CRDC

ANNUAL REPORT 2021–22

Case study

Making it to the top – supporting start-up innovation

The Australian **newspaper launched the inaugural edition of The List: 100 Innovators in late 2021, with start-up guru Anastasia Volkova coming in as number 1.**

CRDC has been partnering with Anastasia and her start-up Regrow Ag (formerly FluroSat) since 2017, when it supported her through a series of start-up workshops, enabling her to incubate and grow the project.

Since then, she's gone on to secure millions in investment, including an equity stake from CRDC, to further develop the state-of-the-art remote sensing and crop/soil modelling technology that allows farmers to measure crop health 'from the air'.

Today, Regrow Ag – of which Anastasia (pictured front cover) is CEO and co-founder – is an award-winning global company that's commercialising climate action through regenerative agriculture. It empowers some of the world's largest brands (Kellogg's, Cargill and General Mills, among others) to reduce greenhouse gas emissions across their supply chains and combat climate change through food production.

Anastasia says to go far and achieve big things, you can't go alone – you need partners.

"CRDC and start-up incubator X-Lab have been invaluable in connecting us with government officials and other ag organisations which has led us to where we are today," Anastasia said.

Anastasia's inclusion in *The Australian's* 2021 list is just one of her many accolades. The recognised thought leader and innovator in regenerative agriculture and sustainable food sourcing is also a member of the Forbes Technology Council, a TEDx Speaker, one of MIT's '35 Under 35' Innovators (2020), and was again included in *The Australian's* Top 100 Australian Innovators List in 2022.

CRDC ANNUAL REPORT

2021-22

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: Ali Kuchel, Janelle Montgomery, Kym Redfern, Lewis Wilson, Melanie Jenson, Paul Grundy, Renee Anderson, Ruth Redfern, Cotton Australia, Regrow Ag and the University of Queensland.

Front cover photo: Anastasia Volkova of Regrow Ag.

Published: October 2022
ISSN: 1039-3544

About CRDC & the Australian cotton industry

The Cotton Research and Development Corporation (CRDC) delivers outcomes in cotton research, development and extension (RD&E) for the Australian cotton industry.

A partnership between the Commonwealth Government and cotton growers, CRDC invests in 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.

Australia's cotton production is closely tied to water availability, making cotton growers naturally adaptive to Australia's seasonal conditions. In 2019–20, the industry grew the smallest cotton crop in 37 years. Just two years later, with a return to more favourable conditions, the 2021–22 crop was the second-largest on record.

Geographically, the industry continues to go through a period of growth, continuing its expansion from its predominant growing base in New South Wales (NSW) and southern and central Queensland (Qld) to northern Victoria (VIC), far north Qld, the Northern Territory (NT) and northern Western Australia (WA).

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

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

CRDC has been driving innovation in the Australian cotton industry for 30 years. From investing in the development of the first genetically modified (GM) cotton varieties in the early 1990s to supporting the creation of a protectant for plants against pests in the early 2020s, CRDC continues to invest in world-leading RD&E to benefit our dynamic cotton industry.

Our industry has built a culture of innovation, driven by the commitment to RD&E and its uptake by our highly adaptive growers. Our role is to ensure this culture endures by delivering 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.

Executive Director of the International Cotton Advisory Committee (ICAC) Kai Hughes recently said that from a cotton point of view, Australia is one of the few countries in the world that are at the cutting edge of research.

There have been some major developments in Australian cotton RD&E during 2021–22.

Creating protectants for plants against pests – both disease and insect – is a game-changer for agriculture. BioClay™, a safe and sustainable alternative to chemical pesticide, has had a breakthrough this year against silverleaf whitefly, one of cotton's (and the world's) most damaging agricultural pests. The BioClay technology has been developed over the past decade by the University of Queensland (UQ) with support from CRDC, Hort Innovation and Nufarm Ltd, and is now the focus of the CRDC-supported Australian Research Council (ARC) Hub for Sustainable Crop Protection.

CRDC is also part of a ground-breaking project to address spray drift. A major collaboration with the Grains Research and Development Corporation (GRDC) and Australian agtech company Goanna Ag was announced in March, with the first of a network of towers installed in April to provide real-time weather data and alerts about the presence of temperature inversions, which is one of the leading causes of spray drift. This project represents the biggest single investment in CRDC's history and the most significant move to improve spray application via RD&E.

These are just two of 213 projects that CRDC has invested in during 2021–22, all designed to deliver impact to growers and the wider cotton industry.

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, collaborators and cotton researchers. Cotton researchers like CEO and co-founder of Regrow Ag, Anastasia Volkova, named as #1 in *The Australian* newspaper's inaugural edition of *The List: 100 Innovators*. We also partner with those outside our sector to solve issues that are bigger than cotton alone. In 2020–21, 42 per cent of CRDC's investments were in cross-sectoral RD&E.

In this report, we outline the fourth year of our investment under the CRDC Strategic RD&E Plan 2018–23. We bring you an update on our progress towards our goals, our 2021–22 investments, innovations and impact.

Richard Haire
CRDC Chair

Dr Ian Taylor
CRDC Executive Director

PROGRESS AGAINST CRDC STRATEGIC R&D PLAN 2018–23

Our Annual Performance Statement

2021–22 marked the fourth 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 with a return to positive seasonal conditions, 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 2021–22 are helping to continue to drive the Australian cotton industry towards a future of innovation, increased commercialisation and digital transformation.

In 2021–22, Australian cotton growers and the Australian Government co-invested $18.3 million through CRDC into cotton RD&E, across 213 projects, and in collaboration with 97 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 2021–22 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. 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.

GOAL ONE: Increasing productivity and profitability on Australian cotton farms

In a tale of extremes, from very hot and dry, to very wet conditions, total production has fluctuated over the course of the Strategic RD&E Plan period more than nine-fold. As well as these extremes in production, cotton growers have had to contend with other factors outside their control, including significant increases in input costs, reduced labour availability (and therefore ability to perform farm operations in a timely manner), and supply chain delays. While this has limited the ability to achieve some production and productivity targets, the introduction of new technologies and farming systems has supported record-breaking yields in individual paddocks, and enabled cotton growers to adapt to these variable conditions.

Outcomes	Performance Indicator	Measures	2018 benchmark	2023 target	2021-22 progress
KEY FOCUS AREA: Optimised farming systems					
Improved yield and quality	Increase in yield over 5 years	Assessment of average bales/ha	9.86 bales/ha (irrigated) 4.0 bales/ha (dryland)	11.6 bales/ha (irrigated) 4.7 bales/ha (dryland)	
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)	1.1 bales/ML (GPWUI)	1.32 bales/ML (GPWUI)	
			10 kg of lint/kg of nitrogen	11.5 kg of lint/kg of nitrogen	
On-farm sustainable development is supported	New farming systems are sustainable and productive	Number of bales produced on new farming systems	—	2 million bales	
KEY FOCUS AREA: Transformative technologies and *my*BMP					
Improved reliability of production	Increase in five-yearly average production	Rolling annual average production (number of bales)	3.4 million bales/year (5-year average)	3.9 million bales/year (5-year average)	
New technologies are adapted for use in cotton	Increased number of technologies are available for cotton growers	Number of new technologies entering	1	5	
Cotton farms are digitally enabled	Increase in on-farm use of digital technology	Percentage of farms using digital technologies	100% connected to internet. 46% devices linked to office	85% devices linked to office	
KEY FOCUS AREA: Protection from biotic threats					
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	60%	85%	
Improved identification, surveillance & management systems	New management practices and systems are available for growers, consultants and industry	Economic impact of pests, weeds and diseases reduced by 40 per cent	—	40%	
Industry is prepared for a biosecurity incursion	Delivery of effective biosecurity preparedness scenarios/exercises (undertaken by cotton industry)	Number of biosecurity preparedness activities undertaken	—	2	
		Percentage of participants reporting increased preparedness	—	85%	

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

GOAL TWO: Improve cotton farming sustainability and value chain competitiveness

The importance of being able to provide high-quality metrics to the supply chain has increased dramatically, and current CRDC investments in both understanding and addressing this requirement provide a solid foundation for being able to report on the impact of cotton production.

Outcomes	Performance Indicator	Measures	2018 benchmark	2023 target	2021-22 progress
KEY FOCUS AREA: Sustainability of cotton farming					
Improved environmental footprint for cotton farms	Increase in sustainability metrics and improved carbon footprint	Percentage of farm native vegetation managed for conservation	6%	6.6%	
		Carbon footprint (kg/CO_2e)	383 kg of CO_2e per bale	325 kg of CO_2e per bale	
KEY FOCUS AREA: Create higher value uses for cotton					
Increased value for Australian cotton	Increase in the number of new commercialised products	Number of new commercialised products	—	2	
Increased understanding of market requirements & opportunities throughout the value chain	Information is publicly available on market requirements and value chain opportunities	CRDC research identifies opportunity to increase the value of cotton by 25 per cent	—	25%	
KEY FOCUS AREA: Measurement and reporting throughout the value chain					
CRDC collaborates in global leadership: sustainability initiatives	Evidence of involvement in global initiatives	Number of global initiatives participated in	4	6	
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	1	3	

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

GOAL THREE: Build adaptive capacity of the cotton industry

The nine-fold swing in production over the course of the CRDC Strategic RD&E Plan has tested the adaptive ability of the industry.

Outcomes	Performance Indicator	Measures	2018 benchmark	2023 target	2021-22 progress
KEY FOCUS AREA: Science and innovation capability and new knowledge					
Science and innovation capacity is strengthened & strategically fit for a digital future	Increase in the number of researchers supported through strategic career pathways	Number of PhD, post-doctoral and early career researchers supported	30	50	
	Increase in the number of scientific exchanges	Number of scientific exchanges	10	20	
Increased understanding of & participation from diverse human capital	Information is available on the diversity of social and business networks (age, gender, roles, culture, range of service providers, occupations and skills)	Report released	—	1	
Increased opportunities for innovation skills development	Degree to which innovation is supported by CRDC	Number of participants in innovation initiatives	100	600	
		Number and details of new ideas generated that provide benefit for the cotton industry	1	5	
KEY FOCUS AREA: Futures thinking					
Australian cotton growers are able to adapt to change	Growers report improved capacity to manage unknown or unexpected events (resilience)	Percentage of growers that report improved general resilience	—	60%	
Increased opportunities for strategic foresighting	Futures workshops lead to recommendations for future opportunities	Number of futures workshops	1	2	
		Number and details of future opportunities to be followed up	18	40	

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

ENABLING STRATEGY ONE:
Strengthening partnerships and adoption

All targets under this strategy are on track to be achieved. While much collaboration has taken place virtually due to COVID-19 travel restrictions, CRDC's co-investment in CottonInfo and its utilisation of regionally based extension officers has enabled ongoing direct engagement with cotton growers and consultants.

Outcomes	Performance Indicator	Measures	2018 benchmark	2023 target	2021-22 progress
KEY FOCUS AREA: Partnerships & Collaboration					
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	Growers: 77% Consultants: 72%	85%	
CottonInfo partnership is maintained and practice change improved	R&D outcomes are demonstrated through extension and adoption activities	Number of demonstration sessions	150	200	
		Percentage of participants that report increased knowledge, skills and intention to change behaviour as a result	70%	85%	
Partnerships are strengthened to engage multi-disciplinary & multi-institutional resources	Evidence of effective collaborative projects	Percentage of investments that include cross-sectoral partnerships	25%	40%	
		Number of new international and national partnerships	2	5	
		Partner satisfaction ranking	8.2 out of 10	8.5 out of 10	
KEY FOCUS AREA: Best practices (*my*BMP)					
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	95%	100%	
KEY FOCUS AREA: Innovation & commercialisation					
Improved R&D innovation & commercialisation	CRDC supports researchers to innovate & become more commercially focused	Number of projects with commercialisation potential	3	5	
	Research partners are supported through the commercialisation process (to ensure successful knowledge transfer)	Researchers report satisfaction with CRDC commercialisation support	—	85%	
	Commercialisation & knowledge transfer is accelerated	Percentage improvement in duration from conception to market entry (per product category)	—	20%	

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

ENABLING STRATEGY TWO: Driving RD&E impact

All targets under this strategy are on track to be achieved.

Outcomes	Performance Indicator	Measures	2018 benchmark	2023 target	2021-22 progress
KEY FOCUS AREA: Impact and effectiveness					
CRDC's RD&E investments meet grower, industry and government needs	Funded projects align with identified research priorities	Percentage of aligned projects	100%	100%	
	Positive stakeholder feedback on the relevance and value of CRDC investments	Percentage of positive responses	Growers: 88% Consultants: 92%	95%	
CRDC monitors and evaluates RD&E impact	Monitoring and evaluation evidence demonstrates RD&E impact	RD&E impact reports	5	5	
CRDC-funded projects demonstrate value and return on investment	Positive return on investment	Investments demonstrate a minimum ratio of benefit/cost	5:1 ROI	> 5:1 ROI	
Growers, the cotton industry & government are informed and aware of RD&E outcomes	Stakeholders report that CRDC communications meet their needs	Communications satisfaction ranking	8.3 out of 10	8.5 out of 10	

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

NB: A dash indicates that no benchmark exists for 2018.

Certification by the Executive Director

I, Dr Ian Taylor, as the accountable authority of Cotton Research and Development Corporation (CRDC), present the 2021–22 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

30 September 2022

2021–22 investment and impact

The Australian cotton industry in 2021–22

CRDC's investment in 2021–22

$18.3 million
CRDC's investment in cotton RD&E on behalf of cotton growers and the Australian Government

213
RD&E projects

97
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 per cent
of CRDC's investments delivered in partnership with the cotton industry.

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

#1
the ranking achieved by CRDC-supported entrepreneur Anastasia Volkova of Regrow Ag in *The Australian* newspaper's list of Australia's top 100 innovators.

8 CRDC projects
with commercialisation potential that have a commercial partner on board or a commercialisation process underway.

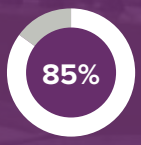
9 priority areas
for the cotton industry under the industry's sustainability targets: water, carbon, biodiversity, pesticides, soil health, quality of work life, wellbeing and social capital, efficiency, and profitability.

$5.5 million
the collective investment from CRDC and GRDC in a five-year partnership with Australian agtech company **Goanna Ag** to help minimise spray drift.

CRDC impact

4 independent environmental assessments commissioned by CRDC since 1991: one per decade.

9,000 native tree seedlings planted in the first year of a partnership between Country Road, Landcare Australia and the cotton industry to increase biodiversity.



85 per cent of participants in CottonInfo extension activities have recorded increased knowledge and awareness as a result of participation.

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 12 months.

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.

8 PhD students CRDC has supported in 2021–22. CRDC also supported eight honours scholars, two postdoctoral researchers, and four CSIRO summer scholars.

233 the number of cotton growers who participated in the 2021 CRDC Cotton Grower Survey, growing an average of 589 hectares of cotton.

0.2 % cotton's contribution to Australia's greenhouse gas (GHG) emissions via growing, ginning and transporting cotton to port. Of cotton's production emissions, nitrogen fertiliser accounts for 60 per cent.

2.8 million collective views amassed by the 240 CRDC-supported best practice videos on the CottonInfo YouTube channel as at June 2022.

76 per cent of cotton growers report typical or high levels of wellbeing. The national average is 73 per cent.

1 in 2 cotton growers surveyed for the 2021 Cotton Grower Survey believe their regional climate patterns will result in a change to their production system over the next 10 years.

73% 73 per cent of respondees in the Community Trust in Rural Industries survey believe cotton farms play an important role in Australian society

SHIFT the name given to the new project to focusing on delivering best practice in cotton's workforce skills, standing for: Social sustainability, Human sustainability, Innovative workplaces, Future focus and Transformational leadership.

RD&E highlights

Major partnership to deliver spray hazard warning system

CRDC and GRDC have collaborated on a $5.5 million investment to help minimise spray drift through a five-year partnership with Australian agtech company, Goanna Ag. Under the partnership, Goanna Ag will develop a spray drift hazardous weather warning system that will provide real-time weather data and alerts to growers and spray operators about the presence of temperature inversions. The warning system builds on breakthrough research supported by GRDC and CRDC, and will be operational in time for the 2022-23 summer cropping season. A study found that the warning system can increase chemical efficacy, improve labour and machinery productivity, and reduce the risk of spraying under hazardous drift conditions, helping the cotton industry avoid $40 million in losses and costs associated with spray drift over five years. The CRDC-GRDC-Goanna Ag partnership is the single largest investment in CRDC's history.

Game-changing spray to revolutionise world-wide pest control

An environmentally friendly spray that targets and kills one of cotton's (and the world's) most damaging agricultural pests – silverleaf whitefly (SLW) – has been created by scientists at UQ. The breakthrough is part of UQ's BioClay™ technology, a safe and sustainable alternative to chemical pesticides that has been developed over the past decade by the University of Queensland (UQ) with support from CRDC, Hort Innovation and Nufarm Ltd. The technology is considered a game-changer for crop protection due to its effectiveness against SLW, a small insect responsible for the loss of billions of dollars in agricultural crops around the world. The BioClay spray uses degradable clay particles that carry double-stranded RNA that enters the plant and protects it without altering the plant's genome. CRDC continues to support BioClay's development through the cross-sectoral and collaborative Australian Research Council (ARC) Hub for Sustainable Crop Protection.

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

In 2021–22, several CRDC-supported R&D innovations continued their progress towards commercial release: Pest Detect, the artificial intelligence smartphone app to help identify silverleaf whitefly; 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; VARIwise, the software that combines in-season imagery with crop production models to provide yield predictions throughout the season; and the CRDC-GRDC-Goanna Ag spray drift hazardous weather warning system. In addition, CRDC also sought a commercial partner for the native plant compound, code named N68, that has potential to become a biological insecticide. Commercial development of these innovations will continue in 2022–23 with support from CRDC.

Report on cotton's annual sustainability progress released

CRDC and Cotton Australia released the inaugural annual progress update against cotton's key sustainability indicators, outlined in the PLANET. PEOPLE. PADDOCK. Sustainability Framework, in June 2022. The annual update, which looks at the year ending June 2021, provides a snapshot of cotton's performance against the nine indicators – PLANET: water, greenhouse gases, biodiversity, pesticides and soil health; PEOPLE: wellbeing and workplace; and PADDOCK: productivity and profitability. The annual updates are designed to fit between cotton's comprehensive five-yearly sustainability reports, giving important insights into progress, so the industry can keep track of areas performing well, and those that need more emphasis. The Sustainability Update 2021 shows that improvements have been made in water-use efficiency, greenhouse gas emissions, insecticide hazard, cotton yields and the physical health of people in cotton communities.

Country Road and cotton: helping to protect biodiversity

The first year of a partnership between Country Road, Landcare Australia and the cotton industry to improve biodiversity on cotton farms has delivered improvements on 34 hectares in the Namoi Valley of NSW via the planting of 9,000 native tree seedlings. Country Road have committed a minimum $600,000 to the partnership over three years, with funds going to Landcare Australia to support biodiversity restoration projects. The first two projects have involved weeks of restoration work including planting thousands of native trees and grasses on the Namoi River. The partnership draws on a CRDC report, published under the Australian Government's National Landcare Program Smart Farming Partnership Initiative Round 1, that mapped biodiversity in Australian cotton landscapes, identified threatened and endangered species, and recommended ways to protect them. Plans are underway for further projects, all of which will be located in priority biodiversity zones.

R&D partnership generating investment funds for dryland cotton research

CRDC and the University of Sydney have partnered on an innovative new initiative to generate additional investment specifically for dryland cotton RD&E. In 2020–21, CRDC contributed to growing 65 hectares of dryland cotton at two of the university's research farms in north-west NSW. The crops were used to support dryland cotton research and when harvested, the initial investment and surplus funds were returned to CRDC, for reinvestment in 2021–22 with the university for further research. The returns from the crop grown at Narrabri are being reinvested to support a PhD project investigating the radiation-use efficiency of cotton and how it may be improved to increase yield in dryland cotton varieties. The returns from the Spring Ridge crop are supporting a PhD investigating the carbon accounts for dryland cotton production, measuring and monitoring soil carbon concentrations, soil water dynamics, and dryland crop yields to assess various management strategies.

Collaboration to tackle major cross-sectoral challenges

Of CRDC's 2021–22 investments, 100 per cent have been in partnership with the cotton industry, and 42 per cent in cross-commodity collaborative projects with fellow RDCs. CRDC led three major collaborations during the year: 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. CRDC is a partner in two major RDC initiatives: growAG, designed to create a global gateway into the Australian research and innovation system; and Agricultural Innovation Australia (AIA), established to drive cross-sectoral research, leverage private sector investment, and target transformational innovation.

Digital strategy for the Australian cotton industry underway

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. In 2021–22, work progressed on the development of a digital strategy for the Australian cotton industry.

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, 89 projects have been supported, with $777,000 invested by CRDC into grower organisations across the valleys. During 2021–22, these projects included: a research project to reduce early season nitrogen losses in the Gwydir Valley; a project to encourage the uptake of digital technology in the Macquarie; a project to improve the soil health of a community demonstration farm in the Southern Valleys; and the installation of weather stations in the Lower Namoi and Central Highlands.

RD&E supporting continued northern industry expansion

The Australian cotton industry continues to grow in Northern Australia, with 24,000 hectares of cotton grown in the north in 2021–22, 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 (CRCNA) and GRDC. The CRCNA partnership has been further strengthened with CRDC Senior R&D Manager Susan Maas commencing a six-month part-time secondment to help deliver cotton-focused research projects. CRDC is also investing in cotton leadership in the northern cotton industry via 2017 cotton researchers of the years Steve Yeates and Paul Grundy, and a new postgraduate study program for CottonInfo technical lead Sharna Holman.

Start-up focus a success: CRDC-supported innovator ranked #1

CRDC-supported entrepreneur Anastasia Volkova and her company Regrow Ag (formerly FluroSat) have been ranked as number one in a list of innovators published by *The Australian* newspaper: *The List: 100 Innovators*. CRDC has been partnering with Anastasia and her start-up since 2017, when it supported her through a series of start-up workshops that enabled her to incubate and grow the project. Since then, she's gone on to secure millions in investment, including an equity stake from CRDC, to further develop the state-of-the-art remote sensing and crop/soil modelling technology that allows farmers to measure crop health 'from the air'. Today, Regrow Ag – of which Anastasia is CEO and co-founder – is an award-winning global company that's commercialising climate action through regenerative agriculture. It empowers some of the world's largest brands to reduce greenhouse gas emissions across their supply chains and combat climate change through food production.

Minister for Agriculture, Fisheries and Forestry visits CRDC Director on-farm

The Minister for Agriculture, Fisheries and Forestry, Senator the Hon. Murray Watt, visited CRDC Director and cotton grower Ross Burnett on his farm at Emerald just days after being sworn in as Minister. The cotton farm was the first farm visited by the Minister since he was appointed to the portfolio in June 2022, and provided an opportunity for discussion about Australia's cotton industry and CRDC's RD&E investments. In addition to this visit, CRDC Directors also visited a number of cotton farms across the cotton-growing valleys in 2021–22: from Far North Qld, the NT and WA to the southern valleys of NSW. Directors spoke directly to cotton growers in each of the regions about their challenges, opportunities and research needs, and heard from researchers about investments delivering innovations and impacts.

Letter of transmittal

CRDC

30 September 2022

Senator the Hon. Murray Watt
Minister for Agriculture, Fisheries and Forestry
Parliament House
Canberra ACT 2601

Dear Minister

It is with great pleasure that I submit the Corporation's Annual Report for 2021–22, 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 2021–22 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 28 September 2022.

Yours sincerely

Richard Haire
Chair
Cotton Research and Development Corporation

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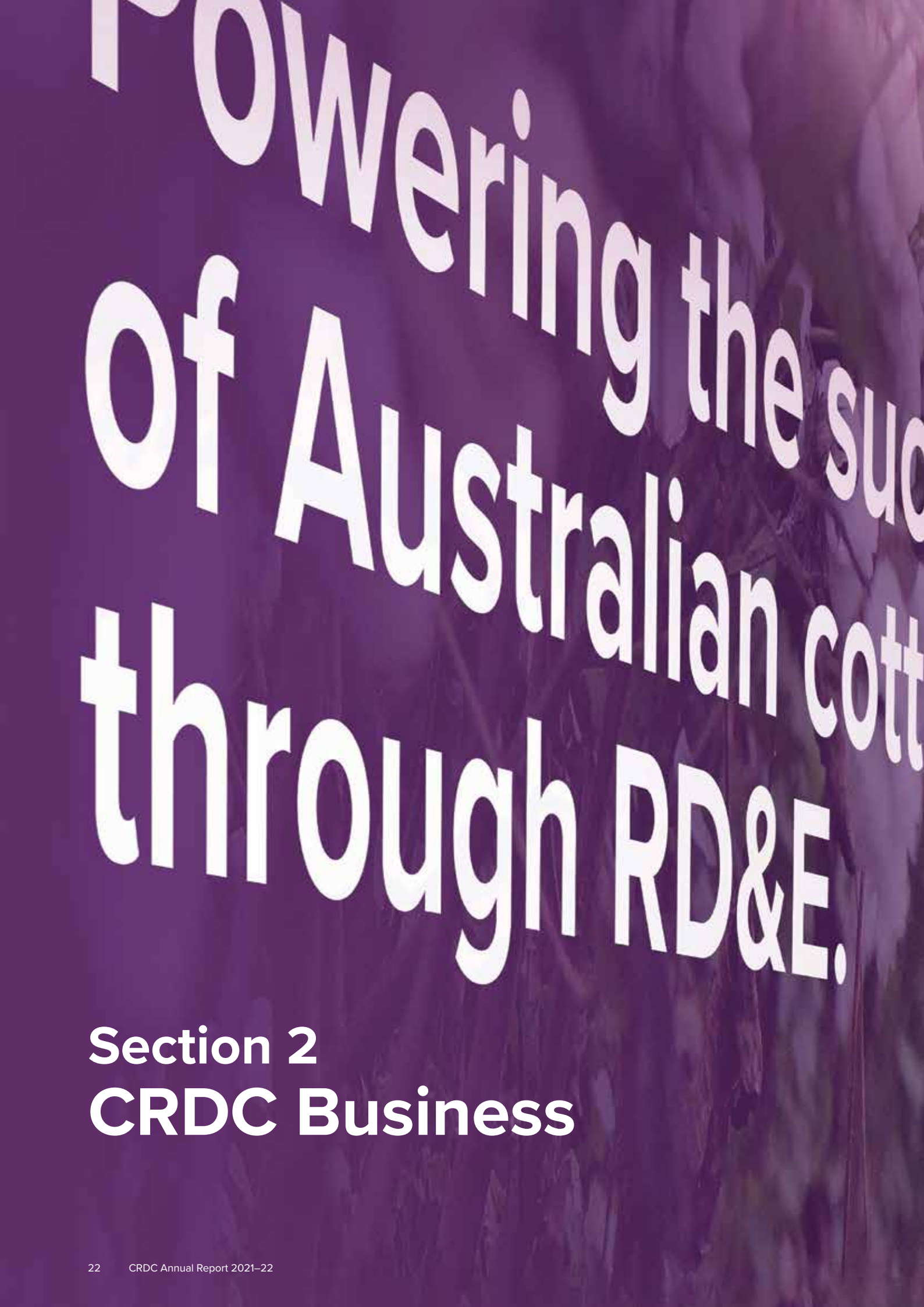
SECTION 1 Executive Summary



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, Fisheries and Forestry; the Department of Agriculture, Fisheries and Forestry; 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 2021–22, we invested $18.3 million in RD&E into 213 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 2021–22, CRDC partnered with 97 research partners, including:

- Department of Agriculture, Fisheries and Forestry (Commonwealth)
- 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 (RDCs)
- 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 2021–22:

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)	2021-2022 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 an annual research priority forum, bringing together the Cotton Australia research and development advisory panels to identify 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

The annual R&D priorities forum, normally held in May in conjunction with Cotton Australia's general meeting, was not held in 2020 due to COVID-19. In lieu of this, Cotton Australia conducted a priorities survey and CRDC engaged virtually with growers and the research panels to identify 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 received from the advisory panels in November 2020.

