COTTON AUSTRALIA

CRDC
COTTON RESEARCH AND DEVELOPMENT CORPORATION

AUSTRALIAN COTTON INTEGRATED SUSTAINABILITY REPORT 2024

AUSTRALIAN COTTON SUSTAINABILITY FRAMEWORK

PLANET. PEOPLE. PADDOCK.

www.australiancottonsustainability.org.au

THE AUSTRALIAN COTTON INDUSTRY...

Up to 1,500 farms, depending on seasonal conditions.

Direct employment on farms and gins of **7,222 people**.

A collaborative industry structure:

- COTTON AUSTRALIA — Policy & advocacy
- CRDC — Research & development
- CottonInfo — Extension of research to growers
- myBMP — Adoption of best practice by growers

PRODUCES COTTON LINT AND SEED...

$3.1 billion gross value of production in 2024.

Long term trend of **2.4 times more cotton from 1.7 times more land** over the past 30 years (based on five-year averages).

Australian cotton production (million bales)

WITHIN A COMPLEX OPERATING ENVIRONMENT.

INSIDE OUR CONTROL
- Policies & strategic direction
- Efficient resource use
- Use of innovation & technology
- Quality of Australian cotton.

OUTSIDE OUR CONTROL
- Seasonal and climatic changes
- Macroeconomic conditions
- Tariffs & other trade barriers
- Domestic legislation.

COMPETITIVE ADVANTAGES
- **High quality** cotton fibre with a track record of quality improvements over time
- ***myBMP*** certification program & **PLANET. PEOPLE. PADDOCK.** Sustainability Framework
- **Natural and biodegradable** fibre.

PLANET. PEOPLE. PADDOCK. COORDINATES A WHOLE-OF-INDUSTRY APPROACH TO...

AUSTRALIAN COTTON SUSTAINABILITY FRAMEWORK
PLANET. PEOPLE. PADDOCK.

IDENTIFY NON-FINANCIAL RISKS & OPPORTUNITIES...

- Water
- Greenhouse gas emissions
- Native vegetation
- Pesticides
- Soil Health
- Workplace
- Productivity
- Economic contribution

AND APPLY STRATEGIES TO MANAGE THEM.

THIS INTEGRATED REPORT DESCRIBES THE AUSTRALIAN COTTON INDUSTRY'S SUSTAINABILITY IMPACTS & PROGRESS FOR THE YEAR TO JUNE 2024 + LONGER TERM TRENDS.

AUSTRALIAN COTTON 2024 SUSTAINABILITY SNAPSHOT

Annual performance and trends.

In farming systems, seasonal variations can make a single year look much better or worse than average. As a result, in the body of this report, data is reported for multiple indicators to show change over one year, and change over longer periods to give a truer indication of what is happening. The snapshot below summarises 2023/24 annual change and longer-term trends:

- Clear positive annual change; clear positive trend over the previous five years
- No significant change; generally flat trend
- Clear negative annual change; clear negative trend over the previous five years.

		SDG Alignment	Targeted Outcomes	Five-year trend	2024	KEY 2024 TAKEOUT
PLANET	**Water**	6 CLEAN WATER AND SANITATION	Increase water use efficiency, within sustainable river and ground system limits	−	−	**Water use efficiency improved slightly.** About 50 per cent less water is used to grow a bale of cotton compared to 1997 in most seasons. In very wet or dry seasons, water efficiency is lower.
	Soil	2 ZERO HUNGER	Sustained cotton productivity growth by improving soil health	−	No annual data	**Regenerative soil health practices are commonly used by growers.** The cotton industry is collaborating with other sectors on a consistent way to measure soil health.
	Biodiversity	15 LIFE ON LAND	Native vegetation management on cotton farms contributes to regional priorities	−	−	**Around four per cent of the area of an average cotton farm is actively managed for conservation.** A collaborative project to manage and measure native vegetation on cotton farms continued to progress.
	Greenhouse gases	13 CLIMATE ACTION	Contribute to the Paris Agreement's aim of a climate neutral world	−	−	**Defining a credible long-term emission reduction path is a current priority.** On average 55 per cent of greenhouse gas (GHG) emissions come from fossil fuels in fertiliser manufacturing and farm machinery, and 40 per cent come from on-farm nitrogen use.
	Pesticides	2 ZERO HUNGER	Support optimal crop production while having no negative impact on human & environmental health	+ Bees × Algae	+ Bees × Algae	**The hazard to bees (from insecticides) and algae (from herbicides) reduced by 91 per cent and 52 per cent respectively since 2004.** However, successive wet seasons and harder-to-control weeds have increased herbicide use in recent years.
PEOPLE	**Workplace**	3 GOOD HEALTH AND WELL-BEING 8 DECENT WORK AND ECONOMIC GROWTH	Keep farmers & core employees Attract casuals & contractors Keep everyone safe & skilled	No trend data No trend data No trend data		**New, insightful indicators are being worked on.** Our revamped sustainability data framework has made our workplace dependencies and impacts clearer and sharpened our thinking on how to measure them. Data will be reported from next year.
PADDOCK	**Productivity**	2 ZERO HUNGER	Increase yield within sustainable environmental boundaries	+ Irrigated + Dryland	− Irrigated − Dryland	**4.8 million bales picked, 78 per cent more than the long-term (35 year) average.** The yield gap between irrigated and dryland cotton shows the importance of sustainable withdrawal of water to deliver sustainable intensification.
	Economic contribution	8 DECENT WORK AND ECONOMIC GROWTH	Resilient farms able to invest in their business & community	+	−	**$3.1 billion** gross value of production in 2024. On average, 67 per cent of gross irrigated cotton revenues flow back into the economy.

ABOUT THIS REPORT

Time frame: One year to 30 June 2024.

Boundary: Australian cotton farms: inputs and on-farm activities.

Frequency: The Australian cotton industry publishes annual sustainability reports. These reports show progress for one year, and trends over five years or longer wherever possible.

Transparency: The Australian cotton industry is focused on transparency. To support this, an online data pack has links to data sources, explanations of methodologies, and assumptions for all data in this update. All data and statements are validated internally, but not third-party verified.

> MORE DETAIL: AUSTRALIAN COTTON SUSTAINABILITY DATA PACK.

Links to other online documents to give more detail to readers are provided throughout this update, wherever you see > MORE DETAIL.

New sections or restatement of previously reported data are clearly marked NEW. NEW

Basis of preparation:

This is the Australian cotton industry's first Integrated Report. It aims to clearly show how the natural, human and economic resources the industry relies on to grow cotton are interlinked, and how a positive or negative impact on one resource can have positive or negative impacts on others.

Disclosures on risk, strategy, governance and metrics for this report are closely aligned to the requirements of the International Sustainability Standards Board's IFRS S1 and S2 sustainability disclosure standards that many of our value chain partners use. While aligned, disclosures in this report are not in accordance with those standards because they are not designed for industry-scale reporting.

Environmental indicators are aligned to Climate-Related Financial Disclosures legislation and Taskforce for Nature-Related Financial Disclosures. Social and economic indicators are aligned to the Global Reporting Initiative. Not all indicators in these disclosure frameworks are reported, either because industry scale data of sufficient accuracy is not available, or because indicators are not relevant to the cotton industry. This report also includes indicators not within these disclosure frameworks, because we have assessed them as important measures of Australian cotton production impacts and dependencies. The Sustainability Data Pack, above, cross-references cotton's PLANET. PEOPLE. PADDOCK. indicators to indicators in multiple disclosure standards.

STATEMENT OF COMMITMENT

Australian cotton growers can point to decades of improvement in many sustainability areas. PLANET. PEOPLE. PADDOCK. is the industry's framework to continue that trend.

The value of sustainability to cotton growers is clear: carefully managing the natural, human and economic resources they depend on makes a farm more efficient, productive, and resilient to seasonal, economic or political shocks.

This report summarises work we are taking to deliver this value to its growers, and the collective progress of the industry. It also distils our strategies to improve, and to give stakeholders inside and outside the industry confidence a clear and credible path for future coordinated and collaborative action is in place.

The Boards of Cotton Australia and the Cotton Research and Development Corporation (CRDC) fully support the PLANET. PEOPLE. PADDOCK. Sustainability Framework and are committed to remaining accountable for the impacts of the Australian cotton industry.

Richard Haire
Chair, CRDC

Liz Stott
Chair, Cotton Australia

The Australian cotton industry acknowledges the Traditional Custodians of the lands of Australia's cotton communities and recognises their enduring connection to the land and waterways that sustain us. We value the Aboriginal and Torres Strait Islander people who have cared for this country for thousands of years. We pay our respects to their Elders past, present and emerging, and extend that respect to all First Nations peoples today.

COVER IMAGE

We value collaboration and transparency, inside and outside the industry. One example of this is Camp Cotton. This Cotton Australia initiative brings customers, merchants and others in our value chain from around the world to see in person how the Australian cotton industry operates.

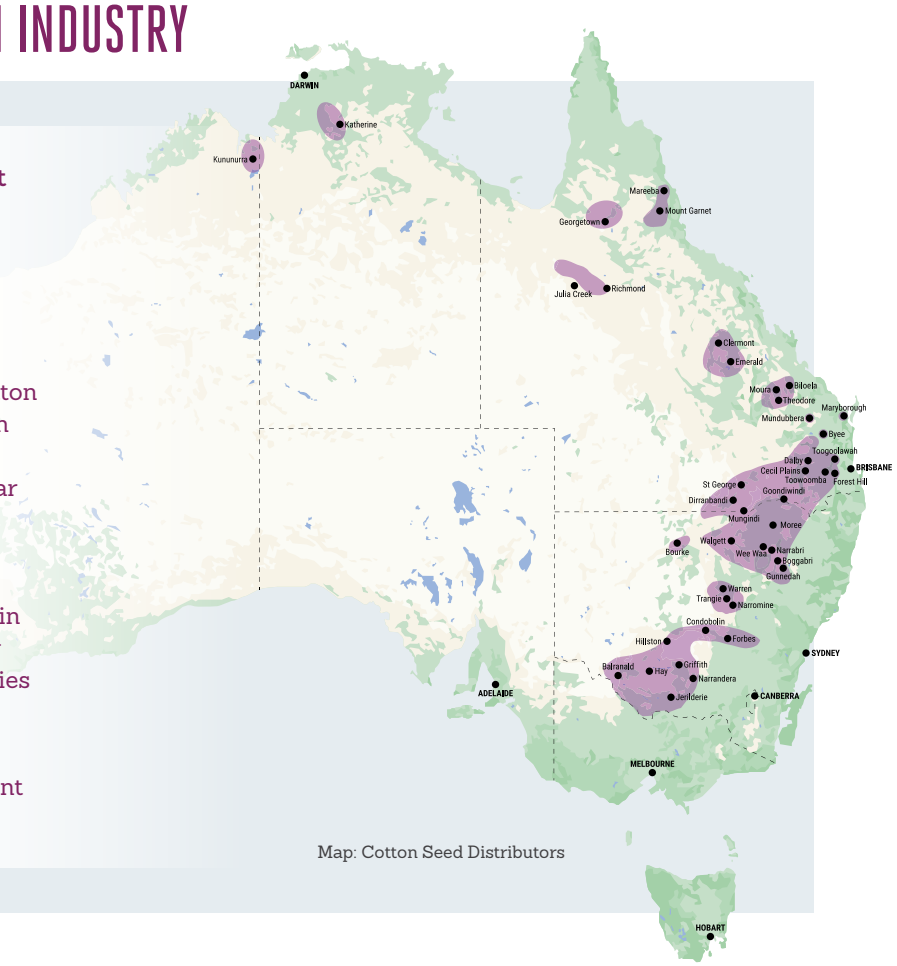
Photos used in this report courtesy of Cotton Australia and CRDC.

ABOUT THE AUSTRALIAN COTTON INDUSTRY

Cotton is a renewable food and fibre that is recyclable and biodegradable. Grown around the world for thousands of years, the cotton plant is a leafy green shrub in the same family as the hibiscus.

Cotton is grown mainly on family farms in inland eastern Australia. In recent years, cotton has also been grown in northern Australia. In 2023/24, about four per cent of the national area was sown in northern Australia, a similar proportion to the previous two seasons.[i] Strict State and Territory regulations are in place to protect the unique environment in these areas. The cotton industry's objective in these new growing regions is to respectfully cooperate with governments and communities to contribute to their stated sustainable development goals.

After picking, cotton is sent to a gin where lint is separated from seeds.



Map: Cotton Seed Distributors

Each kilogram of picked cotton is about:

8 per cent **leaf**

Leaf and other organic plant matter can be composted and added back into soil, under controlled composting systems.

50 per cent **seed**

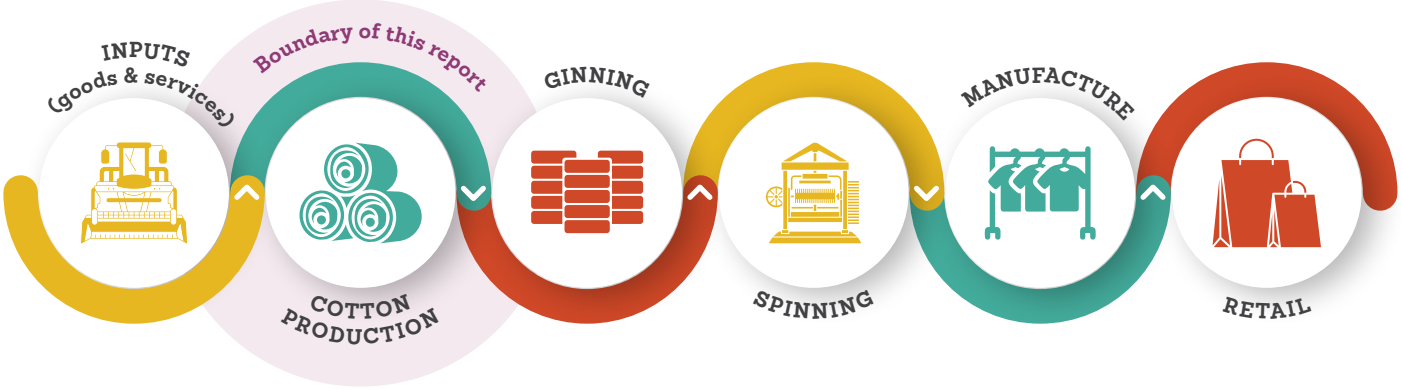
Each kilogram of seed yields about 200 grams of cotton seed oil for cooking and food products. The remaining meal and hulls are used for stock feed.

42 per cent **lint**

Lint is spun into yarn to make a wide range of fabrics. There are no spinning mills in Australia; all lint is exported.

1 kg OF AUSTRALIAN COTTON LINT CAN PRODUCE[ii]: **5.3** T-SHIRTS OR **19** PAIRS OF SOCKS OR **1.1** PAIRS OF JEANS

The cotton lint value chain:



COTTON PRODUCTION MATCHES ANNUAL WATER AVAILABILITY

As cotton is an annual crop, growers adjust the area of cotton they plant each year to reflect changing seasonal conditions. As a result, the area of cotton planted and amount of cotton picked each year is closely tied to water availability, which varies dramatically.

Governments regulate sustainable water use limits to ensure the needs of the environment and humans are met before any water is allocated for irrigation.

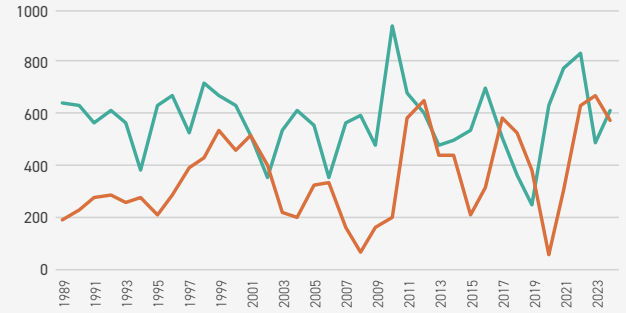
This means the amount of water available for irrigation varies each year with the volume of water in rivers, dams and aquifers.

The top right graph shows there is often a lag between wet or dry years and the area of cotton planted. This is because water is often stored in farm or public dams: it might be a very dry year, but water stored in dams from previous wet seasons allow cotton to be sustainably grown, or it might be a very wet year, but low levels of water in dams from previous dry years prevent large areas of cotton being planted.

When irrigation water is available to farmers, they choose what crop is best to grow with the water made available to them.

Within this water system regulated by governments for sustainable withdrawals, the focus of every cotton grower is to use water as efficiently as possible.

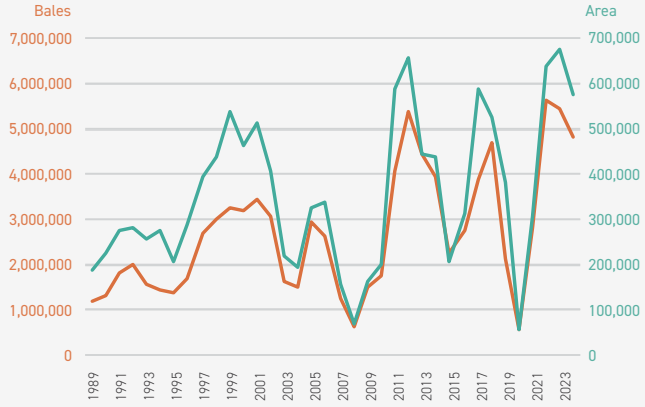
Australian cotton production and average rainfall in traditional cotton-growing regions



Average rainfall mm Total Area '000 ha

Source: Bureau of Meteorology Australian Water Outlook

Australian cotton area and production



Source: Cotton Australia Bales picked Area planted (ha)

2023/24 INSIGHTS (AREA AND YIELD)

Continuing good seasonal conditions saw another large area planted and 4.8 million bales picked. This is **the fourth-largest crop in the industry's history**.

