020–21
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	• An industry steering committee has been established, facilitated by CRDC, to oversee the development of a digital strategy for the cotton industry. This includes a focus on developing the business case for sharing of data along the supply chain. • An app to improve the monitoring and management of silverleaf whitefly was tested. Other projects undergoing commercialisation activities are focused on providing digital technologies to farmers, improving management of spray drift, and irrigation. • A CRDC Grassroots Grant project that commenced is seeking to better understand the needs of growers to organise and maximise their existing data so that they are 'digitally ready'.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2020–21
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 participated in a number of strategic Plant Biosecurity Research Initiative (PBRI) projects to support industry preparedness, including the development of a fall armyworm podcast series and two Rural R&D for Profit cross-industry collaborations: Building national diagnostic capability, and iMapPESTS. • iMapPESTS aims to establish the foundations for a national cross-industry biosecurity surveillance system using state-of-the-art technologies for surveillance, diagnostics and data management. • CRDC, along with other plant-based RDCs, has continued its partnership with Plant Health Australia and the Department of Agriculture, Water and the Environment in the PBRI, which coordinates funding for biosecurity RD&E. It focuses on biosecurity threats to plant-based industries, improving industry resilience, and developing better preparedness, diagnostics, surveillance and management capabilities. • CRDC is participating in two collaborative projects to bring BioClay to growers. BioClay is a novel biological crop protection approach that is non-genetically modified, safe and environmentally sensitive. Early research targets include insects, viruses and fungal disease in several crops, including cotton. • The development of the cotton industry in Northern Australia presents new risks in terms of biosecurity. CRDC is supporting crop protection research in Northern Australia, and virus and vector surveillance linked to Northern Australia Quarantine Strategy activities.

Rural RD&E Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2020–21
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. • 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 Northern Territory. The project includes validating 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. • CRDC led the development of the climate initiative, with fellow RDCs, to help industries and communities prosper, regardless of the pressures of a changing climate. This initiative is now being led by Agricultural Innovation Australia. • CRDC continues to support a dedicated climate extension officer as part of the Australian cotton industry extension program, CottonInfo.
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	• CRDC, Cotton Australia and Cotton Seed Distributors are partners in the Australian cotton industry's extension program, CottonInfo: connecting growers and consultants with research, and helping to achieve best practice. • The CottonInfo team are regionally based in cotton-growing valleys, and include dedicated extension officers and technical leads in the areas of integrated pest management, biosecurity, natural resource management, weed management, energy and climate, irrigation, fibre quality, soil health, nutrition, and disease. • CottonInfo organised or contributed to 54 events involving 1,266 industry stakeholders (including 643 growers, 283 consultants and 75 researchers) in 2020–21. Of these, 33 activities were organised by CottonInfo, and 21 were organised in partnership with other organisations. • The CottonInfo team also support other industry activities, including the Cotton Seed Distributors' crop management tours, Crop Consultants Australia seminars, and Grower of the Year field days.

Science and Research Priorities per CRDC RD&E program 2020–21 ($'000)

Science and Research Priorities	Food	Soil and Water	Transport	Cyber security	Energy	Resources	Advanced Manufacturing	Environmental Change	Health	Total
Goal 1	$6,861	$3,215	$0	$0	$0	$0	$815	$50	$0	**$10,941**
Goal 2	$343	$131	$0	$0	$0	$0	$0	$575	$0	**$1,049**
Goal 3	$623	$5	$0	$0	$0	$0	$0	$0	$20	**$648**
Enabling Strategy 1	$655	$21	$0	$0	$0	$0	$0	$76	$0	**$752**
Enabling Strategy 2	$224	$0	$0	$0	$0	$0	$0	$0	$0	**$224**
TOTAL*	$8,706	$3,372	$0	$0	$0	$0	$815	$701	$20	**$13,614**

* 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.

