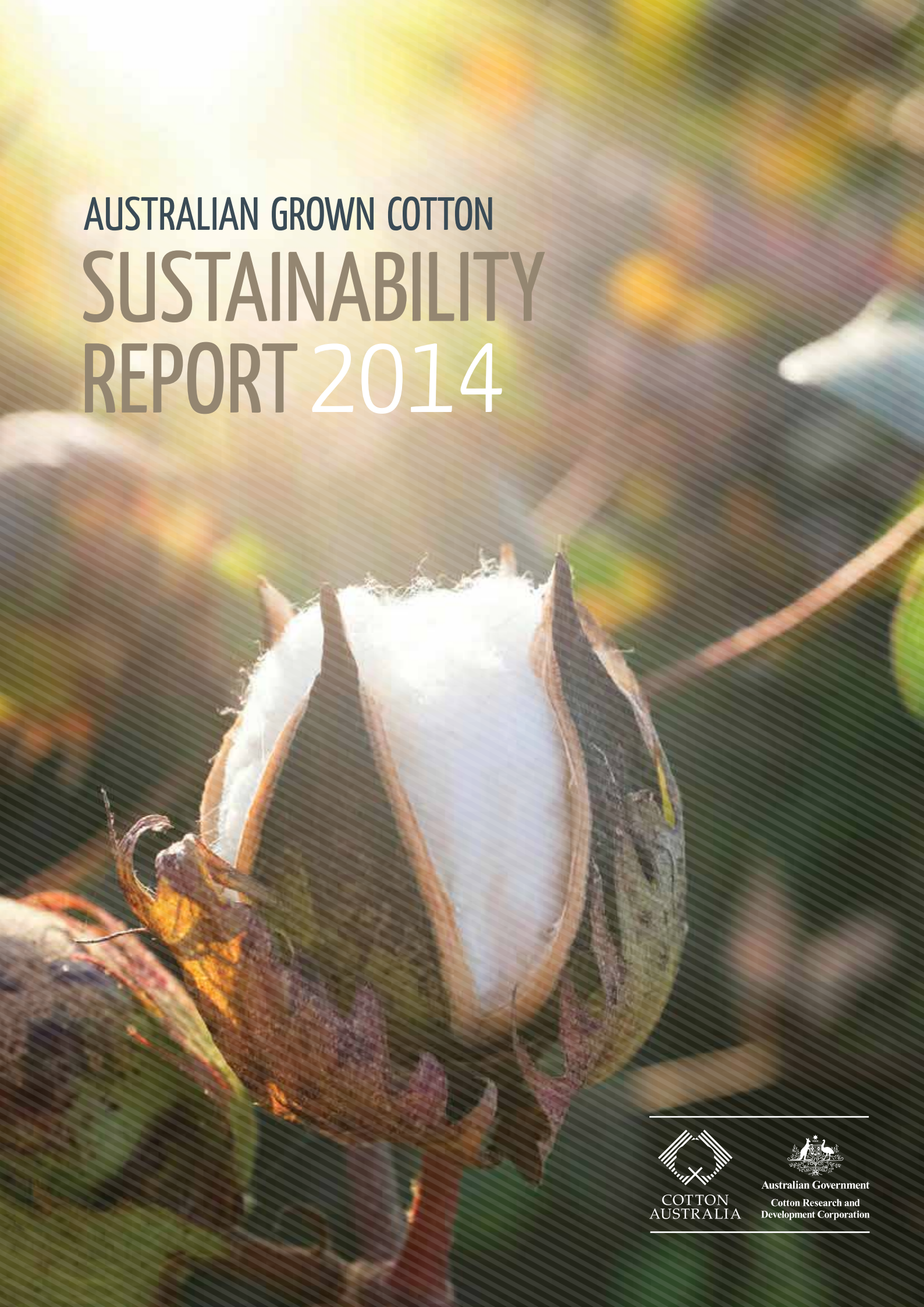
AUSTRALIAN GROWN COTTON
SUSTAINABILITY REPORT 2014



COTTON AUSTRALIA

Australian Government
Cotton Research and Development Corporation

OUR APPROACH

ABOUT THIS REPORT

Cotton is the most widely produced natural fibre in the world. Every day, billions of people wear cotton clothing and use cotton fabrics and products in their everyday lives. Australia is the third largest exporter of cotton in the world and has a reputation for producing high quality cotton.

Cotton Australia and the Cotton Research and Development Corporation (CRDC) have been working together to ensure the Australian cotton industry is a global leader in sustainable agriculture.

// Cotton Australia is the peak body for Australia's cotton growers. Cotton Australia strives to foster a world class agricultural industry that is sustainable, valued for its economic and social contributions and produces very high quality cotton which is in high demand around the globe.

// The Cotton Research and Development Corporation's purpose is to enhance the performance of the Australian cotton industry and community through strategically investing in research and development, and its application.