Australian cotton growers have improved their productivity over time. From 1994 to 2024, the five-year average area planted to cotton increased by 71 per cent while production increased 139 per cent.[iii]

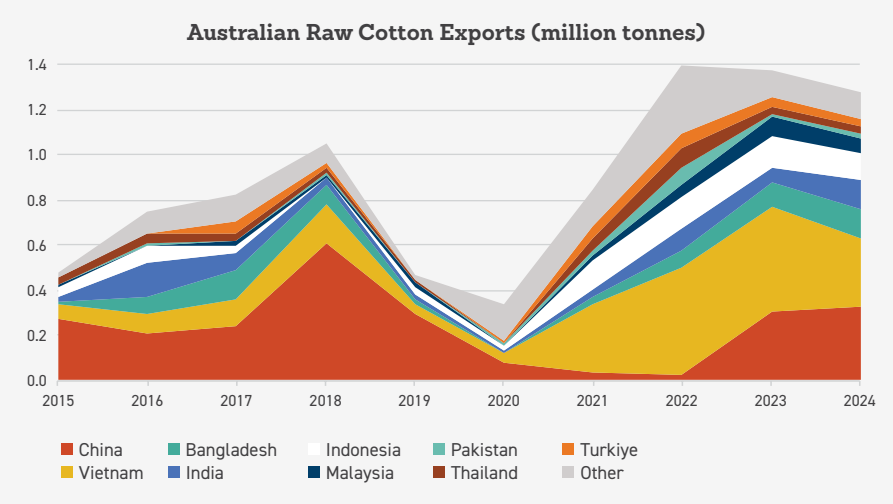
OPERATING ENVIRONMENT

MARKETS

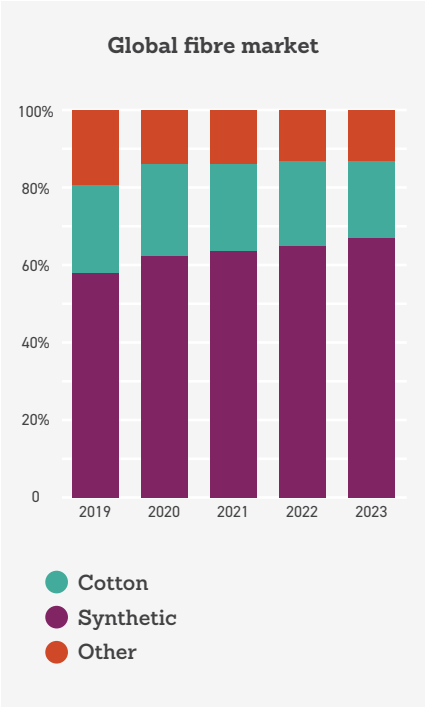
Cotton is Australia's fourth largest agriculture export by value, behind beef, wheat and dairy.

Australian raw cotton lint is sold to spinning mills across a range of export markets, with the top 10 mostly located in Asia and the Subcontinent. These mills spin the fibre into yarn, which is then supplied to textile manufacturers around the world.

In 2020, Australia's cotton export markets underwent a major shift due to global trade disruptions, with market diversification pursued as a deliberate, strategic response.



Source: Australian Cotton Shippers Association via ABS data



Source: Textile Exchange

COMPETITORS

Cotton is grown in more than 70 countries around the world, with China, USA, India, Pakistan and Brazil the world's biggest producing nations. Many producing countries retain significant volumes for their own spinning, weaving and manufacturing industries, making the USA, Brazil and Australia the dominant suppliers in the global cotton export market.

Australia's main competitors in the global cotton market are USA and Brazil, along with man-made fibres such as polyester and nylon which compete on price, availability and performance, but lack cotton's natural and biodegradable qualities.

A record 124 million tonnes of fibre was produced globally in 2023. Cotton accounted for 20 per cent of this production, second to polyester's 57 per cent of global production[iv]. Other fibres used in textiles includes synthetics like nylon, and natural fibres like wool and mohair.

Competitive advantages

The merchants who market and export Australian cotton report it is globally recognised for its exceptional spinnability, driven by premium fibre qualities such as length, strength, and micronaire[v]. Combined with strong sustainability credentials, low contamination, short shipping times, reliable and trusted suppliers, and a stable political environment, makes Australian cotton highly sought-after across international markets.

REPUTATION

Community trust in agriculture research shows trust and acceptance of the cotton industry has been slowly increasing in recent years[vi]. Australian cotton industry trust and acceptance are driven primarily by the perception the community holds of cotton's environmental performance and the way the industry responds to community concerns. Water use is the most important component of this, and community perceptions are closely related to seasonal conditions: trust is lower in drier seasons when water is scarce.

We've been working for over three decades to improve and demonstrate our environmental performance, to acknowledge transgressions (for example, by reporting instances of water breaches in these annual sustainability reports), and to continue to set a strong expectation that every one of the 1,500 or so cotton growing farms in Australia adhere to all environmental legislation. The fourth decadal independent environmental assessment, conducted by GHD and published in 2024, reported the Australian cotton industry has made great strides in its environmental management and reporting systems, with clear signs of collaboration across the industry and a high level of observed on-farm environmental performance.

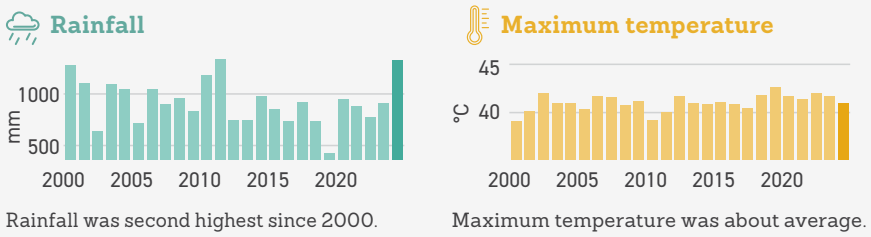
PHYSICAL

Australian **temperatures** have warmed by a mean of 1.4°C on land since national records began in 1910.[vi] Australian **rainfall** is highly variable and is strongly influenced by drivers such as El Niño and La Niña. Despite this natural variability, long term trends are showing a shift towards drier conditions in southern Australia and increased rainfall in northern Australia.[vii]

This natural variability is seen in three of Australia's many cotton growing regions. In 2023, rainfall was about average in Central NSW and Central Queensland, but well above average in Katherine in northern Australia.[viii]

Increasing global temperatures are likely to increase biosecurity risks through new pests and diseases. Cotton growers and other farmers spend significant time and money managing vertebrate pests and weeds, which ABARES estimates cost Australian farmers at least $5.3 billion per year.[ix]

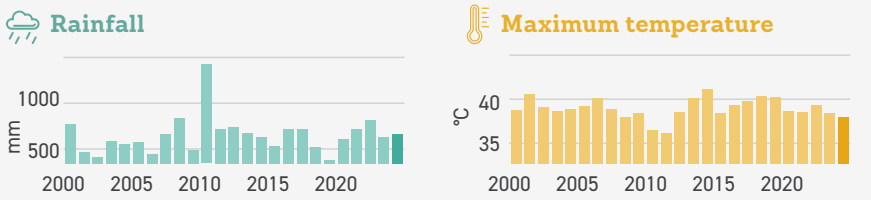
Katherine (Northern Territory)



Rainfall was second highest since 2000.

Maximum temperature was about average.

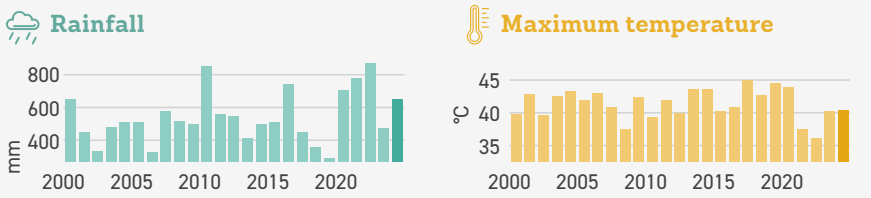
Fitzroy Basin NRM (Central Queensland)



Rainfall was about average.

Maximum temperature was below average.

Central West NRM (New South Wales)



Rainfall was above average.

Maximum temperature was about average.

Source: Australia's Environment in 2023, Terrestrial Ecosystem Research

TECHNOLOGY

Digital and autonomy

Technology is changing all aspects of cotton production, including field machinery, environmental sensors and farm software. Cotton growers have a track record of quickly adopting technologies that have a clear positive impact on their farm business. Key challenges for cotton growers are having sufficient mobile and internet connectivity to make the most of technology, and having earlier access to technologies (especially those developed overseas) as they are proven to be commercially viable.

Human capital

The uptake of digital and autonomous technologies is important to support cotton farm productivity and mitigate a continuing shortage of labour in agricultural industries. Availability of technology on farms can make jobs safer and more interesting. This in turn helps keep people on farms, attract new people to the industry, and keep everyone safer.

SOCIO-ECONOMIC

Economic

Cotton prices are forecast to rise and fall over coming years, in a highly uncertain supply and demand environment. The Reserve Bank of Australia reports "the global economic outlook is highly uncertain; various US policies and responses by other countries could materially affect trading partner growth and inflation outcomes." The outlook for Australian cotton prices over the next five years is variable, with trade shifts, seasonal conditions in major producing countries and consumer demand all impacting the price paid to farmers.[xi]

Geopolitical

The significant geopolitical uncertainty and changes being experienced around the world have the potential to impact input supplies, markets, and prices. Diversification of markets and supply chains, and continuing investment in partnerships, are increasingly important to mitigate geopolitical risks and opportunities.

Regulatory

Australian cotton growers operate in a heavily regulated environment. *my*BMP supports growers to meet regulatory requirements, with detailed checklists of applicable State and Federal legislation covering human rights, pesticide and water use and many other farm practices. The PLANET. PEOPLE. PADDOCK. Sustainability Framework responds to these changes, for example by aligning this sustainability report to climate financial disclosure legislation and potential future nature positive disclosures.

HOW THE AUSTRALIAN COTTON INDUSTRY MANAGES SUSTAINABILITY

AUSTRALIAN COTTON SUSTAINABILITY FRAMEWORK
PLANET. PEOPLE. PADDOCK.

PLANET. PEOPLE. PADDOCK. is the Australian cotton industry's framework to manage non-financial risks and opportunities. It delivers value to Australia and to cotton farmers by supporting the Australian cotton industry's productivity, resilience and market access. It does this by:

- Monitoring stakeholder expectations and the industry's operating environment
- Prioritising the most important risks and opportunities and coordinating a whole-of-industry response
- Measuring progress and quantifying impacts, and transparently communicating these to stakeholders.

PLANET. PEOPLE. PADDOCK. complements *my*BMP and other industry programs.

> MORE DETAIL: FRAMEWORK OVERVIEW

GOVERNANCE

The Australian cotton industry's Sustainability Working Group (SWG) coordinates PLANET. PEOPLE. PADDOCK. The SWG is comprised of representatives from:

- **Cotton Australia:** the industry's peak body, funded by voluntary grower levies, responsible for advocacy and policy development on behalf of Australia's cotton growers
- **Cotton Research and Development Corporation (CRDC):** responsible for the industry's research, development and extension[1] (RD&E), co-funded by compulsory grower levies and the Federal government
- **CottonInfo:** the industry's extension body, a partnership between Cotton Australia, CRDC and CSD
- ***my*BMP:** the industry's on-farm best management practices (BMP) assurance program, co-funded by Cotton Australia and CRDC
- **Australian Cotton Shippers Association:** the peak body of merchants who buy cotton from Australian growers and sell it to spinning mills around the world.

The SWG reports to the Boards of Cotton Australia and CRDC.

[1]"Extension" is an agricultural term for extending research and innovation to farmers in a form they can understand, assess and adopt.

RISK AND OPPORTUNITY IDENTIFICATION AND MONITORING

Quarterly scan

Each quarterly SWG meeting includes a scan of potential risks and opportunities. These are identified through sources including stakeholder feedback, peer-based norms, and physical and transition types of risk and opportunity. The SWG assesses emerging issues for materiality using defined criteria to rate:

- Stakeholder importance
- Financial impact to the industry
- Impact on the industry's environmental, social and economic dependencies
- Likelihood.

Annual review

Industry-scale sustainability data is aggregated annually, or more frequently if data is available. The SWG reviews data to consider the progress of existing actions to achieve targeted outcomes. If new or corrective actions are needed, these are discussed with key personnel in the industry's established programs for RD&E, adoption, and policy.

Decadal independent assessment

The Australian cotton industry has commissioned an independent assessment of its environmental impacts every 10 years since 1991, the first major Australian agricultural industry to do so. These assessments are used to provide a third-party expert assessment of what the industry is doing well, and importantly, identify what can be improved.

> MORE DETAIL: 2024 FOURTH INDEPENDENT ENVIRONMENTAL ASSESSMENT

AUSTRALIAN COTTON AND THE SDGs

The UN Sustainable Development Goals (SDGs) provide a blueprint for humanity to achieve a just and sustainable world. To reach that future, everyone needs to play their part. Each Australian cotton targeted outcome is aligned to a relevant SDG and SDG target. In this way, the Australian cotton industry aims to play its part to create a just and sustainable world.

> MORE DETAIL: AUSTRALIAN COTTON AND THE SUSTAINABLE DEVELOPMENT GOALS

STRATEGY FOR MANAGING SUSTAINABILITY RISKS AND OPPORTUNITIES

PLANET. PEOPLE. PADDOCK. has three strategic pillars.

Embed sustainability into industry plans and culture.

The CRDC 2023-28 Strategic RD&E Plan, Clever Cotton, is closely integrated with the industry's sustainability framework, with the same three pillars: Paddock, People, Planet.

> MORE DETAIL: CLEVER COTTON STRATEGIC PLAN

Sustainability is one of five pillars in the Cotton Australia 2023-28 Strategic Plan. The other four pillars – advocacy, trust, leadership and governance – all impact and support the delivery of the industry's sustainability agenda.

> MORE DETAIL: COTTON AUSTRALIA STRATEGIC PLAN

Cotton Australia, the Australian Cotton Shippers Association and CRDC are collaborating to develop a Strategic Roadmap for the Australian Cotton Industry across five priority areas (transparency, sustainably certified cotton, human rights, industry data and Australian cotton marketing). All are closely aligned to sustainability.

> MORE DETAIL: AUSTRALIAN COTTON INDUSTRY STRATEGIC ROADMAP

Engage frequently and transparently with internal and external stakeholders.

In addition to ongoing engagement through existing mechanisms including meetings, conferences and surveys, the Australian Cotton Sustainability Reference Group (ACSRG) was formed in 2021.

The ACSRG involves representatives from all major cotton stakeholder groups, including brands, government and environmental organisations.

It provides a formal two-way process to help us better understand stakeholder expectations, discuss sustainability performance, and be questioned or guided by a diverse group of experts and thought leaders.

Agendas and summaries of discussion from each ACSRG meeting are posted online.

> MORE DETAIL: STAKEHOLDER ENGAGEMENT

Evidence to demonstrate credible progress, and to make informed decisions.