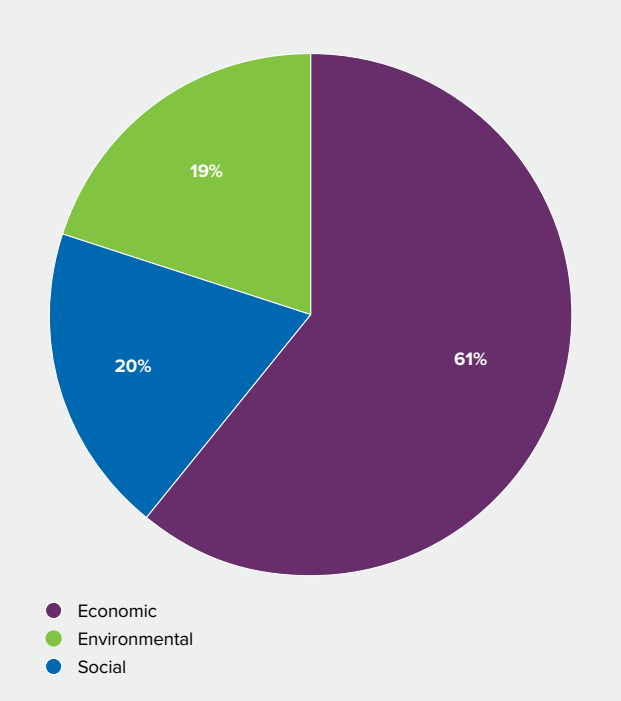
Rural RD&E Priorities per CRDC RD&E Program 2020–21 ($'000)

Rural RD&E Priorities	Advanced Technology	Biosecurity	Soil, Water, and Managing Natural Resources	Adoption of R&D	Total
Goal 1	$1,540	$4,182	$3,555	$1,664	**$10,941**
Goal 2	$149	$0	$778	$123	**$1,049**
Goal 3	$84	$0	$25	$538	**$648**
Enabling Strategy 1	$193	$45	$45	$469	**$752**
Enabling Strategy 2	$1	$0	$0	$223	**$224**
TOTAL*	$1,967	$4,227	$4,403	$3,017	**$13,614**

* 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 2020–21 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 2020–21

Performance outcomes	CRDC investment
Economic	61%
Environmental	19%
Social	20%
TOTAL	**100%**

CRDC program contribution to economic, environmental, and social outcomes 2020–21 ($'000)

Contributions	Economic	Environmental	Social	Total
CRDC programs	**Investment total**	**Investment total**	**Investment total**	**Investment total**
Goal 1	$7,228	$1,956	$1,757	**$10,941**
Goal 2	$339	$425	$286	**$1,049**
Goal 3	$145	$5	$498	**$648**
Enabling Strategy 1	$438	$229	$85	**$752**
Enabling Strategy 2	$123	$28	$73	**$224**
TOTAL*	$8,273	$2,642	$2,699	**$13,614**
Percentage	61%	19%	20%	100%

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

Appendix 3: RD&E Portfolio

CRDC 2020–21 Project List (as at 30 June 2021)

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	TTS	Oct-18	Sep-20
PhD: Assessing yield and fibre quality variability in cotton systems through data science for improved management	US2104	Mikaela Tilse	USYD	Mar-21	Feb-24
Precision management for improved cotton quality	CMSE1802	Robert Long	CSIRO	Jul-17	Dec-20
1.1.2 Improved input efficiencies					
Identifying the trends and drivers of water productivity in Australian cotton through benchmarking (includes CottonInfo technical lead Ben Crawley)	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-22
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	Ag Econ	Mar-20	Jun-21
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 case studies	RRDP2109	Jon Welsh	Ag Econ	Apr-21	Jun-21
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: 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: Monitoring soil water dynamics for improving water-use efficiency	UNSW1801	Ehsan Zare	UNSW	Jul-17	Dec-20
PhD: Sub-paddock-scale prediction of soil-water characteristic: Need for localised calibration	USQ2101	Ned Skehan	USQ	Feb-21	Feb-23
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-21
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					
Delivery of SataCrop crop mapping tool	CA2006	Sally Ceeney	CA	Jul-19	Jun-21
National RD&E Water Use in Agriculture cross-sector strategy	DA2001	Cath Lescun	Dairy Australia	Jul-19	Jun-21
Optimising dryland cotton production in the Namoi Valley	US2102	Stephen Cattle	USYD	Oct-20	Sep-21
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	Matt Hall	CRCNA	Jun-19	May-22
Science leadership for cotton development in Northern Australia	CSP1903	Steve Yeates	CSIRO	Oct-18	Sep-22
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
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 (including CottonInfo technical lead Beth Shakeshaft)	DAN2001	Hayden Petty	NSW DPI	Jul-19	Jun-22
1.2 Transformative technologies					
1.2.1 New technologies are adapted for use in cotton					
Application of molecular tools to monitor 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
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: Economic dairy case studies	RRDP2102	Daniel Armstrong	D-ARM Consulting	Aug-20	Feb-22
Smarter Irrigation 2: Evaporation mitigating solution for Australian cotton water storages	RRDP2007	Greg Qiao	UMELB	Jul-19	May-22