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:

- Integrated Pest Management (IPM) technical leadership
- Novel options and strategies for IPM
- Improved management of silverleaf whitefly on cotton farms
- Defoliating cotton in an increasingly difficult environment
- Validating and implementing new molecular tools for Bt resistance monitoring
- Climate proofing Australia's cotton production through improving crop water use and photosynthetic carbon assimilation
- Tools for assessing and achieving pesticide sustainability targets for the Australian cotton industry
- Review of the biosecurity plan for the cotton industry
- Improved water productivity in fully and partially irrigated systems
- Understanding the environmental co-benefits of irrigation water in the northern Murray Darling basin
- Towards carbon-neutral cotton production: greenhouse gas baseline and mitigation for cotton
- Delivering best practice to manage future workforce skills
- Supporting adaptive research capacity for careers in the cotton industry.

Through the 2021–22 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, Fisheries and Forestry. 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 National Agricultural Innovation 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 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 National Agricultural Innovation Priorities are:

The Science and Research Priorities

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

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

National Agricultural Innovation Priorities

- Australia is a trusted exporter of premium food and agricultural products
- Australia will champion climate resilience to increase the productivity, profitability and sustainability of the agricultural sector
- Australia is a world leader in preventing and rapidly responding to significant pests and diseases through future-proofing our biosecurity system
- Australia is a mature adopter, developer and exporter of digital agriculture

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

The Australian state and territory governments, Rural 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 2021–22, 42 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 2021–22, CRDC partnered with 97 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 program for best management practices, 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 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 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, Fisheries and Forestry 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. As of end June 2022, growAG had featured 2600 research projects (including 216 from CRDC) and showcased 34 commercial opportunities (including six from CRDC) to over 66,000 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

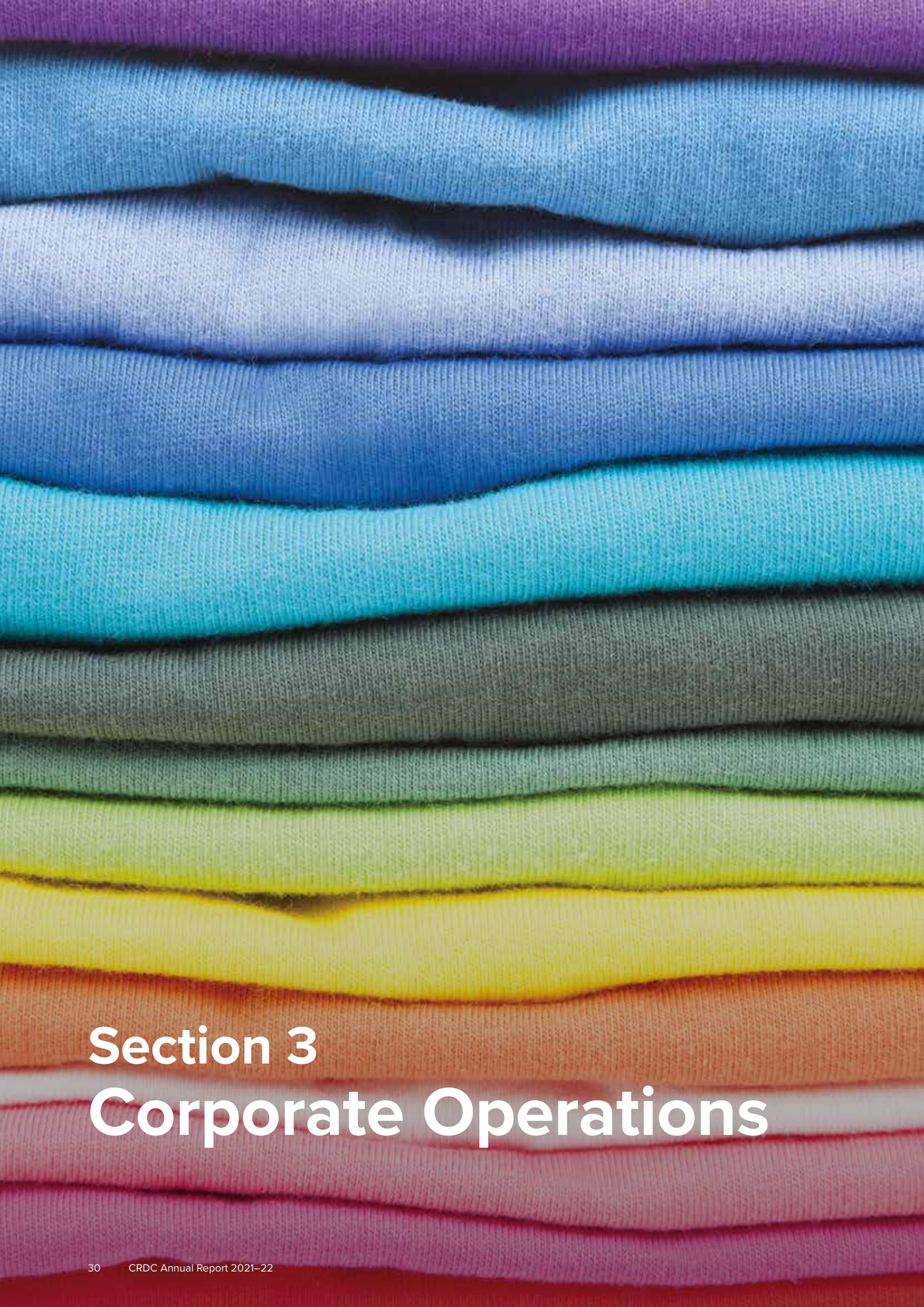
CRDC works in partnership with the Australian Government and fellow RDCs on a number of ongoing grant projects.

CRDC managed three programs in 2021–22 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 2016–22, 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, Fisheries and Forestry.
- **Smarter Irrigation for Profit – Phase 2** *(funded 2019–23, with $7.1 million from the Rural R&D for Profit program – round four)*. Involves fellow RDCs Dairy Australia, Sugar Research Australia, AgriFutures Australia, Grains Research and Development Corporation and other research partners. Administered by the Department of Agriculture, Fisheries and Forestry.
- **New technologies to improve natural resources (biodiversity) on Australian cotton farms – Cotton Landcare Tech Innovations** *(funded 2018–23, 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 2021–22:

- **Area-wide management for cropping systems weeds, investigating the weed management, social and economic opportunity** *(funded 2019–23, 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 2019–23, led by Grains Research and Development Corporation in partnership with CRDC; $4.6 million in funding from the Rural R&D for Profit program – round four)*.



Section 3
Corporate Operations

Business financials

Our investment in RD&E is funded through an industry levy and matching Commonwealth contributions. In 2021–22, we invested $18.3 million in cotton RD&E throughout the industry supply chain. In 2022–23, our estimated cotton RD&E expenditure will be $18.6 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.

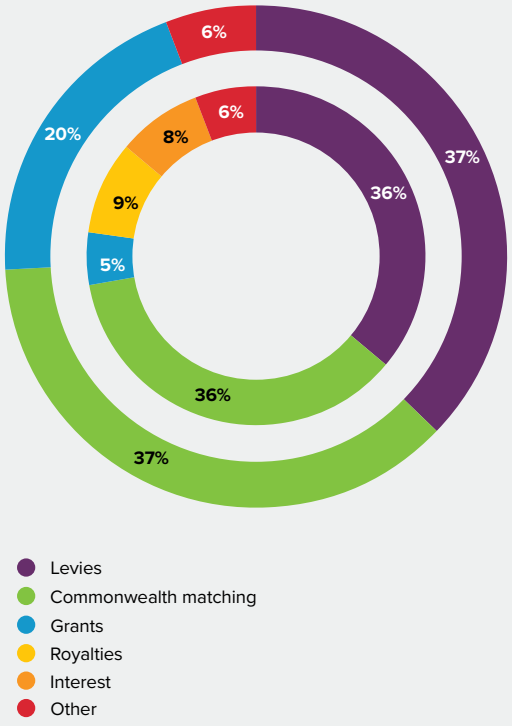
The setting and collection of the industry levy is enabled by the *Primary Industries (Excise) Levies Act 1999 and the Primary Industries Levies and Charges Collection Act 1991*, respectively. The Australian Government's matching contributions in 2021–22 were capped at the value of levies collected because it was lower than the 0.5 per cent of the three-year average gross value of production.

Revenue (Actuals)	2021–22 ($m)
Industry levies	$6.556
Australian Government	$6.552
Royalties	$0.049
Interest	$0.091
Research Grants	$3.465
Other	$0.999
TOTAL	**$17.712**

The following graph demonstrates the change in sources of revenue over the last eight years. The proportion of grant revenue generated by partnerships with the Australian Government, RDCs and commercial enterprises has increased from five per cent to 20 per cent of total revenue.

In 2021–22, the Australian Government's Department of Agriculture, Fisheries and Forestry contributed a total of $2.2 million in revenue to CRDC, via the Rural R&D for Profit program. This revenue has also attracted additional grant revenue of $1.4 million from program partners, industry and cross-sectoral partners.

Change in CRDC revenue mix over eight years: 2014–15 (inner circle) to 2021–22 (outer circle):



Total revenue for 2021–22 of $17.712 million was $4.301 million (32 per cent) above budget of $13.411 million. Total 2021–22 revenue comprised:

- Industry levy revenue of $6.556 million, which includes $5.135 million (82 per cent) of the 2020–21 crop and $1.421 million (13 per cent) of the 2021–22 estimated crop.
- Australian Government matching contribution of $6.552 million, which was capped at the value of levies collected.
- $0.049 million in royalties from the commercialisation of intellectual property.
- Interest revenue of $0.091 million, which was 9 per cent below budget, due to lower than anticipated interest rates.
- Research grants of $3.465 million, which included Rural R&D for Profit, other Commonwealth grants and co-investments from program partners.
- Other revenue of $0.999 million, which includes project refunds.

Expenditure and investment

Actual expenditure for 2021–22 was $18.309 million, which is $0.613 million below the budgeted expenditure of $18.922 million.

Actual ($m)	2021–22
Cotton Crop Size (millions of bales)*	5.624
Total revenue	$17.712
Industry levies	$6.556
Australian Government	$6.552
Royalties	$0.049
Interest	$0.091
Research grants	$3.465
Other**	$0.999
Expenditure total	$18.309
Cotton RD&E activities	$14.835
Total equity position	**$22.460**

* ABARES estimate, Agricultural Commodities June 2022: 1,276,617 kt.
** 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 2021–22 was allocated to the following activities:

Cost Allocation Activity	2021–22
Direct R&D Expenditure (project costs)	$14.835
Indirect R&D Expenditure (administration costs)	$3.474
Total Expenditure	**$18.309**

Portfolio Budget Statement

The CRDC 2021–22 Portfolio Budget Statement 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 2021–22

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	2021–22
TOTAL Budgeted Revenue	$13,410,799
TOTAL Actual Revenue	$17,712,503
TOTAL Budgeted Cost of Outputs	$18,922,152
TOTAL Actual Cost of Outputs*	$18,309,088

* 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. Above-average cotton production is expected in 2022–23, due to current storage levels of public irrigation dams serving the Australian cotton-growing regions, high cotton prices, and the prediction of another La Niña weather event.

CRDC has budgeted for a $5.3 million operating surplus for 2022–23. This reflects revenue of $23.9 million and expenditure of $18.6 million. Industry levy revenue and Commonwealth contributions will continue to be drawn from two crop seasons, 2021–22 and 2022–23.

Forecast expenditure

Budgeted expenditure for 2022–23 is $18.6 million, which is $0.3 million above the 2021–22 actual expenditure. The forecast expenditure for the next two years is budgeted at $21.2 million in 2023–24 and $19.5 million in 2024–25.

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 2021–22 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.

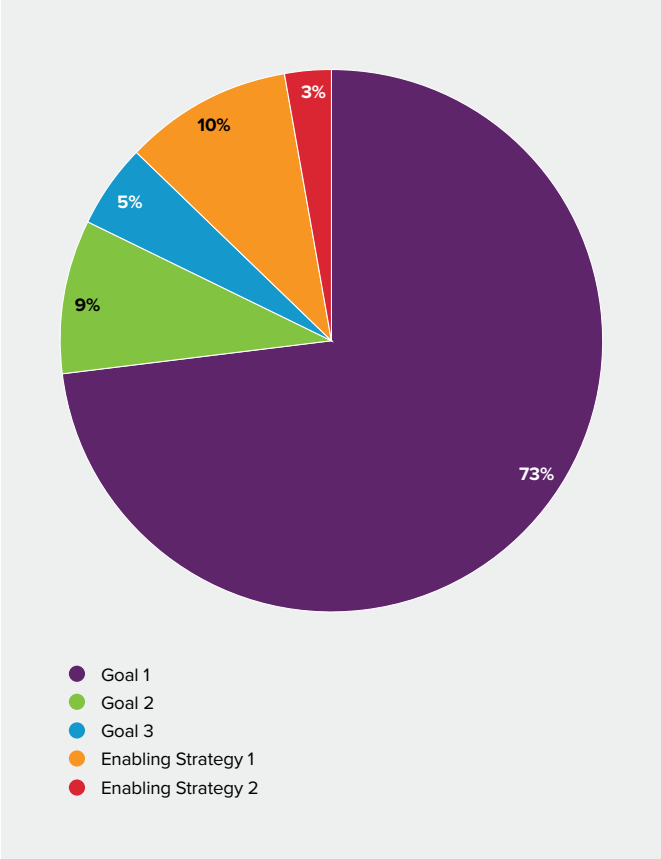
In 2021–22, we invested $14.17 million in RD&E. Of this, $3.61 million was invested in new research commencing in 2021–22.

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	32	49	30	8	213
Expenditure per program area ($m)*	$10.42	$1.31	$0.71	$1.37	$0.36	$14.17
Percentage of expenditure per program area	73%	9%	5%	10%	3%	**100%**

* Refer to Note 1.1C in the financial statements.

Investment by program area



Total number of CRDC projects

CRDC projects	2019–20	2020–21	2021–22
Active projects	135	116	123*
New projects funded	83	62	90
Projects completed	118	70*	111
Continuing projects	116	117*	102

* NB: Six projects reported as completed in 2020–21 received late project extensions, increasing the number of continuing projects in 2020–21 (carried forward as active projects in 2021–22) from 117 to 123.

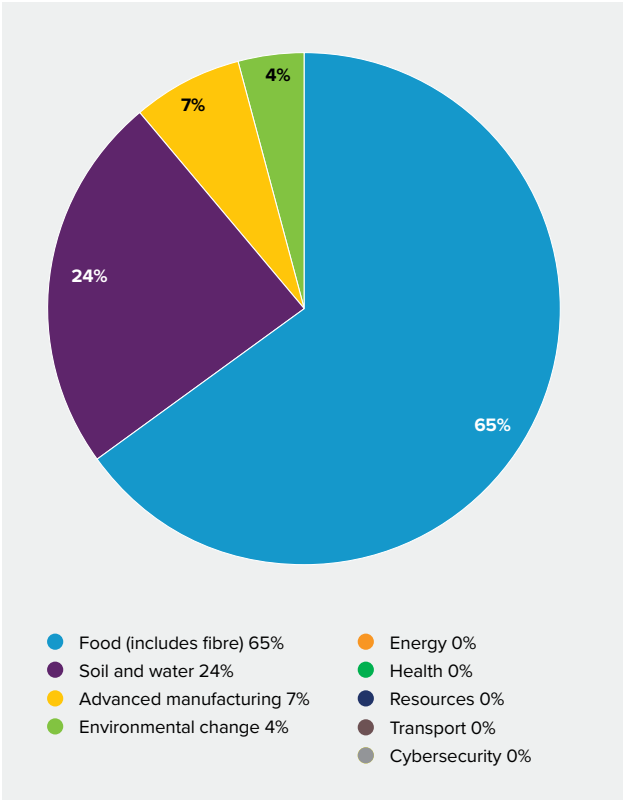
Further detail on CRDC's projects can be found in Section 4: RD&E Portfolio, and in Appendix 3: RD&E Portfolio.

Investments against Government priorities

CRDC's investments in RD&E support the achievement of the Australian Government's Science and Research Priorities, and National Agricultural Innovation Priorities.

CRDC investment by Science and Research Priorities

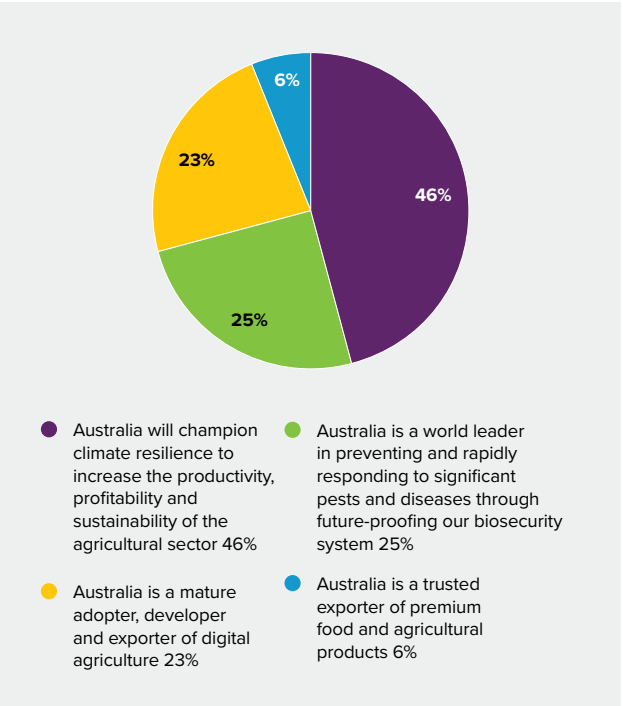
Science and Research Priorities (SRP)	CRDC investment ($'000)
Food (includes Fibre)	$9,248
Soil and water	$3,422
Advanced manufacturing	$951
Environmental change	$545
Energy	$0
Health	$0
Resources	$0
Transport	$0
Cybersecurity	$0
Total	**$14,166**



CRDC investment by National Agricultural Innovation Priorities

National Agricultural Innovation Priorities	CRDC investment ($'000)
Australia is a trusted exporter of premium food and agricultural products	$816
Australia will champion climate resilience to increase the productivity, profitability and sustainability of the agricultural sector	$6,527
Australia is a world leader in preventing and rapidly responding to significant pests and diseases through future-proofing our biosecurity system	$3,589
Australia is a mature adopter, developer and exporter of digital agriculture	$3,234
Total	**$14,166**

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 2021–22, CRDC invested in 94 projects within this goal, accounting for 73 per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicator	Measures	2021–22 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 baseline irrigated yield (2018) is 9.86 bales/ha. The average yield of the 2021 crop was 11.3 bales/ha and the five-year rolling average irrigated yield (to 2021) has increased from the baseline to 10.5 bales/ha, still below the targeted 11.6 bales/ha. The baseline dryland yield (2018) is four bales/ha. The average yield of the 2021 crop was above the baseline at 4.6 bales/ha, but the rolling five-year average dryland yield of 2.4 bales/ha is below the baseline. This is predominately due to prolonged dry conditions in the first half of the Strategic Plan period. While the averages show yields below target, there have been a wide range of yields achieved in both irrigated and dryland cotton crops this year, reflecting the production extremes. Very high yields of 20 bales/ha in irrigated and 10 bales/ha in dryland have been recorded in some crops. These very high yields, well above the industry averages, point to the significant opportunity to increase the overall industry average yield.
	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 water-use efficiency (productivity) target is on track to be achieved, with 2021 data estimating a gross production water-use efficiency (WUE) of 1.4 bales per megalitre, an improvement on the 1.32 bales/ML target. Nitrogen-use efficiency (productivity) continues to improve from a low of 6.6 kg of lint/kg of N in 2019 to 9.8 in 2021, but is still below the baseline of 10 kg of lint/kg of N and the target of 11.5 kg of lint/kg of N.
	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 on new farming systems, including bankless irrigation, the incorporation of cover cropping, and the revised timing of the Central Qld season. In the CRDC Grower Survey 2021, 50 per cent of growers surveyed stated they are, or are planning to, plant cover crops to provide stubble cover. Additionally, 52 per cent of growers in the 2021 survey stated that they had made significant changes to their farming system, including areas related to CRDC-supported RD&E, such as irrigation, minimum tillage and controlled traffic, and fertiliser management. CRDC research is also supporting sustainable farming systems development in Northern Australian cotton through collaboration with the Cooperative Research Centre for Developing Northern Australia (CRCNA) and GRDC. Interest in growing cotton in Northern Australia has increased rapidly; the area planted increased from fewer than 1,000 ha in 2016–17 to 24,000 ha and 113,000 bales in 2021–22. The 2022–23 area is forecast to be 26,000 ha and 135,000 bales.

	1.1.4 Improved reliability of cotton production	Increase in five-yearly average production	Rolling annual average production (number of bales)	While the 2022 and 2023 crops are both forecast to be well above average, the five-year rolling annual average is currently below the baseline of 3.4 million bales, and the target of 3.9 million bales is unlikely to be achieved despite the potential for two successive above-average crops. This is due to three successive years of below-average production, including the lowest production in over 30 years in 2020 due to drought conditions.
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	The target of five new technologies is on track, with the following technologies already, or anticipated to be, available to growers over the life of the Strategic RD&E Plan: • See and Spray™ Select (John Deere) for targeted weed management • Pest Detect App for enhanced silver leaf whitefly monitoring • The stress time algorithm for improved irrigation scheduling, including enhanced image segmentation to extend the window of use of the technology • Spray hazard towers for improved pesticide application • VARIwise for improved irrigation decision making. A patent has been lodged for a novel biopesticide, and expressions of interest sought for a commercial partner.
	1.2.2 Cotton farms are digitally enabled	Increase in on-farm use of digital technology	Percentage of farms utilising digital technologies	In the 2021 CRDC Grower Survey, 69 per cent of respondents indicated that they used sensors and/or automation that required digital connectivity.
1.3 Protection from biotic threats and environmental stresses	1.3.1 Increased understanding of the impact of pests, diseases and weeds, and environmental stresses	Impact information is available to inform improved management practices for growers and industry	R&D investments reflect the potential impact of biotic and environmental stresses to inform management practices	Pesticide data collected from the CRDC and Crop Consultants Australia (CCA) Survey indicates that the 2021 five-year rolling average for Environmental Toxic Load against bees continues to decline, while the measure for algae increased due to greater herbicide use associated with wetter conditions, more weed growth and managing herbicide resistance. 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 2022–23 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, underpinned by strong science and the ability to be readily adopted. For example, research into building disease suppressive soils is continuing, as is refinement of the Pest Detect App to automatically count silverleaf whitefly (SLW) nymphs. In addition to better management, CRDC is supporting new crop protection technologies, such as BioClay™, soil biologicals, new pesticides, and adaption of existing technologies for use in cotton, such as microwave for disease and weed management, AquaTill for crop destruction, and novel plant hormones to manage abiotic stress. Assessments are planned for 2022–23 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	CRDC and CottonInfo continue to support a number of biosecurity activities including raising awareness with growers, consultants, and ginning organisations. The CottonInfo Biosecurity Tech Lead has coordinated cross-industry collaboration activities, and organised and facilitated the Cotton Biosecurity Reference Group's annual review of pest lists and prioritisation of RD&E gaps. Plant Health Australia (PHA) has begun the five-year review of the Cotton Industry's Biosecurity Plan, which includes a review of pest threat lists and prioritisation of RD&E gaps. CRDC has participated in a number of strategic Plant Biosecurity Research Initiative (PBRI) 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 building. Contingency plans for each of the exotic insect pests identified as high priority pests for cotton have recently been completed and/or updated.
			Percentage of participants reporting increased preparedness	At the start of the Strategic RD&E Plan period, 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 developing a plan. Following the implementation of recommendations from 2019's Exercise Blueprint, industry preparedness was measured as part of the 2021 Grower Survey. The survey results indicated that 56 per cent of growers have a farm biosecurity plan, with another seven per cent indicating one is being developed. The survey further highlights that while growers with a plan or developing a plan are more likely to be implementing more biosecurity practices, 84 per cent of growers are using at least one of nine recommended best practices to manage biosecurity, and 40 per cent are implementing all nine.