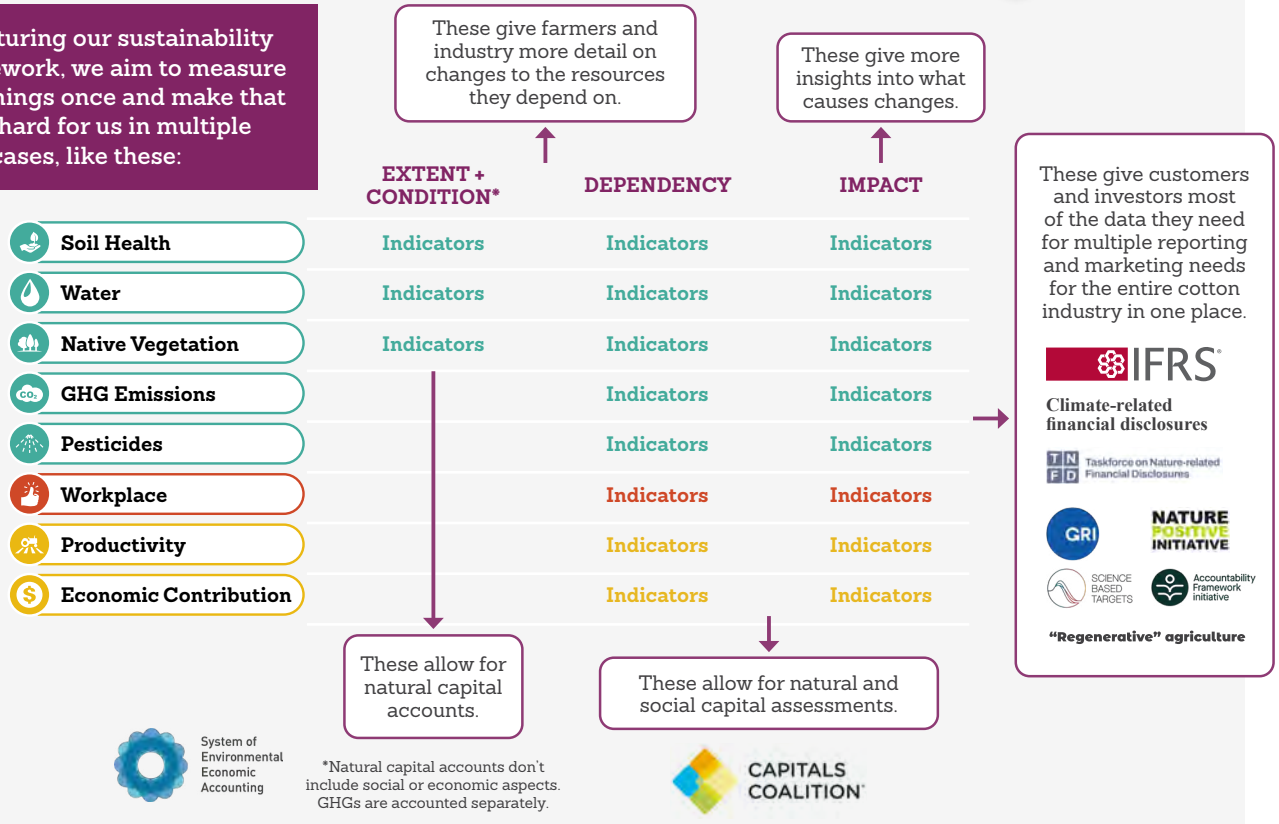
NEW

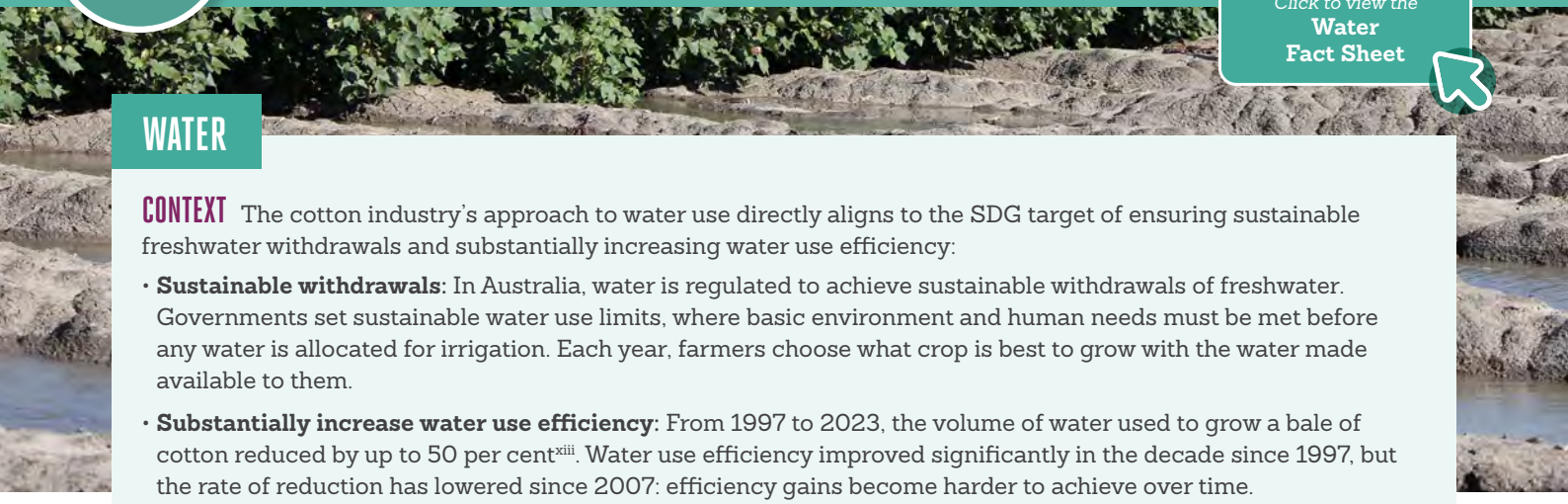
The global sustainability reporting environment has multiple competing standards and methods. To bring more clarity to industry reporting, we have revamped our sustainability data framework to more closely align with the standards we think customers of Australian food and fibre are most likely to use in future.

Indicators from 16 standards and reporting guides have been cross-referenced to indicators in our revamped sustainability data framework. We don't try to measure everything in every standard, and we don't yet have industry-scale data for every indicator. However, we do have most of the data needed by customers and investors for the entire industry, in a single database.

> MORE DETAIL: AUSTRALIAN COTTON SUSTAINABILITY DATA PACK

By restructuring our sustainability data framework, we aim to measure the right things once and make that data work hard for us in multiple other use cases, like these:





Click to view the **Water Fact Sheet**

WATER

CONTEXT The cotton industry's approach to water use directly aligns to the SDG target of ensuring sustainable freshwater withdrawals and substantially increasing water use efficiency:

- **Sustainable withdrawals:** In Australia, water is regulated to achieve sustainable withdrawals of freshwater. Governments set sustainable water use limits, where basic environment and human needs must be met before any water is allocated for irrigation. Each year, farmers choose what crop is best to grow with the water made available to them.
- **Substantially increase water use efficiency:** From 1997 to 2023, the volume of water used to grow a bale of cotton reduced by up to 50 per cent[xiii]. Water use efficiency improved significantly in the decade since 1997, but the rate of reduction has lowered since 2007: efficiency gains become harder to achieve over time.

Risks & opportunities

Availability. Short-term outlook positive, variability increasing over time.

- **Crops will benefit in the short-term** from higher-than-average rainfall in most cotton-growing regions
- **Climate change will create risks and opportunities from more variable climate** and more frequent extreme weather conditions. Extended hot and dry periods would reduce inflows to rivers and increase plant stress; extended wet periods would increase inflows to water systems and soil moisture but could also cause plant stress through water logging and impact crop productivity. Reliable dry and wet seasons may support more cotton production in northern Australia.

Reputation. risk increases in drought years when water is scarce.

- Annual research shows **water is a key driver of community trust** in and acceptance of the cotton industry and that background environmental conditions appear to influence community sentiment: trust is higher in wet years, and lower in dry years[xiv]. Increasing trust will depend on the ability of the industry to communicate improvements in water use efficiency, while demonstrating strong accountability and compliance.

Resource efficiency. Opportunity increasing over time up to a point.

- **Using rain and irrigation water as efficiently as possible is a priority for every cotton grower:** it normally has the biggest impact on yield and is one of the biggest expenses for irrigated cotton. We continue to invest in improving water use efficiency relevant for the very different soils and farming systems where cotton is grown. There are still gains to be made, but eventually plant physiology means it is impossible to significantly improve water use efficiency.

NEW STRATEGY

Where we are now

Slowing water use efficiency gains. The annual rate of improvement from 1997 to 2007 was 9 per cent but has slowed since 2007 to 0.3 per cent.

Perception the industry uses more water than it is entitled to is a key driver of community trust and acceptance of the industry[3]. The negative perception is higher in drought years, but there is a consistent proportion of community who think cotton uses more than its fair share of water.

Where we want to be

Every grower is achieving maximum water use efficiency (dryland and irrigated) for their soil type and location. The range of water use efficiency is narrower or is more accurately explained by different management practices and soil types by region (eg 0.79 bales/ML may be the maximum efficiency for a certain type of soil).

The Australian cotton industry is trusted that it only uses its fair share of water, and does so efficiently. This has been achieved by proactively seeking real time transparency on water use and quality, demonstrating regulatory compliance and emphasising water use efficiency practices.

Actions growers can take now

- Continue to use water legally
- Implement practices to reduce losses and improve efficiency
- Implement soil health practices that enhance water infiltration and water holding capacity
- Avoid excessive fertiliser and pesticide use to prevent water quality impacts.

Actions industry is taking to support growers in future

- Implementing CRDC's 2023-28 Strategic RD&E Plan natural capital actions to strengthen capacity for adaptation to climate change and make farms more resilient to shocks, including water use efficiency research
- Investigating enhanced transparency and accountability mechanisms
- Communicating Australian cotton water use is responsible and sustainable.

[2]Gross Production Water Use Index (GPWUI): accounts for irrigation water (including losses) + rainfall + soil moisture change.
[3]Voconiq Community Trust in the Australian Cotton Industry, 2023.

PROGRESS

EXTENT

Extent is measured by the **volume** of water available to farms for irrigation.

2023/24 INSIGHTS

An accurate and cost-effective way to measure the volume of water resources in rivers and streams, in aquifers, and stored on farm across hundreds of farms is currently not available. We are working to find sources for this data gap.

While this is a gap, it's important to remember all water made available to farmers for irrigation is regulated by state governments. *my*BMP requires a water budget to be prepared and groundwater levels (in aquifers) to be monitored to detect potential trends over time.

CONDITION

Water quality in farming systems is typically measured by salinity, sodicity and acidity. Poor water quality can impact plant and soil health.

*my*BMP requires growers to measure and manage ground water quality, and to efficiently apply and reticulate irrigation water to prevent nutrients or pesticides leaching into ground water.

The Australia cotton industry is a member of the Fitzroy Partnership for River Health, which focuses on collaboration for enhancing water stewardship and environmental protection in this reef catchment. As part of this partnership, we contribute to initiatives for improving water use efficiency, managing run-off and monitoring water quality. We also prioritise collaboration with other risk creators and beneficiaries in cotton catchments to understand the land use risks for water quality and deliver appropriate mitigations to reduce environmental impact.

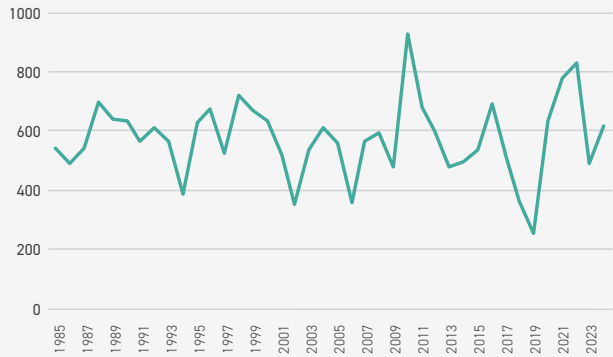
DEPENDENCIES

Rain water availability. Rainfall is measured as mm per year.

2023/24 INSIGHTS

Rainfall is used by cotton growers to produce dryland cotton, and to supplement water applied in irrigated cotton. Annual rainfall on average across cotton-growing regions was above the long-term trend in 2023/24. **This is the fourth year in the past five that has been above average, compared to the previous five-year period when only one year was above average.** More rainfall is positive for productivity and mental health, but it also means more weeds need to be controlled.

Average total annual rainfall (mm) in traditional cotton-growing regions 1985 - 2024



Source: Bureau of Meteorology Australian Water Outlook

In forthcoming work using the Capitals Coalition approach for natural and social capital assessments, QDPI estimated the following valuations as a baseline from which industry can track trends over time.

Water natural capital valuation forthcoming publication[4]

Dependency	Year	Metric	Value $ total	Value $/ha
Rain water availability (effective rainfall)	2019/20	2.77 ML/ha	$88m	$1,504
	2021/22	4.29 ML/ha	$158m	$287

Source: QDPI natural capital assessment using industry data.

By putting a price on rainfall, we can more clearly see its direct value. This will further support messages to farmers about the importance of soil health practices that impact the utilisation of rainfall. For example, if a farmer's soil health practices result in 25 per cent of rainfall that should be soaking into their soil running off, that farmer is losing 25 per cent of the direct value of that water: $374/ha in 2019/20 (a dry year, when the value of water was higher) and $72/ha in 2021/22 (a wet year, when the value of water was lower).

Irrigation water availability, measured as ML per year.

Governments sell licences for farms to extract up to a certain volume of water, and allocate a percentage of the licence to farmers each year based on seasonal conditions. In wet years, farmers may be allocated 100 per cent of their licence; in drier years it will be much less or even zero.

Quantifying the difference between licences and allocations will give important insights into the availability of irrigation water over time. We are looking for ways to fill this data gap.

[4]Data sources: Rainfall is calculated by summing the average rainfall for the most recent year across major cotton-growing river regions for the months November-March (when cotton is growing). ABARES estimates the $/ML to be ~ $543 in 2019/20 and $67/ML in 2021/22. Market price valuation method used: volume rainfall x market price. The Capitals Coalition, a multi-stakeholder organisation recognised as leading the global effort to have the value of all capitals (physical assets, social and environmental) incorporated into decision making.

PROGRESS

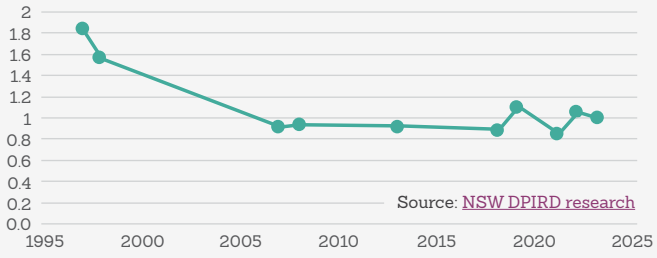
IMPACT DRIVERS

Freshwater use efficiency. Irrigated water use is regulated by governments. The amount of water made available to grow crops is based on seasonal conditions. The focus of Australian cotton growers is to use available water as efficiently as possible.

2023/24 INSIGHTS

The Sustainable Water Use Index measures all water used by the crop to produce a bale of cotton: soil moisture, water from rivers and bores, rain directly falling on the crop and runoff rainfall harvested, and all water lost through evaporation and seepage during storage. It is the direct inverse of GPWUI, described on page 11.

ML/bale sustainable water use index (SWUI) (irrigated) 1997-2023



Source: NSW DPIRD research

In 2023 the volume of total water used to grow one bale of cotton reduced slightly to 1.0 megalitre (ML) from 1.04 ML/bale the previous year. Extrapolating NSW DPIRD survey data to the whole industry, this equates to 4,399 litres (L) of total water per kg of cotton lint. Of this total amount, 3,006 L of irrigated water was used to grow a kg of cotton lint in 2023.[xv]

Climate change. Climate change appears to be creating more extreme and unpredictable seasons.

Research has shown **it takes about 50 per cent less water to grow a bale of cotton compared to 1997 in seasons that don't experience climatic extremes**. In very dry (like 2019) and very wet (like 2022) seasons that figure is closer to 40 per cent.

Drought years reduce yields due to increased plant stress, and have higher temperatures with more evaporation. Wet years impact water productivity in different ways: there may be more rainfall than the crop can use, floods can destroy a crop or result in the need to replant, and heavy rainfall at the wrong time can negatively impact yield.

In forthcoming work using the Capitals Coalition approach for natural and social capital assessments, QDPI estimated the following valuations as a baseline from which industry can track trends over time.

Water natural capital valuation forthcoming publication[6]

Impact driver	Year	Metric	Value $ total	Value $/ha
Blue water consumption (irrigation water applied)	2019/20	6.72 ML/ha	$212m	$3,648
	2021/22	5.66 ML/ha	$161m	$379

Source: QDPI natural capital assessment using industry data.

Farmers convert water resources into financial capital that supports local jobs and farm business investment. Water resources are more efficiently turned into economic capital during normal seasonal conditions, but for local communities they are valued for keeping jobs in drier seasons. In the most severe drought year of 2019/20, farmers grew $4,301/ha of cotton from $3,648/ha of water applied.

Pollutants. Ground and surface water can be impacted by farm sediment, pesticides or fertilisers.

The impact of cotton industry pollutants on water quality is thought to be minimal because most water applied to irrigated cotton fields remains on the farm.

As with water quantity, there is no nationally consistent approach to monitoring water quality in surface and ground water. As a result, we are discussing with government and other stakeholders if a real-time accurate way to measure water quality could be initiated. While attributing water quality impacts to any one industry can be difficult, this approach would both give an early warning to river system users if quality is significantly declining so that preventative action can be taken.

Compliance. We expect every cotton grower to comply with all environmental legislation.

Water use non-compliance (NSW): prosecutions or enforceable undertakings

We report the number of farmers in the public register of water use non-compliance who we know grow cotton (although water may have been extracted by these individuals for crops other than cotton). For context, there are about 900 cotton growers in NSW. No similar data is readily available for other states and territories.

	All NSW	Cotton
2017/18	4	**2**
2018/19	3	**1**
2019/20	2	**0**
2020/21	2	**1**
2021/22	1	**1**
2022/23	0	**0**
2023/24	0	**0**

Source: NSW Natural Resources Access Regulator public register (date of breach).

[5]The time needed to collect the data and undertake the detailed calculations behind water use efficiency means there is a one-year lag in reporting. Data here refers to the 2022/23 season.

[6]Data sources: Water applied: Water Use on Australian Farms, 2020-21 financial year | Australian Bureau of Statistics. Value of water: ABARES estimates the $/ML to be ~ $543 in 2019/20 and $67/ML in 2021/22. Market price valuation method used: volume rainfall x market price. The Capitals Coalition, a multi-stakeholder organisation recognised as leading the global effort to have the value of all capitals (physical assets, social and environmental) incorporated into decision making.

PLANET SOIL HEALTH

Click to view the **Soil Fact Sheet**

Cover cropping research by Dr Tom O'Donoghue - like this trial of sun hemp as a cover crop - is one of a suite of soil health investments the cotton industry is making to improve productivity and climate resilience.