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: Improving the science of water footprinting	RRDP2103	Guy Roth	USYD	Jul-20	Feb-22
Smarter Irrigation 2: Key learning sites southern (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: Monitoring and evaluation case studies and analysis	RRDP2101	George Revell	Ag Econ	Jul-20	Mar-22
Smarter Irrigation 2: New tech integrated smart sensing and 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 and 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 communications	RRDP2104	Cathy Phelps	C&J Phelps Consulting	Jun-20	Jun-22
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 and forums	RRDP2015	Cathy Phelps	C&J Phelps Consulting	Nov-19	May-22
Smarter Irrigation 2: Review of existing and planned broadacre irrigation RD&E – desktop study	RRDP2106	Andrew Curtis	Water Strategies Limited	Feb-21	Jun-21
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 training sessions	RRDP2105	Steve Barratt	MRL Media	Nov-20	Jun-22
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
Technical review of operating standards for autonomous systems in Australian broadacre cropping systems	GRDC2004	Liam Ryan	GRDC	Jun-20	Jan-21
1.2.2 Cotton farms are digitally enabled					
Informing a digital strategy for the Australian cotton industry (Business case)	CRDC2110	Sarah Nolet	AgThentic	Mar-21	Sep-21
Informing a digital strategy for the Australian cotton industry (data audit)	CRDC2111	Ian Posthumus	DataGene	Mar-21	Sep-21
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					
Integrated Pest Management to support the management of emerging pests	CSP1905	Simone Heimoana	CSIRO	Jul-18	Jun-21
Podcasts for fall armyworm management in Northern farming systems	PHA2003	Stuart Keams	PHA	Apr-20	Aug-20
Synthetic biology opportunities in the cotton industry	UWS2101	Robert Sharwood	WSU	Jan-21	Jun-21
Transformation of *Verticillium dahliae*, causal agent of Verticillium wilt of cotton, with the GFP gene	DAN1809	Duy Le	NSW DPI/UQ	Dec-17	Nov-21
Using DNA diagnostics to monitor disease-suppressive cotton farming systems	CAS2101	Rob Long	Crown Analytical	Jul-20	Jun-23
1.3.2 Improved identification, surveillance and management systems for pests, diseases and weeds, and environmental stresses					
AgriPest Challenge workshop	CRDC2114	John James	Enablers of Change	Apr-21	Jun-21
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	WSU	Jul-18	Mar-22
Characteristics of disease-suppressive cotton farming systems and soils understood	DAQ2002	Linda Smith	QDAF	Sep-19	Jun-22
CRDC R&D Manager (disease portfolio)	CRDC2105	Elle Storrier	Macpherson Agronomy Services	Oct-20	Oct-23
Evaluate efficacy of novel chemistries, biocontrol agents and management practices to control Alternaria and Black Root Rot disease in cotton	DAN2101	Duy Le	NSW DPI	Jul-20	Jun-22
iMapPESTS: Assess biosecurity risk for Bt alleles and the Resistance Management Plan implication	RRDP2108	Wee Tek Tay	CSIRO	Jul-17	Mar-22
iMapPESTS: Sentinel surveillance for agriculture	HIA1802	Wee tek Tay & Dean Brooks	HIA	Feb-18	May-22
Improved management of silverleaf whitefly on cotton farms	DAQ1903	Richard Sequeira	QDAF	Jul-18	Jun-22
Improved management of weeds in cotton and grains farming systems (including CottonInfo technical lead Eric Koetz)	DAN2004	Graham Charles	NSW DPI	Nov-19	Jun-22
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
Modern systems agronomy for resilient cotton production	CSP2001	Claire Welsh	CSIRO	Jan-20	Jun-22
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 Sargent	ANU	Feb-17	Aug-20
Plant Health Australia membership subscription 2020-23	PHA2001	Stuart Kearns	PHA	Jul-20	Jun-23
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	Tim Green	NSW DPI	Jul-18	Jul-20