RD&E highlights

ARC Research Hub for Sustainable Crop Protection (UQ2001)

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

The Australian Research Council (ARC) Hub for Sustainable Crop Protection was launched in November 2021 to address challenges of fungicide resistance, chemical residues, off-target effects and environmental harm. It is led by UQ, in collaboration with 15 partners, including CRDC and fellow RDCs GRDC, Wine Australia and Hort Innovation and commercial partner Nufarm Ltd. The Hub research team are taking on the global challenge of transforming crop protection technology by developing and commercialising the innovative biological alternative to chemical fungicide: BioClay™. This breakthrough technology, developed by scientists at UQ, has the potential to become a game-changer in cotton crop protection. BioClay™ is an environmentally friendly biopesticide that aims to control important pathogens of cotton such as silverleaf whitefly and Verticillium wilt, allowing versatility and high target specificity, without affecting the crop's beneficial organisms.

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. Interviews with 80 landholders across the Darling Downs and Riverina valleys found that collaborative weed control with a pooling of resources would provide a better return on investment and most effective control.

Boosting diagnostic capacity for plant production industries (GRDC2001)

This cross-sectoral project aims to improve Australia's national plant diagnostic knowledge, processes and capacity for the early detection of plant biosecurity threats. It involves diagnostics to facilitate early and accurate diagnosis and rapid responses to threats that affect production and access to markets. A comprehensive on-going diagnostic network will be established through this project, integrating with the National Plant Biosecurity Diagnostic Network (NPBDN), with strong collaboration between project partners, industry and government. The project also supports iMapPESTS, another Rural R&D for Profit-funded project, by making available the most advanced diagnostic tools, protocols, training and expertise to accurately detect and identify exotic threats to our plant industries. The project is part of the Australian Government's Rural R&D for Profit program, led by GRDC in partnership with fellow plant RDCs, including CRDC.

Climate proofing Australia's cotton industry through improving crop water use and photosynthetic carbon assimilation (Climate-proof cotton) (UWS2201)

This project aims to generate new, in-depth knowledge around abiotic stress physiology to fortify Australia's cotton production under future climates – specifically the recently observed and projected increasingly severe and frequent heatwaves and droughts. The proposed research builds on the scientific foundations established by the CRDC-supported project, PhD: Building climate change resilience in cotton through translational physiology (ANU1704), and seeks to identify novel heat tolerance and water conservation mechanisms existing in cotton and its wild relatives. The long-term objectives are to redesign cotton photosynthetic biochemistry to enable the cotton industry to withstand environmental extremes and improve resource-use efficiency of nitrogen and water. This will be achieved by identifying photosynthetic traits that may ultimately be deployed in climate-adapted cultivar development programs.

Cotton disease research review (CRDC2207)

The Australian cotton industry has invested in cotton disease research over a number of decades, building a strong knowledge base and making some significant gains in disease management. However, despite the progress made, disease is still one of the leading limitations in the cotton production system. CRDC-supported research to date has focused on understanding disease behaviour, interactions in the farming system, disease diagnostics, understanding rotation and other management options, investigating control measures and, more recently, understanding the suppressive capabilities of soils. In 2021–22, CRDC commissioned a disease research review to reflect on previous investments and outputs, identify research gaps, and strategically review the direction of future CRDC-supported pathology investments to deliver greater impact at the field level.

Cotton production and research at 'L'lara' Narrabri and 'Nowley' Spring Ridge (US2201, US2202)

CRDC and the University of Sydney have partnered on an initiative to generate additional investment specifically for dryland cotton RD&E. In 2020–21, CRDC contributed to growing 65 hectares of dryland cotton at two of the university's research farms in north-west NSW. The crops were used to support dryland cotton research and when harvested, the initial investment and surplus were returned to CRDC, for reinvestment in 2021–22 with the university for further dryland cotton research. The returns from the crop grown at Narrabri are being reinvested to support a PhD project investigating the radiation-use efficiency of cotton and how it may be improved to increase yield in dryland cotton varieties. The returns from the Spring Ridge crop are supporting a PhD investigating the carbon accounts for dryland cotton production, measuring and monitoring soil carbon concentrations, soil water dynamics, and dryland crop yields to assess various management strategies.

Digital strategy for the Australian cotton industry – phase 2 (CRDC2216)

CRDC has formed a steering committee to lead the development of a digital strategy for the Australian cotton industry, involving representatives from across the cotton industry and supply chain. The strategy is being developed in two phases – the first, which was completed in late 2021, included a data and capacity audit of the industry and the development of business cases to determine the value that could be created through data sharing. The data and capacity audit produced several recommendations, including establishing a digital strategy (including data integration, standardisation and automation), establishing a data governance and management group to lead this process, developing a proof-of-concept centralised industry database of on-farm management data, investing in training and education, and developing roles for digital agronomy support and services. Phase 2, which commenced in 2022, will progress the first three of these recommendations: the establishment of the digital strategy; the formation of the data governance and management group; and the proof-of-concept centralised industry database.

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

Improved management of silverleaf whitefly on cotton farms (DAQ1903)

Pest Detect: Silverleaf whitefly app commercialisation and development (CRDC2206)

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 from the University of Southern Queensland (USQ) have developed a new artificial intelligence smartphone app, Pest Detect, with support from CRDC. This clever technology counts pests and guides decision making through an in-built population model. In 2021–22, CRDC and USQ partnered with tech specialists Clevvi to progress development and commercialisation: a step towards delivering the technology to growers and consultants. Pest Detect will be used in conjunction with the new SLW decision support tool, developed through the QLD DAF project Improved management of silverleaf whitefly on cotton farms.

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.

Modern systems agronomy for resilient cotton production (CSP2001)

This project aims to help optimise cotton production and protect the farming system from biotic threats and environmental stresses by increasing research capacity and capability for applied cotton systems research. The project is developing responsive agronomic practices for irrigated, dryland and abiotically stressed cotton through research, leveraging plant growth regulator chemistry and applying modern sensing technologies and data analytics. It packages and applies technologies for improving productivity on-farm, driving innovation and facilitating the rapid delivery of solutions. It also supports collaboration among other research initiatives, such as climate change physiology, soil compaction, digital agronomy, and investigating the feasibility of sprayable biodegradable polymer technology, to enable the application of such outcomes in a systems context.

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. 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. The project concluded in 2021–22 and its 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.

PhD: Assessing yield and fibre quality variability in cotton systems through data science for improved management (US2104)

This PhD project aims to unlock the potential of diverse farm datasets to understand variability of yield and fibre quality in the cotton system. It recognises the volume of on-farm data, yield maps and fibre quality data that is collected, and that big data analytics and machine learning present promising avenues to process this data into a useful format for growers. From a yield perspective, this process could lead to a greater understanding of the causes of variation within fields, aiding in management practice decisions. From a fibre perspective, the project will develop a fibre quality model through a data-driven approach to highlight regions and suggest causes of variations. This could ultimately estimate the fibre quality at harvest at a within-field scale. The project complements previous CRDC-supported research regarding modelling and forecasting fibre quality using sensors and UAV remotely sensed imagery.

Potential for broadacre cropping in the Northern Territory (CRCNA2001)

This project aims to support the development of viable broadacre cotton systems in the NT through the collation of historical broadacre cropping data and natural resource information, and an understanding of market opportunities. Led by the Cooperative Research Centre for Developing Northern Australia (CRCNA), the project focuses on dryland and irrigated systems growing cotton and peanut crops. 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. As part of CRDC's support for northern Australia research, in June 2022 CRDC Senior R&D Manager Susan Maas commenced a six-month part-time secondment to CRCNA, helping to deliver projects under their cotton, grains and cattle research initiative.

Supporting southern cotton production systems: Cotton research officer (DAN2001)

A survey of southern cotton growers conducted under a former CRDC-supported research project found that cotton establishment and replanting remains the most challenging issue in growing cotton, with 30 per cent seedling mortality identified in cotton disease surveys. Soil temperature, cold and hot shocks, depth of planting seed, irrigation water temperature and soil borne disease in back-to-back cotton were identified as the most significant factors. This project appointed a dedicated Cotton Research Officer to Yanco Agricultural Institute, co-supported by CRDC and NSW DPI, to collect detailed plant and crop data from research trials to develop clear and quantified strategies to optimise seeding establishment and improve crop agronomy. The Cotton Research Officer works closely with the CottonInfo Regional Extension Officer for southern NSW, and is also part of the CottonInfo team as the Technical Lead for Disease.

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, Fisheries and Forestry as part of its Rural R&D for Profit program. The project covers 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's 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 project is due for completion in 2022–23.

Supporting farming system adaptation to climate and biological threats (DAQ2201)

This multi-faceted project delivers RD&E to improve the industry's ability to sustainably manage emerging pests and biosecurity risks, adapt agronomic practices to better exploit a changing climate, and improve defoliation practices to reduce inputs and off-target impact risks. The project delivers industry-wide technical leadership for Integrated Pest Management (IPM) and biosecurity via the CottonInfo Technical Leads, and best production practices for Central Qld and northern Australia (Far North Qld, NT, WA) in partnership with CottonInfo and key researchers. The project underpins a postgraduate study program focused on a management framework for cluster caterpillar (*Spodoptera litura*) in Northern Australia, building future scientific capacity with tropical expertise. It also builds on previous CRDC-supported research in Central Qld to further investigate adaptive crop production and farming system tactics to increase or maintain yields in hotter climate regions for the future.

Validation and implementation of new molecular tools for Bt resistance monitoring (CSP2204)

Ensuring the continued efficacy of Bt cotton is of critical importance to the cotton industry, and resistance in the target insect *Helicoverpa* spp. remains a threat. As such, this project is a partnership with Bayer and CSIRO to continue research into Bt resistance. It builds on existing CSIRO research to deliver molecular approaches for resistance allele detection, which will considerably increase the throughput of screening compared to the current bio-assay approach. The higher throughput system provides the opportunity to improve efficiencies and gain statistical power to improve the rigour of population analyses. The project also focuses on validating the molecular tool for F1 and F2 resistance testing for *Helicoverpa armigera* and *Helicoverpa punctigera*, linking with previous and existing Bt resistance monitoring programs. The validation study will provide the basis for a more detailed future study using the tool to evaluate the regional structure of populations and existing resistance management tactics in the cotton industry's Resistance Management Plan (RMP).

Case study

Game-changing spray to revolutionise world-wide pest control

An environmentally friendly spray that targets and kills one of cotton's (and the world's) most damaging agricultural pests – silverleaf whitefly – has been created by scientists at the University of Queensland.

The breakthrough is part of UQ's BioClay™ technology, a safe and sustainable alternative to chemical pesticides, which has been developed over the past decade by Queensland Alliance for Agriculture and Food Innovation (QAAFI) and the Australian Institute for Bioengineering and Nanotechnology (AIBN), with support from CRDC, Hort Innovation and Nufarm Ltd.

Research team leader Professor Neena Mitter (pictured) said it was a game-changer for crop protection because it was effective against whitefly (*Bemisia tabaci*), a small insect responsible for the loss of billions of dollars in agricultural crops around the world.

"Silverleaf whitefly (SLW) is considered an invasive species in the United States, Australia, Africa and several European countries and attacks more than 500 plant species, including cotton, pulses, chilli, capsicum, and many other vegetable crops," Professor Mitter said. "The insect lays eggs on the underside of the leaves, and the nymphs and adults suck the sap from the plant resulting in reduced yields."

In addition, whiteflies also transmit many viruses that pose a threat to healthy crops.

Control of the pest has been difficult because of its ability to quickly develop resistance to traditional chemical pesticides. The BioClay spray uses degradable clay particles that carry double-stranded RNA that enters the plant and protects it without altering the plant's genome.

"It is the first time the BioClay platform has been used to target sap-sucking insect pests," Professor Mitter said.

"When whiteflies try to feed on the sap, they also ingest the dsRNA, which kills the insect by targeting genes essential to its survival. The world of RNA is not just responsible for COVID-19 vaccines, it will also revolutionise the agricultural industry by protecting plants from viruses, fungi and insect pests," she said.

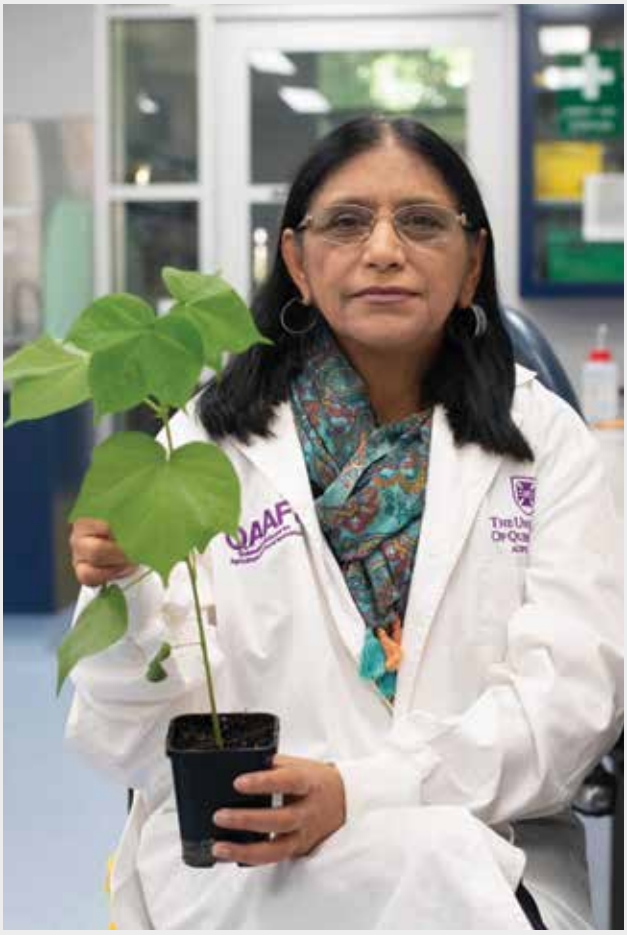
To identify suitable gene targets, PhD candidate Ritesh Jain went through the global database of genome sequences.

"Initially, we had to screen hundreds of genes specific to SLW to see which ones would affect their growth," Mr Jain said. "Importantly, the dsRNA proved harmless when fed to other insects, such as stingless bees and aphids."

CRDC's Senior R&D Manager, Susan Maas says SLW is a major pest of cotton globally due to its ability to contaminate and downgrade lint quality.

"This innovation will support the industry to maintain Australia's reputation for producing uncontaminated, high-quality cotton in a safe and environmentally friendly way" Ms Maas said.

The researchers will now work with commercial partner Nufarm Ltd to test the whitefly BioClay formulation in real-world production systems. The research is published in *Nature Plants*.



For more: read the full article in the Winter 2022 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Dryland cotton research finds a home

A new R&D partnership has generated an extra $280,000 for dryland cotton research.

In a partnership with the University of Sydney, CRDC provided $75,000 toward growing 65 hectares of dryland cotton at two of the university's research farms in NSW in 2020–21. The crops were used to support dryland cotton research and when harvested, the initial investment and surplus returned to CRDC, to be reinvested with the university for further dryland cotton research.

The cotton was grown at the University's 'L'lara' (Narrabri) and 'Nowley' (Spring Ridge) farms, with a great first season success, averaging 5-6 bales per hectare – and a total return of approximately $432,000. This enabled CRDC to reinvest an additional $280,000 in dryland research with the University of Sydney, and continue the $75,000 support at the farms for crops this season.

The returns from the crop grown at 'L'lara' will be reinvested to support a new PhD project investigating the radiation-use efficiency of cotton and how this may be improved to increase yield in dryland cotton varieties. The returns from 'Nowley' will support a new PhD project investigating the carbon accounts of dryland cotton production. It will measure and monitor soil carbon concentrations, soil water dynamics and dryland cotton crop yields to assess the effects of various management strategies.

CRDC Executive Director Dr Ian Taylor (pictured with CRDC Deputy Chair Rosemary Richards, University of Sydney's Guy Roth, and dryland cotton grower Geoff O'Neill) initially approached the University of Sydney to propose the partnership, with the aim of increasing investment in dryland cotton research and creating opportunities to expand the potential of dryland cotton.

"Being dictated to by the weather has meant setting up dryland cotton research in the field has always been tricky, and commercial dryland trials generally require more land than irrigated trials due to the planting configurations used," Ian said.

"We have worked with growers in the past to run commercial trials, but generally it's a one-in-four or five-year rotation crop for them – so the opportunities for research can be scarce, particularly during drought years. In addition, current research facilities just don't have the area to run large-scale experiments."

Organising continuous access to sites dedicated to dryland cotton research is difficult – especially at a commercial scale, but this partnership with the University of Sydney has resolved this issue.

"When we first considered this business model for 'participatory research', we were in drought. As dryland is an important component of the cotton system, we focused on how we could provide greater investment in dryland cotton research," Ian said.

CRDC discussed the idea with University of Sydney's Professors Iain Young and Alex McBratney, who were very supportive of the idea and agreed to trial the model for one year. They agreed that if the trial was successful, there would be support to continue the new approach.

"To have sites dedicated to dryland cotton research is critical, so this is really positive news for the cotton industry, and to be partnering with one of the best research institutions in the country, this is a huge bonus for dryland growers," Ian said. "Furthermore, the return on our investment in growing costs means we can fund more research. The partnership allows us to better support dryland research by having dedicated sites and investing specifically in projects that increase dryland capacity and capability. Our aim is to continue to build expertise in dryland cotton growing and research."

For more: read the full article in the Autumn 2022 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Bringing biosecurity and research focus to the north

Most growers and consultants in the Australian cotton industry would by now be familiar with fall armyworm (*Spodoptera frugiperda*) since its arrival in Australia in early 2020. However, some would be less familiar with our own endemic species, the cluster caterpillar (*Spodoptera litura*) which is common in tropical regions.

Cluster caterpillar can cause damage to a wide variety of agricultural crops and has been a frequent pest of cotton in Northern Australia since the 1950s. Unlike *Helicoverpa* species, Spodoptera spp. have a naturally higher tolerance to Bt toxin proteins which has enabled larval survival in some Bollgard 3® crops in tropical regions.

The adoption of Bollgard 3® (which is only registered in Australia for control of *Helicoverpa*) has reduced the observed frequency of cluster caterpillar over the past few seasons compared to previous generation Bt technology; however, there is still low but ongoing survival in some cotton crops. Why a small percentage of larvae are surviving in some crops but not others is unknown.

CRDC is supporting QLD DAF and CottonInfo Biosecurity Technical Lead, Sharna Holman (pictured), as part of her PhD studies, on research that will inform a management framework for cluster caterpillar in tropical cotton systems.

Planned research will determine cluster caterpillar ecology within Bollgard 3® in tropical farming systems; pest adaptations that may advantage survival on Bollgard 3®; and damage potential of cluster caterpillar to inform in-crop management.

This PhD research program brings together multiple stakeholders from QLD DAF, the WA Department of Primary Industries and Regional Development, the University of Queensland and Bayer.

As part of the research program, Sharna will be based in Kununurra during the cotton season from 2022 conducting field studies and providing support to growers and local industry through CottonInfo. She will collaborate with the existing North Australian Crop Research Alliance (NACRA) and DPIRD RD&E staff in the north, and will help to link the region to CottonInfo and broader industry.

Sharna is looking forward to the opportunity to live in WA during their season, making a change from her base at Toowoomba.

"I'm really looking forward to being based in Kununurra each cotton season, immersing myself in the region and learning first-hand from growers and consultants the strengths and challenges of cotton production in tropical climates," Sharna said.

"Additionally, Northern Australia is of particular risk for the arrival of exotic pests and disease due to the humid climate and close proximity to Indonesia and Papua New Guinea."

Sustainable crop protection has been raised by northern growers as a high-priority issue. This project will build help build connections between southern and northern systems.

"Being based in the north is beneficial to my CottonInfo Biosecurity Technical Lead role as it will assist with building relationships with biosecurity officers, crop protection researchers and industry across Northern Australia to be better positioned to face emerging exotic pest issues."

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

Case study

The science is in – check your N rate

Reducing the volume of emissions released in cotton production while sustaining carbon in the soil and vegetation on cotton farms is a focus for CRDC.

As an industry, reducing nitrogen (N) fertiliser application to within industry guidelines and improving N-use efficiency (NUE) would decrease the risk of excess environmental losses of N, which saves money and reduces environmental harm. It's an important step in lowering the industry's carbon footprint and demonstrating commitment to sustainability. Emissions are dominated by nitrous oxide, with fertilisers contributing about 60 per cent of the greenhouse gases to grow, gin and move a bale of irrigated cotton to port.

The 2019 Australian Cotton Industry Sustainability Report showed on-farm greenhouse gas emissions had increased by 12.6 per cent since the previous report five years earlier. As a result, the Australian cotton industry as a whole, through the PLANET. PEOPLE. PADDOCK. Sustainability Framework, has committed to reducing greenhouse gas emissions.

Results are already positive, with the most recent data from the 2019–2020 season showing improved NUE. This led to an estimated 14 per cent decrease in emissions per bale from 2018–19, and a 24 per cent reduction from the peak emissions per bale in the 2016–17 season.

A substantial body of information from over 20 years of research is available to guide N management decisions and improve NUE. CRDC led fellow research and development corporations from the dairy, sugar and horticulture industries in the More Profit from Nitrogen (MPfN) project, a five-year partnership that wound up in late 2021. It was an initiative of the Australian Department of Agriculture, Fisheries and Forestry's Rural R&D for Profit program. The focus of the research was to support practice change among growers from these industries to improve NUE, increase profitability and decrease emissions.

Economists from AgEcon evaluated the MPfN projects and the program as a whole. The study found adoption occurs in stages depending on the overlapping of a range of underlying factors including the strength of extension pathways and stakeholders' appetite for risk and change (social aspects), and underlying market conditions relating to the commodity and the innovation (economic aspects).

In the evaluation of the projects under the MPfN program, MPfN stakeholders identified a wide range of social and economic barriers, with the primary impediments being the perceived risk of missing out on lost productivity with less N application, combined with the low cost of traditional N sources such as urea.

"Together, these factors support a culture in many industries where N is applied as a form of cheap insurance to maximise productivity," says economist George Revell who conducted the evaluation.

"The identified social and economic factors present potential barriers to change, reducing the rate or level of overall adoption of new practices and technologies. Understanding and addressing these barriers and reinforcing the key research messages through industry-specific resources and extension becomes critical to achieving incremental practice change and industry impact.

"I think we will see adoption over time as MPfN recommendations are integrated into industry resources and extension programs. Promisingly, stakeholders commented that adoption was already evident in all industries involved in MPfN, with demonstrated potential for economic and environmental benefits including yield or quality improvements, reduced N inputs, and reduced losses of N to the environment."

For more: read the full article in the Autumn 2022 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 2021–22, CRDC invested in 32 projects within this goal, accounting for nine per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicator	Measures	2021–22 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 three to four per cent, equivalent to the percentage recorded in 2018. CRDC Grower Surveys show this figure (below the target of 6.6 per cent and the 6 per cent baseline) has been relatively stable for several years. Improving native vegetation condition on farms is slow, and can be hindered by many factors, including drought, excessive grazing, cost, time, or lack of knowledge of practices that have the greatest benefit in the regional landscape, such as the most appropriate species of trees to plant. To address these issues, CRDC has established two important projects with the aim of increasing the positive impact of industry and grower investments in enhancing biodiversity: 1. Working with regional natural resource organisations to understand how the cotton industry and individual growers can contribute to regionally specific biodiversity priorities 2. Commissioning behavioural research to better understand how to encourage growers to invest time and money in improving biodiversity in the cotton landscape.
			Carbon footprint (kg of CO_2e per bale)	The current estimated emissions footprint of Australian cotton production is 255 kg of CO_2e per bale. This is an improvement on the target of 325 kg of CO_2e per bale. It is important to note the target is an emissions target and does not consider sequestration, for example, of native vegetation on-farm. While the industry does not yet assess sequestration at the industry scale, case studies have highlighted that individual farms can be carbon positive when carbon sequestration is taken into account. Accurately measuring sequestration at the industry level will be a focus to ensure that a complete picture of the industry's footprint can be calculated. This is being done in conjunction with a collaborative project under Agriculture Innovation Australia seeking to determine a common methodology for determining greenhouse gas emissions 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	One item of technology, an innovation to enhance the moisture management functionality of cotton fabrics, has been sold to a commercial party. Drought conditions and reduced funding has resulted in a number of concepts not progressing, including use of cotton in compression athletic wear or sound-proofing panels; the use of glycine to enhance cotton textile quality and development of conductive cotton-based yarns.
	2.2.2 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	Small premiums are available to *my*BMP certified growers through participation in the Better Cotton Initiative. Otherwise, budget constraints due to the drought limited the potential to invest in new opportunities to increase the value of cotton.
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	The target of six initiatives has been met. CRDC continues to participate directly in six global initiatives: ICAC's Expert Panel on the Social, Economic and Environmental Performance of Cotton; Sustainable Agriculture Initiative; Sustainable Apparel Coalition; 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, Meat and Livestock Australia and the Grains Research and Development Corporation.
	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	The target of three reports/sources of sustainability information is on track to be achieved. Following the release of the Australian Cotton Sustainability Report in 2019, CRDC has supported stakeholder consultation on sustainability targets and establishing the externally focused Australian Cotton Sustainability Reference Group. The 2021 Sustainability Update was published in June 2022, and the industry's fourth Independent Environmental Assessment has commenced. A CRDC project, supported by the National Landcare Program, that mapped biodiversity in Australian cotton landscapes is being used to support cotton farmers regenerate riparian areas in a partnership between industry, Landcare and Country Road. Projects have been established to enable reporting against the industry's sustainability indicators, including the development of appropriate social capital and wellbeing indicators, and the implications of European Union policies on sustainability labelling requirements for raw materials used by European companies.