SOIL

CONTEXT Healthy soil is a living, dynamic environment, full of microbial and macroinvertebrate life that help to recycle essential plant nutrients, improve soil structure, and control plant disease and pests. Because healthy soil is alive, the Australian cotton industry encourages cotton growers to follow principles essential for a living system: provide food and shelter to the organisms within soil.

These best management practices have started to be called 'regenerative' in recent years, but cotton growers have been using them for many years to protect ancient Australian soils.

Risks & opportunities

Resource efficiency and resilience: opportunity increasing over time.

- The healthier soil is, the better it will perform the functions growers depend on to grow cotton. Soils that function as well as they can on a farm will reduce input costs and optimise yield which, combined, will boost gross margins. At the same time, high functioning soils should be more resilient to climate extremes.

Physical: risk increasing over time without appropriate practices.

- Soil degradation, erosion and loss of fertility have impacts on input costs and yield, and will increase over time without appropriate soil health practices. Impacts are likely to be exacerbated by climate extremes.

Market: opportunity potentially increasing over time.

- Access to markets may increase with evidence of 'regenerative' or other soil health practices deemed by customers to be positive for the environment. There may also be small premiums, but for most farmers the financial benefit of improved productivity and resilience will far outweigh market-based premiums. The cotton industry assumes cropping soils are unable to permanently sequester carbon, and therefore does not consider soil carbon credits to be an opportunity.

NEW STRATEGY

Where we are now

No nationally consistent and cost-effective way to measure soil health.

Varying levels of understanding on the best soil health practices to apply that will have the greatest positive impact on a farm business.

Where we want to be

Cotton growers have tools to measure soil health, and value the benefits soil properties and functions give to their farm business.

Cotton growers use that information to make informed decisions about optimising the health of their soil as the foundation of a productive and resilient farm business.

The cotton industry is recognised as a leader in soil health practices that minimise inputs and optimise production of food, feed and fibre.

Actions growers can take now

- Adopt practices that give soil more food (living roots, diverse crops) and shelter (minimal physical disturbance).

Actions industry is taking to support growers

- Investing in a cross-sector project to develop a nationally consistent approach to measuring soil health
- Implementing CRDC's 2023-28 Strategic RD&E Plan actions to progressively improve soil health. This includes a suite of soil health RD&E investments to accelerate practices that build climate resilient soils and capture value from soil security
- Achieving the CRDC 2023-28 Strategic RD&E Plan target of demonstrating cotton farms have maintained and enhanced natural capital and are more resilient to shocks by 2028.

PROGRESS

EXTENT

Extent is measured by the **area** of soil used to grow cotton.

2023/24 INSIGHTS

About 15 per cent less area of cotton was planted in 2023/24 than the previous two seasons. The area planted was roughly in line with the area planted in non-drought years for the past 15 years.[xvi]

Area planted to cotton	2020	2021	2022	2023	2024
Ha	58,858	271,739	550,541	565,514	473,887

Source: Cotton Australia

CONDITION

Condition measures the quality of soil **properties** that support the production of cotton. These include soil organic carbon, salinity, acidity, sodicity, and effective root depth.

2023/24 INSIGHTS

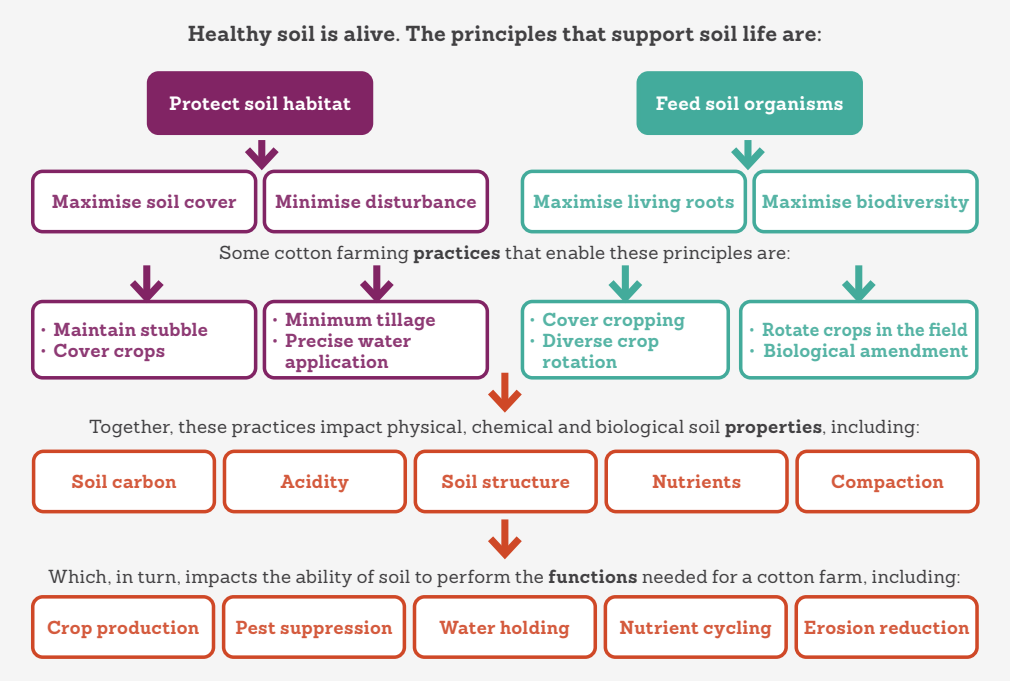
Soil's complexity and regional differences make it difficult to measure properties and functions at the industry scale. A National Soil Strategy was released in 2021, and will deliver nationally consistent key performance indicators and methods to measure soil health. We support this strategy.

Until those agreed measures are in place, we are encouraging greater adoption of practices to provide food and shelter to soil organisms.

> MORE DETAIL: AUSTRALIAN COTTON SOIL HEALTH FRAMEWORK

DEPENDENCIES

Soil **functions** that support the production of cotton. Water infiltration, water holding capacity, nutrient cycling capacity, resilience to weather extremes, and pest and disease suppression are some of the functions farmers rely on to grow crops.



IMPACT DRIVERS

Practices chosen by farmers to manage their land, and which impact soil functions and properties.

Healthy soil practices should aim to give soil:

- Food (through the use of diverse rotations and cover crops)
- Shelter (by maintaining ground cover, reducing erosion, and minimising tillage).

2023/24 INSIGHTS

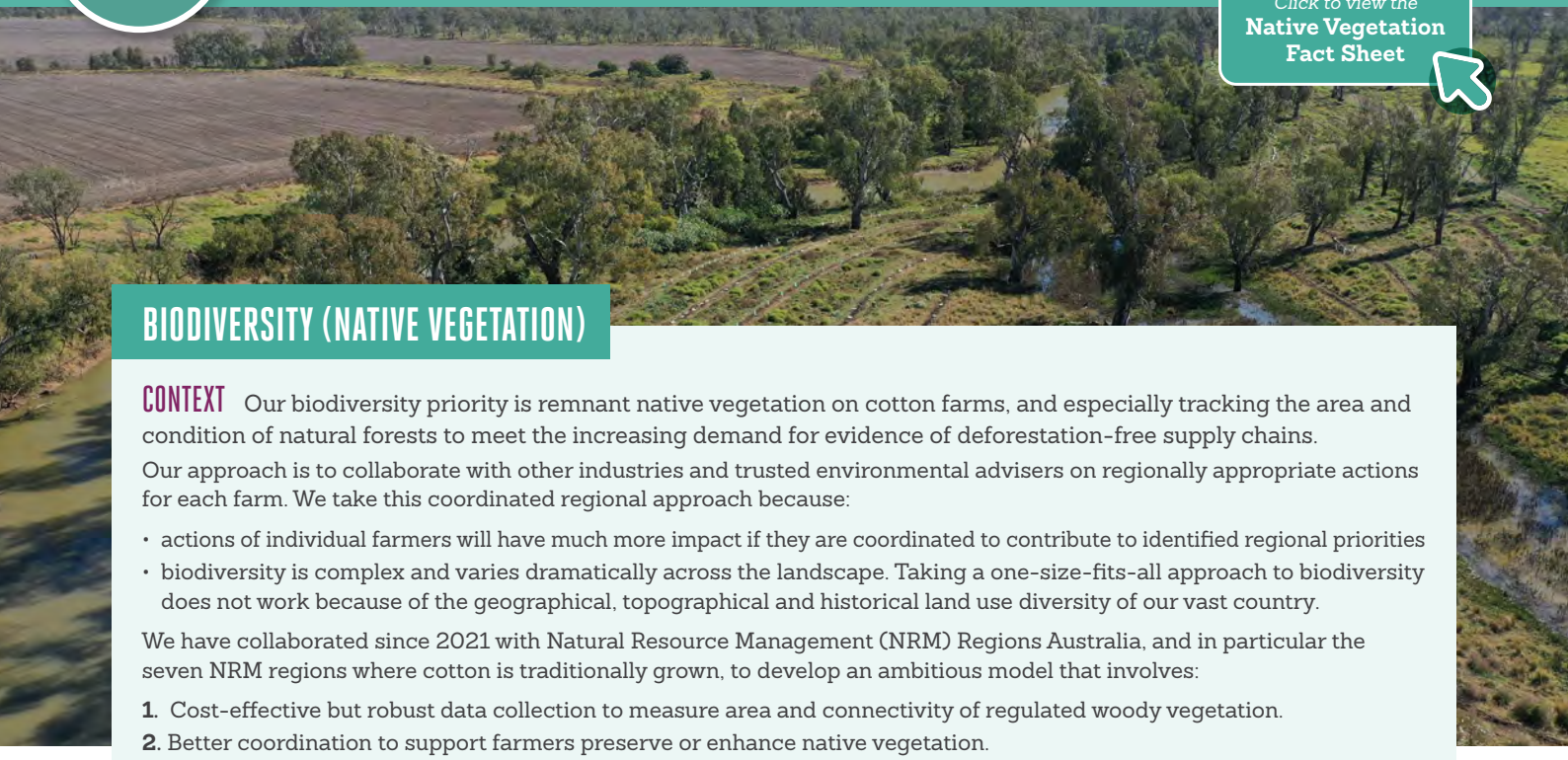
CRDC grower surveys in recent years indicate high levels of common regenerative soil health practices. (This question was not asked in the 2024 survey).

Use of soil health practices	2020	2022	2023
% of growers who conserve crop residues	98	98	-
% of growers using minimum tillage	92	86	-
% of growers using cover cropping	56	46	54
% of growers using rotation systems including legumes	-	81	-

Source: CRDC Grower Survey

PLANET BIODIVERSITY (NATIVE VEGETATION)

Click to view the **Native Vegetation Fact Sheet**



BIODIVERSITY (NATIVE VEGETATION)

CONTEXT Our biodiversity priority is remnant native vegetation on cotton farms, and especially tracking the area and condition of natural forests to meet the increasing demand for evidence of deforestation-free supply chains.

Our approach is to collaborate with other industries and trusted environmental advisers on regionally appropriate actions for each farm. We take this coordinated regional approach because:

- actions of individual farmers will have much more impact if they are coordinated to contribute to identified regional priorities
- biodiversity is complex and varies dramatically across the landscape. Taking a one-size-fits-all approach to biodiversity does not work because of the geographical, topographical and historical land use diversity of our vast country.

We have collaborated since 2021 with Natural Resource Management (NRM) Regions Australia, and in particular the seven NRM regions where cotton is traditionally grown, to develop an ambitious model that involves:

1. Cost-effective but robust data collection to measure area and connectivity of regulated woody vegetation.
2. Better coordination to support farmers preserve or enhance native vegetation.

Risks & Opportunities

Market: a need to demonstrate lack of deforestation or degradation is increasing over time.

The Global Biodiversity Framework's first target is to bring the loss of areas of high biodiversity importance to close to zero by 2030.

Many sustainability frameworks used by customers need evidence of value chains being free of deforestation since 2020. Not all customers will adopt this requirement, but it's likely premium customers will increasingly seek deforestation-free value chains.

Reputation: risks will remain high.

- Any land clearing has the potential to attract negative scrutiny, even in regions where governments support limited clearing of land for sustainable development. Illegal land clearing will negatively impact our reputation and increase regulatory and market access risk.

Financial incentives: scale of opportunity is uncertain – direct payments to farmers for biodiversity are currently scarce.

- New markets may emerge to reward farmers for maintaining or enhancing biodiversity, on top of carbon credit payments for new tree plantings.

NEW STRATEGY

Where we are now

Credible action is needed to meet increasing demand for deforestation- and conversion-free supply chains, and for disclosing nature-related financial impacts

Confusion is a barrier to action:

- There is so much conflicting 'noise' about what to do, farmers don't know who to trust
- Biodiversity is not 'core business' for most farms, so it's not clear what is needed to effectively manage biodiversity.

Where we want to be

Australian cotton industry maintains markets and increases the proportion of premium customers with metrics and practices giving evidence that biodiversity is managed on cotton farms in accordance with legal requirements and in line with independent regional biodiversity plans.

All of agriculture collaborates for every farm wanting to take voluntary action to contribute to identified regional priorities to maximise benefit to agriculture, nature, and Brand Australia. The cotton industry has developed a model to achieve this.

Actions growers can take now

- Operate within the law by never illegally clearing land
- Consider the impact of deforestation or land conversion on access to markets and premiums
- Consider improving the area and/or condition of existing biodiversity.

Actions industry is taking to support growers

- Developing a new way to coordinate resources and develop consistent messaging across farming systems to help farmers manage and measure biodiversity on their farm
- Challenging the view a single global goal should apply everywhere. Zero deforestation is appropriate for many areas of the world, but in regions that have seen minimal deforestation, a blanket zero deforestation target appears to be inequitable
- Implementing CRDC 2023-28 Strategic RD&E Plan natural capital actions that help maintain biodiverse ecosystems.

PLANET BIODIVERSITY (NATIVE VEGETATION)

PROGRESS

EXTENT

Extent is measured by the **area** of native vegetation on farms that grow cotton.

CONDITION

Condition of biodiversity is measured by the quality of the vegetation and its connectivity. However, there is no agreed way globally or nationally to measure condition, and it is hard to measure at scale.

2023/24 INSIGHTS

In the traditional cotton growing regions of NSW and Queensland, on average about **21 per cent of the total area of a cotton farm has remnant native vegetation, including grasslands**[xvii] **and 12.9 per cent of the total area has woody vegetation**[xviii]. Most native vegetation area on cotton farms is used for grazing livestock.

On average, **0.9 per cent of the total area of a cotton farm has regionally significant patches of riparian zone (beside waterways) woody vegetation**[xix]. These patches of high-quality vegetation are one way to measure connectivity of vegetation. Connectivity is, in turn, one way to measure condition of native vegetation. It's important because vegetation that is connected allows fauna to move across the landscape; fragmented or disconnected vegetation makes this harder. Maintaining the quality and area of riparian connectivity is a priority for the cotton industry.

NEW

Our partnership with NRM Regions Australia has included CRDC funding one of these independent regional organisations, South Queensland Landscapes, to develop a method for measuring the area of regulated woody vegetation (extent, described above) and the area of significant riparian patches of woody vegetation (connectivity, an indicator of condition) on farms that grow cotton. This method uses a Terrestrial Ecological Research Network satellite dataset. To date, this work has focused on the traditional cotton-growing areas in NSW and Queensland.

> MORE DETAIL: MAPPING WOODY VEGETATION FACTSHEET

Woody vegetation on Australian cotton farm	2020
Aggregate area of farms that grow cotton (ha)	5,447,849
Extent ha: Aggregate regulated woody vegetation on farms that grow cotton in NSW and Queensland	704,264
Extent %: Aggregate regulated woody vegetation on farms that grow cotton	12.9%
Connectivity ha: Aggregate connectivity of significant riparian patches of regulated vegetation to regional high priority ecosystems on farms that grow cotton in NSW and Queensland	49,299
Connectivity %: Aggregate connectivity of significant riparian patches of vegetation to regional high priority ecosystems on farms that grow cotton	0.9%

Source: SQ Landscapes "Mapping Woody Vegetation" method.

PLANET BIODIVERSITY (NATIVE VEGETATION)

PROGRESS

DEPENDENCIES

Habitat provision.
Native vegetation provides habitat to threatened species and to beneficial birds, bats and insects that prey on insect pests in nearby fields.

Carbon storage.
Woody vegetation on cotton farms, particularly riparian species such as river red gums sequester and store large amounts of carbon.

Other.
Ecosystem services provided by native vegetation include regulating water quality, mitigating erosion and providing visual amenity.

2023/24 INSIGHTS

Farmers understand the value of native plants and animals to the farm landscape including wind breaks, buffers in riparian areas and habitat for beneficial birds, bats and insects that prey on cotton pests. This is all part of cotton growers' investment in Integrated Pest Management (IPM). While these ecosystem services provide a direct private good to cotton growers, natural ecosystems on farms also provide a significant public good that benefits society.

Biodiversity natural capital valuation forthcoming publication[6]

In forthcoming work using the Capitals Coalition approach for natural and social capital assessments, QDPI estimated the following valuations as a baseline from which industry can track trends over time.