The Australian cotton industry is committed to sustainability and continuous improvement. This is its first sustainability report prepared according to the principles and framework of the Global Reporting Initiative for Sustainability Reporting (G4 version). In preparing the report the industry has considered more than 100 sustainability indicators, reviewed the literature and international frameworks, and consulted stakeholders.

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EXECUTIVE SUMMARY

Sustainability has long been a key focus of the Australian cotton industry. Today, Australian cotton growers grow more cotton on less land, with more efficient water use and with less impact on the environment than ever before.

The Australian cotton industry:

// Is dedicated to becoming the producer and supplier of the most environmentally and socially responsible cotton in the world.

// Aims to be a global leader in sustainable agriculture by investing in research and development and reporting against recognised sustainability indicators.

// Is committed to delivering independent, evidence based assessments of its sustainability and environmental performance and communicating this with a common voice.

The industry has a strong research and development culture. Over the past 24 years, the Cotton Research and Development Corporation (CRDC) has invested $200 million in research, development and extension on behalf of Australian cotton growers and the Australian Government – delivering an estimated minimum $1.4 billion benefit back to growers on their farms, and twice that value to the wider community.

Cotton Australia has recently joined two international sustainability partnerships: the Cotton LEADS Program and the Better Cotton Initiative. *my*BMP is the Australian cotton industry's voluntary farm and environmental management system for growers to improve on-farm production. *my*BMP ensures that the Australian cotton industry produces economically, socially and environmentally sustainable cotton. 45 percent of Australia's cotton produced is grown on farms participating in the *my*BMP program.

ECONOMIC CATEGORY

The economic aspects considered for this report are cotton production statistics, crop yield and quality, and its economic value.

31%
MARKET SHARE

Cotton is the most widely produced natural fibre in the world and represents about 31 percent of the world textile market.

Australia produces three percent of the world's cotton but is the third largest exporter, behind the US and India. More than 99 percent of Australia's cotton is exported.

There are up to

1500

cotton farms in Australia

Australia's cotton farmers produce enough cotton to clothe 500 million people.

Australian yields are high by international standards, almost three times the world average.

ANNUAL PRODUCTION ON AVERAGE FOR THE LAST FIVE YEARS (2009-2014):

Irrigated planted area was
354,775 ha

Dryland planted area was
96,074 ha

Irrigated crop yield was
9.85 bales/ha [2236 kg/ha]

Dryland crop yield was
4.09 bales/ha [928 kg/ha]

Total production was
881,463 metric tonnes [3.9 million bales]

The gross value of production was
$2 billion

Average cotton area per farm
495 ha

30 to 60%

Cotton is a major commodity, representing from 30 to 60 percent of the gross value of the total agricultural production in regions where it is grown. The average profitability of growing cotton in 2013 was $410/ha.

Australian cotton is viewed worldwide as having an excellent quality fibre. It is used to produce high quality yarns for use in the woven and knitted apparel sector.

ENVIRONMENTAL CATEGORY

The environmental aspects for this report included soil health, water use, groundwater, biodiversity, riparian land management, integrated pest management, pesticide use and greenhouse gas emissions.

Farmers are taking action to improve soil health

Water is critical to maximise crop yields and fibre quality.

The proportion of farmers monitoring groundwater quality has increased significantly from 20 percent in 2006 to 62 percent in 2011.

40%

increase in cotton water productivity over the last decade.

Comparing 5 year averages for the periods 2008-13 and 1998-03, the amount of insecticide used has reduced from 5.12 kg to 0.55 kg active ingredient per hectare.

// The whole farm irrigation efficiency index improved from 57 percent to 70 percent.

// The crop water use index is above three kg/mm/ha, high by international standards.

// 96 percent of irrigators have improved their furrow irrigation system or changed to an alternate irrigation system.

On average cotton farms have approximately 42 percent of their land dedicated to native vegetation. More than 42,000 birds representing 45 species were found on farm water storages in the Gwydir Valley, 153 bird species were found in natural vegetation in the Namoi Valley, 450 species of invertebrates have been recorded in one cotton field during the summer.

Nitrogen fertilisers and energy consumed on farms are a major source of greenhouse gas emissions, and the industry continues to invest in research, demonstration trials and decision support tools focused on improving nitrogen and energy use efficiency.

89% **The cotton industry has achieved an 89 percent reduction in insecticide use.**

SOCIAL CATEGORY

Key social aspects for the cotton industry include education levels, demographics, employment, health, social capital, research and development and legal compliance.

The number of cotton growers with a diploma level or above qualification has risen from 30 percent in 1990 to 50 percent in 2011. These qualification levels are higher than other agricultural sectors and above the average Australian population.

10,000 people

COTTON AUSTRALIA ESTIMATES 10,000 PEOPLE ARE DIRECTLY EMPLOYED BY THE COTTON INDUSTRY IN A NON-DROUGHT YEAR.