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
Khapra beetle response	CA1708	Sally Ceeney	CA	Jan-17	Oct-20
Plant Biosecurity Research Initiative (PBRI) Phase 2	HIA2101	Jo Luck	HIA	Jul-20	Jun-23
Prevention and preparedness for fall armyworm (*Spodoptera frugiperda*)	GRDC2005	WT Tay & TK Walsh	GRDC/CSIRO	Jun-20	Jun-21
GOAL 1 TOTAL: $10.94 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					
Cotton Landcare Tech Innovations: Communications support	NLP1903	Bernadette Pilling	HOC	Nov-18	Mar-22
Cotton Landcare Tech Innovations: Creating a legacy for biodiversity management research – Grower engagement	NLP2104	Liz Otto	Cornerstone Sustainability	Jun-21	Nov-21
Cotton Landcare Tech Innovations: Creating a legacy for biodiversity management research – The social science perspective	NLP2103	Angela Dean	QUT	Jun-21	Nov-21
Cotton Landcare Tech Innovations: Florabank workshops	NLP2102	Stacey Vogel	CRDC	Jul-19	Jun-22
Cotton Landcare Tech Innovations: Improved natural capital (biodiversity) on Australian cotton farms	NLP1901	Stuart Parsons	QUT	Jan-19	May-22
Cotton Landcare Tech Innovations: Improved natural capital (biodiversity) on Australian cotton farms	NLP1902	Rhiannon Smith	UNE	Jul-18	Jun-22
Cotton Landcare Tech Innovations: Two Revegetation Demonstration field days	NLP2101	Stacey Vogel	CRDC	Jul-20	Jun-21
Climate Research Strategy for Primary Industries (CRSPI): Developing a common methodology	AIA2102	Michelle Ford	AIA	Jun-21	Feb-23
Feasibility study of managed aquifer recharge for improved water productivity for Australian cotton production	ANU1901	Anthony Jakeman	ANU	Aug-18	Dec-21
Greenhouse gas baseline and mitigation for cotton	CSP2102	Hizbullah Jamali	CSIRO	May-21	Jun-22
Impacts and solutions: A scoping study on relative impacts of irrigation infrastructure on fish	DAQ2101	Michael Hutchison	QDAF	Jul-20	Jun-22
PhD: Farm-wide microgrid decision support system for the Australian cotton industry	UTS1901	Yunfeng (Forrest) Lin	UTS	Aug-18	Jun-22
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	Dec-21
Quantifying the potential environmental impacts of pesticides used on cotton farms	DAN1803	Mick Rose	NSW DPI	Jul-17	Sep-21
Secretariat Support for Australian Screen Advisory Panel	CRDC2104	Craig Copeland	Ozfish Unlimited	Aug-20	Jun-22
Synthesis of natural resource assets in the cotton-growing regions of eastern Australia	FWPA1801	Julian Wall	Eco Logical Aust	Jan-18	Jul-20
Updates to Cooler Cotton website	CRDC2116	David McClymont	DHM Environmental Software Engineering	Jul-20	Jun-21