Biodiversity (forests) dependencies experimental assessment (2020 data)	Metric	Value $ total	Value $/ha
Beneficial species habitat[7]	704,264ha	$66.5m	$95
Threatened species habitat[8]	49,299ha	$81.3m	$1,650
Carbon storage[9]	152.7 t C/ha	$4.2b	$5,343

Source: QDPI, using SQ Landscapes estimation of woody vegetation

Providing habitat for beneficial species that prey on pests in cotton provides a private good for cotton growers by reducing reliance on insecticides.

While habitat for beneficial species directly benefits farmers, most other ecosystem services from native vegetation on farms benefit society as a whole. For example they provide habitat for threatened or endangered native species on cotton farms, and the trees cotton growers have kept on their farms are storing carbon. Land holders can only receive carbon payments for new plantings on previously cleared land; carbon stored in mature trees is not recognised.

This significant public good being provided by Australian cotton growers benefits people everywhere, but farmers receive no recognition for this. If society expects farmers to maintain native vegetation, there is a strong argument society should contribute to the benefit we all receive.

[7]Assumptions: Valuation based on the presence of beneficial species reducing average annual insecticide cost ($189/ha in 2023/24) by 50 per cent. This approach assumes all natural forest on farms that grow cotton provides habitat for beneficials. As no allowance has yet been made for proximity of habitat to a crop, this method will over-estimate the value.

[8]Assumptions: Valuation based on the cost of establishing new habitat, estimated at $1,650/ha in 2023/24. This approach counts only high value patches of riparian vegetation as providing habitat for threatened species. In reality, there will be native and threatened species in all classes of vegetation. This method will under-estimate the value.

[9]Assumptions: Valuation based on an Australian Carbon Credit Unit price of $35/t$CO_2$e. Assumes 1 ha mixed plantings forest has a total tree carbon production of 152.66 over a 100-year lifetime Primary Industries Climate Challenge Centre.

PLANET BIODIVERSITY (NATIVE VEGETATION)

PROGRESS

IMPACT DRIVERS

Land use. Establishing fields for the first time for plant-based agriculture requires the removal of existing vegetation. Impact can be reduced by retaining or restoring buffer zones to waterways, corridors for wildlife, and high value ecosystems.

2023/24 INSIGHTS

Data in woody vegetation table on page 18 shows a 2020 baseline. Because this is currently relatively expensive to measure at scale, and because land use change is limited, change in land use is intended to be measured every five years using the current method. This may change if a more cost-effective way can be found to measure biodiversity on farms at scale.

Governments in northern Australia have policies and programs to support sustainable development within areas they have strategically identified, to encourage more plant-based agriculture. In Queensland, the state government negotiated with individual farmers many years ago to map areas of high value vegetation to be protected under clearing legislation, and what the government has termed lower value unregulated vegetation which could be cleared without permits. Many farms have business plans – based on the certainty provided by this legislative process – to clear permissible areas of lower value vegetation to support agricultural production.

For these reasons we expect some individual farms will clear relatively small areas of land for plant-based agriculture, including cotton, in future years. We expect any land clearing regardless of jurisdiction to be completely in line with legislation.

We have communicated to growers that even if land clearing is legal, customers seeking zero deforestation supply chains are not likely to buy food or fibre produced on land that has been cleared since 2020, the commonly accepted point in time for "deforestation-free" claims. We would be failing in our role not to make farmers aware of these risks and opportunities.

At the same time, Cotton Australia is communicating to governments and customers that if they are serious about zero deforestation, they should be prepared to pay the world's farmers for maintaining the natural ecosystems they have kept intact. Cotton Australia is also pointing out their actions to date are instead tantamount to punishing those farmers by not allowing sustainable development of farmland while at the same time conversely and perversely rewarding farmers who have long since cleared or degraded their land.

Invasive alien species. Native vegetation requires ongoing maintenance to reduce the impact of weed and animal (such as feral pig) pests.

Cotton farms managing weeds and pests in natural areas	2019	2022
Weed control in natural areas in the past 12 months	70%	65%
Pest control in natural areas in the past 12 months	na	63%

Source: CRDC Grower Survey

Invasive weeds and feral pests in native vegetation reduce food sources and habitat for native animals. There is no quantitative data on the impact of weeds and pests on the extent or condition of native vegetation on cotton farms, but previous grower surveys show most farmers are actively managing this problem. Cotton growers invest time and money to control environmental weeds and feral pests to reduce impacts on their crops. Broadleaf weeds are also typically better habitat for pests than native vegetation, and can host viruses.

Climatic extremes that create wetter or drier than normal seasons.

Floods can destroy newly planted seedlings, and drought can kill or reduce the condition of native vegetation. In the last five years, Australia has endured the effects of floods, fires and drought making it challenging to report what may have been revegetated in the valleys where cotton is grown. As with weeds and pests, there is currently no data available on the industry scale impact of climatic extremes on native vegetation.

PLANET GREENHOUSE GAS EMISSIONS

Click to view the **GHG Fact Sheet**

GREENHOUSE GAS EMISSIONS

CONTEXT Growing, ginning and transporting cotton to port is estimated to account for about 0.2 per cent of Australia's greenhouse gas emissions (GHGs)[xx].
The vast majority of Australian cotton production GHG emissions come from the pre-farm manufacture and on-farm use of nitrogen (N) fertiliser. On-farm fuel accounts for about 20 per cent of cotton's emissions.

We are supporting national efforts to increase the accuracy of agricultural GHG emissions estimates, and to reduce farmer confusion around GHG measurement, mitigation and adaptation. We have also developed a strategy and credible pathways for reducing emissions.

> MORE DETAIL: AUSTRALIAN COTTON EMISSIONS REDUCTION RESEARCH STRATEGY

Five-year average of Australian cotton GHG emissions sources, 2020-2024

Source: Ekonomou A., Eckard R.J. (2021), University of Melbourne C-GAF based on the Australian National Greenhouse Gas Inventory methodology

Risks & Opportunities

Physical: risks and opportunities increasing over time.

- Climate change is forecast to increase temperatures and increase extremes in temperature and rainfall. This may increase risks (reduced inflows to rivers, flood damage, and increase plant stress potentially increasing costs and decreasing yield), but it may also create seasonal opportunities (increased water in storages and soil moisture, and potentially increased plant growth with higher atmospheric CO_2 if water is available).

Regulatory: pressures increasing over time.

- It's now mandatory for many corporations to report how GHGs are managed in their value chain, and what their value chain emissions are. This provides an opportunity for the cotton industry to support customers and investors to meet compliance disclosure obligations, with a proactive approach to support efficient farm data collection.

Market: opportunities increasing over time.

- With increasing scrutiny on scope 3 emissions, there is an opportunity to differentiate to our customers the low carbon footprint of cotton against synthetic fibres. Cotton lint production has a GHG intensity about 20 times lower than the production of polyester's raw material which is made from fossil fuel[xxi].

Reputation: increasing over time if supported by evidence.

- Community trust and acceptance will increasingly be determined by perceived action to manage GHGs and other environmental issues.

Resource efficiency: increasing over time.

- Reducing N inputs while maintaining target yield levels will reduce costs as well as reducing the main source of GHG emissions in cotton production.

PLANET GREENHOUSE GAS EMISSIONS

NEW STRATEGY

Where we are now

Credible action is needed to meet growing demand for data and action to maintain access to markets.

Better data is needed GHG data mainly comes from surveys. Data quality needs to improve to give confidence to customers to buy, and to growers to act.

Clarity on carbon is a major barrier to action. Growers are frustrated by the complexity and inconsistency of messaging from different sources.

Where we want to be

Australian cotton maintains markets, avoids "high carbon" discounts, and increases premium markets.

High quality GHG data is collected from every field by 2028 as part of a broader industry data platform plan.

Australian agriculture has a common approach to carbon, and by 2028, Australian cotton growers are recognised as having high GHG literacy and for taking action.

Actions growers can take now

- Reduce N inputs and improve N use efficiency
- Improve soil health to help reduce inputs
- Consider options to convert pumps to renewable energy and other energy efficiency measures
- Consider maintaining or increasing the area of trees to store or remove carbon
- Use online tools to calculate your GHG emissions.

Actions industry is taking to support growers in future

- Implementing an emissions reduction research strategy to give a clear and credible path for emissions reduction
- Improving data quality and collection
- Collaborating with other industries on consistent messages and actions across farming systems
- Investing in water and N use efficiency, soil health, and plant breeding to mitigate climate change impacts
- Encouraging commercialisation of low emission technologies outside our control, especially green N manufacture and diesel fuel alternatives, and encouraging adoption by growers when commercialised.

PROGRESS

IMPACT DRIVERS

GHG emissions.
N is essential for plant growth, but N fertiliser also accounts for about 66 per cent of cotton GHG emissions, both on-farm and pre-farm. Diesel fuel for machinery and irrigation pumps contributes about 20 per cent of cotton production GHGs.[xxii]

GHG removals.
We encourage farmers to increase and/or maintain woody vegetation to sequester atmospheric carbon. Soil carbon receives a lot of attention, but in Australian cropping systems, permanently storing carbon in soil is difficult and uncertain.

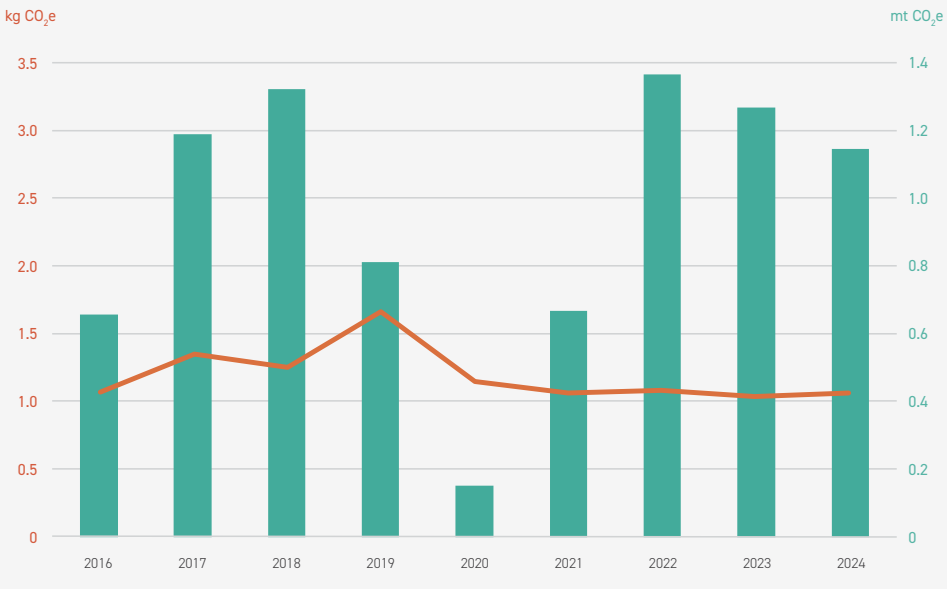
Due to difficulties of estimating removals accurately at the industry scale, removals are currently assumed to be zero. This means we currently report emissions only, not net emissions, for the Australian cotton industry.

2023/24 INSIGHTS

Total annual GHG emissions reduced in line with a reduced volume of cotton grown in 2024. The emissions intensity of Australian cotton was 1.05kg CO_2e per kg of lint, which has been the average for the past four seasons. The five-year average emissions intensity to 2024 is 18 per cent lower than the five-year average to 2020. However, at least some of the higher intensity in the previous period was a result of severe drought and hence lower yields.

Dryland cotton production is highly variable depending largely on rainfall. Dryland cotton normally has a higher carbon intensity than irrigated cotton, especially in very dry seasons.

Australian cotton GHG emissions, total and intensity (kg CO_2e / kg)



Source: Ekonomou A., Eckard R.J. (2021), University of Melbourne C-GAF based on the Australian NGGI methodology

NEW AUSTRALIAN COTTON GHG EMISSION ACCOUNTS, 2024 AND FIVE-YEAR AVERAGE 2020 TO 2024[1]

TOTAL COTTON EMISSIONS

	TOTAL (tCO_2e)		CO_2 (t)		CH_4 (tCO_2e)		N2O (tCO_2e)	
	2024	5-year av 2020-24	2024	5-year av 2020-24	2024	5-year av 2020-24	2024	5-year av 2020-24
Scope 1 – mechanical	238,287	190,110	236,914	189,015	186	149	1,186	946
Scope 1 – agricultural	492,207	398,026	117,359	95,042	0	0	374,847	302,985
Scope 1 - LULUCF	0	0	0	0	0	0	0	0
Scope 2	8,392	6,650	8,392	6,650	0	0	0	0
Scope 3 (pre-farmgate)	410,824	319,554	410,824	319,554	0	0	0	0
TOTAL EMISSIONS (t)	**1,149,709**	914,340	773,489	610,260	186	149	376,034	303,931
TOTAL EMISSIONS INTENSITY kg CO_2e / kg lint	**1.05**	1.06						

IRRIGATED COTTON EMISSIONS

	TOTAL IRRIGATED (tCO_2e)		CO_2 (t)		CH_4 (tCO_2e)		N2O (tCO_2e)	
	2024	5-year av 2020-24	2024	5-year av 2020-24	2024	5-year av 2020-24	2024	5-year av 2020-24
Scope 1 – mechanical	188,481	153,466	187,395	152,582	147	120	938	764
Scope 1 – agricultural	408,827	338,633	97,317	80,871	0	0	311,510	257,762
Scope 1 - LULUCF	0	0	0	0	0	0	0	0
Scope 2	5,356	4,403	5,356	4,403	0	0	0	0
Scope 3 (pre-farmgate)	322,691	259,822	322,691	259,822	0	0	0	0
TOTAL	**925,134**	756,324	612,758	497,678	147	120	312,448	258,526
IRRIGATED EMISSIONS INTENSITY kg CO_2e / kg lint	**1.01**	1.04						

DRYLAND COTTON EMISSIONS

	TOTAL IRRIGATED (tCO_2e)		CO_2 (t)		CH_4 (tCO_2e)		N2O (tCO_2e)	
	2024	5-year av 2020-24	2024	5-year av 2020-24	2024	5-year av 2020-24	2024	5-year av 2020-24
Scope 1 – mechanical	49,806	36,644	49,519	36,433	39	29	248	182
Scope 1 – agricultural	83,380	59,394	20,043	14,170	0	0	63,338	45,223
Scope 1 - LULUCF	0	0	0	0	0	0	0	0
Scope 2	3,036	2,247	3,036	2,247	0	0	0	0
Scope 3 (pre-farmgate)	88,133	59,731	88,133	59,731	0	0	0	0
TOTAL	**224,355**	158,016	160,731	112,582	39	29	63,585	45,406
DRYLAND EMISSIONS INTENSITY kg CO_2e / kg lint	**1.28**	1.40						

[1]Accounts prepared in line with the Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard (2004). Emissions are Scope 1 (from direct cotton production actions, eg nitrogen in soil or diesel in machinery, Scope 2 (from purchased fossil fuel electricity) or Scope 3 (from indirect actions cotton production contributes to, eg the manufacture of fertiliser used for cotton). LULUCF are emissions from land use, land use change, and forestry and are assumed to be in equilibrium.

Click to view the **Pesticides Fact Sheet**

PESTICIDES

CONTEXT Pesticides (including insecticides and herbicides) are part of a cotton grower's pest control toolbox called Integrated Pest Management (IPM). IPM is a management approach enabling growers to choose the tool that best controls pests with the least risk to human and environmental health. All pesticides in Australia are approved by the government regulator: if a grower chooses a pesticide to control a specific pest, it has been assessed as safe to use as directed by the label.

Risks & Opportunities

Market and reputation: risk increasing over time.

- Scrutiny on the use of pesticides, and in particular 'highly hazardous' pesticides, is likely to continue to increase. This may require more evidence of safe use of pesticides to access markets, negative perceptions on the impact of pesticides, and potentially access to fewer options.

Technology: opportunity increasing over time.

- The cotton industry invests heavily in IPM to ensure pesticides are just one tool used to control pest weeds and insects. Technology will play an increasingly important role to:
  - » Optimise pesticide application, such as via robots and optical sprayers
  - » Further reduce the off-farm impact of pesticides, such as the cotton and grain industry co-investment in the Weather and Networked Data system (WAND)
  - » Provide alternative controls such as biologicals and biotechnology.

Physical: risk increasing over time.

- New diseases and changing of pest and disease spectrum are expected to increase with a changing climate and natural pest movement. Managing resistance levels in pests to certain pesticides will remain an ongoing challenge.

NEW STRATEGY

Where we are now

Increasing use of herbicides in the 2020s: The five-year average use of herbicides, measured by grams of active ingredient (ai) per hectare, increased by 33 per cent from 2020 to 2024. This is the result of consecutive wetter seasons growing more weeds, and more use of residual (as opposed to knockdown) herbicides to manage resistance.

Decreasing use of insecticides for almost three decades. Insecticide use per hectare reduced 96 per cent from 2004 to 2024.

Where we want to be

Australian cotton pesticide use is widely recognised as supporting optimal crop production while having no negative impact on human and environmental health.

New indicators and improved water quality monitoring across catchments further build community trust in the safe use of pesticides by all industries in a catchment.

Actions growers can take now

- Follow the industry IPM strategy
- Apply pesticides according to best practice to eliminate spray drift, including using WAND where available.