RD&E highlights

Cotton industry social and wellbeing sustainability indicators (UC1901)

Achieving greater 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 enables the industry to identify those performing well and those where intervention may be required for improvement. 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. The most recent results, from the 2021 Regional Wellbeing Survey, show that 76 per cent of cotton growers report typical or high wellbeing, compared to the national average of 73 per cent.

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 tubestock 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. The project is due to end in 2022–23.

Greenhouse gas baseline and mitigation for cotton – phases 1 and 2 (CSP2102)

This project aims to establish a greenhouse gas (GHG) emission baseline for the Australian cotton industry, using the most up to date methods, data and technology. The project uses the same research team and methodology of an assessment conducted for GRDC and the Australian grains industry, to ensure cotton's result is in line with other agricultural industries, and comprehensive for a cotton and grains farming system. Phase 1 of the project focuses on establishing a baseline of GHG emissions and viable pathways towards carbon neutral cotton production. Phase 2 focuses on these mitigation pathways and seeks to answer the question of whether carbon neutral cotton can be achieved without compromising productivity and profitability, identifying the trade-offs that may be required if the industry were to pursue carbon neutral production. This research is fundamental to ensure a strong scientific foundation for the cotton industry's strategy decisions about carbon neutral cotton production.

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 RDCs and two rural organisations have combined to assess community trust in the Australian agriculture sector. The project identifies strategies, best practice approaches and interventions that are common across the sector. 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. A cotton-specific focal study found that the four key drivers for trust in cotton are: environmental responsibility; responsiveness to community concerns; the fair use of water in agriculture; and government regulation of the cotton industry. CRDC and Cotton Australia are working collaboratively with the researchers on this project, with the results informing the industry's trust and social licence strategy.

Quantifying the potential environmental impacts of pesticides used on cotton farms (DAN1803)

Pesticides (including insecticides and herbicides) are part of the cotton industry's Integrated Pest Management (IPM) approach. Pesticide use has changed over time: insecticide volume reduced by 95 per cent per hectare between 1993 and 2019 as genetically modified cotton and IPM were introduced. In the same period, a move to less tillage to control weeds increased herbicide use by 20 per cent. However, volume does not paint a full picture of potential impact as it doesn't take into account the differing toxicity of pesticides. Environmental Toxic Load (ETL) is a measure of hazard that takes into account these differences in toxicity. This project includes measuring the ETL for two indicator species: bees and algae. Cotton's goal is to achieve a five per cent ETL reduction over five years. The most recent results show that the ETL for bees has reduced and cotton is on track to meet this goal. However, the ETL for algae has increased due to a combination of a wetter seasons creating a higher volume of weeds than previous drought years, additional controls needed to manage a higher weed seed risk caused by farmers bringing fodder onto farms during drought, and greater use of residual herbicides to manage glyphosate resistance. The project is also seeking to validate indicators through water and air monitoring.

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 guide 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)

This project provides the resources to deliver the cotton industry's PLANET. PEOPLE. PADDOCK Sustainability Framework and strategy, including coordinating sustainability reporting and overseeing 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. In May 2022, the *Australian Cotton Sustainability Update 2021* was published, providing a snapshot of performance against the industry's nine priority social, economic and environmental sustainability topics for cotton: PLANET – water, greenhouse gases, biodiversity, pesticides and soil health; PEOPLE – wellbeing and workplace; and PADDOCK – productivity and profitability.

Threads and Opportunities symposium (CSP2205)

In May 2022, the 'Threads and Opportunities Symposium: science engineering sustainable fibres, for closing the loop in Australia' online event focused on accelerating science and innovation to achieve sustainable circularity for fibres. Sessions included keynotes on circularity; lessons from First Nations fibres in Australia and NZ; trends, challenges and opportunities for natural and man-made fibres; traceability and sustainability; and impacts for soil, water, waste reduction and recycling. The event was organised by a collective of fibre scientists at CSIRO, Deakin University, the University of New England, the University of NSW and QUT, with support from partners CRDC and CSIRO, and sponsors Cotton Australia, Australian Wool Innovation and The Woolmark Company. Over 200 people participated, representing the natural fibre industries, research bodies, education institutes, brands and retailers, and non-government organisations.

Undertaking the Fourth environmental assessment of the Australian cotton industry (CRDC2210)

The Australian cotton industry's fourth independent environmental assessment has been commissioned by CRDC, Cotton Australia and the industry's Sustainability Working Group and is being conducted by global firm GHD. It marks the fourth external examination of cotton's environmental performance in 30 years, following a commitment to undertake assessments every 10 years. Assessments were conducted in 1991, 2003 and 2012. The assessment will review the industry's response to the recommendations from the third environmental assessment in 2012, identify current and emerging environmental issues and their implications, and assess current action against these issues. The assessment will include a combination of desktop research, interviews with industry stakeholders, and on-farm visits to farms of all sizes across all growing regions. Industry bodies including the best management practices program, *my*BMP, the industry's extension program, CottonInfo, and sustainability programs will also be reviewed to gauge responsiveness to environmental issues, and on-farm practices will be assessed to ensure they are in line with current and future expectations and trends.

Case study

Shining the spotlight on sustainability

CRDC and Cotton Australia have released the inaugural annual progress update against cotton's key sustainability indicators, outlined in the PLANET. PEOPLE. PADDOCK. Sustainability Framework.

The annual update, which looks at the year ending June 2021, provides a snapshot of cotton's performance against the nine indicators – PLANET: water, greenhouse gases, biodiversity, pesticides and soil health; PEOPLE: wellbeing and workplace; and PADDOCK: productivity and profitability.

The annual updates are designed to fit between cotton's comprehensive five-yearly sustainability reports, giving important insights into progress, so the industry can keep track of areas performing well, and those that need more emphasis.

"The update shows that improvements have been seen in water-use efficiency, a reduction in greenhouse gas emissions per bale and insecticide hazard, and an increase in both cotton yield and the physical health of people in cotton communities," said Chris Cosgrove, cotton's sustainability lead.

"On the downside, we've seen a reduction in mental health in cotton communities, and an increase in herbicide hazard as the result of a wetter season with higher weeds numbers and an increase in the use of residual herbicides."

What does it mean for growers?

A long-term trend of improvement in many areas is something the industry can be proud of, says Chris. It also helps us tell a positive story to people who buy Australian cotton. In terms of areas for improvement, across the industry as a whole priority needs to be given to:

- Reducing net greenhouse gas emissions, by improving nitrogen-fertiliser efficiency, reducing electricity and energy from fossil fuels, and keeping carbon in soil and in native vegetation.
- Reducing herbicide toxicity and volume where alternatives are available, such as via alternatives to residuals and use of optical sprayers, ensuring all changes are in line with cotton's resistance management strategy.
- Improving farm safety.
- Continuing to adopt practices to improve soil health by maintaining soil cover, reducing soil disturbance, maximising living roots, and maximising biodiversity above and below the ground.
- Protecting biodiversity on farms by avoiding native vegetation loss, preserving native vegetation, and restoring land to native vegetation to provide habitat for beneficials and native animals.

What is cotton doing to achieve sustainability?

PLANET. PEOPLE. PADDOCK. is helping the Australian industry to be a global leader in sustainable cotton production. It sets sustainability targets, coordinates a whole-of-industry strategy to achieve these targets, and engages with growers, the wider cotton industry, cotton communities, and important community groups on actions and progress.

Priorities for Cotton Australia, CRDC and the Sustainability Working Group to continue to improve the PLANET. PEOPLE. PADDOCK. Sustainability Framework are to: improve the quality of our data; contribute to national work to have a consistent approach to managing and measuring native vegetation and soil health; and continue to work with other industries to have consistency across sustainability frameworks, and to share ideas and resources to increase our ability to meet targets.

Along with the annual snapshot, CRDC and Cotton Australia have also released an online sustainability data pack with more detailed information and methodologies. This data pack will be kept updated in real time, to provide an important source of information on cotton's progress.

For more: read the full article in the Winter 2022 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight and view the update at www.crdc.com.au/growers/sustainability.

Case study

Leading the way in independent assessments

The Australian cotton industry has commissioned an independent expert to conduct the fourth assessment of its environmental performance.

The industry's first environmental audit was conducted in 1991. At that time, the Australian cotton industry was the first cotton industry in the world to conduct a full, independent environmental audit of its operations to benchmark environmental sustainability performance and impact and devise industry-wide measures for improvement.

A second audit in 2003 showed major improvements and made recommendations for additional work primarily in the areas of water-use efficiency and biodiversity.

The third independent environmental assessment in 2012 found that the Australian cotton industry, through its research and development investments and effective interrelationships between industry research institutions, grower organisations, commercial service providers and growers themselves, had been substantially transformed since 2003.

The fourth assessment will take place in 2022. CRDC, Cotton Australia and the industry's Sustainability Working Group have commissioned respected global firm GHD to conduct the assessment that will do three things:

1. Assess the industry's response to the third environmental assessment recommendations.
2. Identify current and emerging environmental issues and their implications for the industry and on-farm management.
3. Assess current industry action on environmental issues in light of issues identified in the first two steps. This will include:
   - Impact – if the industry's on-farm environmental practices and outcomes are in line with current and future expectations and trends.
   - Responsiveness – how well industry bodies, *my*BMP, CottonInfo and sustainability programs are aligned, and how well the industry is able to identify and respond to environmental issues.

The fourth independent environmental assessment will involve a combination of desktop research, interviews with industry stakeholders, and on-farm visits to assess environmental practices and impacts. A report will be released in late 2022 and the findings will help inform the industry's sustainability efforts, driven by CRDC, Cotton Australia and the Sustainability Working Group under the PLANET. PEOPLE. PADDOCK Sustainability Framework.

CRDC General Manager R&D Investment, Allan Williams, has a long history working in sustainability and led the development of the BMP program in the 1990s.

"Importantly for the Australian cotton industry, we scientifically measure change over time," Allan said. "We currently conduct environmental assessments every decade and report our progress to stakeholders via formal Sustainability Reports. On the back of the 2012 environmental assessment, the Australian industry committed to expanding its focus beyond environmental sustainability by producing a Sustainability Report at least every five years that also covers social and economic sustainability.

"In recent years we've also committed to producing an annual snapshot of performance in the years between the five-year Sustainability Reports. And we've gone beyond simple reporting our impacts to actively seeking to understand what is important to the industry and its stakeholders, what we should be aiming to achieve, and what we need to do to get there."

For more: read the full article in the Summer 2021–22 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

What's all the fuss about trust?

How much does the community really trust Australian agriculture, and what would inspire greater trust in our rural industries?

To answer these questions, CRDC is collaborating on the Community Trust in Rural Industries research program – a partnership involving CRDC and 10 of its fellow rural research and development corporations, the National Farmers' Federation and NSW DPI, to enable rural industries to proactively address community trust. The program is led by AgriFutures Australia, and its aim is to develop an aligned approach to long-term engagement with the community over the course of three years.

Two years of research data has been collected and analysed by lead researcher Dr Kieren Moffat, the founder and CEO of Voconiq, a company that has its foundations in CSIRO.

Dr Moffat and his team have found that trust in, and acceptance of, rural industries is strong and increasing, with the majority of Australians seeing farmers as responsible stewards of the land. This trust brings with it great responsibility – the community expects farmers not to compromise environmental responsibility for economic sustainability.

The research shows that trust in rural industries is dependent on four key drivers: environmental responsibility; responsiveness to community concerns; the importance of products produced by rural industries; and distributional fairness (meaning that the benefits of rural industries are shared fairly especially with regional communities).

"Building trust isn't just giving consumers more science, more research or more information... research shows it's about demonstrating that you share their values when it comes to topics they care about most, like environmental stewardship," Dr Moffat said.

According to Dr Moffat, taking action based on community concerns is fundamental to building trust with Australians.

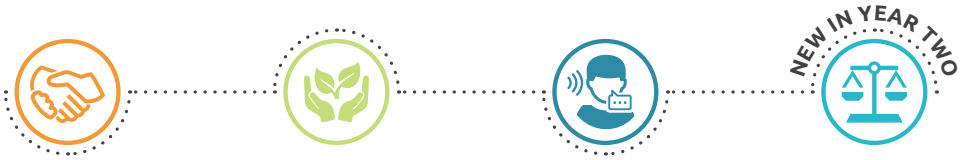
"Acknowledging when things go wrong and actively responding, rather than remaining silent on challenging issues, received strong endorsement from community members. Industry responsiveness via listening and responding to community concerns is a strong driver of trust in the research," said Dr Moffat.

CRDC's Executive Director Dr Ian Taylor said the research shows that the pathway to building and maintaining community trust is to be responsive to community attitudes, particularly around environmental sustainability and resource use.

"This is particularly relevant to the cotton industry right now, as we begin our fourth independent environmental assessment and continue finalising our sustainability targets under the PLANET. PEOPLE. PADDOCK. Sustainability Framework," he said.

"These initiatives are clear demonstrations of 'responsiveness through action' and of providing proactive, transparent, long-term engagement on emerging issues and concerns. The setting of our sustainability targets, and our efforts of continuous improvement to reach them, are a clear indicator that we as an industry are taking our environmental responsibility seriously."

What drives trust in rural industries?



PRODUCTS OF RURAL INDUSTRIES
Food and fibre products connect Australians to the people that produce them.

ENVIRONMENTAL RESPONSIBILITY
Rural industries operate sustainably and manage resources like water responsibly.

RESPONSIVENESS
Industry listens to community and takes action based on their concerns.

DISTRIBUTIONAL FAIRNESS
Benefits of rural industries are shared fairly (especially with regional communities).

For more: read the full article in the Autumn 2022 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Country Road goes on farm for biodiversity

Over the past 12 months a partnership between Landcare Australia, Country Road and the cotton industry has resulted in 34 hectares of biodiversity improvements in the Namoi Valley in NSW.

Two well-known cotton-farming families, the Kahls and Watsons have so far been involved in the project, funded by a corporate contribution and the sale of Verified Australian Cotton Heritage Sweats. Country Road has committed $600,000 over three years.

"It's brilliant to see the impact this partnership has had in just one year," said Country Road Managing Director Elle Roseby. "Country Road is so proud to support the great work being undertaken by local cotton farmers to leave a positive biodiversity legacy."

In the project, weeks of restoration work have included planting thousands of native trees and grasses on the Namoi River. Landcare Australia CEO Dr Shane Norrish said the organisation was very proud of the achievements of this partnership to date.

"The project will assist to increase biodiversity, restore local ecosystems, protect soil health, provide natural habitats for threatened species, improve water quality and contribute to the sustainable management and productivity of the landscape," Shane said.

The work draws on a 2019 CRDC project that mapped biodiversity in Australian cotton landscapes, identified threatened and endangered species, and recommended ways to protect them. The first project kicked off at the Kahl's family farm near Wee Waa where part of the Namoi River is being revegetated and stock excluded to increase habitat and shelter for native animals, reduce erosion and improve water quality. The second project is with the Watson family at 'Merriendi' near Boggabri where 3.7 kilometres of trees and grasses are being planted to improve ecology along the river on a newly acquired property. Plans are also underway for projects three, four and five, which will all be located in priority biodiversity zones.

The Australian cotton industry is providing additional support through CRDC and the Australian Government's National Landcare Program Smart Farming Partnership Initiative's Cotton Landcare Tech Innovations 2021 project.

"This includes a five-hectare research trial by the University of New England to investigate which revegetation methods have the greatest survival rates on floodplain soils, drone plantings, and a native plant propagation training workshop that's been held with Kamilaroi traditional owners," CRDC R&D Manager and CottonInfo Biodiversity Technical Lead Stacey Vogel said.

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.

"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," said Stacey (pictured with CRDC R&D Manager Elsie Hudson and cotton grower Robyn Watson).

"These projects are providing much-needed funding for farmers to undertake important biodiversity works. Using research undertaken by CRDC we can prioritise where and how we restore biodiversity to get the best outcome for threatened and iconic species found in cotton landscapes. The partnership also showcases the benefits of improving biodiversity to other cotton farmers and demonstrates to the non-agricultural community, such as Country Road customers, some of the positive ways cotton farmers are managing biodiversity."

For more: read the full article in the Summer 2021–22 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 this goal. To work towards this, CRDC focuses investments to deliver science and innovation capability and new knowledge, and to facilitate futures thinking.

In 2021–22, CRDC invested in 49 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	2021–22 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 eight honours, eight PhDs and two postdoctoral researchers in 2021–22. CRDC continues to support the introduction of early-career researchers, through such initiatives as the Postgraduate Cotton Careers Tour, which provides researchers interested in a career in cotton with access to industry organisations, networking and career opportunities. In 2022, CRDC supported 12 early-career researchers to attend the Australian Cotton Conference.
			Number of scientific exchanges	Under COVID-19 travel restrictions, almost all planned conferences were cancelled or postponed during the 2021–22 year.
	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	The target of one report being released has been met, with the finalisation of a postdoctoral project focused on developing an understanding of the needs of a future cotton workforce. Findings from the work have been incorporated into a new project that commenced 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	COVID-19 travel restrictions have limited the ability to support innovation initiatives in 2021–22.
			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, plant sensing to inform water-use efficiency, and biodiversity monitoring are continuing their development. CRDC continued to be a challenge agency for Australian Government's Business Research and Innovation Initiative (BRII) in 2021–22. 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. In partnership with Cotton Australia and the NSW Environmental Protection Agency, CRDC worked with six of these groups to test the feasibility of these ideas, with two of them now working on delivery of 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	The target of 60 per cent is on track. The CRDC-supported 2021 Regional Wellbeing Survey indicates 76 per cent of cotton growers report typical or high wellbeing. In comparison, the national average for the same measure is 73 per cent.
	3.2.2 Increased opportunities for strategic foresighting	Futures workshops lead to recommendations for future opportunities	Number of futures workshops	The target of two workshops has been met. Workshops held include those focused on: considering a future scenario of less access to pesticides; fewer input systems; and a novel farming system workshop. In addition, CRDC organised two virtual workshops with the industry and stakeholders, a horizon scanning and a scenario planning workshop, to help inform the new CRDC Strategic RD&E Plan. CRDC also led multiple multi-stakeholder workshops to underpin development of the climate initiative, now handed over to Agricultural Innovation Australia.
			Number and details of future opportunities to be followed up	COVID-19 has limited the ability to run as many workshops as had initially been envisioned during 2021–22, although virtual engagement has been used. Workshops held include a series of future scenarios workshops with crop consultants that explored impact of loss of key pesticides and led to CRDC investing in review of defoliation practices and scoping alternatives to existing products. This activity, along with the workshops held for a proposed AgriPest Challenge, informed the project 'Tools for assessing and achieving pesticide sustainability targets for the Australian cotton industry', as well as ongoing Integrated Pest Management (IPM) RD&E. In addition, strategic foresighting activities have been a core component of the process for developing the industry sustainability indicators.

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. The industry provides employment and growth both directly and indirectly, and provides broader social and economic benefits to communities and the wider nation. This project provides robust, evidence-based information on cotton's direct and indirect socio-economic contribution. Early results from the research, which focused on the 2015–16 year, show that cotton directly contributed $671 million to the Australian economy in that year. When the direct effect plus flow-on effects from inter-industry purchases and working spend are considered, the total economic stimulus from the cotton industry in 2015–16 was $1.8 billion added value. The quantifiable economic component of the project will be complemented by case studies to demonstrate the 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.

Australian Rural Leadership Program (RIR1903, RIR2201)

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 2021–22, cotton's Course 27 participant Ruth Redfern of Narrabri graduated from her program, Course 28 participant Justin McMillan of Narrabri continued his, and Course 29 participants Aaron Kiely of Emerald and Jack Brennan of Warren were announced. The ARLP celebrates its 30th anniversary in 2022. Since the first course in 1993, the Australian cotton industry has supported 44 leaders to complete the program.

CRDC Grassroots Grants (CGA2002-2205)

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, 89 projects have been supported, with $777,000 invested by CRDC into grower organisations across the valleys. During 2021–22, these projects included: a research project to reduce early season nitrogen losses in the Gwydir Valley; a project to encourage the uptake of digital technology in the Macquarie; a project to improve the soil health of a community demonstration farm in the Southern Valleys; and the installation of weather stations in the Lower Namoi and Central Highlands.

CSIRO student vacation scholarship program 2021–22 (CSP2102)

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 second time in 2021–22, offering four students the opportunity to work across cotton-focused research projects. The projects looked at genotypic variation in transpiration of cotton in response to drought, testing NIR technology to assist the cotton industry to monitor nitrogen-use efficiency in real time, improving cotton quality for better dye uptake, and diversity in cover crop selection. The students presented their research to CRDC, CSIRO Agriculture and Food team members and other sponsors at a symposium at the end of the program.

Delivering best practice to manage future workforce skills (CQU2201)

This project builds on previously supported CRDC workforce research that explored career decisions and pathways, work adjustments, skills, learning and training, diversity, inclusion, leadership and personal management skills. Out of the findings from the earlier research, development and extension opportunities were identified to integrate a future-of-work perspective into current workforce management practice for the cotton industry. This project, which began in 2021–22, develops and extends evidence-based cotton industry-specific resources, and explores the effectiveness of these in shifting behaviours, thinking and practices. The project has been titled SHIFT after the five pillars it is built around: Social sustainability, Human sustainability, Innovative workplaces, Future focus and Transformational leadership.

Future Cotton Leaders Program (CA2101, CA2201)

The Future Cotton Leaders Program is a collaboration between Cotton Australia and CRDC, designed to develop emerging leaders within the cotton industry. Although the program is generally held every two years, the 2020 program was held over to 2021 due to the impacts of COVID-19. 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. Thirty future leaders participated across the 2020-21 and 2022 programs, with the latter set to conclude at the Australian Cotton Conference in August.

Horizon Scholarship 2022 (RIRDC2203)

The Horizon Scholarship program is a collaboration between AgriFutures Australia, CRDC, other RDCs, the Cooperative Research Centre for Developing Northern Australia (CRCNA) and FMC Australasia to provide eligible university students with a $10,000 bursary over two years to develop their leadership skills and expand their networks. The program is open to students in agriculture-related or STEM degrees with major studies and/or subject selections that align to agriculture. Scholarship recipients are selected on the basis of their commitment to a career in agriculture, as well as their leadership potential and tertiary academic record. As part of the program, students attend an annual four-day professional development workshop and complete two weeks of industry work placements per year. The 2022 CRDC-supported Horizon Scholarship recipient is Bachelor of Agricultural Sciences student Ayla Christophers of the University of Adelaide.

Nuffield Australia Farming Scholarships (CRDC2301)

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 2021–22, CRDC and Cotton Australia supported cotton grower Richard Quigley of Trangie. Richard's research investigates cropping systems and methods to retain more crop residue in zero-tillage farming systems. Cotton grower Billy Browning of Narromine is also completing a Nuffield scholarship, with support from the Department of Agriculture, Fisheries and Forestry and the Murray-Darling Basin Authority, focused on alternative irrigation options to optimise water-use efficiency and renewable solutions such as solar pumps and battery storage.

Rural Safety and Health Alliance (RIRDC2201)

The Rural Safety and Health Alliance is a partnership of 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, ABA2101)

The Annual ABARES Science and Innovation Awards, run by the Department of Agriculture, Fisheries and Forestry, 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 2021–22 supported two award recipients: the 2021 winner, Demi Sargent of the Australian National University, and the 2022 winner, Dr Xiaoqing Li of CSIRO. Demi's project is looking to boost a cotton plant's ability to process CO2, greatly increasing its ability to tolerate drought and heat stress, thereby helping protect the cotton industry from the effects of climate change. Xiaoqing's project is focused on testing the ability to improve Australian cotton fibre traceability through a genetically engineered cotton germplasm.

Case study

Time for a shift in thinking about workforce

As agricultural industries across Australia seek to sure-up sustainable on-farm workforces, cotton is looking to tailor a new approach, titled SHIFT.

SHIFT will deliver a suite of resources and tools to support cotton's workforce attraction, retention and development through the CRDC-supported project 'Delivering best practice for management of future skills'.

It is aimed at aiding the development, coaching, training and leadership required to ensure a future-ready workforce and to embed these within cotton businesses. It is being led by long-term cotton industry workforce researcher, Dr Nicole McDonald, with leadership specialist, Ruralscope's Jo Eady, new CRDC-supported PhD student Chantal Corish, and Dr Amy Cosby who leads the Agriculture Education and Extension research team at the Central Qld University (CQU) Institute for Future Farming Systems.

Each member of this team brings specialist knowledge and skills to the table. Nicole has recently completed a CRDC project focused on cotton's future workforce: the catalyst for SHIFT. Jo leads the Australian Future Cotton Leaders Program for CRDC and Cotton Australia, and Chantal (pictured) is a cotton grower and psychologist based at Goondiwindi. Her PhD study is investigating the role of psychological safety on farms and will be directly integrated into the SHIFT project.

"SHIFT refers to a shift in mindset, behaviours and culture to create a sustainable on-farm workforce," Nicole said. "It is called SHIFT after the five pillars that this project is built around.

These pillars are: Social sustainability, Human sustainability, Innovative workplaces, Future focus and Transformational leadership.

"Each of these pillars were recurrent themes in my earlier research for how people were taking action to adapt to the future of work. It is a workforce development framework that is truly from the cotton industry, for the cotton industry, and is centred on the mechanisms by which we achieve the positive workforce outcomes we're striving for: high performance, engagement and satisfaction, all of which lead to better production outcomes."

Nicole likened the attitude to that of a sports team that wants to win – they direct their focus on executing their game to the best of their ability.