2.2 Create higher value uses for cotton					
2.2.1 Increased value for Australian cotton					
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-22
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					
Joint RDC Community Trust Project	RIRDC1903	Jennifer Medway	AgriFutures	Jun-19	May-22
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	UC	Jun-19	Jun-22
Membership of the Sustainable Agriculture Initiative (SAI) platform – Australian chapter	CRDC1902	Selwyn Heilbron	SAI Platform (Aust) Inc	Jul-18	Jun-22
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-24
2.3.2 The value chain is transparent and understood by participants					
PhD: Sustainable value chain analysis of the Australian cotton industry	QUT1901	Zoe Mellick	QUT	Jul-18	Nov-21
GOAL 2 TOTAL: $1.05 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					
Australian Rural Leadership Program: Course 26, Course 27, Course 28, TRAIL 2020, TRAIL 2021	RIR1903	Matt Linnegar	ARLF	May-19	Dec-22
Cotton Production Course	UNE2002	Oliver Knox	UNE	Jan-20	Jun-23
CRDC R&D Manager (People and Capacity)	CRDC2106	Rachel Holloway	Rachel Holloway	Jul-20	Jun-23
CSIRO student vacation scholarship program 2020–21	CSP2101	Michiel van Lookeren Campagne	CSIRO	Jul-20	Jun-21
Future Cotton Leaders Program	CA2101	Kay, Adam	CA	Jul-20	Jun-21
Honour scholarship: Nutrient stratification in the soil under irrigated and dryland cotton systems in contrasting soil types	US2101	Sarah MacKay	USYD	Feb-21	Dec-21
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
Postgraduate tour – Careers in cotton industry: farm to fashion 2021	CRDA2107	Trudy Staines	CRDC	Jul-20	Jun-21
Science and Innovation Awards for Young People in Agriculture: 2019 and 2020 – Dean Brooks and Dinesh Kafle	ABA1901	Maree Finnegan	ABARES	Jul-18	Jun-22
Science and Innovation Awards for Young People in Agriculture: 2021 and 2022 – Demi Sargent and TBA	ABA2101	Maree Finnegan	ABARES	Jul-20	Jun-22
3.1.2 Increased understanding of the diverse human capital in regional communities					
Australian cotton industry socio-economic study	CRDC2012	JP Van Moort	ACIL Allen Consulting	Feb-20	Dec-21
People in Agriculture website	DA1502	Shane Hellwege	Dairy Australia	Jul-14	Jun-21
Postdoc: Understanding and planning for the future cotton workforce	USQ1801	Nicole McDonald	USQ	Oct-17	Sep-20
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: On-farm evaluation of pumping telemetry	CGA2002	Amanda Thomas	Macquarie CGA	Sep-19	Aug-21
Grassroots Grant: Central Highlands cotton growers tour of St George agriculture	CGA2104	Aaron Kiely	Central Highlands CG&IA	Dec-20	Jun-21
Grassroots Grant: Climate change – planting times, pests and spray drift	CGA2003	Alec Macintosh	Walgett CGA	Dec-19	Jan-21
Grassroots Grant: Demonstration farm of IoTR and LoRaWAN technology	CGA2004	Tom Crothers	St George CGA	Nov-19	Aug-20
Grassroots Grant: Digitally enabled cotton farms	CGA2102	Amanda Thomas	Macquarie CGA	Sep-20	Oct-21
Grassroots Grant: Digitally ready Cotton farmers	CGA2103	Iva Quarisa	Southern Valleys CGA	Sep-20	May-21
Grassroots Grant: Increasing cotton grower skills, and awareness through projects across the Darling Downs Cotton growing communities	CGA2106	Georgie Krieg	Darling Downs CGA	Nov-20	Sep-21
Grassroots Grant: NT cotton industry development – Promoting biosecurity of the emerging cotton industry to the NT community and engaging growers in *my*BMP	CGA2101	Andrew Philip	NT Farmers	Aug-20	Oct-21
Grassroots Grant: Ord and Northern Territory crop development tour	CGA2105	Hollie Gall	Macintyre Valley CGA	Jan-21	Dec-21
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					
Grower RD&E advisory panels and industry committees 2019-22	CA2002	Sally Ceeney	CA	Jul-19	Jun-22
Sponsorship: CSIRO AgCatalyst 2021	CSP2004	Mark Peoples	CSIRO	May-20	Nov-21
GOAL 3 TOTAL: $0.65 MILLION					