// There are about **6.6 people** per farm (1.6 employees/100 cotton hectares, with a highly variable range across regions).

// Cotton represents less than **0.02 percent** of all claims in agriculture for injuries less than four days and five-plus days.

// Overall cotton growers are much younger than farmers in other agricultural industries in Australia.

HIGH SOCIAL CAPITAL

// The Australian Cotton Conference is one of the largest conferences of any agricultural industry in Australia with more than **1800 delegates.**

AUSTRALIAN COTTON GROWERS ARE INNOVATIVE AND RAPIDLY ADOPT NEW TECHNOLOGIES

// **82 percent** use new round module pickers.

99% ADOPTION **of transgenic traits for insect and weed management.**

// **70 percent** of farmers use soil moisture probes, up from 40 percent in 2006 (highest of all agriculture industries in Australia).

// **90 percent** using satellite navigation systems in tractors.

// **84 percent** use a smart phone or tablet for accessing information about their farming system.

// **93 percent** of farmers use integrated pest management (IPM).

The proportion of women working in key industry organisations is 60%

OUR STRATEGY

JOINT LETTER FROM THE CHAIRS - OUR COMMITMENT TO SUSTAINABILITY

Sustainability is integral to stakeholders both within and external to the industry.

In 2009, leaders in the Australian cotton industry recognised the potential for improving industry performance, organisational collaboration and capacity through a shared view of the future. A 20 year timeline was chosen to ensure a long-term strategic focus.

The *Cotton Industry Vision 2029* is: "Australian cotton, carefully grown, naturally world's best". [i]

Key elements of the Cotton Industry Vision 2029 are to make Australian cotton:

// **DIFFERENTIATED** a world-leading supplier of elite quality cotton that is highly sought in premium market segments.

// **RESPONSIBLE** the producer and supplier of the most environmentally and socially responsible cotton in the world.

// **TOUGH** a resilient industry, equipped for future challenges.

// **SUCCESSFUL** exciting new levels of performance that transform productivity and profitability of every sector of the industry.

// **RESPECTED** an industry recognised and valued by the wider community for its contribution to fibre and food needs of the world.

// **CAPABLE** an industry that retains, attracts and develops highly capable people.

THE AUSTRALIAN COTTON INDUSTRY

// Is dedicated to becoming the producer and supplier of the most environmentally and socially responsible cotton in the world.

// Aims to be a global leader in sustainable agriculture by investing in research and development and reporting against recognised sustainability indicators.

// Is committed to delivering independent, evidence based assessments of its sustainability and environmental performance and communicating this with a common voice.

// Utilises its best management practice program (*my*BMP) as a pivotal platform to maintain the cotton industry's social licence to operate. *my*BMP provides the tools for growers to leave a smaller environmental footprint and the means to demonstrate the industry's commitment to sustainable practices.

The principles in this statement are built from the strategic plans of Cotton Australia, the CRDC and the Cotton Industry Vision 2029[ii].

The Australian cotton industry has a 21 year history of independent environmental assessments and is unique among Australian agricultural industries in documenting performance and practice change over such a long period. Cotton Australia and CRDC are committed to continuing an independent, evidence based assessment of cotton industry's sustainability and environmental performance and reporting outcomes to stakeholders and industry.

Consumers, government and communities around the world are increasingly interested in the sustainability of agriculture and its products. As part of the industry strategy to better meet stakeholder needs, Cotton Australia has recently joined two international sustainability partnerships: the Cotton LEADS™ Program and the Better Cotton Initiative. The National Farmers Federation (of which Cotton Australia is a member), in its *Blueprint for Australian Agriculture 2013-2020,* has a high priority goal to improve and promote the agricultural industry's environmental sustainability. One of the strategies identified is to develop sustainability indicators.

Notably, at the 2013 annual International Cotton Advisory Committee (ICAC) Plenary Meeting, the committee received a report titled *Measuring sustainability in cotton farming systems: Towards a guidance framework*[iii] from its Expert Panel on the Social, Environmental and Economic Performance of Cotton Production (SEEP). SEEP provided recommendations about the indicators which should be used to measure sustainability in cotton production at the global level. The recommended indicators cover the three pillars of sustainability - social, environmental and economic. This report was developed as envisaged by SEEP as part of developing an agreed set of indicators for the industry.

The Australian cotton industry is committed to a continued focus on achieving a successful, resilient and responsible industry. As part of this commitment we will establish a forum to actively engage with our stakeholders to discuss opportunities for improvement. This will include developing specific sustainability targets that:

// Boost farm productivity.
// Increase water use efficiency.
// Reduce the carbon footprint.
// Enhance biodiversity.
// Reduce work related injuries and fatalities.
// Facilitate increased sustainability reporting across the supply and value chain for cotton.