Actions industry is taking to support growers in future

- Advocating to corporations and governments for access to the full range of crop protection technologies and controls.
- Advocating for governments to set consistent guidelines in line with science-based targets for environmental monitoring of pesticides.
- Preparing for a pesticide-limited future by:
  - » Maintaining access to the pesticides we already have, through continued use of IPM and resistance management strategies to ensure their responsible and safe use
  - » Investing in R&D for novel control alternatives to pesticides
  - » Where alternatives do not exist, articulating to stakeholders the steps in place to safely use pesticides in Australia, until an alternative is found.

PLANET PESTICIDES

PROGRESS

DEPENDENCIES

Access to the full range of cultural, mechanical, biological, chemical, genetic and technological crop protection tools needed to support best practice pest, weed and disease control.

2023/24 INSIGHTS

Pesticides are just one tool used to control pests. New pest control tools can take several years before they are commercially available in Australia, but we invest in a range of research initiatives to support pest management. Recent research includes screening potential alternative controls to pesticides categorised as 'highly hazardous'.

IMPACT DRIVERS

Use of IPM strategies. IPM strategies include providing habitat for natural predators, crop rotations, genetically modified (GM) crops, novel pest controls, tillage, and when appropriate, pesticides.

2023/24 INSIGHTS

No new data is available for 2024, but previous grower surveys have shown high levels of IPM adoption.

% growers using selected IPM practices:	2019	2022	2023
Recommended thresholds are used	97%	95%	94%
Beneficial insects are conserved whenever possible	96%	99%	98%
Insecticide Resistance Management Strategy is followed	89%	97%	97%

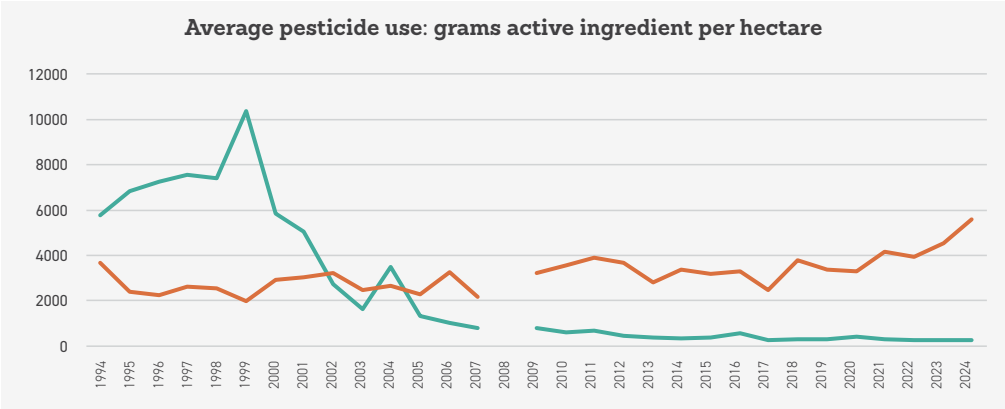
Source: CRDC Grower Survey

Use of pesticides. Farm pesticides have been assessed by the scientific government regulator as having a safe level of impact on human and environmental health, when used as directed by the label.

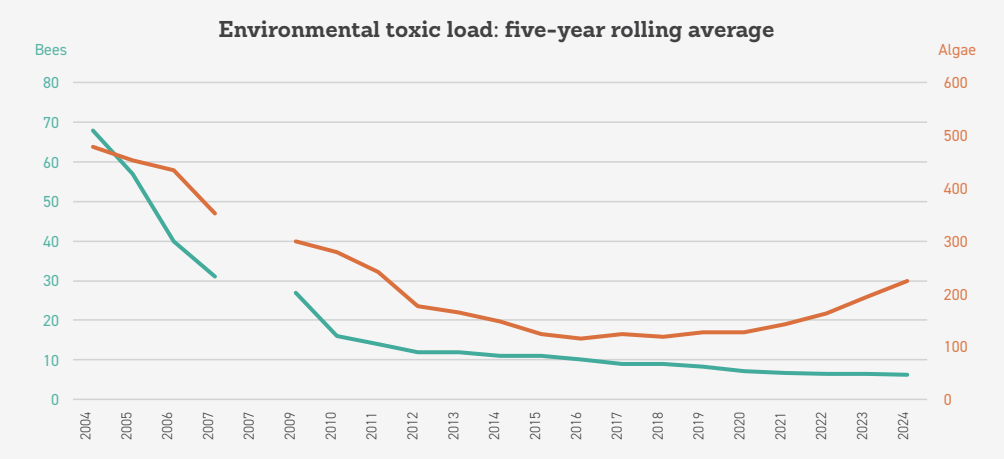
Pesticide use has changed over time: the five-year average insecticide volume reduced by 96 per cent per hectare between 1998 and 2024 as GM cotton and IPM was introduced. In the same period, a move to rely less on tilling the soil to control weeds increased herbicide use by 61 per cent.

However, volume does not paint a full picture of potential impact as it doesn't account for the differing toxicity of pesticides. Environmental Toxic Load (ETL) is a measure of hazard that does this.

> MORE DETAIL: ENVIRONMENTAL TOXIC LOAD ANIMATED EXPLAINER



Source: Industry sales data



Source: CRDC commissioned research. No data collected in 2008 due to drought

The five-year average ETL for bees[10] (an insecticide indicator species) and ETL for algae (a herbicide indicator species) has reduced by 91 per cent and 52 per cent respectively from 2004 to 2024[xiii]. This suggests the pesticide hazard has significantly reduced over the past 20 years.

However, the volume and hazards of pesticides used has been very different in recent years. From 2023 to 2024, **the annual five-year average ETL for bees decreased marginally, continuing a long-term trend of low use and hazard.** The introduction of GM cotton resistant to key insect pests and significant industry investment in IPM are the main reasons behind this. It is now not uncommon for crops not to be sprayed at all for insect pests.

Conversely, the use and hazard of herbicides has continued to trend up in recent years. From 2023 to 2024 the five-year average ETL for algae increased 17 per cent. Several factors are contributing to this increase:

- More weeds have grown in recent years, due to consecutive wet seasons increasing the weed seedbank
- Use of residual herbicides – which have a higher toxicity than knockdown herbicides – has increased as part of the industry's coordinated resistance management strategy and to kill difficult-to-control weeds
- The use of herbicides has likely been overstated, as reported data has not captured the increasing area of fields using optical sprayers to detect weeds. Cameras are increasingly used on spray equipment to spray only weeds instead of the entire field – which reduces herbicide use significantly – but the data reporting process still shows the entire field being treated.

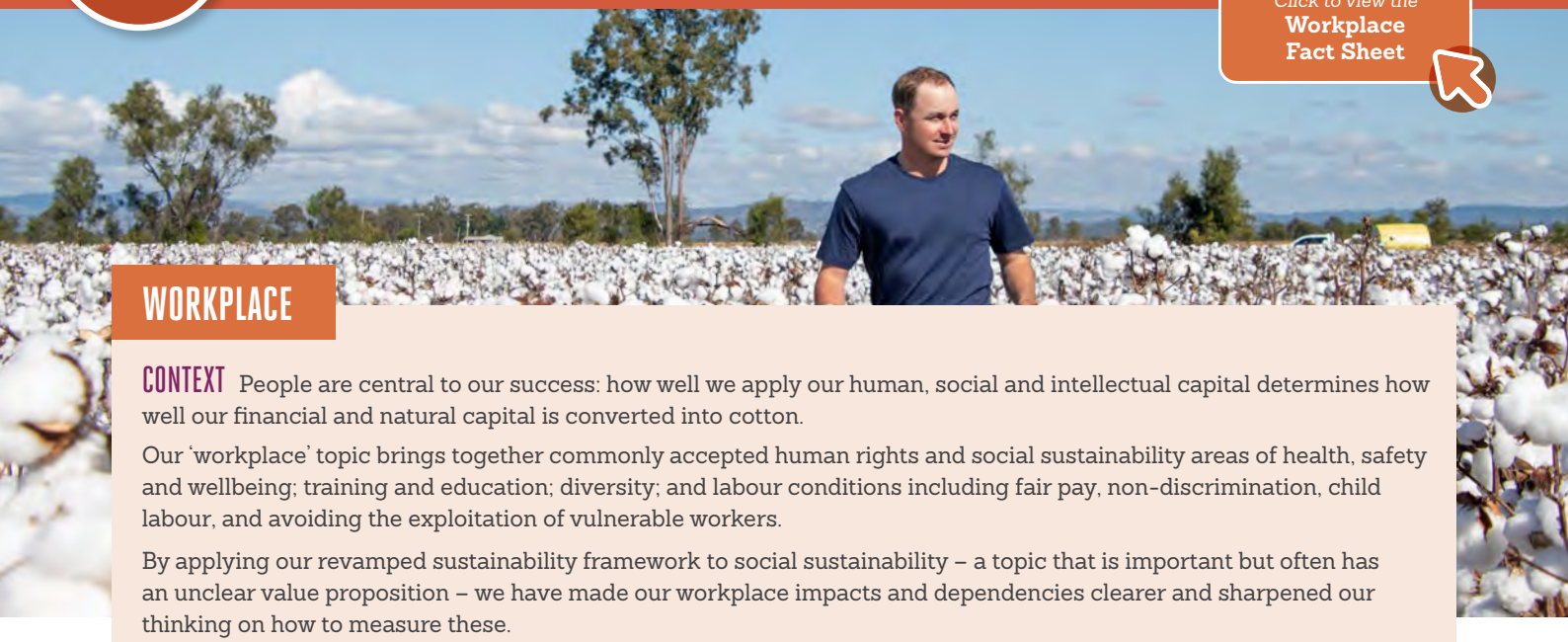
Importantly, while the use and hazard of herbicides has increased, the actual risk to the environment remains low when pesticides are used as directed by the label.

With continued wet seasons, herbicide use is likely to remain high in the short- to medium-term. However, technologies are progressing to reduce herbicide usage, including:

- Robots and conventional spraying equipment equipped with optical technology to spot spray weeds in fallow fields instead of the whole field (referred to as green-on-brown) have high adoption rates. This reduces herbicide use in the non-cotton phase of the farm system
- Optical equipment to spot spray weeds in crops (referred to as green-on-green) is an emerging technology with early commercial machines now available in Australia
- Prototypes of green-on-green technology to till weeds (instead of spraying them) in crops have been tested and look promising
- Robots that shut down when environmental conditions are not ideal. This increases precision of application to weeds, and reduces off target movement.

[10]Note ETL for bees does not include insecticides applied as a seed dressing to prevent pests eating the seed before it germinates. This data has not been available until recently. This will be added in future reporting, which is expected to increase the ETL for bees (but not change the trend).

Click to view the **Workplace Fact Sheet**



WORKPLACE

CONTEXT People are central to our success: how well we apply our human, social and intellectual capital determines how well our financial and natural capital is converted into cotton.

Our 'workplace' topic brings together commonly accepted human rights and social sustainability areas of health, safety and wellbeing; training and education; diversity; and labour conditions including fair pay, non-discrimination, child labour, and avoiding the exploitation of vulnerable workers.

By applying our revamped sustainability framework to social sustainability – a topic that is important but often has an unclear value proposition – we have made our workplace impacts and dependencies clearer and sharpened our thinking on how to measure these.

> MORE DETAIL: WORKPLACE INDICATORS HARMONISATION DISCUSSION PAPER

Risks & Opportunities

Market and reputation: opportunity increasing over time.

- Increasing customer demand for evidence – beyond the presence of regulation – that human rights are met is an opportunity for all Australian agriculture to proactively measure and improve the already-high levels of human rights on Australian farms
- Evidence of safe and inclusive workplaces, and of strong environmental management, may make the industry more appealing for new employees and support community trust in cotton farming.

Resource efficiency: opportunity increasing over time.

- Keeping people on farms safe and welcome, encouraging a diversity of ideas, and retaining them on farms for longer will improve productivity, reduce costs, and support innovation.

Technology: opportunity increasing over time.

- Introduction of new technologies that have the potential to make the workplace safe and more rewarding for employees.

NEW STRATEGY

Where we are now

Too many serious accidents. For the last 15 years, on average about one person died and about 40 people had a serious injury (needing more than five days off work) every year.

Growers know human capital is critical, but don't know how to attract staff and improve workforce capability. 98 per cent of growers want workers to feel like a valued part of the farm business and 63 per cent find it difficult to get the permanent staff they need.[xxiv]

Labour practices and workplace conditions not well known by the community. Most people have no view on whether workers on cotton farms are exploited;[xxv] this is a risk if community concerns about farm workplace conditions increase (and an opportunity to mitigate this risk).

Where we want to be

A culture of taking safety seriously results in zero fatalities and serious injuries every year. This eliminates trauma on families and farm businesses and frees up space in the rural health system.

Every cotton grower knows the drivers of a high-performance cotton workplace, and the actions they can take to keep employees and support their productivity.

The Australian cotton industry is regarded as an employer of choice because of its track record of providing transparent, proactive evidence that shows cotton farm workplaces are welcoming, inclusive, safe and gives people the opportunity to fulfill their potential.

Actions growers can take now

- Meet legal requirements for labour standards in the workplace
- Adopt a zero tolerance for high safety risk behaviours.

Actions industry is taking to support growers in future

- Collaborating with other agricultural sectors to coordinate accurate and more cost-effective whole farm workplace data collection, ensuring we measure what matters.
- Using improved data to:
  - » better inform WHS research and training
  - » better inform workplace culture research and training
  - » meet increasing customer demand for evidence human rights are being upheld
  - » attract people to the industry, and advocate for support and investment where it's most needed to make a difference
  - » advocate to improve supply chain labour practices.

PROGRESS

DEPENDENCY

Keeping cotton growers and core employees. This refers to farmers, farm managers and the core skilled employees farmers work hard to keep in the business permanently. A profitable cotton business helps farmers keep core employees year-round.

IMPACT DRIVERS

Availability of water; management style; investment in automation and technology; workplace culture; connection to community. Workplace and wellbeing research suggests these factors are more important for keeping core people on farms than the number of hours worked.

2023/24 INSIGHTS

Rainfall has been relatively high for several seasons. This supports the whole farm business, and other non-cotton farming businesses in the region.

The Regional Wellbeing Survey shows **cotton growers have much higher-than-average community involvement,** measured by volunteering and attending meetings or events held by local groups.

Adoption of automation technology increased in the past three years, perhaps spurred by COVID labour shortages. Technology is sometimes seen as a negative as it can reduce the need for casual labour. However, when used to make farm jobs safer and more interesting, technology can be an important driver in keeping the permanent employees farms most depend on.

Cotton growers value their workers, with 98 per cent agreeing that it's important to them that workers feel a valued part of the business. Conversely, only 7 per cent of growers agreed they "do not really care who they have employed on-farm, as long as the job gets done." These questions are used here as a proxy while we work with experts to identify key indicators that can be used to measure farm workplace culture and management style across agriculture industries.

Availability of water	2018	2020	2024
% above/below long-term average in traditional cotton-growing regions	+44	-15	+7

Source: BoM calculation.

Connection to community	2018	2020	2021
Community involvement (mean 1-7)	4.4	5.3	4.1
Volunteering (mean 1-7)	4.4	5.6	4.4

Source: Regional Wellbeing Survey, University of Canberra.

Investment in technology	2018	2021	2024
Use of automation on farm (%)	35%	28%	46%

Source: CRDC Grower Survey: "Are you currently using any automation (including automation for irrigation) on your farm?"[xxvi]

Workplace culture		2018	2024
% agree it's important workers feel valued		95%	98%

Source: CRDC Grower Survey: % agree or strongly agree "It is important to me that workers feel like a valued part of my farm business"[xxvii]

Management style
No data available

PROGRESS

DEPENDENCY

Attracting casual and contract employees. Growing cotton involves seasonal peaks, especially around harvesting.

These peaks are filled by a mixture of contractors (skilled people often with their own equipment and who generally live in regional Australia) and casual labour (often backpackers, students and other people from urban centres or overseas).

IMPACT DRIVERS

Human rights and environmental responsibility. These drivers are especially important for casual (eg backpacker or seasonal) employees. Evidence of having safe, inclusive workplaces will make cotton farms more appealing; environmentally responsible is a key driver of broader community trust.

2023/24 INSIGHTS

Whole of agriculture annual research into community trust shows **the cotton industry's perceived environmental responsibility is increasing but is closely tied to availability of water.** An ongoing priority is to build community acceptance by demonstrating zero tolerance for illegal water use, communicating that water used for irrigation in Australia is regulated by governments, and showing the work being done to maximise efficiency from every drop of water.

No data is currently available for many human rights indicators, such as fair pay, non-discrimination, no child labour, and avoiding exploitation of vulnerable workers.

While Australia has extensive legislation to protect workers rights, an increasing number of stakeholders want to see evidence that human rights are upheld on Australian farms. In response, we are advocating a whole-of-agriculture approach to develop low cost but robust methodologies to collect this data in a coordinated way.

While we wait for this work to take shape, **existing data shows**:

- **an increasing proportion of female and Indigenous employees in the industry and a balance of ages**
- **most cotton farms have plans to avoid discrimination.**

Perceived environmental responsibility	2021	2022	2023
Cotton uses more water than it is entitled to	25%	34%	40%
Cotton is committed to reducing GHGs	na	na	41%
I trust cotton to use pesticides responsibly	na	na	61%

Source: Voconiq community trust research. % agree or strongly agree.