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 GRDC/CRDC: Spray drift hazard alert and prediction system	GRDC2003	Gordon Cumming	GRDC	Jul-18	Jun-22
Sponsorship: 20th Australian Cotton Conference Foundation	CA2004	Tracey Byrne-Morrison	CA	Dec-19	Nov-22
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)	AE2101	Jon Welsh	Ag Econ	Jul-20	Jun-23
Communicating cotton best production practices with video	DAQ1901	Tonia Grundy	QDAF	Jul-18	Jun-21
Cotton industry database management	CRDC2101	Lee Armson	Making Data Easy	Jul-20	Jun-23
CottonInfo Field Demonstration Trial: Autumn cover crop trial 2020–21	CSD2102	Kieran O'Keeffe	CottonInfo	Sep-20	Jun-21
CottonInfo Field Demonstration Trial: Cotton Group Membership APEN 2020–21	CRDA2104	Allan Williams	CRDC	Jul-20	Jun-21
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: IPM: Demonstrating the ability of the crop to compensate for early season post-damage	CSD2104	Amanda Thomas	CottonInfo	Oct-20	Aug-21
CottonInfo Field Demonstration Trial: Irrigation ToolBox Series – Farm Walks	CSD2103	Janelle Montgomery	CottonInfo	Oct-20	Mar-21
CottonInfo Field Demonstration Trial: Native vegetation long-term monitoring sites	CSD2101	Stacey Vogel	CottonInfo	Jul-20	Jun-21
CRDC NRM R&D Manager and CottonInfo technical lead	CRDC2102	Stacey Vogel	Stacey Vogel Consulting	Jul-20	Jun-23
Identifying key issues to maintain and improve Australian cotton fibre quality (including CottonInfo technical lead and *my*BMP module lead)	CRDC2103	Rene van der Sluijs	TTS	Oct-20	Jun-23
Irricom Meeting 2020	CRDA2106	Sarah Dadd	NSW DPI	Feb-21	Feb-21
National biosecurity and disease extension and coordination and CQ regional extension	DAQ1801	Paul Grundy	QDAF	Jul-17	Jun-21
Northern Queensland cotton tour	CRDA2105	Bradley Jonsson	Jonsson Farm	Feb-21	Apr-21
NSW DPI CottonInfo technical lead – nutrition (includes *my*BMP module lead)	DAN1906	Jon Baird	NSW DPI	Jan-19	Jun-21
Proofreading: *Australian Cotton Production Manual* (ACPM) *2021 and Cotton Pest Management Guide* (CPMG) *2021*	CRDC2108	Helen Dugdale	Helen Wheels HR	Apr-21	Jul-21
Proofreading: *Australian 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					
Actioning climate initiative systems innovation approach recommendations	CRDC2109	Will Soutar	Climate-KIC Aust Ltd	Jan-21	Feb-21
Agricultural Innovation Australia membership	AIA2101	Allan Williams	AIA	Jul-20	Jun-21
Climate Research Strategy for Primary Industries (CRSPI) 2017–21	CCR1801	Anwen Lovett	CRSPI	Jul-17	Sep-21
Northern cropping linkage workshop 2021	CRDA2108	Susan Maas	CRDC	May-21	May-21
4.2 Best practice (*my*BMP)					
4.2.1 Best practice is based on science and measured impact					
Ensuring best practice is based on science	CRDC2113	Chris Cosgrove	Sustenance Asia	Apr-21	Mar-24
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
Commercialisation process coordination and support for SLW App (NEC1901)	CRDC2107	Doug McCollum	AGK Services	Oct-20	Feb-21
Commercialising novel insecticides and synergists	CRDA2101	Allan Williams	CRDC	Jul-20	Jun-21
CRDC due diligence for climate-proof cotton – Independent technical review	CRDA2102	Carl Ramage	Rautaki Solutions P/L	Jul-20	Oct-20
CRDC due diligence for climate-proof cotton – Independent technical review: Shelston IP	CRDA2103	Susan Maas	CRDC	Jul-20	Oct-20
Darling Downs Network: support, insurance and maintenance	MRES2101	Graeme Tepper	MRES	Aug-20	Jun-21
GOAL 4 TOTAL: $0.75 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					
CRDC Strategic RD&E Plan 2023–28: Project management	CRDC2112	Bernadette Pilling	HOC	Mar-21	Jun-23
5.1.2 CRDC monitors and evaluates RD&E impact					
Annual consultant qualitative and quantitative surveys	CCA1901	Laura Causer	CCA	Mar-18	Dec-21
Collaboration: Evaluation and Measuring impact 2019–20	SRA2002	Ben Simpson	SRA	Oct-19	Sep-20
Collaboration: Evaluation and Measuring impact 2020–21	SRA2101	Ben Simpson	SRA	Oct-20	Sep-21
CRDC Cotton Grower Survey 2020–22	CRDC2014	Michael Sparks	Intuitive Solutions	Jul-20	Mar-23
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	Warrenbri Farming Partnership	Jul-18	Jul-20
GOAL 5 TOTAL: $0.22 MILLION					

TOTAL INVESTMENT IN RD&E: $13.61 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)
AIA	Agricultural Innovation Australia
ANTSO	Australian 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
GMO	genetically modified organism
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

PBRI	Plant Biosecurity Research Initiative
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	postdoctoral
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
SAI	Sustainable Agriculture Initiative
SRA	Sugar Research Australia
spp.	species
TIMS	Transgenic and Insect Management Strategy Committee
TTS	Textile Technical Services
UC	University of Canberra
UL	University of Leeds
UMELB	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
Verticillium wilt	a disease caused by the soil-borne fungal pathogen *Verticillium dahliae*
WHS	work health and safety
WSU	Western Sydney University

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)
2020–21 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)

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