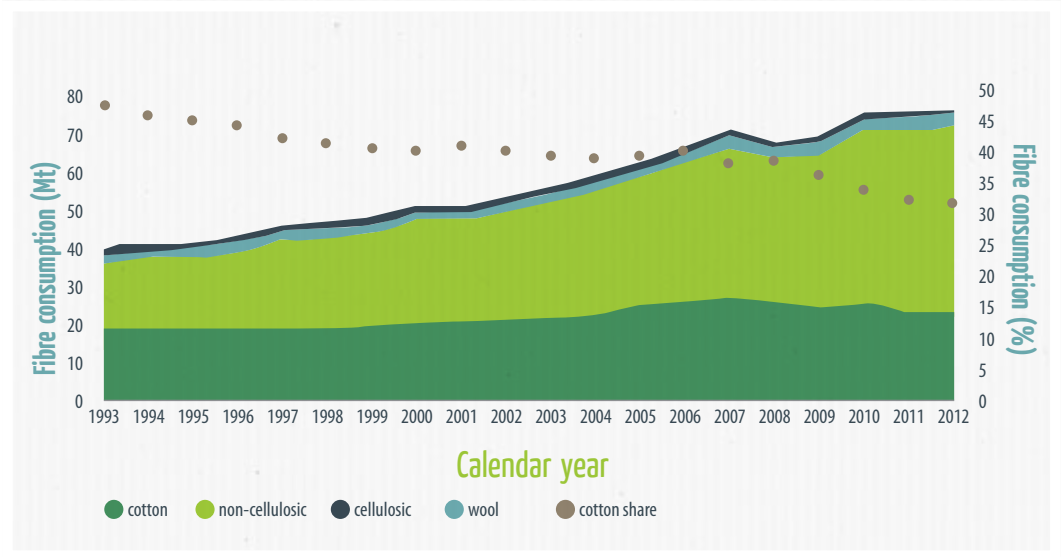
Lyndon Mulligan
Chair, Cotton Australia

Dr Mary Corbett
Chair, Cotton Research and Development Corporation

INTERNATIONAL COTTON SITUATIONAL ANALYSIS

Cotton has been widely used and traded as fibre and fabric for more than 5,000 years. Cotton is the most commonly produced natural fibre in the world and represents about 31 percent of the world textile market. By contrast, wool accounts for three percent, and other natural fibres like silk, hemp, linen and mohair make up a very small proportion of global textiles (less than one percent each). Man-made fibres make up more than 60 percent of the global textile market and this proportion is increasing. World consumption for cotton is growing, but at a much slower rate compared to man-made fibres (Figure 1).

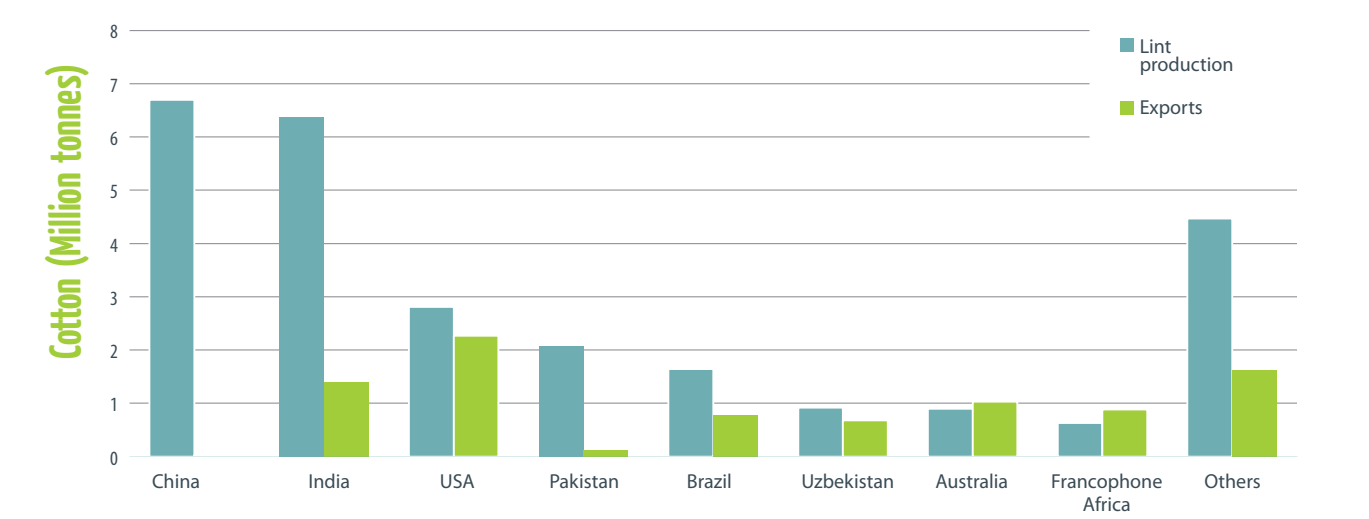
Figure 1. World consumption for cotton and man-made fibres



Source: International Cotton Advisory Committee 2012

Cotton is produced in more than 100 countries in the world, but six of them - China, India, Pakistan, USA, Brazil and Uzbekistan - contribute about 80 percent of production. On average 33-34 million hectares are planted to cotton annually around the world, producing about 26 million tonnes of lint.