"If we consider attraction and retention as the way we know we have a 'winning' employer of choice status, ensuring we have the skills, structures and are taking actions focused on effectively addressing each of the pillars of SHIFT is how we master our game," Nicole says.

"The future of work is volatile, uncertain, complex and ambiguous, and requires a capable workforce to embrace the changes required to adapt to new developments on-farm.

"Best practice people management relies on the successful ability of growers to lead their teams through change processes, and is important for worker motivation to learn and accept/use new technology, worker engagement, job satisfaction and retention."

For more: Read the full article in the Winter 2022 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Future of cotton is in its leaders

Planning for the future means giving people the skills to lead an industry.

Under the guidance of specialist Jo Eady from RuralScope, a group of 11 enthusiastic cotton industry participants met in Armidale in 2021 as a part of the Australian Future Cotton Leaders Program. The program, supported by CRDC and Cotton Australia, has been turning out industry leaders over more than a decade. The intake is biennial, and the program began in 2007, with the aim to give participants usable skills to take back to their communities, associations, boards and paddocks.

In the program Jo runs 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 in developing their leadership skills in a real-life scenario.

Many graduates follow on to hold leadership positions at a whole-of-industry level, for example within Cotton Australia and CRDC, as well as industry committees and projects. CRDC board director Ross Burnett is a graduate of the inaugural program, while CRDC R&D Manager Susan Maas graduated in 2009.

A number of Future Cotton Leaders graduates have gone on to the Australian Rural Leadership Program or become Nuffield Scholars, including growers Aaron Kiely from Emerald (pictured), Nigel Corish from Goondiwindi, and Renee Anderson from Emerald, while consultant and farmer Emma Ayliffe was recently named the ABC and Kondinin Group's Young Farmer of the Year.

Two of the cotton industry's best known researchers, Rose Broderick and Karen Kirkby, were early career scientists when they signed up, and have gone on to be leaders in their respective research fields. Recent graduates include climate specialist Dr Katie Broughton, Dr Dean Brookes and CottonInfo Biosecurity Technical Lead Sharna Holman.

The course always includes an intake of people with various skills and industry experience and/or knowledge and at different stages of their 'leadership journey'. Some may already be considered leaders.

The 2021 cohort included cotton industry researcher Nicole McDonald, former CottonInfo Stewardship Technical Lead and now Cotton Australia Policy Manager, Sally Ceeney, along with growers, consultants and agribusiness professionals. The course manages to remain relevant to these diverse groups.

"Each program always has diversity in it – this is a huge plus of this program," Jo said.

"Participants focus on their future visions and their projects, and my role as a facilitator is to be able to read and assess and then to push and pull, encourage and challenge, support and hold a mirror up so that each can become more self-aware. Only when this is done can a participant see changes in the way they approach, operate and lead."

"There is no room in the future for leaders who are only technically proficient – effective future leaders will be those who take responsibility for finding and bringing out the potential in others. We are entering a much more collaborative leadership stage, as opposed to a positional leaders stage which is what ag is built on.

"Leadership is about others, not just about yourself or the title or position you hold," Jo said.

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

Case study

Innovation in traceability rewarded

CSIRO research scientist Dr Xiaoqing Li, recipient of this year's CRDC-supported ABARES Science and Innovation Award, is helping to take cotton traceability to the next level.

Together with her colleagues in CSIRO's Novel Synthetic Plant Fibres team, Xiaoqing (pictured) recently developed an engineered cotton germplasm, which produces a protein that does not exist naturally in cotton fibres.

Through the Science and Innovation Award, Xiaoqing will now investigate whether this protein could be used to develop a method to trace cotton to its original source.

She says her project fills a gap in the science.

"If this protein is stable and can be detected after fibre matures, we can possibly trace it from the beginning to the end of the life of the fibre," Xiaoqing says.

"We hope this work leads us in a new direction to developing plant-based tracing technology.

"Customers are seeking more sustainable products in the textile industry, grown in a sustainable way and manufactured under fair labour conditions.

"Unfortunately, without good traceability, it's hard to tell where the material comes from."

"Existing traceability techniques typically rely on special equipment and processing that is not easy to access, or on extra processing steps to attach materials on top of cotton fibres.

"Alternatively, physical records could be used but are cumbersome and can lack transparency."

Xiaoqing told *Spotlight* that the award came as a surprise, as she knew there were many great research projects and deserving applicants.

"I feel very lucky to receive this award. It's a great opportunity for our novel fibre work to be used in a new area that is important for the industry.

"I hope it leads to more research and development in plant-based solutions for the traceability of cotton fibre, as well as other agricultural products," she said.

CRDC has long been involved in the ABARES Science and Innovation Awards. Cotton's first involvement was in 2002, and CRDC has consistently supported the awards since 2011 as a way to acknowledge and reward young scientists for their exploration of concepts and the creation of new knowledge in the pursuit of scientific breakthroughs.

Recent CRDC-supported recipients include Dr Priscilla Johnston (CSIRO) for her research into a 'smart' polymer to slow evaporation; Rhys Pirie (University of Queensland, UQ) for his research into re-purposing organic wastes into fertiliser and glass recycling; Dr Dean Brookes (UQ) for his research into scanning irrigation water for trace amounts of pest and pathogen DNA; Dr Dinesh Kafle (Qld DAF) for his research into priming cotton with silicon to protect against Fusarium wilt and reniform nematode; and Dr Demi Sargent (WSU) for her research into shielding the cotton industry from the effects of climate change.

For more: Read the full article in the Winter 2022 edition of CRDC's *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Giving scholars a reason to return

Summer vacation scholars are relishing the experience of working with cotton industry researchers on research projects set to have a significant impact on the industry. The students are a part of CSIRO's Agriculture and Food's Vacation Scholarship Program, which is aimed at students in second-or third-year undergraduate studies.

This program is supported by researchers from CSIRO Agriculture and Food (led by Dr Hazel Parry) and agricultural industries through CRDC, Cotton Seed Distributors (CSD), the Grains Research & Development Corporation, and Meat & Livestock Australia.

"Engagement with industry in our program is a win-win-win," Hazel said. "Firstly, for the students to undertake exciting projects with real-world applications; secondly, for industry to gain insight to and benefit from the new ideas emerging at CSIRO; and thirdly for our scientists to have capacity to explore those ideas and gain visibility for them".

CRDC and CSD have supported four students who worked on research challenges set by CSIRO cotton researchers over the summer university holidays. Researchers Dr Katie Broughton, Dr Tim Weaver, Dr Xiaoqing Li and Dr Mark Farrell and Nina Welti worked with students Corey Cutler, Ellie Bennett (pictured with Tim Weaver and Kellie Gordon), Lara Horvat and Kaidy Morgan. None of the students had previously worked in cotton research, but all gave very positive reports of their experience, which has opened up options in cotton research that they had not considered.

The projects are designed by the researchers so the students could complete their component within the 10-week program. The program is an avenue to give these students an experience that may encourage them back to the industry after they graduate.

Cotton researcher Dr Hiz Jamali leads the program's engagement with the cotton industry including coordinating cotton-related projects.

"The program addresses difficulties in finding and hiring quality Australian graduates who are ready to begin their careers in science and innovation," he said. "By exposing talented undergraduate students to the excitement of scientific research, we hope to attract these students to careers in biological and agricultural sciences, while at the same time contributing to CSIRO's research effort in basic and strategic research in sustainable agriculture."

Dr Xiaoqing Li feels the experience gives the students a greater insight into working in ag research to help influence career paths.

"I think it gives a great opportunity for them to develop a deeper understanding of the research fields," she said. "It also shows the day-to-day life of a researcher and connects them with various people related to a research life: all of those things will have some effect on their career paths."

CRDC Executive Director Dr Ian Taylor said previous CRDC-supported studies show that exposure to an industry and the ability to create contacts and networks greatly increases the likelihood of a graduate – or for that matter a farm-based employee – coming to the industry.

"From the responses of the students, it is clear that a summer scholarship opens up a whole new world of research, and in some cases, makes them seriously contemplate a career they hadn't considered before," Ian said.

For more: read the full article in the Autumn 2022 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 2021–22, CRDC invested in 30 projects within this goal, accounting for 10 per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicators	Measures	2021–22 progress
4.1 Partnerships and collaboration	4.1.1 Growers/ consultants value CRDC farming systems research outcomes	Maintain or increase the number of growers/consultants that value CRDC research outcomes	Percentage of growers/ consultants that report valuing CRDC outcomes	The target of 85 per cent of growers and consultants that report valuing CRDC outcomes is on track. The latest data indicates 86 per cent of growers and 83 per cent of consultants value CRDC's outcomes.
	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 worked with 36 CRDC-supported research projects in 2021–22 to improve impact through increased awareness and practice change. This included running 20 on-farm trials to demonstrate practice, and delivering 48 extension activities to over 1100 participants. In addition, CottonInfo raised awareness through weekly newsletters sent to over 3,000 recipients; fortnightly regional Crop Check updates during the season; and videos and podcasts. 27 new videos produced in 2021–22 received over 5,000 views. Eight podcasts were produced with 345 downloads.
			Percentage of participants that report increased knowledge, skills, and intention to change behaviour as a result	Evaluation of participants in CottonInfo extension activities indicate that 85 per cent recorded increased knowledge and awareness as a result of participating in the activities, and 72 per cent had an intention to change practices. Demonstration sites in 2021–22 covered nutrition, irrigation, weed management, disease management, early season Integrated Pest Management (IPM), rain grown picking options and defoliation.
	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	The target of 40 per cent is on track. 42 per cent of RD&E investments in 2021–22 were through cross-sectoral partnerships including strategic collaborations on water-use efficiency, nitrogen management, novel crop protection, biosecurity, European Union engagement, and Northern Australia.

			Number of new international and national partnerships	A number of national partnerships are continuing, including the Rural Safety and Health Alliance, Agriculture Innovation Australia, and the Landcare Australia, Cotton Australia, CRDC and Country Road collaboration to improve biodiversity on cotton farms. International partnerships include membership of Textile Exchange and participation in Cotton2040.
			Partner satisfaction ranking	In 2019-20 partners rated satisfaction with CRDC as 8.4 on a scale of 1-10, where 1 is the lowest and 10 highest. Partner satisfaction will be measured again in November 2022 as part of the triennial CRDC Stakeholder Survey.
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	Eight of the 17 projects that have commercialisation potential either have a commercial partner on board or have commercialisation processes underway.
		Research partners are supported through the commercialisation process	Researchers report satisfaction with CRDC commercialisation support	CRDC's contracted Commercialisation Manager reviews commercialisation approaches. Changes in researcher satisfaction will be assessed at the end of the Strategic RD&E 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)	CRDC's contracted Commercialisation Manager advises and enacts a process to reduce time from conception to market entry. Percentage improvement will be assessed at the end of the Strategic RD&E Plan once the revised processes are bedded down and have had sufficient time to be implemented.

RD&E highlights

20th Australian Cotton Conference Foundation Sponsorship (CA2004)

After a four year hiatus due to COVID-19, the Australian Cotton Conference returns in 2022 with support from CRDC. The event is run by Cotton Australia and the Australian Cotton Shippers Association (ACSA), with CRDC and Cotton Seed Distributors (CSD) as Foundation Sponsors, having supported the event since its inception. As core component of the Foundation Sponsorship is providing support for cotton growers to attend Conference: CRDC and CSD's contribution ensures that 800 growers can receive a $100 discount on their attendance. The Conference theme for 2022 is 'Here for Good': a nod to the industry's resilience over several challenging seasons, as well as an opportunity to explore the positive contributions the industry is making in sustainability, research, innovation, supply chains and to our cotton communities. The 2022 Conference takes place in August 2022, with preparations by the committee (including representation from CRDC) occurring across 2021–22.

Agricultural Innovation Australia membership (AIA2101)

CRDC continued its support for Agriculture Innovation Australia (AIA) Ltd in 2021–22. AIA was established by the collective 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 for Australian agriculture. As a single point of contact for cross-industry strategies, the intent of AIA is to 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 investments on issues of national importance.

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. Key deliverables in 2021–22 have included an economic analysis of installation of micro-hydro power; the development of a full suite of industry gross margins including for the Northern Australian cotton industry; conducting energy use and sustainability calculations to support the industry's sustainability and Cotton Australia's Cotton to Market programs; and managing cotton's involvement in the Managing Climate Variability cross-sectoral research program.

Collaboration agreement GRDC/CRDC: Spray drift hazard alert and prediction system (GRDC2003)

Spray drift hazard alert and warning systems (DISA2201)

CRDC and the Grains Research and Development Corporation have collaborated on a $5.5 million investment to help minimise spray drift through a five-year partnership with Australian agtech company Goanna Ag. Under the partnership, Goanna Ag will develop a spray drift hazardous weather warning system that will provide real-time weather data and alerts to growers and spray operators about the presence of temperature inversions. Goanna Ag will establish, operate and maintain a network of 100 Profiling Automatic Weather Stations (PAWS) across the grain and cotton regions of NSW, Southern and Central Qld. The PAWS have remote sensing capability and new proprietary software to provide growers and spray contractors with real-time weather data every 10 minutes. With the ability to accurately identify the presence of hazardous temperature inversions, growers and spray contractors can reduce spray drift risk. The PAWS warning system builds on breakthrough research, conducted and published by Drs Graeme Tepper and Warwick Grace with support from GRDC and CRDC. It will be operational in time for the 2022-23 summer cropping season.

Commercialisation process coordination and support for WSU plant extract pesticides (CRDC2218)

CRDC had partnered with Western Sydney University (WSU) on a previous research project to identify and develop botanical insecticides and synergists, primarily from Australian but also exotic flora. This project identified a potential plant extract, with the code name N68, that shows promising insecticidal activity combined with favourable off-target traits. Initial screening suggests excellent activity in controlling Cotton Aphid (*Aphis gossypii*) as well as activity on whitefly, thrips, two-spotted mites, olive lace bug, diamondback moth and Qld fruit fly. CRDC and WSU believe that this compound has potential to address significant challenges faced by farmers around the world and represents a rare opportunity for a commercial partner to help bring this technology to market. This project is providing process coordination and support as CRDC seeks a commercial partner to further investigate the potential to develop this compound as a biological insecticide.

CottonInfo technical lead for nutrition (DAN2202)

The CottonInfo technical lead for nutrition, Jon Baird of NSW DPI, is responsible for connecting growers with the latest research outcomes regarding cotton nutrition, and ensuring the relevant *my*BMP module and best practices are based on science. Nutrition is a critical area of focus for extension, given the important role of nitrogen in cotton production and its subsequent contribution to greenhouse gas emissions. As nitrogen fertiliser accounts for 60 per cent of cotton production's greenhouse gas emissions, improving the efficiency of nitrogen use is essential to reducing emissions. The CottonInfo nutrition technical lead plays a key role in helping growers adopt research outcomes and best practice. Jon is a research and development agronomist with NSW DPI, is currently completing a PhD in nitrogen and irrigation management, and is involved in the industry's research projects regarding nutrition, so is well placed to fulfil this role.

CottonInfo field demonstration trials (CSD2104-CSD2201)

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 2021–22, three trials were run: one across all valleys focused on Integrated Pest Management (IPM) and the ability of the crop to compensate for early season pest damage; one across all valleys focused on increasing productivity and profitability through improved water-use efficiency via toolbox training sessions of irrigation staff; and one in St George focused on the irrigation performance and efficiency of a siphon-less irrigation system. The trials are directly linked to relevant CRDC-supported research projects.

Support for the Sustainability Working Group, industry sustainability reporting and integration of research into *my*BMP (CRDC2113)

The Australian cotton industry's Sustainability Working Group oversees and manages the delivery of the industry's sustainability commitments and reporting. It is comprised of representatives from CRDC, Cotton Australia, CottonInfo, the Australian Cotton Shippers Association, and a grower representative. This project provides expert support to the Sustainability Working Group, and ensures the integration of sustainability and research outcomes into *my*BMP, the industry's voluntary farm and environmental management program for growers, supported by Cotton Australia and CRDC. *my*BMP 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, and providing strong linkages to sustainability.

Case study

Spray hazard warning system breaks new ground

Cutting-edge technology, a new partnership and a $5.5 million investment by the cotton and grains industries is behind the installation of the first of 100 weather stations planned for NSW and Qld cotton and grains regions, helping to solve the critical issue of spray drift.

Through a five-year partnership with Australian agtech company Goanna Ag, announced in March 2022, the investment will see the Grains Research and Development Corporation (GRDC) and CRDC develop a hazardous inversion warning system to give growers and sprayer operators real-time weather data and alerts about the presence of hazardous temperature inversions: a key element for the risk of spray drift.

The first tower in the network was installed in April at Goondiwindi in South-East Qld, with the entire system aiming to be up and running for the 2022–23 summer cropping season.

A study commissioned by CRDC and GRDC found that the warning system can increase chemical efficacy, improve labour and machinery productivity, and reduce the risk of spraying under hazardous drift conditions.

“Assuming successful uptake, the warning system could help the cotton industry avoid $40 million in losses and costs associated with spray drift over five years,” AgEcon economist Jon Welsh, who conducted the study, said.

CRDC Senior R&D Manager Susan Maas (pictured with Goanna Ag’s Tom Dowling and GRDC’s Gordon Cumming) said the major causes of drift damage are spraying at the wrong time, and having a poor understanding of inversions and other spray efficacy best management practices.

“The new warning system can predict hazardous inversions in advance,” she said. “This is novel technology and the predictive capabilities of up to 24 hours is also unique. Other weather monitoring systems that have been tested in the past simply measure the occurrence of an inversion at night, which has been known in a generic sense for a long time.

“The new warning system builds on breakthrough research conducted and published by Dr Graeme Tepper and Dr Warwick Grace with support from GRDC and CRDC.”

Goanna Ag will establish, operate and maintain the network of 100 Profiling Automatic Weather Stations (PAWS) across grain and cotton-growing regions of NSW, Southern and Central Qld. The PAWS have remote sensing capability and new proprietary software to provide growers and spray contractors real-time weather data every 10 minutes.

CRDC’s Executive Director Dr Ian Taylor said the partnership with Goanna Ag builds on six years of collaborative research and development from the two research and development corporations.

“As research leaders, our organisations are committed to investing in research that supports improved on-farm practices and the sustainability of agriculture,” Ian said. “Spray drift is a significant issue for agriculture and the wider community and reducing its potential and impact is critical.”

For more: read the full article in the Winter 2022 edition of CRDC’s *Spotlight* magazine www.crdc.com.au/spotlight.

Case study

Seeking partners to commercialise novel biopesticide with global potential

Blue sky thinking by CRDC and Western Sydney University (WSU) has uncovered a promising new plant-based compound for combatting common insect pests in cotton, horticulture and broadacre crops. A rare opportunity now exists for a commercial partner to further develop the early-stage biological pesticide with global market potential.

Genetic modification of cotton plants, coupled with the adoption of Integrated Pest Management practices, has enabled Australian cotton growers to reduce their use of synthetic pesticides. But as agronomist and CRDC consultant Doug McCollum explained, pest control isn't a 'tick a box' item.

"We see both long-term and seasonal change in the ecology of cotton fields, where things that were once a major problem fade into the background, but other pests pop up in their place," said Doug.

From regulatory changes to insect resistance and market pressures from ecologically conscious consumers – the race is on to develop alternatives. "CRDC knows we need to keep working in this area – creating Plan Bs that protect our growers into the future," said Doug.

CRDC's latest Plan B is a novel biopesticide compound that could revolutionise not just cotton pest control, but the entire global agricultural pesticides market. In partnership with WSU, CRDC has uncovered a plant extract that, in lab tests and an early field trial, shows tremendous promise in controlling common crop insect pests.

"WSU looked at about 250 plant species – both native and exotic – and tested around 450 extracts to see whether they had insecticidal activity against key pest species," explained Doug. "The ones which did were then tested for off-target traits, like impacts on beneficial insect species and phytotoxic effects on the crop."

What emerged was a commercially cultivable native plant compound – code named N68 – that shows excellent insecticidal activity in controlling cotton aphids (*Aphis gossypii,* pictured) as well as good activity on whitefly, thrips, two spotted mites, olive lace bug, diamondback moth, and Queensland fruit fly. The compound also has favourable off-target traits: low phytotoxicity, low impact on non-target organisms, and a low eco-toxicological profile.

"The research actually uncovered more compounds that we could potentially look at later on," added Doug. "The early indications are good, with WSU having already uncovered a simple, safe and economical method for extracting N68 from the plant.

"This compound gives good insect control at relatively low concentrations," explained Doug. "And because the compound can be cultivated on a commercial scale to produce and harvest the active metabolites, this increases the chances that it will be a commercially viable product in the future."

With the early legwork done, CRDC offers a valuable opportunity for a commercial partner to hit the ground running. CRDC is looking for a partner to run with the project from here, taking on the further testing needed to determine whether N68 is the next big thing in crop insect pest control. With the typical research timeline from discovery to commercialisation taking anywhere up to 10 years, CRDC offers prospective investors a real leg up in bringing a product to market sooner. And there's a long list of potential benefits that will entice investors.

"Current testing suggests it's a new mode of action for insect control," said Doug. "From a resistance point of view, that would be a game changer, because it's getting harder to find new synthetic compounds. N68 has already proven it is effective against resistant aphid populations. There's huge commercial advantage in bringing out something that works differently to everything else on the market."

For more: read the full article in the Winter 2022 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 2021–22, CRDC invested in eight projects within this goal, accounting for three per cent of our total RD&E expenditure.

Performance against the Strategic Plan

Key Focus Areas	Outcomes	Performance Indicator	Measures	2021–22 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 in 2021–22 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 highly valued by 92 per cent and 89 per cent of growers and consultants respectively. 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	In 2021–22, economic case studies analysed the potential farm-level impact of four technologies: nitrogen timing, nitrogen product, canopy temperature sensors, and evaporation mitigation.

	5.1.3 CRDC-funded projects demonstrate value and return on investment	Positive return on investment (ROI)	Investments demonstrate a maximum ratio of benefit/cost	In 2021–22, economic case studies analysed the potential farm-level impact of four technologies: nitrogen timing, nitrogen product, canopy temperature sensors, and evaporation mitigation. These case studies will help inform a larger return on investment study that will report in 2022–23.
	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 Stakeholder Survey indicated that CRDC's current communications satisfaction ranking is 8.3 out of 10, unchanged from the 2016 baseline. Our 2023 goal is 8.5 out of 10. Communications satisfaction will be measured again in November 2022 as part of the triennial CRDC Stakeholder Survey.

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 2020–21 season, surveying 53 cotton consultants, representing 320 cotton growers and covering 124,026 hectares, which is 40 per cent of the Australian cotton production area for that season. The report is available at the CRDC website (www.crdc.com.au/publications).

Australian Cotton Conference 2022: Innovation Alley (CA2202)

A feature of the Australian Cotton Conference 2022 is Innovation Alley, a showcase of the innovations and technology invested in by CRDC. Twelve innovators have been selected, each with a space in the Conference trade hall and on the Conference program. The 12 innovators are: growAG's global innovation gateway; the Goanna Ag spray hazard warning system; BRII challenge winners LX Design House and SwarmFarm Robotics; the AI app for whitefly Pest Detect; the iMapPESTS sentinels to identify airborne pests; Regrow Ag's remote sensing technology; key innovations from Smarter Irrigation for Profit phase 2 and the Cotton Landcare Tech Innovations 2021 project; game changing crop protection BioClay; high pressure crop destruction for dryland AquaTill; and innovative vision-based plant detection technology, See & Spray Select™.

CRDC Cotton Grower Survey (CRDC2014)

CRDC's annual survey of cotton growers gathers 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 2021 Cotton Grower Survey collected data for the 2020–21 season. A total of 233 growers participated in the survey, growing an average of 589 hectares of cotton, and reporting an average irrigated yield of 11.88 bales per hectare. Questions covered the 2020-21 crop, R&D impact on the farming system, water-use efficiency, disease management, sustainability, and workforce and training. The report is available at the CRDC website (www.crdc.com.au/publications) in PDF and interactive digital formats.

CRDC economic impact assessment (AE2202)

The CRDC economic impact assessment project evaluates the impacts of CRDC's investments to demonstrate economic, social and environmental outcomes to our cotton growers and the government. To achieve this, the research team are conducting a random sample of 18 of CRDC's projects, identifying and describing their pathway to impact, conducting economic, social and environmental impact assessments, and undertaking cost-benefit analysis. As CRDC is one of the 15 RDCs that form the Council of Rural RDCs, the assessment is conducted in line with the agreed Council of Rural RDC guidelines, which will enable a collective assessment of all RDC-supported research. Prior to this project, the last formal impact assessment of CRDC's portfolio was in 2018.


Australia

Case study

Survey shows carbon and climate on the radar for cotton growers

More than one in two growers surveyed for the 2021 CRDC Grower Survey believe their regional climate patterns will result in a change to their production systems over the next 10 years.

With the results of the 2021 survey now out, it found that larger farms were more likely to believe this proposition than medium or smaller farms.

In addition, 29 per cent of growers surveyed reported they were actively assessing the carbon footprint of their production system. Compared to small- and medium-sized farms, larger farms were more actively undertaking assessments, which varied across the regions. That said, almost six in 10 growers were making or planning to make changes to reduce their carbon footprint.

The inclusion of questions around climate and carbon in the 2021 survey comes at a time as targets for emissions are being set and refined by governments around the world – and as the cotton industry works to formalise its own targets under the PLANET. PEOPLE. PADDOCK Sustainability Framework.