Diversity & inclusion	2011	2016	2021
Gender: % female	22	23	28
Age: % < 29 years	27	21	24
Age: % 30-49 years	42	41	35
Age: % >50 years	29	38	39
% Aboriginal or Torres Strait Islander	5.1	5.6	6.9

Source: ABS Australian Census

Absence of discrimination	2024
Presence of farm workplace bullying plan	63%
Presence of farm workplace harassment plan	63%
Presence of farm workplace discrimination plan	61%
Incidents of discrimination	na

Source: CRDC Grower Survey: "Does your business have a written or unwritten plan for.. bullying, harassment, discrimination (written or unwritten)."[xxix]

PROGRESS

DEPENDENCY

Keeping everyone safe and appropriately skilled. Making farm workplaces safer, largely by eliminating unnecessary risks and risk-taking, remains a priority. Ensuring farms have the skills needed to adapt to a changing climate and take advantage of new technologies will be important to maintain our human capital resources.

IMPACT DRIVERS

Training and culture. We invest in skills and safety training to further reduce rates of injury and to give our people the future-proof skills they need. More may need to be invested in behavioural science and norms. We are increasingly seeking to collaborate with other agricultural industries in managing and measuring training.

2023/24 INSIGHTS

The University of Sydney has updated its five-yearly report into Australian cotton farm's health and safety data, previous conducted in 2019. This report showed a **small decline in the number of fatalities, but a gradual increase in the number of serious injuries since 2012.** Further work to address machinery related fatalities and injuries, plus serious injuries from falls on the same level and muscular stress, are identified as priorities for action.

The need to prioritise a reduction in serious injuries is emphasised by serious injuries comprising virtually all the time lost (~99 per cent) and compensation costs (~90 per cent) in the period, compared to short term injuries.

Fatalities & injuries attributed to cotton production	2009-13	2014-18	2009-23
Total fatalities	5	8	<5
Mean annual serious injuries	35	43	47

Source: University of Sydney research commissioned by CRDC.
Note: ethical considerations prevent stipulating fewer than five fatalities. 'Serious injuries' are five or more lost workdays.

While average wellbeing for cotton growers is relatively high, research shows a large 'wellbeing divide' in which a significant proportion of cotton growers had low wellbeing while others had very high wellbeing. Cotton growers reported higher psychological distress compared to other farmers. These likely reflect the ongoing effects of extended periods of drought in many cotton growing regions during 2019 and 2020.

Wellbeing and mental health	2018	2020	2021
Global Life Satisfaction (mean 0-100)	77	74	64
Mental health (mean 6-30 psychological distress; lower is better)	12	14	12

Source: Regional Wellbeing Survey, University of Canberra.

Census data shows **cotton farm and gin workers are relatively highly educated.** However, this is a poor indicator of skills being fit for purpose or future-proof. We are encouraging a cross-sector collaboration to collect more regular and meaningful skills data to guide future allocation of resources.

Skills	2011	2016	2021
% post-school qualifications	39	49	52

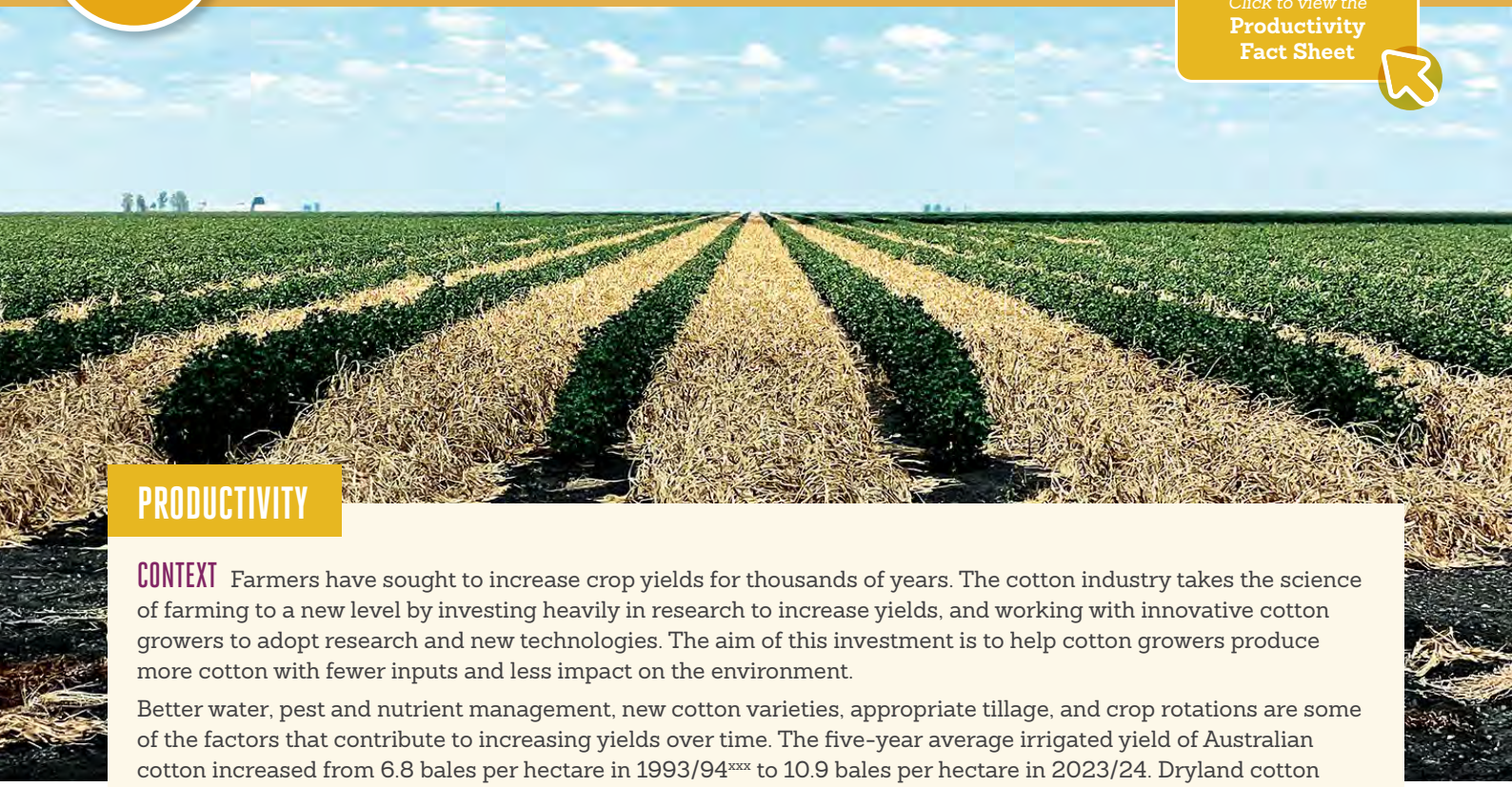
Source: ABS Australian Census.

Workplace support	2024
Presence of career development plan	57

Source: CRDC Grower Survey: "Does your business have a written or unwritten plan for performance and career development reviews (written or unwritten)."[xxix]

PADDOCK PRODUCTIVITY

Click to view the **Productivity Fact Sheet**



PRODUCTIVITY

CONTEXT Farmers have sought to increase crop yields for thousands of years. The cotton industry takes the science of farming to a new level by investing heavily in research to increase yields, and working with innovative cotton growers to adopt research and new technologies. The aim of this investment is to help cotton growers produce more cotton with fewer inputs and less impact on the environment.

Better water, pest and nutrient management, new cotton varieties, appropriate tillage, and crop rotations are some of the factors that contribute to increasing yields over time. The five-year average irrigated yield of Australian cotton increased from 6.8 bales per hectare in 1993/94[xxx] to 10.9 bales per hectare in 2023/24. Dryland cotton yield increased from 2.6 to 3.5 bales per hectare in the same period. We recognise it is important yield is not increased at the expense of environmental and social sustainability.

Risks & opportunities

Technology: opportunity increasing over time.

- Digital and autonomous technologies can reduce inputs and improve productivity, and make farm work more rewarding and interesting.

Reputation and market: opportunity increasing over time.

- Our aim of improving productivity within environmental and social boundaries is in line with increasing demand for sustainable intensification of agriculture.[11] Demonstrating this with evidence can support both our reputation and meet increasing demand for traceable, sustainable fibres.

Physical: risk and opportunity increasing over time.

- Increased extremes in temperature and rainfall may increase risks and opportunities, as noted in the GHG section.

NEW STRATEGY

Where we are now

Yield is king. This well-used grower cliche acknowledges the importance of maximising output, but to stakeholders outside the industry it implies a focus on yield at all costs, which is not the case.

It also is misleading. A high yield grown with excessive inputs like nitrogen and water is not a great agronomic or financial achievement, and is likely masking underlying limiting factors that could be addressed if more attention were paid to inputs than output.

Where we want to be

Efficiency is king. The conversation has moved to optimising every input:

- profitability is maximised
- yield targets are met or exceeded
- natural and human capital is improved to support greater resilience
- an Australian cotton industry known for maximising yield within environmental and social sustainability boundaries enhances its reputation.

Actions growers can take now

- Maximise yield within sustainable natural capital boundaries:
  - » Optimise every input
  - » Protect the human and natural capital needed to grow cotton efficiently.

Actions industry is taking to support growers

- Establishing an industry-owned data platform to deliver increased productivity through better farm decision-making, supported by innovative research to deliver better solutions
- Undertaking research to build resilience to an increasingly variable climate with limited water and reduced inputs.

[11]Sustainable intensification is defined as a process or system where agricultural yields are increased without adverse environmental impact and without the conversion of additional non-agricultural land.

PROGRESS

DEPENDENCIES

Favourable seasonal conditions. Water is normally the main limiting factor for cotton production; with limited water, limited cotton is grown. Hot conditions normally associated with dry seasons put further stress on cotton plants which can further impact productivity; unseasonally cold weather impacts cotton seedling growth and can reduce the amount of fruit produced by the plant.

IMPACT DRIVERS

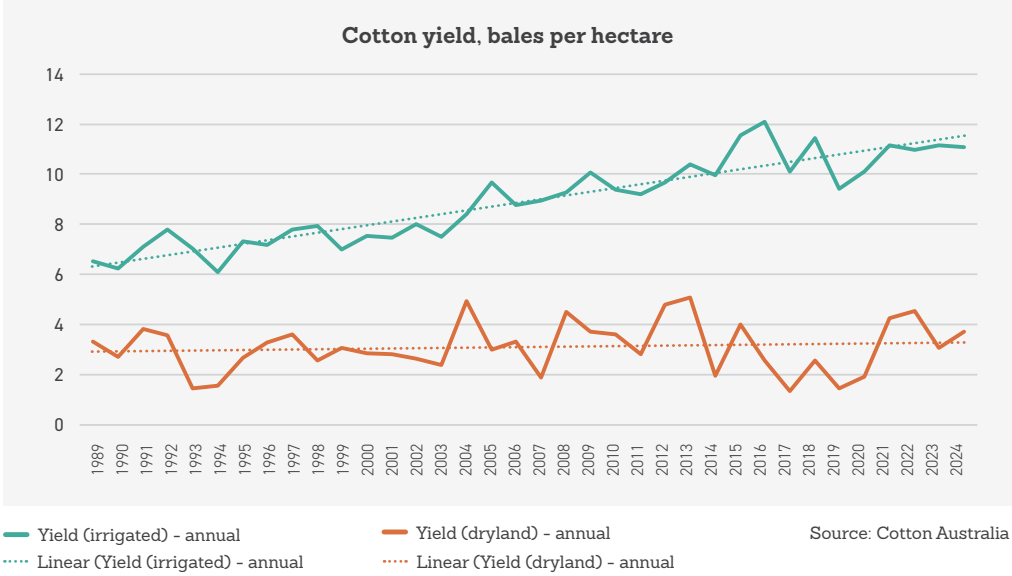
Farm management practices. With seasonal conditions outside the control of growers, the practices chosen by individuals to grow cotton (including water efficiency, soil health, pest control and other agronomic decisions) have a major impact on productivity. This is in part determined by having access to technologies.

2023/24 INSIGHTS

Irrigated cotton output was in line with average yield since the last drought broke in 2021, at 11.1 bales per hectare. Average dryland cotton yield increased from the previous season and was slightly above the five-year dryland average.

This graph clearly shows a long-term trend of increasing yield from irrigated cotton compared to dryland. The five-year average irrigated yield of Australian cotton increased by 60 per cent from 1994 to 2024 compared to a 34 per cent average dryland yield increase in the same period.[xxx]

This highlights the important role of irrigation when water is sourced from a regulated system to produce sustainably grown food and fibre, as it is in Australia. Sustainably withdrawn water produces far more food and fibre than relying on rainfall alone, and smooths out the volatility that creates much uncertainty and stress in farming.



Source: Cotton Australia

PADDOCK ECONOMIC CONTRIBUTION

Click to view the **Economic Contribution Fact Sheet**

ECONOMIC CONTRIBUTION

CONTEXT Australian agriculture makes a large contribution to the Australian economy, especially to regional Australia. The Australian cotton industry is no exception.

Australian cotton farms and gins are estimated to employ 7,222 people,[12] not including contractors. Post-farm gate, the industry directly employs people in marketing, export and cotton classing, and supports jobs for researchers, agronomists, rural suppliers and other input providers.

Risks & opportunities

Reputation: opportunity increasing over time.

- Quantifying the economic contribution the cotton industry makes to regional economies and Australia more broadly is an important driver of community trust and acceptance.

External factors: risks increasing over time.

- By far the most impact on a cotton growers' ability to contribute to the economy is their profitability. Reducing inputs while achieving yield targets can improve profitability, but many factors are outside the control of farmers. These include exchange rates, interest rates and cotton prices.

NEW STRATEGY

Where we are now

Community uncertainty about the benefits of the cotton industry to Australia. Community trust research shows the export value of Australian cotton is accepted, but how widely the benefits of cotton are shared with cotton communities and the nation is not appreciated.

Where we want to be

Australian cotton industry is recognised by decision-makers and influencers for the contribution it makes to rural economies and Australia more broadly.

Actions growers can take now

- Prioritise support for local and regional economies
- Continue to operate profitable farms and reinvest in a productive, sustainable and resilient whole farm business

Actions industry is taking to support growers

- Establishing an industry-owned data platform to deliver increased profitability through better decision-making, facilitating innovative research to deliver better solutions
- Implementing RD&E to achieve CRDC's 2023-28 Strategic RD&E Plan goal of delivering $1 billion in additional value to the Australian cotton industry across three pillars: Paddock, People and Planet
- Developing and implementing an Australian Cotton Strategic Roadmap that enhances the sustainability, market access and value of Australian cotton through five priority areas:
  - » Traceability
  - » Sustainably certified cotton
  - » Human rights
  - » Industry data
  - » Australian cotton marketing.

[12]The cotton industry needs to make this estimate because Census data significantly under-represents employment numbers: farmers growing other crops or livestock may not choose 'cotton growing' as their primary occupation, and it is done in August when seasonal employment in cotton is lowest.

PADDOCK ECONOMIC CONTRIBUTION

PROGRESS

DEPENDENCIES

Farm profitability. Profitability is essential for all farmers. Profitable cotton growers generate more economic value for society than unprofitable ones and have more resilient whole-of-farm businesses. Importantly though, the industry does not encourage profitability at the expense of other sustainability topics – economic sustainability needs to be balanced with environmental and social sustainability.

Profitability is a function of many drivers; some are outside the industry's control (seasonal conditions, cotton prices, exchange rates, input costs) while others (yield, operating costs) can be influenced by growers.

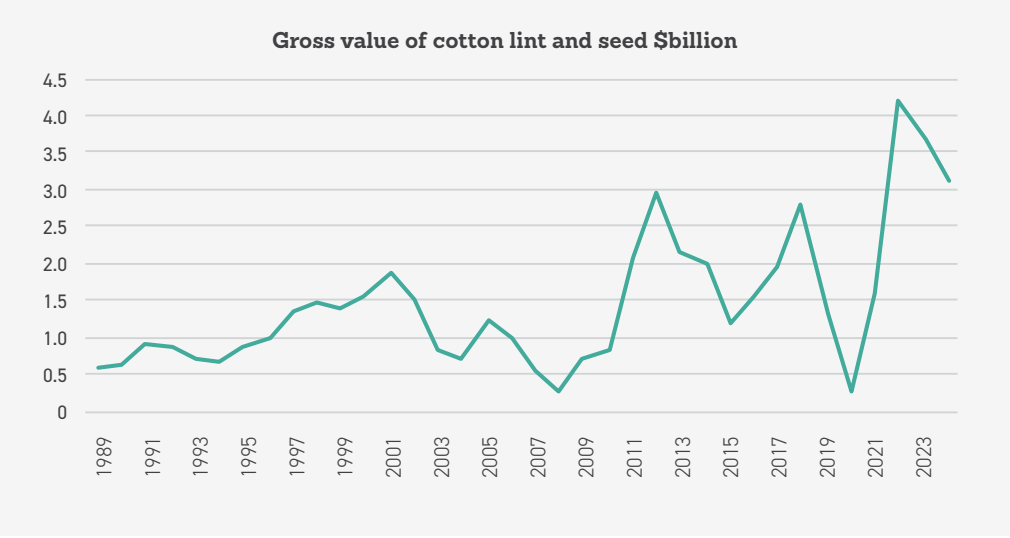
IMPACT DRIVERS

Economic value generated. The factors that influence profitability also impact gross cotton production revenues: seasonal conditions, global cotton prices, exchange rates, yield and operating costs. The factors that can be influenced are the areas industry invests in research and innovation.