Figure 2. World cotton production and exports from major producing countries



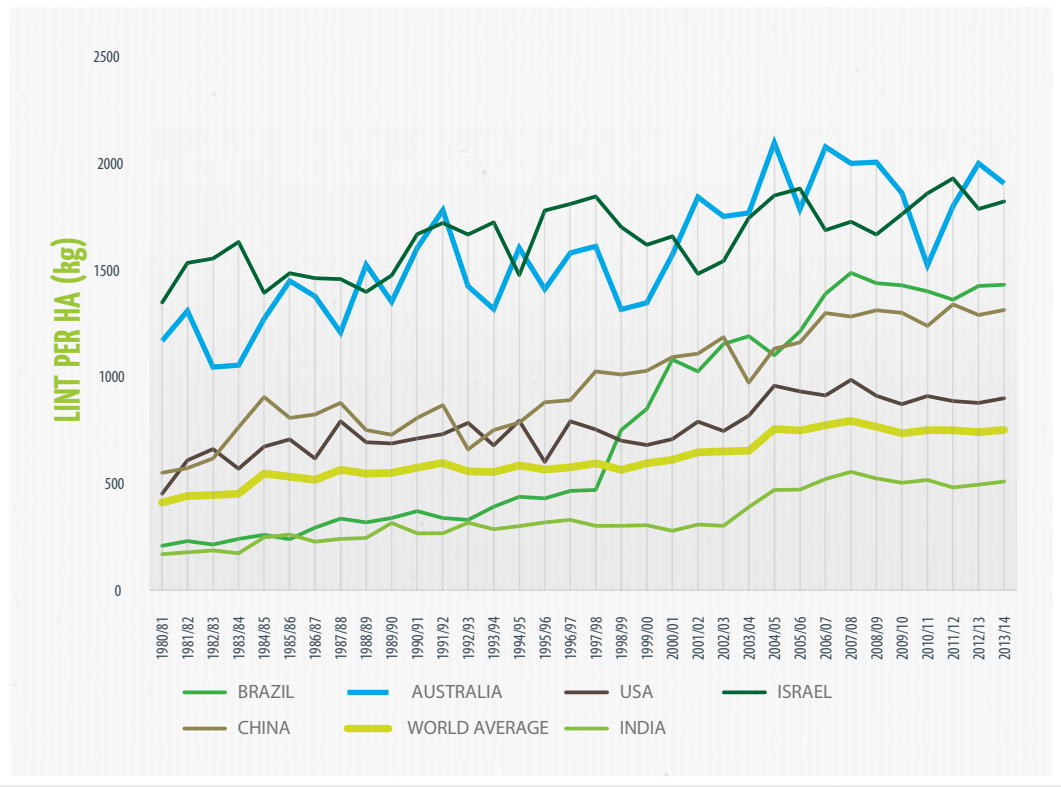
Source: ICAC 2014 Note: Figures for 2014 include carry over stocks from 2013.

Australia produces around three percent of the world's cotton but is the third largest exporter, behind the USA and India (Figure 2). More than 99 percent of Australia's cotton is exported. In an average year, Australia's cotton growers can produce enough cotton to clothe 500 million people.

Australian yields are high by international standards, almost three times the world average.

Figure 3 shows Israel and Australian yields are consistently higher than other major producing countries and the world average.

Figure 3. Cotton lint yields for major producing countries between 1980 – 2014



Source: ICAC 2014

Irrigation modernisation has improved water use efficiency.

The Australian Government is a member of the International Cotton Advisory Committee (ICAC), which is the international forum for governments to discuss cotton issues.

The ICAC has noted that cotton's international competitive challenges include:

// Man-made fibres now dominate the global fibre market with cotton's share declining as man-made fibre quality and production capacity improves.

// Competition for resources, such as land and water, with other crops.

// Rising input costs.

// Consumer pressures to reduce input use.

// Shifts in consumer spending away from clothing and home furnishings.

// Demonstrating sustainable practices.

// High volatility of prices caused by climate variability and government measures that distort markets.

// Fibre quality standardisation and classification.

// Accelerating yield and fibre quality improvement.

// Increasing the participation of women in the cotton industry.