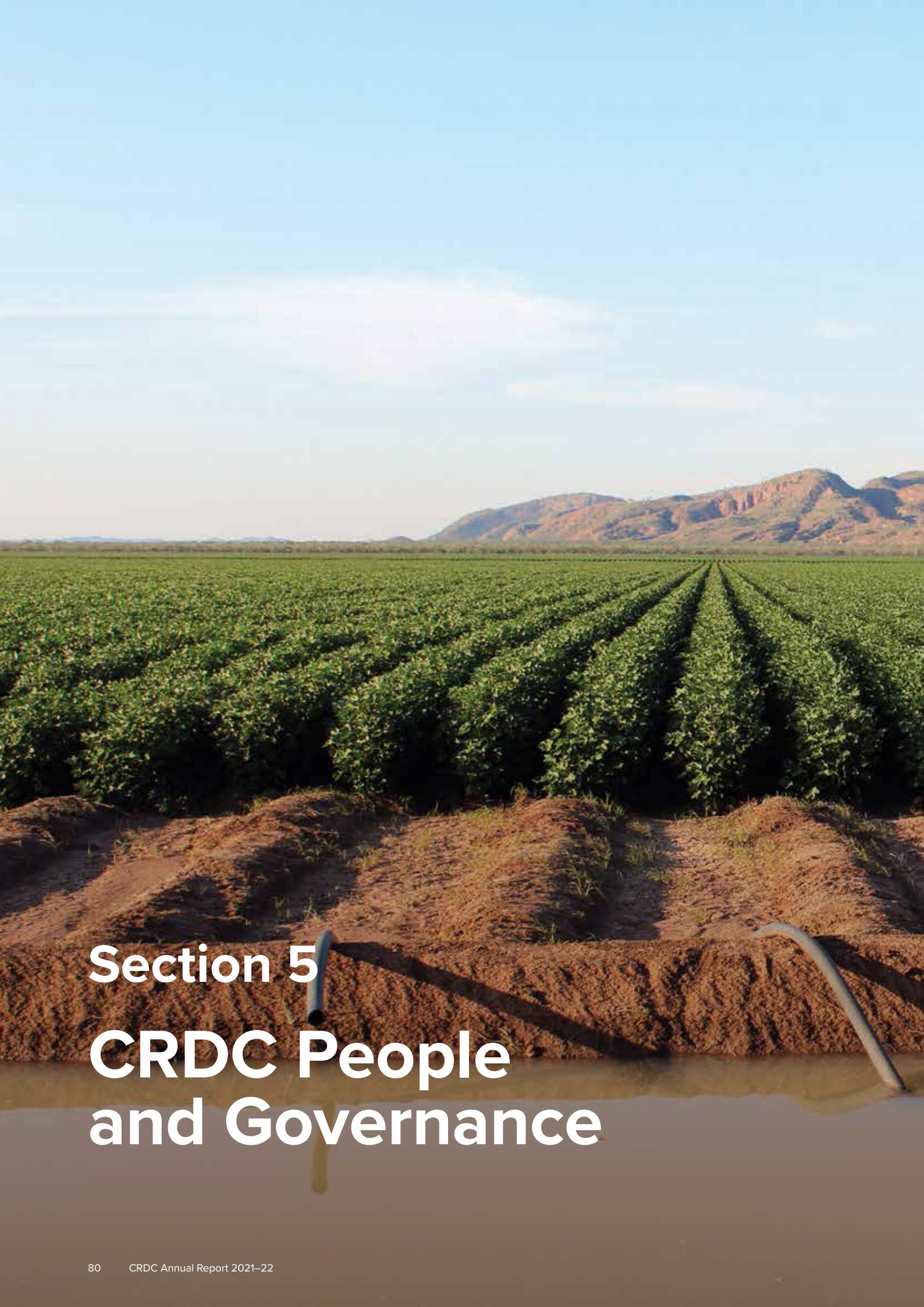
The framework was introduced in April 2020, and measured in both the 2020 and 2021 CRDC Grower Surveys. Awareness of the framework has increased from 32 per cent to 46 per cent in just 12 months, while a majority of growers (67 per cent) believe it is very important for the industry.

A total of 233 growers participated in the survey, representing 20 per cent of all cotton growers in 2020-21. The survey covered a range of topics, including the impact of R&E on farming systems, water, diseases, sustainability, and workforce and training.

The survey results are available to download from the CRDC website. An interactive digital dashboard is also available to enable growers to explore the data in more depth, including comparisons of farm sizes and growing valleys.

The 2022 CRDC Grower Survey will open in June 2022, with all cotton growers and farm managers invited to participate. It provides valuable information to CRDC and the cotton industry about on-farm practices and priority areas for future research.

For more: read the full article in the Summer 2021–22 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.



Section 5
CRDC People and Governance

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.
Reappointed: 29/08/2022 until 28/08/2025.
Chair of the Remuneration Committee.

Ms Rosemary Richards – Deputy Chair

BAgEc, MBA, GAICD

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 180 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

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 Qld 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

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

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

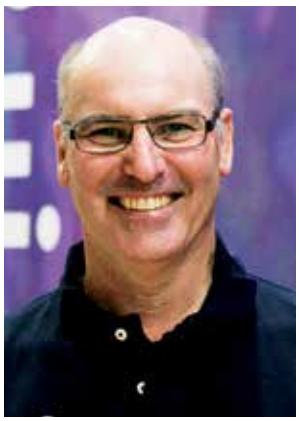
BAppSc, GAICD

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.



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 UQ, 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, Fisheries and Forestry), 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 2022

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 2021–22, 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 2021–22. In addition to face-to-face meetings, the Board and its Committees conduct much of their work via email, video-conference and telephone, supported by a secure online information portal. CRDC finds this arrangement to be effective, productive and cost-effective.

Board meeting	Date	Location
Meeting 5 – 2021	19 August 2021	Video-conference
Meeting 6 – 2021	7 October 2021	Video-conference
Meeting 7 – 2021	19 November 2021	Video-conference
Meeting 1 – 2022	12 January 2022	Video-conference
Meeting 2 – 2022	16 February 2022	Brisbane QLD
Meeting 3 – 2022	6 April 2022	Narrabri NSW
Meeting 4 – 2022	23 June 2022	Griffith NSW

Attendances at Board meetings

Director	Meeting 5 2021	Meeting 6 2021	Meeting 7 2021	Meeting 1 2022	Meeting 2 2022	Meeting 3 2022	Meeting 4 2022	TOTAL
Richard Haire	✓	✓	✓	✓	✓	✓		6 of 7
Les Copeland	✓	✓	✓	✓	✓	✓	✓	7 of 7
Rosemary Richards	✓	✓	✓	✓	✓	✓	✓	7 of 7
Ross Burnett	✓	✓	✓	✓	✓	✓	✓	7 of 7
Gary Fitt	✓	✓	✓	✓	✓	✓	✓	7 of 7
Danielle Kennedy	✓	✓	✓	✓	✓	✓	✓	7 of 7
Peta Slack-Smith	✓	✓	✓		✓	✓	✓	6 of 7
Ian Taylor	✓	✓	✓	✓	✓	✓	✓	7 of 7

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) N
on-board member total consultancy for 2021–22 $6,494 ex. GST

Non-Executive Directors who are members of the Audit Committee are not remunerated by the entity for any duties performed as part of the committee.

Attendances at Audit Committee meetings

Member	11 Aug 2021 *Video-conference*	27 Oct 2021 *Video-conference*	3 Feb 2022 *Video-conference*	18 May 2022 *Video-conference*	TOTAL
Les Copeland	✓	✓	✓	✓	4 of 4
Rosemary Richards	✓	✓	✓	✓	4 of 4
Peta Slack-Smith	✓	✓	✓	✓	4 of 4
Ross Burnett	✓	✓	✓	✓	4 of 4
Samuel Skelton	✓	✓	✓	✓	4 of 4

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. Non-Executive Directors who are members of the IP and Commercialisation Committee are not remunerated by CRDC for any duties performed as part of the committee.

Attendances at Intellectual Property and Commercialisation Committee meetings

Member	22 July 2021 *Video-conference*	20 Oct 2021 *Video-conference*	23 Mar 2022 *Video-conference*	TOTAL
Rosemary Richards	✓	✓	✓	3 of 3
Les Copeland	✓	✓	✓	3 of 3
Danielle Kennedy	✓	✓	✓	3 of 3
Gary Fitt	✓	✓	✓	3 of 3

Remuneration Committee

The Remuneration Committee advises the Board on the Executive Director's remuneration and senior staff remuneration adjustments. Non-Executive Directors who are members of the Remuneration Committee are not remunerated by CRDC for any duties performed as part of the committee.

Attendances at Remuneration Committee meetings

Member	7 Jul 2021 *Video-conference*	11 Nov 2021 *Video-conference*	25 Feb 2022 *Video-conference*	1 June 2022 *Video-conference*	TOTAL
Richard Haire	✓	✓	✓	✓	4 of 4
Les Copeland	✓	✓	✓	✓	4 of 4
Rosemary Richards	✓	✓	✓	✓	4 of 4

Statement of principles

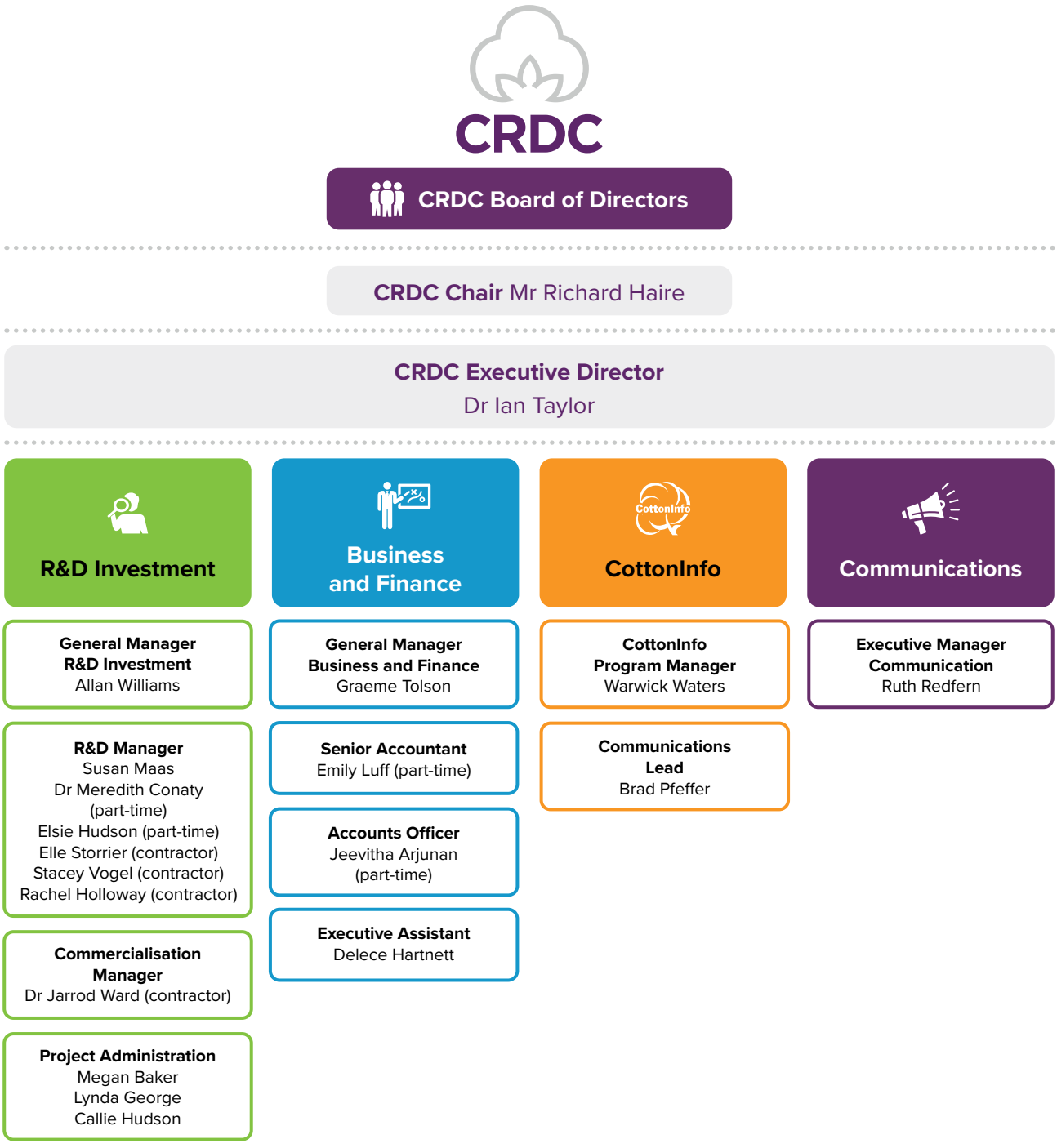
CRDC Directors and staff members are required to:

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

CRDC Employees

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

CRDC Organisational Structure as at 30 June 2022:



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 11 full-time employees and four part-time employees as at 30 June 2022.

CRDC employees

Employee type	2017 –18	2018 –19	2019 –20	2020 –21	2021 –22
Full-time employees	11	9	9	8	11
Part-time employees	2	1	3	2	4
Casual	0	0	0	0	0
TOTAL employees*	**13**	**10**	**12**	**10**	**15**

*CRDC employees as at 30 June each year, excluding contractors. For 2021-22, contractors equalled 1.7 full time equivalents (FTE).

Staff training and development

In 2021–22, CRDC spent $27,997 on training and $2,509 on recruitment. Areas of direct training activities were cyber security training, Microsoft short courses, first aid training, employee and executive coaching, and policy and procedural 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 2022, 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			$5,268				$57,948
Rosemary Richards	Deputy Chair	$26,340			$2,634				$28,974
Les Copeland	Non-executive Director	$26,340			$2,634				$28,974
Ross Burnett	*Non-executive Director*	$26,340			$2,634				$28,974
Gary Fitt	*Non-executive Director*	$26,340			$2,634				$28,974
Danielle Kennedy	*Non-executive Director*	$26,340			$2,634				$28,974
Peta Slack-Smith	*Non-executive Director*	$26,340			$2,634				$28,974
Ian Taylor	Executive Director	$258,165		$18,079	$25,529	$7,444			$309,217
Allan Williams	GM R&D Invest.	$179,890			$18,027	$7,399			$205,316
Graeme Tolson	GM Business & Finance	$176,940			$18,027	$3,110			$198,077
Total		**$825,715**	**-**	**$18,079**	**$82,655**	**$17,953**	**-**	**-**	**$944,402**

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.

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, Fisheries and Forestry.
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, Fisheries and Forestry 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, Fisheries and Forestry 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 2021–22, CRDC has been accountable to the Australian Parliament through the former Minister for Agriculture and Northern Australia, the Hon. David Littleproud MP (July 2021-May 2022), and the Minister for Agriculture, Fisheries and Forestry, Senator the Hon. Murray Watt (May 2022-onwards).

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 2021–22.

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 2021–22 to the then Minister, the Hon. David Littleproud MP on 30 June 2021, with the plan commencing 1 July 2021. The Annual Report for 2020–21 was submitted to the former Minister on 8 October 2021, and the Minister tabled the report in Parliament on 21 October 2021.

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 2021–22.

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 2021–22.

Significant changes in the state of affairs

CRDC had no significant changes in its state of affairs in 2021–22.

Judicial decisions

CRDC had no judicial decisions in 2021–22.

Reviews by outside bodies

CRDC had no reviews by outside bodies in 2021–22.

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 2021–22 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 2021–22
Initiatives during 2021–22 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 2021–22.
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 2021–22.

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 2021–22, 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 2021–22, CRDC spent $1,144,240 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
24hr Business Plan Pty Ltd	Strategic RD&E Plan consulting
Ahurei Pty Ltd	Intellectual Property management services
Argo Fibre Processing	Secretariat services
C&J Phelps Consulting	Program management services
Carolyn Martin	Communications and publications services
Cheryl Durrant	Strategic RD&E Plan consulting
Computers Now Pty Ltd	Information and Technology services
ICD Project Services	Program management services
Ionize Pty Ltd	Cybersecurity services
Jobs Australia Enterprises	Contract staff
KEOwned Pty Ltd t/as KEO Design	Website services
Lee Ellen Armson	Administration services
Macpherson Agronomy Services Pty Ltd	Program management services
Melanie Jenson	Communications and publications services
Neil Deacon Graphic Design	Communications and publications services
Nexia Sydney Audit Pty Ltd	Internal audit services
Rachel Holloway	Program management services
Revolution IT Pty Ltd	Information and Technology services
Shelston IP Pty Ltd	Intellectual Property management services
St Strategic Services Pty Ltd	External investment consulting
Stacey Vogel Consulting	Program management services
The Nickelle Family Trust	Human Resources services
The Strategic Directions Group Pty Ltd	Grant management software consultancy

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 2021–22, CRDC contributed $55,334 to Cotton Australia for industry consultation, capacity building of advisory panel members, and RD&E projects. These funds assist Cotton Australia in 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 2021–22, CRDC contributed a total of $55,054 to Cotton Australia for the following co-funded project activities:

- $40,000 towards the joint Cotton Australia and CRDC Australian Future Cotton Leaders Program
- $15,054 towards CRDC's Innovation Alley at the Australian Cotton Conference 2022, run by Cotton Australia and the Australian Cotton Shippers Association.

Selection Committee Report

CRDC

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

July 2022

Senator the Hon. Murray Watt
Minister for Agriculture, Fisheries and Forestry
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 advise that there were no activities performed by the Cotton Research and Development Corporation (CRDC) Board Selection Committee during the year 1 July 2021 to 30 June 2022.

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

Australian National Audit Office

INDEPENDENT AUDITOR'S REPORT

To the Minister for Agriculture, Fisheries and Forestry

Opinion

In my opinion, the financial statements of the Cotton Research and Development Corporation (the Entity) for the year ended 30 June 2022:

(a) comply with Australian Accounting Standards – Simplified Disclosures 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 2022 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 as at 30 June 2022 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 – Simplified Disclosures 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
38 Sydney Avenue, Forrest ACT 2603
Phone (02) 6203 7300

Auditor's responsibilities for the audit of the financial statements

My objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes my opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with the Australian National Audit Office Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial statements.

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

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

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

Australian National Audit Office

Fiona Sheppard
Acting Executive Director

Delegate of the Auditor-General

Canberra
1 September 2022

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 2022 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, on 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
31 August 2022

Les Copeland
Director
31 August 2022

Ian Taylor
Executive Director
31 August 2022

Graeme Tolson
Chief Financial Officer
31 August 2022

STATEMENT OF COMPREHENSIVE INCOME

for the period ended 30 June 2022

	Notes	2022 $	2021 $	Original Budget $
NET COST OF SERVICES				
Expenses				
Employee benefits	1.1A	**2,288,478**	1,849,622	2,172,000
Suppliers	1.1B	**1,057,381**	803,980	1,272,000
Grants	1.1C	**14,835,113**	14,116,033	15,287,000
Depreciation and amortisation	2.2A	**128,116**	152,821	191,000
Losses from asset sales		**-**	1,650	-
Total expenses		**18,309,088**	16,924,106	18,922,000
OWN-SOURCE INCOME				
Own-source revenue				
Revenue from contracts with customers	1.2A	**3,514,349**	4,176,115	3,481,000
Interest	1.2B	**90,735**	190,616	100,000
Project refunds	1.2C	**997,837**	685,772	250,000
Other revenue		**1,445**	-	-
Total own-source revenue		**4,604,366**	5,052,503	3,831,000
Total own-source income		**4,604,366**	5,052,503	3,831,000
Net (cost of)/contribution by services		**13,704,722**	11,871,603	15,091,000
Revenue from Government				
PIRD Act 1989 Contribution	1.2D	**6,551,777**	2,077,224	4,790,000
Levies and penalties	1.2E	**6,556,360**	2,077,281	4,790,000
Total revenue from Government		**13,108,137**	4,154,505	9,580,000
Surplus/(Deficit) attributable to the Australian Government		**(596,585)**	(7,717,098)	(5,511,000)
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		**(120,436)**	69,865	-
Total other comprehensive income/(loss)		**(120,436)**	143,292	-
Total comprehensive income/(loss) attributable to the Australian Government		**(717,021)**	(7,573,806)	(5,511,000)

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

STATEMENT OF COMPREHENSIVE INCOME (CONTINUED)

for the period ended 30 June 2022

Budget Variances Commentary

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

The original budget is the Corporation's 2021-22 Portfolio Budget Statements (PBS).

Suppliers expense is lower than budget by $0.215 million due to impact of COVID-19 temporarily reducing travel and delaying ICT grant management system enhancements.

Grants expense is lower than budget by $0.452 million due to projects delayed during COVID-19. Contract variations have extended COVID-19 impacted projects and transferred part of the funding to the 2022-23 year.

Project refunds is higher than budget by $0.748 million as a result of an increase in surplus project funds returned by research organisations.

Commonwealth Contributions and Industry Contributions, comprising of industry levies and penalties, higher than budget by $3.528 million as a result of an increase in rainfall increasing cotton production from which industry levies are collected and Commonwealth contributions are determined.

STATEMENT OF FINANCIAL POSITION

as at 30 June 2022

	Notes	2022 $	2021 $	Original Budget $
ASSETS				
Financial assets				
Cash and cash equivalents	2.1A	**15,403,644**	15,129,908	7,115,000
Investments	2.1B	**8,000,000**	7,000,000	10,500,000
Trade and other receivables	2.1C	**2,584,766**	2,413,513	1,327,000
Other investments	2.1D	**92,976**	213,412	144,000
Total financial assets		**26,081,386**	24,756,833	19,086,000
Non-financial assets				
Land and buildings	2.2A	**764,719**	770,000	781,000
Plant and equipment	2.2A	**204,330**	267,316	401,000
Computer software	2.2A	**26,492**	27,879	131,000
Total non-financial assets		**995,541**	1,065,195	1,313,000
Total assets		**27,076,927**	25,822,028	20,399,000
LIABILITIES				
Payables				
Suppliers	2.3A	**195,726**	56,715	200,000
Grants	2.3B	**3,775,146**	2,049,349	4,000,000
Other payables	2.3C	**62,705**	52,503	-
Total payables		**4,033,577**	2,158,567	4,200,000
Provisions				
Employee provisions	3.1A	**582,979**	486,069	454,000
Total provisions		**582,979**	486,069	454,000
Total liabilities		**4,616,556**	2,644,636	4,654,000
Net assets		**22,460,371**	23,177,392	15,745,000
EQUITY				
Reserves		**347,081**	347,081	307,000
Other reserves		**(17,024)**	103,412	-
Retained surplus		**22,130,314**	22,726,899	15,438,000
Total equity		**22,460,371**	23,177,392	15,745,000

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

STATEMENT OF FINANCIAL POSITION (CONTINUED)

as at 30 June 2022

Budget Variances Commentary

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

The original budget is the Corporation's 2021-22 Portfolio Budget Statements (PBS).

Cash and cash equivalents and Investments above PBS by $5.789 million was a result of increase in industry levies collected and Commonwealth contributions, increase in project refunds and reduced expenditure.

Trade and other receivables above PBS by $1.258 million is represented by increases in industry levies collected and held by the Department in June 2022 and matching Commonwealth contributions.

Plant and equipment below PBS by $0.197 million as a result of delayed replacement of motor vehicles and ICT infrastructure during COVID.

Grants payable below PBS by $0.225 million as a result of COVID-19 impacted projects being extended and part of 2021-22 funding being transferred to 2022-23.

STATEMENT OF CHANGES IN EQUITY

for the period ended 30 June 2022

	2022 $	2021 $	Original Budget $
RETAINED EARNINGS			
Opening balance			
Balance carried forward from previous period	**22,726,899**	30,443,997	20,949,000
Adjusted opening balance	**22,726,899**	30,443,997	20,949,000
Comprehensive income			
Surplus/(Deficit) for the period	**(596,585)**	(7,717,098)	(5,511,000)
Total comprehensive income	**(596,585)**	(7,717,098)	(5,511,000)
Closing balance as at 30 June	**22,130,314**	22,726,899	15,438,000
ASSET REVALUATION RESERVE			
Opening balance			
Balance carried forward from previous period	**347,081**	273,654	273,000
Adjusted opening balance	**347,081**	273,654	273,000
Comprehensive income			
Other comprehensive income	**-**	73,427	-
Total comprehensive income	**-**	73,427	-
Closing balance as at 30 June	**347,081**	347,081	273,000
OTHER RESERVES			
Opening balance			
Balance carried forward from previous period	**103,412**	33,547	34,000
Adjusted opening balance	**103,412**	33,547	34,000
Comprehensive income			
Other comprehensive income	**(120,436)**	69,865	-
Total comprehensive income	**(120,436)**	69,865	-
Closing balance as at 30 June	**(17,024)**	103,412	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 2022

	2022 $	2021 $	Original Budget $
TOTAL EQUITY			
Opening balance			
Balance carried forward from previous period	**23,177,392**	30,751,198	21,256,000
Adjusted opening balance	**23,177,392**	30,751,198	21,256,000
Comprehensive income			
Surplus/(Deficit) for the period	**(596,585)**	(7,717,098)	(5,511,000)
Other comprehensive income	**(120,436)**	143,292	-
Total comprehensive income	**(717,021)**	(7,573,806)	(5,511,000)
Closing balance as at 30 June	**22,460,371**	23,177,392	15,745,000

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 2021-22 Portfolio Budget Statements (PBS).

Deficit for the period below PBS deficit by $4.914 million is a result of the higher than budget industry levies collected and Commonwealth contributions, higher than budget project refunds and reduced expenditure, as noted in the budget variance commentary on the Comprehensive Income Statement.