Economic value distributed. Multiple factors also influence where the cotton industry has an economic impact. The presence of vibrant local service centres is perhaps most important: these are more likely to have goods and services, have potential labour pools, and provide a hub to attract and retain people to farms.

2023/24 INSIGHTS

The 2023/24 Australian cotton crop's gross value of production (delivered to gin) of $3.1 billion was lower than the previous two seasons in line with smaller crops, but above the five-year average of $2.6 billion.



Source: ABARES[xxxi]

NEW

New research has estimated on average, 67 per cent of gross revenues earned by irrigated Australian cotton farms flow back into the economy through purchase of goods and services, employee wages, taxes and payments to providers of capital.

For the five years 2019 to 2023, irrigated cotton farms injected on average $1.5 billion into the economy; the majority of this is likely to be in regional economies.

Cotton farming's total economic contribution would be higher when the approximately 10 per cent of dryland cotton production is added in; a lack of data for dryland cotton businesses currently prevents this estimate being made.

Quantifying the economic value distributed to the economy is important new research that lets our stakeholders more clearly see the direct value Australian cotton growers provide to Australia.

> MORE DETAIL: AUSTRALIAN COTTON ECONOMIC VALUE DISTRIBUTED

Cotton growers support regional economies in particular:

- About 80 per cent of cotton grower business expenses are spent locally
- The average Australian cotton farm has about six employees[xxxiii]
- In 2021/22 the Australian cotton industry was estimated to directly employ 7,222 people on farms and in gins; when flow-on effects are considered that figure grows to 21,896 people[xxxiv]
- Analysis of mixed farming operations shows irrigated cotton has a much higher return on assets managed than other crops, which provides greater whole-farm resilience and ability to manage through poorer seasons.[xxxv]

PADDOCK ECONOMIC CONTRIBUTION

Economic value generated $b	2019	2020	2021	2022	2023	2024
Gross value (cotton lint and seed)	1.3	0.3	1.6	4.2	3.7	3.1

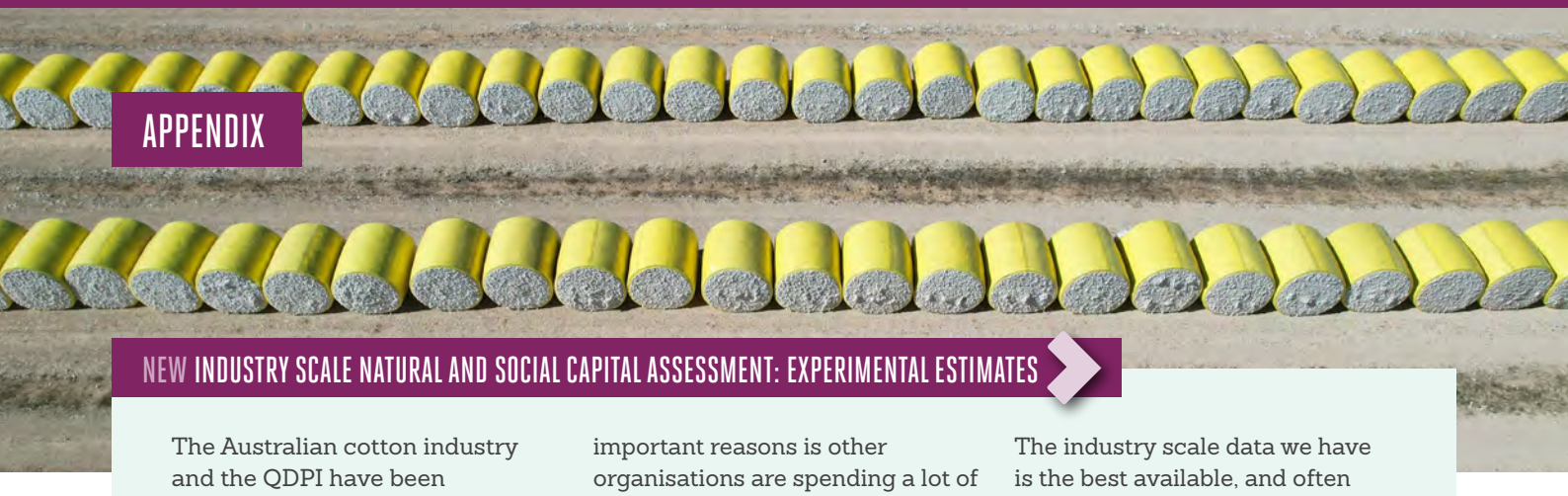
Source: ABARES Agricultural commodities: December quarter 2024

Economic value distributed $m (irrigated cotton)	2019	2020	2021	2022	2023
Total	**1,273**	**456**	**1,095**	**2,099**	**2,470**
Operating costs	1,023	377	793	1,523	1,710
Employee wages and salaries	101	41	70	122	180
Payments to government / taxes	84	12	170	379	464
Payment to providers of capital	65	26	62	75	116

Source: Estimate based on commissioned research by Boyce. No data is available for 2024 because there is a lag in analysing financial year farm business data.

Other indicators of economic contribution	2017	2020	2021	2023
Proportion of cotton business expenses spent locally*	79	76	-	82
Average number of employees per farm*	11	5	7	6
Volunteering rate (mean 1-7)**	-	5.6	4.4	-

*Source: CRDC Cotton Grower Survey
**Source: Regional Wellbeing Survey



APPENDIX

NEW INDUSTRY SCALE NATURAL AND SOCIAL CAPITAL ASSESSMENT: EXPERIMENTAL ESTIMATES

The Australian cotton industry and the QDPI have been collaborating for two years to use data collected in the revamped Australian cotton sustainability data framework to produce an experimental industry-scale natural and social capital assessment. This is one of the world's first industry-led partial natural and social capital assessments[xii]. It follows guidance provided by the Capitals Coalition, a multi-stakeholder organisation recognised as leading the global effort to have the value of all capitals included in decision-making.

Natural and social capital assessments measure and value change in impacts and dependencies. Natural capital accounting measures and values change in extent and condition.

We are focusing on an "assessment" instead of an "account" initially for several reasons. One of the most important reasons is other organisations are spending a lot of time experimenting with farm-scale natural capital accounting already. Rather than duplicate that work, we are focusing on assessments and talking to those organisations to ensure our extent and condition indicators are consistent with theirs.

Our hope is if we can eliminate duplication and contribute to a nationally consistent approach to natural and social capital assessment methodologies, the accuracy and usefulness of these assessments will quickly increase. This work is being widely shared with other agriculture industries and value chains to support this aim.

We are deliberately calling this an experimental assessment to mirror the language used in Australia's first National Ecosystem Accounts, experimental estimates, released in 2025 by the Australian Bureau of Statistics.

The industry scale data we have is the best available, and often assumptions have had to be made.

Rather than be relied upon for an accurate valuation, this assessment should be used to form a baseline to see observable trends over time and demonstrate what is possible as data quality improves.

The goal of this project is to give deeper insights into how the Australian cotton industry creates, preserves, or erodes value over time, to enhance decision making.

This pioneering work has uncovered technological limitations and barriers, but also generated actionable insights to enhance reporting accuracy and decision-making.

Ultimately, this initiative lays the groundwork for a scalable, transparent and credible natural and social capital assessment framework that promotes resilient, profitable and responsible agricultural systems.

Insights from the first Australian cotton experimental natural and social capital assessment include:

$4.2 billion

carbon stored in woody vegetation on farms that grow cotton.

What does this mean?

Farmers can only receive carbon payments for new 'additional' plantings. Farmers who have kept trees in the landscape are providing billions of dollars of value to the global community, but not being recognised for it.

$297/ha

rainfall in a WET SEASON.

$1,504/ha

rainfall in a DRY SEASON.

What does this mean?

By putting a price on rainfall, we can more clearly see its direct value in both wet and dry seasons. This will further support messages to all farmers about the importance of soil health practices that impact the utilisation of rainfall.

33 years

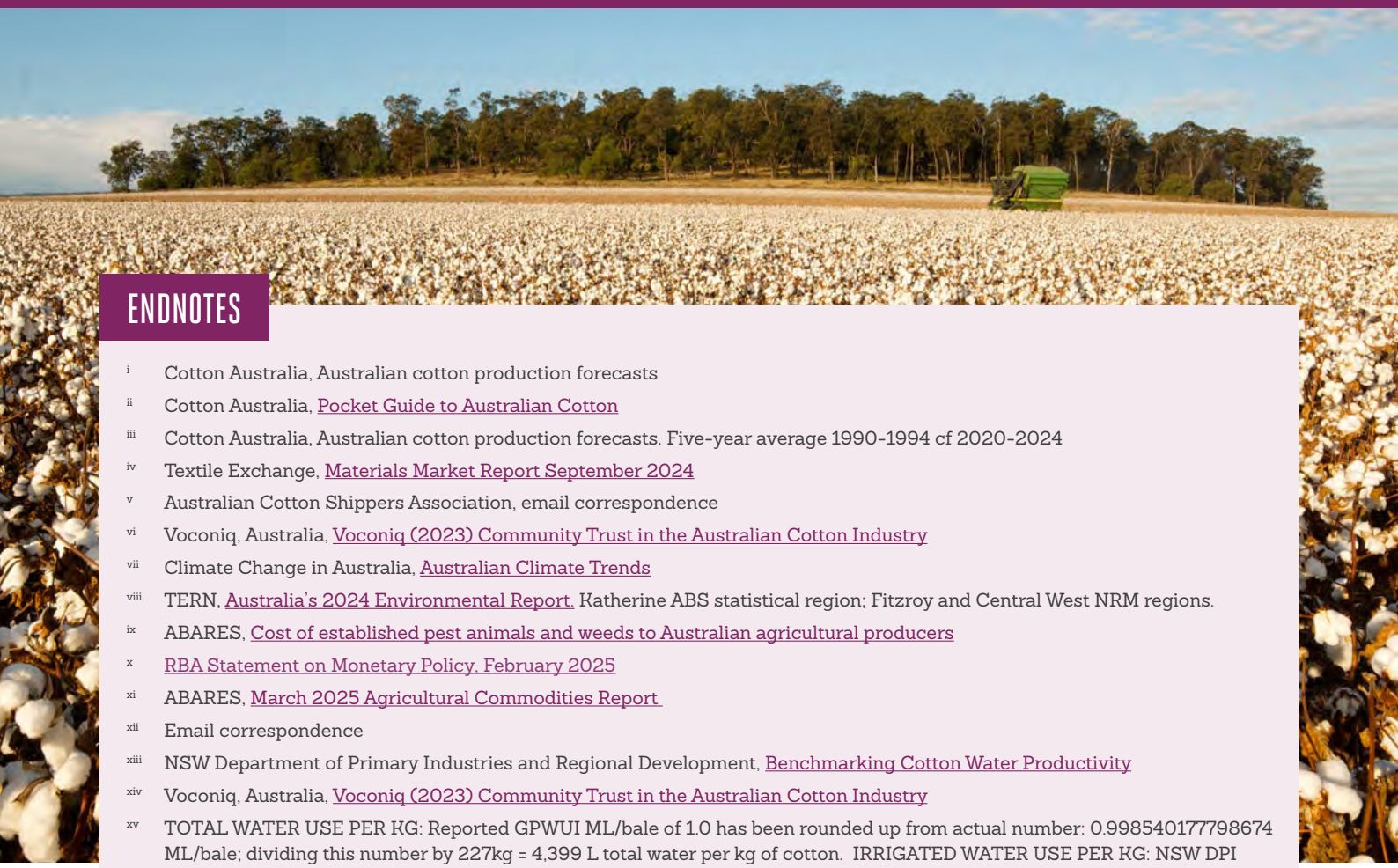
of healthy life lost per fatality.

1.8 years

of healthy life lost per serious injury.

What does this mean?

These quantitative valuations aim to show the impact of health and safety in a new light. New insights may provide new motivation for individuals to make changes that lead to safer workplaces.



ENDNOTES

i Cotton Australia, Australian cotton production forecasts

ii Cotton Australia, Pocket Guide to Australian Cotton

iii Cotton Australia, Australian cotton production forecasts. Five-year average 1990-1994 cf 2020-2024

iv Textile Exchange, Materials Market Report September 2024

v Australian Cotton Shippers Association, email correspondence

vi Voconiq, Australia, Voconiq (2023) Community Trust in the Australian Cotton Industry

vii Climate Change in Australia, Australian Climate Trends

viii TERN, Australia's 2024 Environmental Report. Katherine ABS statistical region; Fitzroy and Central West NRM regions.

ix ABARES, Cost of established pest animals and weeds to Australian agricultural producers

x RBA Statement on Monetary Policy, February 2025

xi ABARES, March 2025 Agricultural Commodities Report

xii Email correspondence

xiii NSW Department of Primary Industries and Regional Development, Benchmarking Cotton Water Productivity

xiv Voconiq, Australia, Voconiq (2023) Community Trust in the Australian Cotton Industry

xv TOTAL WATER USE PER KG: Reported GPWUI ML/bale of 1.0 has been rounded up from actual number: 0.998540177798674 ML/bale; dividing this number by 227kg = 4,399 L total water per kg of cotton. IRRIGATED WATER USE PER KG: NSW DPI survey found the average irrigated water applied to cotton was 7.61 ML/ha; this was multiplied by total 2023 irrigated hectares (416,485) = 3,171,370 total ML applied to cotton; this was divided by total 2023 irrigated bales produced (4,810,680) = 0.66 ML/bale irrigated water applied; dividing this by 227kg = 2,904 L irrigated water per kg of cotton.

xvi Based on Cotton Australia, Australian cotton production forecasts since 2010: mid-400,000 ha

xvii CottonInfo, Managing biodiversity in cotton landscapes

xviii SQ Landscapes "Mapping Woody Vegetation" method

xix SQ Landscapes "Mapping Woody Vegetation" method

xx The 0.2% here is cotton's contribution to all Australian emissions. Data provided by Francois Visser in 2019 [av total industry emissions 2015-2019 cradle to port = 1.1mt CO_2e; total Aust emissions 2017 (most recent accounts at the time) = 521mt CO_2e = 0.2%].

xxi The carbon footprint of Australian cotton lint production, from cradle to port, is 1.60kg per kg of lint (per Farm-level strategies to reduce the life cycle greenhouse gas emissions of cotton production: An Australian perspective. Hedeyati et al). The carbon footprint of polyethylene terephthalate (PET) production – the main input to polyester – is 33.05kg CO_2e per kg of PET according to a 2023 ABC report quoting 2018 RMIT research.

xxii Calculation from Primary Industries Climate Challenges Centre cotton Greenhouse Accounting Frameworks (C-GAF)

xxiii CCA sales data and researcher calculations

xxiv CRDC, 2024 Grower Survey

xxv Voconiq, Australia, Voconiq (2023) Community Trust in the Australian Cotton Industry

xxvi CRDC, 2024 Grower Survey

xxvii CRDC, 2024 Grower Survey

xxviii CRDC, 2024 Grower Survey

xxix CRDC, 2024 Grower Survey

xxx Cotton Australia, Australian cotton production forecasts

xxxi Average of CRDC Grower Survey business expenses spent locally = 79%. [2023 (82%), 2020 (76%), 2019 (80%) and 2017 (79%).]

xxxii CRDC, 2023 Grower Survey

xxxiii ABARES, Agricultural commodities: September quarter 2024 - Statistical tables - data tables XLS. Table 13

xxxiv ACIL Allen research, 2024

xxxv AgriPath, Water, N and Rate of Return (unpublished research). 5-year analysis 2021 and 2022. From 2022 report: *Both the 2021-22 and 5-year average ROAM for irrigation assets is higher than whole farm asset returns. Irrigation assets are making a significant contribution to whole farm profitability. High gross margin provides greater business resilience and the ability to manage through periods of lower cropping intensity due to low water allocations /availability.*

AUSTRALIAN COTTON SUSTAINABILITY FRAMEWORK

PLANET. PEOPLE. PADDOCK.

This Sustainability Report has been developed by the Sustainability Working Group on behalf of the Australian cotton industry.

We encourage you to provide feedback on how we can improve this Report or our management of sustainability.

Email us at: talktous@cotton.org.au

www.cottonaustralia.com.au | www.crdc.com.au
www. australiancottonsustainability.org.au

Forward looking statements. This report includes for the first time forward-looking statements of sustainability-related risks and opportunities. As defined by the European Sustainability Reporting Standard, these are uncertain environmental, social or governance events or conditions that, if they occur, could cause a potential material negative or positive effect on the undertaking's business model, strategy and sustainability strategy, its capability to achieve its goals and targets and to create value, and therefore may influence its decisions and those of its business relationships as regard to sustainability matters.

Because they relate to the future and involve uncertainties that are difficult to predict and largely outside the control of the Australian cotton industry, judgement has been used to identify risks and opportunities the industry thinks are relevant to the decision-making of users of this report, and faithfully represents that sustainability-related risk or opportunity. Actual events, risks and opportunities may differ materially from those implied by these forward-looking statements. Therefore, you should not rely on any of these forward-looking statements. The Australian cotton industry welcomes feedback on the risks and opportunities identified, and their potential likelihood and impact, as we work to improve our sustainability reporting in line with emerging and evolving sustainability reporting requirements.