AUSTRALIAN COTTON SITUATIONAL ANALYSIS

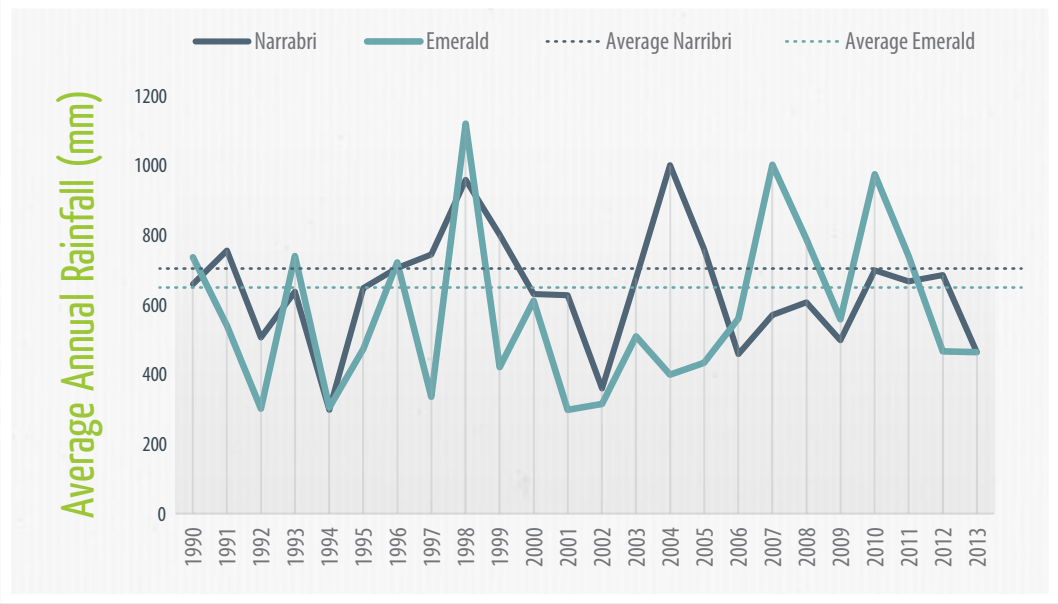
The cotton industry is an integral part of the Australian economy, worth more than $2 billion per annum in export earnings and helping to underpin more than 50 rural communities. The industry is made up of approximately 1500 farms in regional New South Wales (NSW) and Queensland as well as cotton ginning facilities and a range of associated support industries, including crop consultants, input suppliers, farming contractors, cotton classers and cotton merchants. About 65 percent of Australia's cotton is grown in NSW with the remainder grown in Queensland (Figure 4).

From 1920 to 1960 cotton was grown on a small scale as a dryland crop in Queensland. Yields were less than 180kg/ha. The most dramatic change to cotton production followed the completion of major river headwater dams and the subsequent introduction of irrigation in northern NSW during the 1960s to 1980s. In 2013-14 some commercial cotton crops were grown for the first time in northern Victoria.

Figure 4 Australian cotton growing regions

Cotton is mostly grown in the 400-800mm summer rainfall zone, which means cotton crops can receive significant amounts of their water needs from rain during the growing season. The cracking clay soils where cotton is grown can store up to 150 -170mm of plant available water in a 130cm profile, especially following a wet winter prior to cotton planting.
The highly variable climate can lead to droughts or flooding rains and both extremes have been experienced in the past decade (Figure 5). The largest crop on record was 566,000 hectares planted in 2011-12. The area of rain-grown cotton changes considerably from year to year depending on rain and prices.

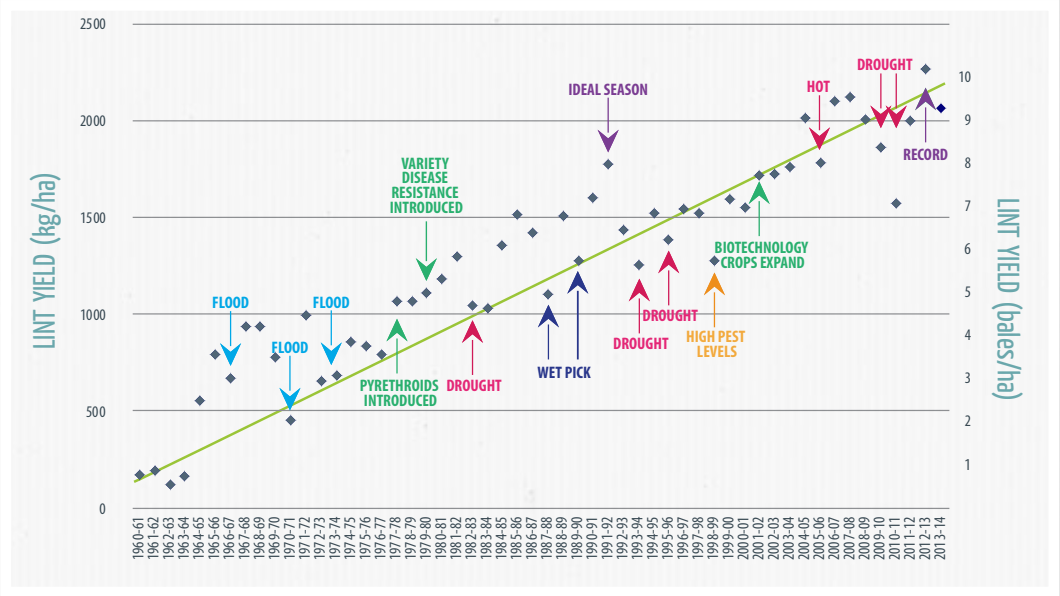
Figure 5 Long term average rainfall for Emerald, Qld and Narrabri, NSW