CASH FLOW STATEMENT

for the period ended 30 June 2022

	Notes	**2022 $**	2021 $	Original Budget $
OPERATING ACTIVITIES				
Cash received				
Industry levies and penalties		**6,390,391**	1,326,243	4,790,000
Commonwealth contributions		**6,385,808**	1,326,185	4,393,000
Royalties		**63,940**	68,834	5,000
Grants		**3,905,875**	4,481,880	3,476,000
Interest		**68,037**	229,329	100,000
Net GST received		**993,010**	1,307,998	1,649,000
Other		**1,063,112**	868,252	249,000
Total cash received		**18,870,173**	9,608,721	14,662,000
Cash used				
Employees		**2,185,537**	1,793,924	2,172,000
Grants		**14,345,525**	17,714,277	16,936,000
Suppliers		**1,006,913**	952,565	1,272,000
Total cash used		**17,537,975**	20,460,766	20,380,000
Net cash from/(used by) operating activities		**1,332,198**	(10,852,045)	(5,718,000)
INVESTING ACTIVITIES				
Cash received				
Proceeds from sales of property, plant and equipment		**-**	991	-
Investments		**19,000,000**	33,000,000	20,000,000
Total cash received		**19,000,000**	33,000,991	20,000,000
Cash used				
Purchase of property, plant and equipment		**58,462**	44,066	246,000
Investments		**20,000,000**	23,000,000	14,000,000
Total cash used		**20,058,462**	23,044,066	14,246,000
Net cash from/(used by) investing activities		**(1,058,462)**	9,956,925	5,754,000
Net increase/(decrease) in cash held		**273,736**	(895,120)	36,000
Cash and cash equivalents at the beginning of the reporting period		**15,129,908**	16,025,028	7,079,000
Cash and cash equivalents at the end of the reporting period	2.1A	**15,403,644**	15,129,908	7,115,000

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

CASH FLOW STATEMENT (CONTINUED)

for the period ended 30 June 2022

Budget Variances Commentary

Cash Flow Statement for not-for-profit Reporting Entities

The original budget is the Corporation's 2021-22 Portfolio Budget Statements (PBS).

Industry levies and Commonwealth contributions increased by $3.593 million as a result of higher than budget in industry levies collected and matching Commonwealth contribution determined in accordance with the PIRD Act 1989.

Grant receipts higher than budget by $0.430 million as a result of new research grants being contracted and a 2020-21 grant being received in 2021-22.

Net GST receipts lower than budget by $0.656 million as a result of a decrease in project milestones payable to research organisations.

Other receipts higher than budget by $0.814 million as a result of an increase in surplus project funds returned by research organisations.

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

Grant payments lower than budget by $2.590 million as a result of an increase in grants payable at the end of year.

Supplier payments lower than budget by $0.265 million as a result of a decrease in supplier expenses during the year as noted under the Income Statement.

Investments cash used, net of cash received, is above PBS as a result of an increase in levies and Commonwealth contributions received.

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 – Simplified Disclosure 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.

Standard / Intrepretation	Nature of change in accounting policy, transitional provisions, and adjustment to financial statements
AASB 1060 General Purpose Financial Statements – Simplified Disclosures for For-Profit and Not-for-Profit Tier 2 Entities	AASB 1060 applies to annual reporting periods beginning on or after 1 July 2021 and replaces the reduced disclosure requirements (RDR) framework. The application of AASB 1060 involves some reduction in disclosure compared to the RDR with no impact on the reported financial position, financial performance and cash flows of the entity.

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 2022.

1.1 EXPENSES

	2022 $	2021 $
1.1A: EMPLOYEE BENEFITS		
Wages and salaries	**1,964,063**	1,602,869
Superannuation:		
Defined contribution plans	**201,731**	157,497
Leave and other entitlements	**122,684**	89,256
Total employee benefits	**2,288,478**	1,849,622

Accounting Policy

Accounting policies for employee related expenses are contained in the People and Relationships section.

1.1B: SUPPLIERS		
Goods and services supplied or rendered		
Corporate governance	**178,942**	56,250
Consultants	**97,547**	305,895
Corporate services	**21,166**	17,840
Information technology	**461,236**	241,810
Legal services	**87,257**	9,700
Levy management	**14,927**	10,057
Personnel services	**41,633**	32,749
Property services	**91,256**	68,213
General administration	**32,625**	31,700
Total goods and services supplied or rendered	**1,026,589**	774,214
Goods supplied	**121,822**	94,605
Services rendered	**904,767**	679,609
Total goods and services supplied or rendered	**1,026,589**	774,214
Other suppliers		
Remuneration of auditors	**27,000**	27,000
Workers compensation expenses	**3,792**	2,766
Total other suppliers	**30,792**	29,766
Total suppliers	**1,057,381**	803,980

Lease commitments

The Corporation does not have any current lease arrangements.

1.1 EXPENSES (CONTINUED)

	2022 $	2021 $
1.1C: GRANTS		
Research, Development & Extension (RD&E) Projects		
Australian Government entities	**1,713,810**	2,157,364
State and Territory Governments	**3,699,980**	3,847,179
Universities and Colleges	**4,533,995**	4,692,858
Commercial entities	**4,218,687**	2,916,389
Total contracted RD&E Projects	**14,166,472**	13,613,790
Corporate extension activities	**418,803**	346,449
Total RD&E projects & activities	**14,585,275**	13,960,239
Grant acquittal	**36,505**	-
Transfer from (to) contract asset	**213,333**	155,794
Total grants	**14,835,113**	14,116,033
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	**9,460,608**	8,320,028
Funded through research grant revenue	**1,884,450**	5,135,245
Total research grant commitments payable	**11,345,058**	13,455,273

1.2 OWN-SOURCE REVENUE AND GAINS

OWN-SOURCE REVENUE	2022 $	2021 $
1.2A: REVENUE FROM CONTRACTS WITH CUSTOMERS		
Rendering of services		
Research grants	**3,465,004**	4,104,424
Royalties	**49,345**	71,691
Total revenue from rendering of services	**3,514,349**	4,176,115
Total revenue from contracts with customers	**3,514,349**	4,176,115

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	**2,151,520**

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 at point in time - AASB 15	**1,313,484**
Total research grants	**3,465,004**

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

- Royalties - usage-based	**14,824**
- Royalties - donation	**34,521**
- Royalties - Royalties recognised at point in time - AASB 15	**49,345**

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 (CONTINUED)

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.

	2022 $	2021 $
Rural R&D for Profit - More Profit from Nitrogen: enhancing the nutrient use efficiency of intensive cropping and pasture systems	**-**	300,354
Rural R&D for Profit - Smarter Irrigation for Profit phase 2	**713,105**	3,740,927
Other research grant commitments	**200,000**	122,619
Total research grant commitments receivable	**913,105**	4,163,900

1.2 OWN-SOURCE REVENUE AND GAINS (CONTINUED)

	2022 $	2021 $
1.2B: INTEREST		
Deposits	**90,735**	190,616
Total interest	**90,735**	190,616

Accounting Policy

Interest revenue is recognised by using the effective interest method.

1.2C: PROJECT REFUNDS		
Project refunds	**997,837**	685,772
Total Project Refunds	**997,837**	685,772

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	**6,551,777**	2,077,224
Total revenue from Government	**6,551,777**	2,077,224

1.2E: LEVIES AND PENALTIES		
Industry Levies	**6,551,794**	2,077,207
Penalties	**4,566**	74
Total levies and penalties	**6,556,360**	2,077,281

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.

** From 1 July 2022, as a result of Machiney of Government changes, the portfolio department will now be the Department of Agriculture, Fisheries and Forestry.*

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

	2022 $	2021 $
2.1A: CASH AND CASH EQUIVALENTS		
Cash on hand or on deposit	**15,403,644**	15,129,908
Total cash and cash equivalents	**15,403,644**	15,129,908

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	**8,000,000**	7,000,000
Total investments	**8,000,000**	7,000,000

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	**163,786**	32,178
Contract assets	**-**	213,333
Total goods and services receivables	**163,786**	245,511

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	**1,120,010**	954,041
- Industry levies receivable	**1,120,010**	954,041
Total government receivables	**2,240,020**	1,908,082
Other receivables		
GST receivable from the Australian Taxation Office	**150,314**	251,973
Interest	**30,646**	7,947
Total other receivables	**180,960**	259,920
Total trade and other receivables	**2,584,766**	2,413,513

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

2.1 FINANCIAL ASSETS (CONTINUED)

	2022 $	2021 $
2.1D: OTHER INVESTMENTS		
Shares in unlisted companies	**92,976**	213,412
Net other investments	**92,976**	213,412

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 2021							
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 1 July 2021	**210,000**	**560,000**	199,008	68,308	**267,316**	**27,879**	**1,065,195**
Additions – Purchases	**-**	**10,455**	-	34,157	**34,157**	**13,850**	**58,462**
Depreciation and amortisation	**-**	**(15,736)**	(45,476)	(51,667)	**(97,143)**	**(15,237)**	**(128,116)**
Total as at 30 June 2022	**210,000**	**554,719**	153,532	50,798	**204,330**	**26,492**	**995,541**
Total as at 30 June 2022 represented by							
Gross book value	**210,000**	**570,455**	308,651	342,593	**651,244**	**875,497**	**2,307,196**
Accumulated depreciation, amortisation and impairment	**-**	**(15,736)**	(155,119)	(291,795)	**(446,914)**	**(849,005)**	**(1,311,655)**
Total as at 30 June 2022	**210,000**	**554,719**	153,532	50,798	**204,330**	**26,492**	**995,541**

1. The carrying amount of computer software included $nil (2021: $2,417) purchased software and $26,492 (2021: $25,462) internally generated software..

No indicators of impairment were found in 2022 (2021: $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 $nil for freehold land (2021: $20,000) 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 $nil for buildings on freehold land (2021: $53,427) 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 (CONTINUED)

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:

	2022	2021
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 2022. 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 (2021: 3 to 5 years).

All software assets were assessed for indications of impairment as at 30 June 2022.

2.3 PAYABLES

	2022 $	2021 $
2.3A: SUPPLIERS		
Trade creditors and accruals	**109,935**	56,715
Contract liabilities	**85,791**	-
Total suppliers	**195,726**	56,715

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	**299,080**	316,634
State and Territory Governments	**922,981**	441,980
Universities and Colleges	**1,119,246**	472,768
Other research organisations	**41,000**	76,000
Private sector		
RD&E service providers	**1,392,839**	741,967
Total grants	**3,775,146**	2,049,349

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.
Grants are accrued based on the research grants annual budget in recognition of the project activities being undertaken by the grantee. The grantee is paid on receipt of regular progress reports and approval by CRDC.

2.3C: OTHER PAYABLES		
PAYG & FBT payable	**62,254**	52,503
Other	**451**	-
Total other payables	**62,705**	52,503

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

	2022 $	2021 $
3.1A: EMPLOYEE PROVISIONS		
Leave	**582,979**	486,069
Total employee provisions	**582,979**	486,069

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.

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:

	2022 $	2021 $
Short-term employee benefits	**843,794**	835,266
Post-employment benefits	**82,655**	75,645
Other long-term employee benefits	**17,953**	15,449
Total key management personnel remuneration expenses	**944,402**	926,360

Notes: The total number of key management personnel that are included in the above table is 10 (2021: 14).

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:

	2022 $	2021 $
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
Total transactions with related parties	-	23,210

4. MANAGING UNCERTAINTIES

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

4.1 FINANCIAL INSTRUMENTS

	2022 $	2021 $
4.1A: CATEGORIES OF FINANCIAL INSTRUMENTS		
Financial Assets		
Financial assets at amortised cost		
Cash and cash equivalents	**15,403,644**	15,129,908
Term deposits	**8,000,000**	7,000,000
Trade and other receivables	**194,432**	253,458
Total financial assets at amortised cost	**23,598,076**	22,383,366
Financial assets at fair value through other comprehensive income (investments in equity instruments)		
Shares in unlisted companies	**92,976**	213,412
Total financial assets at fair value through other comprehensive income (investments in equity instruments)	**92,976**	213,412
Total financial assets	**23,691,052**	22,596,778
Financial Liabilities		
Financial liabilities measured at amortised cost		
Grants payable	**3,775,146**	2,049,349
Suppliers payable	**195,726**	56,715
Total financial liabilities measured at amortised cost	**3,970,872**	2,106,064

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.	2022 $	2021 $
Movements in available-for-sale financial assets		
Opening balance	**213,412**	143,547
Fair value gains/(losses) through other comprehensive income	**(120,436)**	69,865
Closing balance of available-for-sale financial assets	**92,976**	213,412

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 other comprehensive income; and

b) 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.

4.1 FINANCIAL INSTRUMENTS (CONTINUED)

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 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

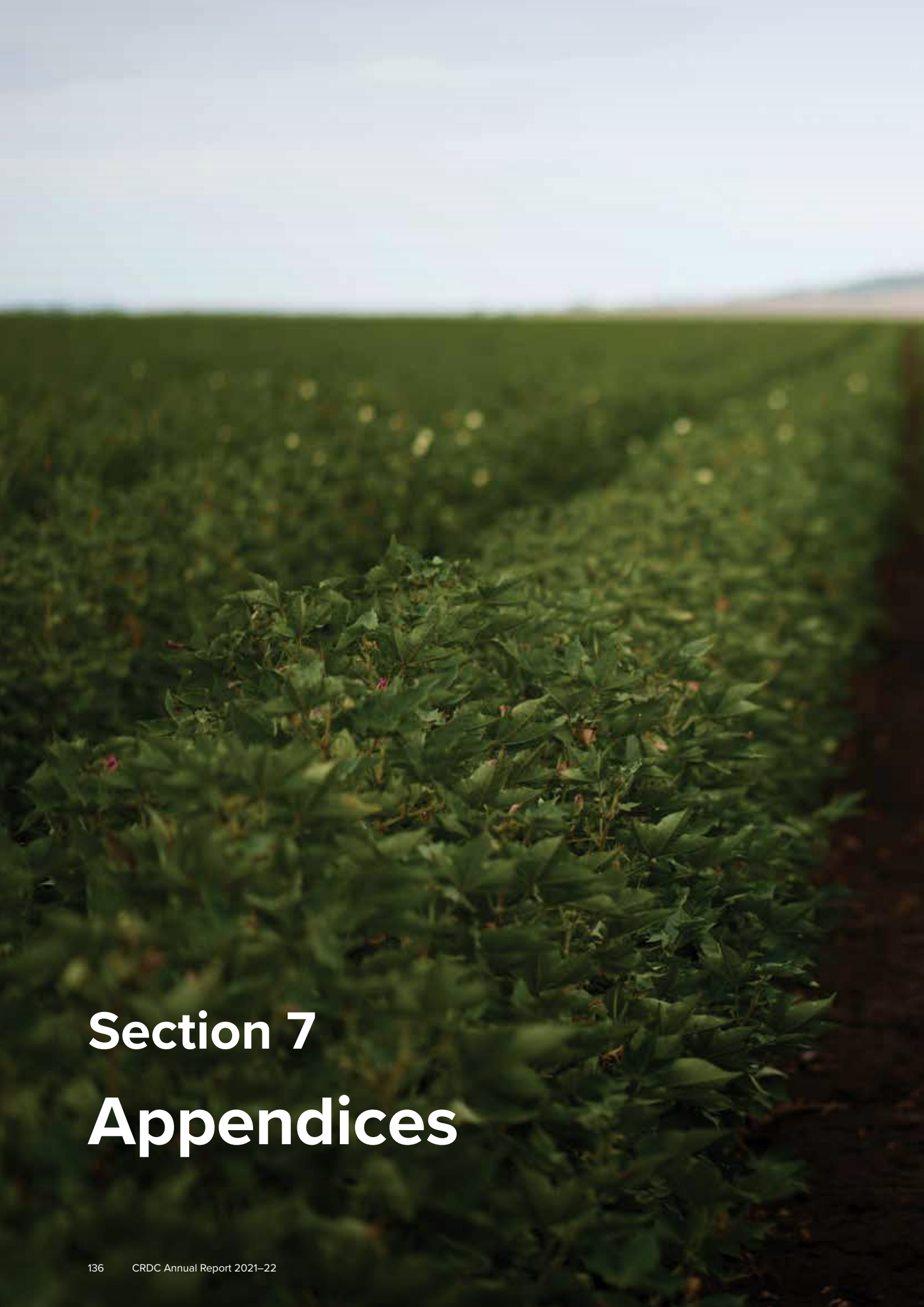
	2022 **$**	2021 $
Financial assets at amortised costs		
Interest revenue	**90,735**	190,616
Net gain on financial assets at amortised cost	**90,735**	190,616
Investments in equity instruments at fair value through other comprehensive income		
Gain/(Losses) recognised in equity	**(120,436)**	69,865
Net gains/(losses) on investments in equity instruments at fair value through other comprehensive income	**(120,436)**	69,865
Net gain from financial assets	**(29,701)**	260,481

5. OTHER INFORMATION

5.1 CURRENT/NON-CURRENT DISTINCTION FOR ASSETS AND LIABILITIES

5.1A: CURRENT/NON-CURRENT DISTINCTION FOR ASSETS AND LIABILITIES

	2022 $	2021 $
Assets expected to be recovered in:		
No more than 12 months		
Cash and cash equivalents	**15,403,644**	15,129,908
Term deposits	**8,000,000**	7,000,000
Trade and other receivables	**2,584,766**	2,413,513
Total no more than 12 months	**25,988,410**	24,543,421
More than 12 months		
Other investments	**92,976**	213,412
Land and buildings	**764,719**	770,000
Plant and equipment	**204,330**	267,316
Computer software	**26,492**	27,879
Total more than 12 months	**1,088,517**	1,278,607
Total assets	**27,076,927**	25,822,028
Liabilities expected to be settled in:		
No more than 12 months		
Suppliers	**195,726**	56,715
Grants	**3,775,146**	2,049,349
Other payables	**62,705**	52,503
Employee provisions	**341,664**	293,798
Total more than 12 months	**4,375,241**	2,452,365
More than 12 months		
Employee provisions	**241,315**	192,271
Total more than 12 months	**241,315**	192,271
Total liabilities	**4,616,556**	2,644,636



Section 7
Appendices

Appendix 1: Australian Government Priorities

CRDC's investments in RD&E during 2021–22 supported the achievement of the Australian Government's Science and Research Priorities and National Agricultural Innovation Priorities, as outlined below.

National Agricultural Innovation Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2021-22
Australia is a trusted exporter of premium food and agricultural products	• Food • Soil and Water • Advanced Manufacturing	• To ensure Australia remains a trusted exporter, CRDC invested in a number of projects in 2021–22, including ensuring an understanding of the implications of European Life Cycle Assessment (LCA)-based labelling legislation (in partnership with GRDC, MLA and AWI); maintaining *my*BMP, the industry's environmental assurance program, to ensure it remains up to date with the latest research information; and collecting and reporting on the key sustainability metrics desired by the market through the publication of the Australian Cotton Sustainability Update 2021 in collaboration with Cotton Australia. • Australian cotton is known for its excellent quality, and CRDC continues to support a dedicated fibre quality technical lead as part of the CottonInfo team. CottonInfo is the Australian cotton industry's extension program: connecting growers and consultants with research, and helping to achieve best practice. It is a partnership between CRDC, Cotton Australia and Cotton Seed Distributors.
Australia will champion climate resilience to increase the productivity, profitability and sustainability of the agricultural sector	• Food • Soil and water • Environmental change • Transport • Resources • Energy • 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 Australian Cotton Sustainability Update 2021 noted that 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. The greenhouse emissions produced per bale of cotton declined, while total emissions from the industry increased due to increased production. • CRDC continues to support a dedicated climate extension technical lead as part of the CottonInfo team. • In addition, a post-doctoral project 'Climate-proofing Australia's cotton industry through improving crop water use and photosynthetic carbon assimilation (Climate-proof cotton)' commenced. This project aims to find genetic pathways to improve the heat and drought tolerance of cotton.

National Agricultural Innovation Priorities	Science and Research Priorities	CRDC RD&E outputs and outcomes 2021-22
Australia is a world leader in preventing and rapidly responding to significant pests and diseases through future-proofing our biosecurity system	• Food • Soil and water • Transport • Environmental change	• CRDC, along with other plant-based RDCs, have continued their partnership with Plant Health Australia and the Department of Agriculture, Fisheries and Forestry in the Plant Biosecurity Research Initiative (PBRI). PBRI coordinates funding for biosecurity research, development and extension and attracts further co-investment. It focuses on biosecurity threats to plant-based industries and developing better preparedness, diagnostics, surveillance and management capabilities in addition to improving industry resilience. • In addition to this partnership, in 2021–22, CRDC commenced a review of the cotton industry's biosecurity plan with Plant Health Australia. • CRDC continued its investment in iMapPESTS, which aims to establish the foundations for a national cross-industry surveillance system using state-of-the-art technologies for the components of a surveillance, diagnostics and data management system. • CRDC also continued to invest to support bringing the BioClay™ technology 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. • Additionally, development of the cotton industry in Northern Australia presents new risks in terms of biosecurity. In 2021–22, CRDC continued its support for crop protection and biosecurity research in Northern Australia as well as virus and vector surveillance linked to Northern Australia Quarantine Strategy activities.
Australia is a mature adopter, developer and exporter of digital agriculture	• Food • Soil and water • Environmental change • Energy	• In 2021–22, the See & Spray™ Select technology developed by USQ and supported by CRDC, Sugar Research Australia and Hort Innovation was successfully commercialised with John Deere. The technology will enhance resistance management, save time and reduce herbicide use. • In addition, technology to enhance irrigation management based on measurement of the temperature of crop canopy was tested in the United States by commercial partner, Discovery Ag (trading as Goanna Ag). • And, in a major partnership with GRDC and Goanna Ag, a spray drift hazardous weather warning system is being established. The system will provide real-time weather data and alerts to growers and spray operators about the presence of temperature inversion. The ability to accurately identify the presence of hazardous temperature inversions will reduce the spray drift risk for growers and spray contractors.

Science and Research Priorities per CRDC RD&E program 2021–22 ($'000)

Science and Research Priorities	Food	Soil and Water	Transport	Cyber security	Energy	Resources	Advanced Manufacturing	Environmental Change	Health	Total
Goal 1	$6,805	$2,996	$0	$0	$0	$0	$545	$74	$0	**$10,420**
Goal 2	$315	$277	$0	$0	$0	$0	$0	$721	$0	**$1,313**
Goal 3	$621	$89	$0	$0	$0	$0	$0	$0	$0	**$710**
Enabling Strategy 1	$1,153	$59	$0	$0	$0	$0	$0	$157	$0	**$1,368**
Enabling Strategy 2	$355	$0	$0	$0	$0	$0	$0	$0	$0	**$355**
TOTAL*	$9,248	$3,422	$0	$0	$0	$0	$545	$951	$0	**$14,166**

* Refer to Note 1.1C in the financial statements.

National Agricultural Innovation Priorities per CRDC RD&E Program 2021–22 ($'000)

National Agricultural Innovation Priorities	Australia is a trusted exporter of premium food and agricultural products	Australia will champion climate resilience to increase the productivity, profitability and sustainability of the agricultural sector	Australia is a world leader in preventing and rapidly responding to significant pests and diseases through future-proofing our biosecurity system	Australia is a mature adopter, developer and exporter of digital agriculture	Total
Goal 1	$234	$5,543	$3,361	$1,282	**$10,420**
Goal 2	$461	$852	$0	$1	**$1,313**
Goal 3	$5	$34	$0	$671	**$710**
Enabling Strategy 1	$116	$98	$228	$925	**$1,368**
Enabling Strategy 2	$0	$0	$0	$355	**$355**
TOTAL*	$816	$6,527	$3,589	$3,234	**$14,166**

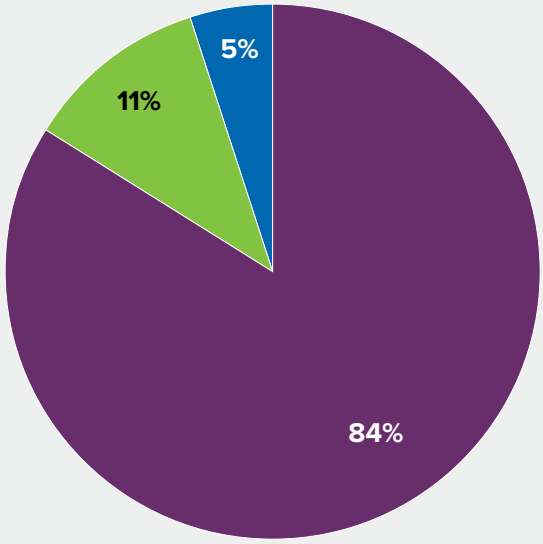
* Refer to Note 1.1C in the financial statements.

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 2021–22

Performance outcomes	CRDC investment
Economic	84%
Environmental	11%
Social	5%
TOTAL	**100%**



CRDC program contribution to economic, environmental, and social outcomes 2021–22 ($'000)

Contributions CRDC programs	Economic Investment total	Environmental Investment total	Social Investment total	Investment total
CRDC programs	**Investment total**	**Investment total**	**Investment total**	**Investment total**
Goal 1	$10,061	$359	$0	**$10,420**
Goal 2	$27	$1,093	$193	**$1,313**
Goal 3	$290	$0	$420	**$710**
Enabling Strategy 1	$1,233	$104	$32	**$1,368**
Enabling Strategy 2	$355	$0	$0	**$355**
TOTAL*	$11,965	$1,556	$645	**$14,166**
Percentage	84%	11%	5%	100%

* *Refer to Note 1.1C in the financial statements.