Source: Bureau of Meteorology

For the past 10 years, on average, 83 percent of the Australian cotton crop was irrigated and produced 92 percent of the national crop with an average yield of 9.59 bales/ha. Australian irrigated lint yields per unit area are now the highest of any major cotton producing country in the world, being about three times the world average. Yields have continued to move upwards from 1200kg/ha in the 1970s, through 1400kg/ha in the 1980s to 1600kg/ha in the 1990s and can now be greater than 2270kg/ha (10 bales/ha). Figure 6 shows the rising trend in yields as well as significant technology and climatic events which occurred. Most of this yield gain is attributed to plant breeding and exploiting genetic variation and genotype response to modern management.

Figure 6 Technology and climatic impacts on cotton yields



Australian cotton prices vary due to the world cotton price (priced in US dollars) and the Australian/US dollar exchange rate. Taking into account the world cotton price and currency exchange rates, for the last two years they have hovered around $440/bale. About 270 kilograms of fuzzy cotton seed is produced for every 227 kilogram bale of cotton fibre and this seed is currently valued around $370/tonne.

The Australian cotton industry faces many challenges which are addressed by the current 2013-2018 strategic plans of Cotton Australia and CRDC. These challenges include:

// Competition from man-made fibres (especially polyester) that now dominates the global fibre market, with cotton's share continuing to decline.

// Falling farm profitability and increasing input costs.

// Maintaining yield and fibre quality improvements.

// Rising competition for natural resources such as water and land.

// Demonstrating environmental stewardship and sustainability in line with community and market expectations.

// Managing climatic variability and its impact on production.

// Biosecurity and transgenic trait stewardship.

// Attraction and retention of skilled labour.

// Ensuring innovation and its adoption from research and development.

COTTON PRODUCTS

The cotton plant produces fruit, known as bolls. When mature the crop is picked and ginned - which separates the cotton fibre (or lint) from the seed. Cotton lint makes up about 42 percent of the picked cotton by weight, and contributes about 85 percent of the total income from a cotton crop. The other 15 percent of income is from cotton seed.

Cotton lint is spun into yarn that is woven or knitted into a wide range of fabrics such as velvet, corduroy, chambray, velour, jersey and flannel. Cotton fabric is used to make denim jeans, socks, towels, t-shirts, bed sheets and underwear. Cotton's strength and absorbency make it an ideal fabric for medical and personal hygiene products. Other uses of cotton fibres include furnishings, car-tyre cord, fishing nets and bookbinding. Some very short fibres that remain on the cottonseed after ginning are called linters. These can be used to produce items such as bandages, swabs, bank notes, cotton buds and x-rays.

Cotton is a sought-after fibre due to its non-allergenic properties, softness which people like close to their skin, ability to be blended with synthetic and natural fibres, easiness to dye because of its white colour, strength, and breathability that keeps the body cool in summer and warm in winter.

Cotton seed, which makes up around half the weight of the picked cotton, is mostly used to make cotton seed oil. One tonne of cotton seed yields approximately 200kg of oil, 500kg of cotton seed meal and 300kg of hulls.

Cotton seed oil is cholesterol free, high in polyunsaturated fats and contains high levels of anti-oxidants (vitamin E) which contribute to its long shelf life. It is particularly sought by restaurants and snack food stores for deep frying and is also used in the manufacture of some margarines and salad dressings. Cotton seed oil is also used to make products such as soap, emulsifiers, cosmetics, pharmaceuticals, rubber, paint, water proofing agents and candles.

The by-product of the oil-extraction process is meal, which is used as stock feed. Cotton seed meal is a high protein meal that can be fed to most animals. Cotton seed hulls are also a valuable feed source for livestock. Whole cotton seed can also be used as a supplement for ruminant livestock. It is high in energy, protein and fibre, and can be fed as a supplement in dry standing pastures or as an ingredient in feedlot rations. Global cotton seed production can potentially provide protein requirements for half a billion people and many billions of other animals[iv].

Australian Cotton Towel Range DRI GLO.

STRENGTHENING LINKAGES WITH THE SUPPLY CHAIN

Cotton Australia, with CRDC and the Australian Cotton Shippers Association, is collaborating with international and domestic brand owners and retailers to encourage demand for Australian cotton in the production of their fabrics. Cotton Australia is driving this demand by becoming active participants in Cotton LEADS™ and the Better Cotton Initiative. Both programs provide manufacturers, brands and retailers with a reliable cotton supply chain and confidence that their raw material is responsibly produced and identified.