Appendix 3: RD&E Portfolio

CRDC 2020–21 Project List (as at 30 June 2022)

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
PhD: Assessing yield and fibre quality variability in cotton systems through data science for improved management	US2104	Mikaela Tilse	USYD	Mar-21	Feb-24
1.1.2 Improved input efficiencies					
Identifying the trends and drivers of water productivity in Australian cotton through benchmarking (includes CottonInfo technical lead)	DAN2002	David Perovic / Malim McLeod	NSW DPI	Jul-19	Jul-22
Improving the nitrogen use efficiency of cotton crops through better understanding the role of dissolved organic nitrogen	CSP1904	Dio Antille	CSIRO	Jul-18	Jun-22
More Profit from Nitrogen - Final communications	RRDP2201	Liam Driver	Video Lift	Jul-21	Aug-21
More Profit from Nitrogen - Graphic design services	RRDP2204	Kristy Fielder	Black Canvas Pty Ltd	Aug-21	Sep-21
More Profit from Nitrogen - New technologies and managements: transforming nitrogen use efficiency in cane production	RRDP1719	Matt Redding	QDAF	Sep-16	Sep-21
More Profit from Nitrogen - Project Management Committee meetings	RRDP1722	Allan Williams	CRDC	Jul-16	Sep-21
More Profit from Nitrogen - Project communications	RRDP1735	Allan Williams	CRDC	Jul-16	Jun-21
More Profit from Nitrogen - Science leadership and project coordination	RRDP1711	Marguerite White	ICD Project Services	Nov-16	Sep-21
More Profit from Nitrogen - YourData platform	RRDP1727	Jeff Coutts	Coutts J&R	Feb-17	Jun-21
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
What are the drivers and limitations of practice change for Nitrogen application in the Australian cotton industry	AE2201	Jon Welsh	AgEcon	Jul-21	Mar-22
1.1.3 On-farm sustainable development is supported					
Cotton production and research at 'L'lara' Narrabri 2021-22	US2201	Stephen Cattle	USYD	Oct-21	Sep-22
Cotton production and research at 'Nowley' Spring Ridge 2021-22	US2202	Stephen Cattle	USYD	Oct-21	Sep-22
Limited water decision support	DAN2203	Sarah Dadd	NSW DPI	Jul-21	Jun-24
Optimising dryland cotton production in the Namoi Valley 2020-21	US2102	Stephen Cattle	USYD	Oct-20	Sep-21

Optimising dryland cotton production on the Liverpool Plains 2020-21	US2103	Stephen Cattle	USYD	Oct-20	Sep-21
PhD: Classifying the suitability of Murrumbidgee Valley soils for cotton production	US2002	Jonathon Moore	USYD	Mar-20	Jun-23
Potential for broadacre cropping in the Northern Territory	CRCNA2001	Matt Hall	CRCNA	Jun-19	Dec-22
Science leadership for cotton development in Northern Australia	CSP1903	Steve Yeates	CSIRO	Oct-18	Sep-22
Supporting farming system adaptation to climate and biological threats (including CottonInfo technical leads Paul Grundy and Sharna Holman)	DAQ2201	Paul Grundy	QDAF	Jul-21	Jun-24
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
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					
ASABE seed finger system publication	CRDA2201	Allan Williams	CRDC	Jul-21	Sep-21
Defoliating cotton in an increasingly difficult environment	CRDC2201	Mark Congreve	ICAN	Jul-21	Jun-22
Determining efficacy of microwave treatment for controlling weed cotton, problem weeds and black rot root	CRDC2211	Liam Hescock	Growave Pty Ltd	Sep-21	Nov-21
Future Farm Phase 2: Improving farmer confidence in targeted nitrogen 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	Sep-22
Smarter Irrigation 2: Beyond water smart - Advancing dairy irrigation system performance	RRDP2012	James Hills	UTAS	Jul-19	May-22
Smarter Irrigation 2: Communicating the outcomes	RRDP2207	Cathy Phelps	CRDC	May-22	Jun-22
Smarter Irrigation 2: Cross sectoral integration and extension	RRDP2005	Louise Gall	GVIA	Jul-19	May-22
Smarter Irrigation 2: Dairy case studies	RRDP2211	Lee-Ann Monk	Lee-Ann Monk	Jun-22	Jul-22
Smarter Irrigation 2: Development of information resources	RRDP2210	Annette McCaffery	Annette McCaffery	Jun-22	Jul-22
Smarter Irrigation 2: Economic dairy case studies	RRDP2102	Daniel Armstrong	D-ARM Consulting	Aug-20	May-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: Legacy and instructional videos	RRDP2208	Steve Barratt	MRL Media	May-22	Jun-22
Smarter Irrigation 2: Monitoring and evaluation	RRDP2020	Adam McNeill	KG2	Jun-20	May-22

Smarter Irrigation 2: Monitoring and evaluation case studies and analysis	RRDP2101	George Revell	AgEcon	Jul-20	May-22
Smarter Irrigation 2: Monitoring and evaluation final report	RRDP2206	Lyndal Hasselman	Earth Up Consulting	Apr-22	Jul-22
Smarter Irrigation 2: New tech integrated smart sensing & automation for cotton	RRDP2003	John Hornbuckle	DU	Jul-19	May-22
Smarter Irrigation 2: Plant-based sensing for cotton irrigation	RRDP2006	Hizbullah Jamali	CSIRO	Jul-19	May-22
Smarter Irrigation 2: Precise real-time automated cotton & dairy irrigation for improved water productivity	RRDP2002	Joseph Foley	USQ	Jul-19	May-22
Smarter Irrigation 2: 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 & forums	RRDP2015	Cathy Phelps	CRDC	Nov-19	May-22
Smarter Irrigation 2: Review of existing and planned broadacre irrigation RD&E – desk top study	RRDP2106	Andrew Curtis	Water Strategies Limited	Feb-21	Jul-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: Supporting commercial partnerships	RRDP2205	Dallas Gibb	IP Active	Oct-21	Apr-22
Smarter Irrigation 2: Understanding the irrigation professional development needs of young agronomists and the value proposition of building their skills	RRDP2203	Paul Higgins	Emergent Futures Pty Ltd	Oct-21	Mar-22
Smarter Irrigation 2: Updating the Irrigation Scheduling Tools and Technologies booklet	RRDP2209	Lou Gall	Ace Regional Marketing	May-22	Jul-22
Smarter Irrigation 2: Video training sessions	RRDP2105	Steve Barratt	MRL Media	Nov-20	Jun-22
Smarter Irrigation 2: Videos part II	RRDP2202	Steve Barratt	MRL Media	Oct-21	Jan-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
1.2.2 Cotton farms are digitally enabled					
Digital strategy for the Australian cotton industry - phase 2	CRDC2216	Simon Jenkins	DataGene	Dec-21	Oct-22
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
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					
Climate proofing Australia's cotton industry through improving crop water use and photosynthetic carbon assimilation (Climate-proof cotton)	UWS2201	Demi Sargent	WSU	Jul-21	Jun-24
Cotton disease research review	CRDC2207	Mark Gibberd	Curtin University	Jul-21	Jun-22
Integrated Pest Management to support the management of emerging pests	CSP1905	Simone Heimoana	CSIRO	Jul-18	Jan-22
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					
ARC Research Hub for Sustainable Crop Protection	UQ2001	Neena Mitter	HIA/UQ	Jul-19	Aug-25
Area wide management for cropping systems weeds, investigating the weed management, social and economic opportunity	GRDC2002	Rick Llewellyn	GRDC	Aug-19	Jun-23
Biological based products for improved cotton production	UWS1901	Brajesh Singh	WSU	Jul-18	Aug-22
Characteristics of disease suppressive cotton farming systems and soils understood	DAQ2002	Linda Smith	QDAF	Sep-19	Oct-22
CRDC R&D Manager (disease portfolio)	CRDC2105	Elle Storrier	Macpherson Agronomy Services	Oct-20	Oct-23
Developing proactive approaches to IPM in cotton production systems	CSP2203	Simone Heimoana	CSIRO	Sep-21	Aug-24
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 & the Resistance Management Plan implication	RRDP2108	Wee Tek Tay	CSIRO	Jul-17	Mar-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-23
Modern systems agronomy for resilient cotton production	CSP2001	Katie Broughton	CSIRO	Jan-20	Dec-22
Novel options and strategies for integrated pest management in Australian cotton	CCA2201	Doug McCollum	CCA	Jul-21	Sep-22
Novel topical vegetable, cotton virus and whitefly protection: BioClay	HIA1803	Neena Mitter	HIA/UQ	Feb-18	Jul-21
Plant Biosecurity Research Initiative (PBRI) Phase 2	HIA2101	Jo Luck	HIA	Jul-20	Jun-23
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	Dec-21
Review of the Cotton Industry Biosecurity Plan	PHA2201	Stuart Kearns	PHA	Jul-21	Jun-24
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
Tools for assessing and achieving pesticide sustainability targets for the Australian cotton industry	DAN2201	Mick Rose	NSW DPI	Jul-21	Jun-23
Validation and implementation of new molecular tools for Bt resistance monitoring	CSP2204	Sharon Downes	CSIRO	Sep-21	Aug-24
1.3.3 Industry is prepared for a biosecurity incursion					
Boosting diagnostic capacity for plant production industries	GRDC2001	K'trie Coster	GRDC	Jul-19	Jun-23
Pest Detect: Silverleaf whitefly app commercialisation and development	CRDC2206	Brendan McDonald	Clevvi	Jul-21	Apr-22
GOAL 1 TOTAL: $10.42 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					
Building profitable farming systems for the future through increasing Soil Organic Carbon (SOC) and optimising Water Use Efficiency (WUE) in a changing climate	CRDC2202	Annette McCaffery	DCRA	Jul-21	Jun-23
Cotton Landcare Tech Innovations: Communications support	NLP1903	Bernadette Pilling	HOC	Nov-18	Jul-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-22
Cotton Landcare Tech Innovations: Innovation Alley 2022 Australian Cotton Conference	NLP2201	Stacey Vogel	CRDC	Jun-22	Jul-22
Cotton Landcare Tech Innovations: Updating Birds on Cotton Farms publication	NLP2202	Stacey Vogel	CRDC	Jun-22	Jul-22
Climate Research Strategy for Primary Industries (CRSPI): Developing a common methodology	AIA2102	Alison Laing	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 - phases 1 and 2	CSP2102	Hizbullah Jamali	CSIRO	May-21	Jun-25
Impacts and solutions: A scoping study on relative impacts of irrigation infrastructure on fish	DAQ2101	Michael Hutchison	QDAF	Jul-20	Aug-22
PhD: Farm-wide microgrid decision support system for the Australian cotton industry	UTS1901	Yunfeng (Forrest) Lin	UTS	Aug-18	Sep-22
Quantifying the nitrogen cycle: from farmgate to catchments, groundwater and atmosphere	ANSTO1801	Dioni Cendon	ANTSO	Jul-17	Jun-22
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
Understanding the environmental co-benefits of irrigation water in the northern Murray-Darling Basin	GU2201	Peta Zivec	GU	Jul-21	Jun-24
Updates to Cooler Cotton website	CRDC2217	David McClymont	DHM Environmental Software Engineering	Jul-21	Jun-22

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
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	Aug-22
Threads and opportunities symposium: science engineering sustainable fibres for closing the loop in Australia May 2022	CSP2205	Michiel van Looker-en Campagne	CSIRO	Mar-22	Jun-22
2.3 Measurement and reporting throughout the value chain					
2.3.1 CRDC collaborates in global leadership for sustainability initiatives					
Australian participation in the European Union product environmental footprint technical advisory board	CRDC2008	Angus Ireland	AWI	Sep-19	Dec-22
Cotton industry social and wellbeing sustainability indicators	UC1901	Jacki Schirmer	University of Canberra	Jun-19	Nov-22
Membership of the Sustainable Agriculture Initiative (SAI) platform - Australian chapter	CRDC1902	Selwyn Heilbron	SAI Platform (Aust) Inc	Jul-18	Jun-24
Membership of the Sustainable Apparel Coalition	CRDC2205	Glenn Robinson	SAC	Jul-21	Jun-24
PhD: Textile supply chain transparency and accountability	UL1901	Jacqueline Vates & Mark Sumner	UL	Oct-18	Jun-22
Sustainability metrics for the cotton industry	CRDC1944	Chris Cosgrove	Sustenance Asia	Jun-19	Jun-22
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	Feb-22
Undertaking the Fourth environmental assessment of the Australian cotton industry	CRDC2210	Susan Madden	GHD	Sep-21	Oct-22
GOAL 2 TOTAL: $1.31 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 and 2021	RIR1903	Tristan Richmond	ARLF	May-19	Dec-22
Australian Rural Leadership Program: Course 29, 30 & 31	RIR2201	Tristan Richmond	ARLF	Jul-21	Dec-25
Australian Rural Leadership Program: TRAIL 2022, 2023 & 2024	RIR2201	Tristan Richmond	ARLF	Oct-21	Oct-24
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 2021-22	CSP2102	Michiel van Lookeren Campagne	CSIRO	Jul-21	Jun-22
Future Cotton Leaders Program 2020-21	CA2101	Paul Sloman	CA	Jul-20	Jun-22
Future Cotton Leaders Program 2022 and 2024	CA2201	Paul Sloman	CA	Oct-21	Oct-24
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
Horizon Scholarship 2022: Alya Christophers	RIRDC2203	Abbey O'Callaghan	AgriFutures	Apr-22	Jan-24
Improving grower decision in complex systems: A targeted tool to assist cotton growers in appropriate technology adoption	QUT2001	Geraldine Wunsch	QUT	Jul-19	Nov-22
Nuffield Australia Farming Scholarship	CRDC2301	Jodie Redcliffe	Nuffield Australia	Feb-22	Oct-24
PhD: Drought resilient cotton: Combining synthetic biology solutions to improve cotton productivity under future water limited and heatwave conditions	UWS2202	Garima Dubey	WSU	Mar-22	Mar-25
Science and Innovation Awards for Young People in Agriculture: 2019 & 2020 - Dean Brooks and Dinesh Kafle	ABA1901	Maree Finnegan	ABARES	Jul-18	Jun-22
Science and Innovation Awards for Young People in Agriculture: 2021 & 2022 - Demi Sargent & Xiaoqing Li	ABA2101	Maree Finnegan	ABARES	Jul-20	Jun-23
Summer scholarship: Properties of cement mortar incorporating cotton fibres	UON2201	Ryan Monaghan	University of Newcastle	Dec-21	Feb-22
Supporting adaptive research capacity for careers in the cotton industry	CSP2201	Trudy Staines	CSIRO	Jul-21	Jan-22
Travel: Attend the 2022 Australian Cotton Conference - Dianna Somerville	CRDA2210	Dianna Somerville	RDA Riverina	Jun-22	Aug-22
Travel: Attend the 2022 Australian Cotton Conference - Elizabeth Czislowki	UQ2202	Elizabeth Czislowki	UQ	Jun-22	Aug-22
Travel: Attend the 2022 Australian Cotton Conference - Garima Dubey	UWS2203	Garima Dubey	WSU	Jun-22	Aug-22
Travel: Attend the 2022 Australian Cotton Conference - King Yin Lui	CRDA2207	King Yin Lui	DPIRD	Jun-22	Aug-22
Travel: Attend the 2022 Australian Cotton Conference - Kylie Simpfendorfer	CRDA2206	Kylie Simpfendorfer	DPIRD	Jun-22	Aug-22
Travel: Attend the 2022 Australian Cotton Conference - Ruth Nettle	UM2201	Ruth Nettle	UMELB	Jun-22	Aug-22
Travel: Attend the 2022 Australian Cotton Conference - Thomas O'Donoghue	US2205	Thomas O'Donoghue	USYD	Jun-22	Aug-22

Travel: Attend the 2022 Cotton Conference – Chris Schelfhout	CRDA2205	Chris Schelfhout	DPIRD	Jun-22	Aug-22
Travel: Attend the 2022 Cotton Conference – Jack Daniel	CRDA2211	Jack Daniel	Northern Australian Crop Alliance	Jun-22	Aug-22
Travel: Attend the 2022 Cotton Conference – Peter Shotton	CRDA2212	Peter Shotton	NT DITT	Jun-22	Aug-22
Travel: Attend the 2022 Cotton Conference – Rhys Flynn	CRDA2208	Rhys Flynn	DPIRD	Jun-22	Aug-22
Travel: Attend the 2022 Cotton Conference – Sarah Nolan	CRDA2209	Sarah Nolan	DPIRD	Jun-22	Aug-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	Jun-22
Delivering best practice to manage future workforce skills	CQU2201	Nicole McDonald	CQU	Oct-21	Sep-24
3.1.3 Increased opportunities for innovation skills development					
Designing the integration of extension into research projects	HIA2201	Jane Wightman	HIA	Jan-22	Jul-22
3.2 Futures thinking					
3.2.1 Australian cotton growers are able to adapt to change					
Grassroots Grant: Digitally enabled cotton farms	CGA2102	Amanda Thomas	Macquarie CGA	Sep-20	Jun-22
Grassroots Grant: Increasing cotton grower skills and awareness	CGA2106	Georgie Krieg	Darling Downs CGA	Nov-20	Dec-21
Grassroots Grant: On-farm evaluation of pumping telemetry	CGA2002	Amanda Thomas	Macquarie CGA	Sep-19	Aug-21
Grassroots Grant: Ord & Northern Territory crop development tour	CGA2105	Hollie Gall	Macintyre Valley CGA	Jan-21	May-23
Grassroots Grants: Improving soil on Coleambally community demo farm	CGA2204	James Kanaley	Southern Valley CGA	Dec-21	Dec-22
Grassroots Grants: Central Highlands weather station network	CGA2205	Danni Ingram	Central Highlands CGA	Feb-22	Jun-22
Grassroots Grants: Northern crop production growers guide	CGA2101	Simone Cameron	NTFarmers	Aug-20	Dec-21
Grassroots Grants: Reducing nitrogen losses early season	CGA2202	Peter Birch	Gwydir CGA	Jul-21	Jun-22
Grassroots Grants: The connectivity challenge	CGA2203	Amanda Thomas	Macquarie CGA	Dec-21	Dec-22
Grassroots Grants: Cuttabri weather station	CGA2201	Jeff Hamblin	Lower Namoi CGA	Sep-21	Jun-22
Nuffield Australia Farming Scholarship 2020: Richard Quigley	CRDC2009	Jodie Redcliffe	Nuffield Australia	Apr-19	Dec-22
Rural Safety and Health Alliance collaboration 2021-24	RIRDC2201	Jennifer Medway	AgriFutures	Jul-21	Jun-24
3.2.2 Increased opportunities for strategic foresight					
CRDC investment strategy	CRDC2219	Steve Thomas	ST Strategic Services	Apr-22	Jun-22
CRDC Strategic RD&E Plan - scenario generation and planning workshops	CRDC2204	Cheryl Durrant	Cheryl Durrant	Jul-21	Dec-21
CRDC Strategic RD&E Plan - structure development	CRDC2209	Andrew Baxter	24HR Business Plan	Jul-21	Jun-22
Grower RD&E advisory panels and industry committees 2019-22	CA2002	Sally Ceeney	CA	Jul-19	Jun-22
Sponsorship: CSIRO AgCatalyst 2022	CSP2004	Michiel van Lookeren Campagne	CSIRO	May-20	Nov-22
GOAL 3 TOTAL: $0.71 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, energy and business analysis for cotton growers (including CottonInfo technical lead)	AE2101	Jon Welsh	AgEcon	Jul-20	Jun-23
Cotton industry database management	CRDC2101	Lee Armson	Making Data Easy	Jul-20	Jun-23
CottonInfo field demonstration trial: Demonstrating the ability of the crop to compensate for early season post damage	CSD2104	Amanda Thomas	CSD	Oct-20	Aug-21
CottonInfo field demonstration trial: Head ditch talks	CSD2202	Janelle Montgomery	CSD	Nov-21	Mar-22
CottonInfo field demonstration trial: Optimisation of application in tailwater backup systems	CSD2201	Andrew McKay	CSD	Oct-21	Aug-22
CottonInfo membership Australasia-Pacific Extension Network (APEN)	CRDA2202	Warwick Waters	CRDC	Jul-21	Jun-22
CottonInfo multimedia content development	DAQ2202	Tonia Grundy	QDAF	Jul-21	Jun-24
CottonInfo technical lead for nutrition (includes *my*BMP module lead)	DAN2202	Jon Baird	NSW DPI	Jul-21	Jun-24
CRDC NRM R&D Manager and 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
Proofreading Australian Cotton Production Manual (ACPM) 2021 and Cotton Pest Management Guide (CPMG) 2021	CRDC2108	Helen Dugdale	Helen Wheels HR	Apr-21	Jul-21
4.1.3 Partnerships are strengthened to engage multi-disciplinary and multi-institutional resources					
Agricultural Innovation Australia membership	AIA2101	Allan Williams	AIA	Jul-20	Jun-24
Climate Research Strategy for Primary Industries (CRSPI) 2017-2021	CCR1801	Anwen Lovett	CRSPI	Jul-17	Sep-21
Climate Initiative - learning and evaluation	CRDC2214	Anwen Lovett	CRRDC	Jul-21	Jun-22
Sponsorship: Australasia-Pacific Extension Network conference 2022	CRDA2203	Warwick Waters	CRDC	Jul-21	Jun-22
Sponsorship: NT Farmers Roadshow - Bus tour	CRDA2204	Simone Cameron	NTFarmers	May-22	May-22

4.2 Best practice (*my*BMP)					
4.2.1 Best practice is based on science and measured impact					
Economic data collection	BCA2201	Jono Hart	Boyce	Jul-21	Jun-22
Farm performance – rate of return data for cotton sustainability report	CRDC2208	Simon Fritsch	Agripath	Nov-21	Mar-24
Improving mobile & fixed plant and vehicle safety	RIRDC2202	Jennifer Medway	AgriFutures	Jul-21	Jun-22
Support for the sustainability working group, industry sustainability reporting and integration of research into *my*BMP	CRDC2113	Chris Cosgrove	Sustenance Asia	Apr-21	Jun-24
WHS *my*BMP module review	CRDC2220	Wayne Schwalbach	Employment Mediation	May-22	Jun-22
4.3 Innovation and commercialisation					
4.3.1 Improved R&D innovation and commercialisation					
Commercialisation management tasks	CRDC2002	Jarrod Ward	Ahurei	Jul-19	Jun-24
Commercialisation process coordination and support for Pest Detect SLW App	CRDC2107	Doug McCollum	AGK Services	Oct-20	Dec-21
Commercialisation process coordination and support for WSU plant extract pesticides	CRDC2218	Doug McCollum	AGK Services	Apr-22	Sep-22
Investigating options for protection of multiarray thermal sensor IP	IP2202	Jarrod Ward	Ahurei	May-22	Sep-22
Patent Application No. PCT/AU2021/050903 UWS1401	IP2201	Jarrod Ward	CRDC	Jul-21	Jun-22
Spray drift hazard alert and warning systems	DISA2201	Alicia Garden	Discovery Ag	Jan-22	Jun-28
Storage of mobile hazard towers	CRDC2213	Andrew Baartz	Baartz Electrical	Jul-21	Jun-22
GOAL 4 TOTAL: $1.37 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	Doug McCollum	CCA	Mar-18	Dec-21
Annual consultant qualitative and quantitative surveys 2022-24	CCA2202	Doug McCollum	CCA	Apr-22	Mar-25
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
CRDC stakeholder survey 2022	CRDC2215	Michael Sparks	Intuitive Solutions	Mar-22	Nov-22
5.1.3 CRDC funded projects demonstrate value and return on investment					
CRDC economic impact assessment	AE2202	George Revell	AgEcon	Jun-22	Oct-22
5.1.4 Growers, the cotton industry and government are informed and aware of RD&E outcomes					
Australian Cotton Conference 2022: Innovation Alley	CA2202	Tracey Byrne-Morrison	CA	May-22	Nov-22
GOAL 5 TOTAL: $0.36 MILLION					

TOTAL INVESTMENT IN RD&E: $14.17 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
Bollgard 3®	Cotton varieties contain three genes resistant to *Helicoverpa* spp.
Bollgard II®	Cotton varieties contain two genes resistant to *Helicoverpa* spp.
CA	Cotton Australia
CCA	Crop Consultants Australia Inc.
CGA	Cotton Grower Association
CHDC	Central Highlands Development Corporation
CottonInfo	Joint venture between CRDC, Cotton Australia and CSD to deliver cotton extension activities
CottonLEADS	Australian and United States program to lead responsible cotton production sustainably
CQ	Central Queensland
CQU	Central Queensland University
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
DAFF	Department of Agriculture, Fisheries and Forestry
DCRA	Dryland Cotton Research Association
DJPR	Department of Jobs, Precincts and Regions (Victoria)
DPIRD	Department of Primary Industries and Regional Development (Western Australia)

DU	Deakin University
GM	Genetically Modified
GMO	Genetically Modified Organism
GRDC	Grains Research and Development Corporation
GU	Griffith University
GVIA	Gwydir Valley Irrigators Association
ha	Hectare
HIA	Horticulture Innovation Australia (Hort Innovation)
HOC	House of Communications
HRMS	Herbicide Resistance Management Strategy
ICAN	Independent Consultants Australia Network
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
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
NT DITT	Northern Territory Department of Industry Trade and Tourism
PBRI	Plant Biosecurity Research Initiative
PBS	Portfolio Budget Statements
PGPA Act	*Public Governance, Performance and Accountability Act 2013*
PHA	Plant Health Australia
PhD	Doctor of Philosophy
PIRD Act	*Primary Industries Research and Development Act 1989*
QAAFI	Queensland Alliance for Agricultural and Food Innovation
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
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
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, the PGPA Rule, and the CRDC Funding Agreement.

Annual Report item	PIRD Act	PGPA Act / PGPA Rule	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	s28(a)(i)	s39(1)(b) s17BE (g)	Clause 9.2(a-d)
Year in review: RD&E highlights	s28(a)(i) 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(a)(ii) s28(d)	s17BE(b)	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) s17BE(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)(i) s28(a)(ii) s28(a)(iv) s28(a)(v) s28(a)(vi) s28(c) s143(2)	s17BB s17BE (a), (b), (c), (d), (e), (f) & (t)	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)(ii) s28(a)(viii) s28(d)	s43(4) s17BE(b) 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) s28(a)(ii)	s17BB s17BE(b)	Clause 9.2(a-d)
Appendix 2: Environmental performance	s28(a)(i) s28(a)(ii)	s17BE(b)	Clause 9.2(a-d)
Appendix 3: RD&E Portfolio list	s28(a)(i) s28(a)(ii)		
Appendix 4: Glossary & acronyms		s17BD	
Appendix 5: Annual reporting requirements		S46(3) s17BD s17BE (u)	Clause 9.2(a-d)

NB: Section 28(a)(ia) of the PIRD Act is not applicable to CRDC.

CRDC

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