// Cotton LEADS™ is Cotton Australia's partnership with the US cotton industry (The Cotton Foundation) to promote the use of responsibly produced cotton, by providing evidence of best practice cotton production and traceability in the supply chain. Cotton LEADS™ has more than 200 global partners including Brooks Brothers, Tesco, Fruit of the Loom, TexHong, Shanghai Imagine Home Textiles and Datsun Weaving (more information is available at **www.cottonleads.org**).

// The Better Cotton Initiative (BCI) is a not-for-profit organisation based in Switzerland, stewarding the global standards for 'better cotton', and bringing together cotton's complex supply chain, from the farmers to the retailers. BCI exists to make global cotton production better for the people who produce it, better for the environment it grows in and better for the sector's future, by developing 'better cotton' as a sustainable mainstream commodity. BCI partner organisations include Adidas, Gap Inc, H&M, IKEA, Oxfam, and the World Wide Fund for Nature (WWF) (more information is available at **www.bettercotton.org**).

*my*BMP: FARM MANAGEMENT SYSTEM www.myBMP.com.au

*my*BMP is the cotton industry's voluntary farm and environmental management system for growers to improve on-farm production. *my*BMP ensures that the Australian cotton industry produces economically, socially and environmentally sustainable cotton by providing:

// a central access point to the industry's best practice standards.
// technical support.
// self-assessment mechanisms.
// practical tools.
// auditing processes.

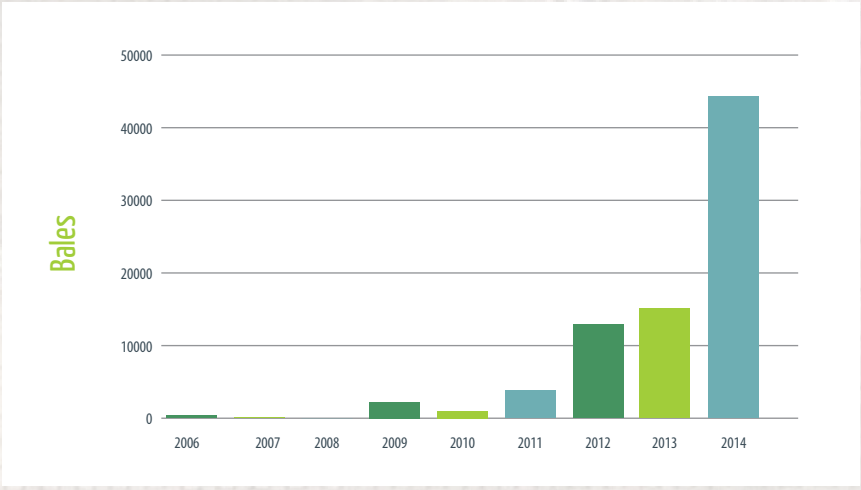
*my*BMP is also the industry's assurance mechanism. *my*BMP helps the industry manage risks and assures the community that the industry is committed to best management practice.

Currently there are 315 farms, producing 45 percent of Australia's cotton, participating in the *my*BMP Program and 45 of these farms have completed an external assurance audit for certification to the *my*BMP standard. In 2013 around eight percent of cotton bales were produced on certified *my*BMP farms, and the number of bales shipped in 2014 has increased significantly and is expected to rise further as 2014 shipments continue (Figure 7).

By the end of 2014, the Australian cotton industry aims to have 60 percent of the industry utilising *my*BMP. The targets for 2016 are:

// 100 percent of cotton growers complete level 1 *my*BMP accreditation.
// 40 percent of cotton growers complete level 2 *my*BMP accreditation.
// 10 percent of cotton growers complete *my*BMP certification.

Figure 7. *my*BMP certified cotton bales shipped to customers



Source: Cotton Australia

OUR ORGANISATIONAL PROFILE

The Australian cotton industry is made up of many diverse individuals and organisations. The Australian Cotton Industry Council (www.acic.org.au) is a whole of industry forum for sharing information, discussing strategies and promoting cooperation between industry organisations. It includes growers, researchers, ginners, classers, marketers, consulting agronomists, chemical and seed suppliers.

Cotton Australia (**www.cottonaustralia.com.au**) is the peak body for Australian cotton growers. Cotton Australia is a not for profit company limited by guarantee. Cotton Australia supports a regional cotton growers association in each region where cotton is produced. Cotton Australia strives to foster a world class agricultural industry that's sustainable, valued for its economic and social contributions and produces very high quality cotton in demand around the globe. Cotton Australia provides a united voice for cotton growers across research and development, stewardship, natural resources management, biosecurity, and community engagement. This is achieved through policy and advocacy, education, communication and grower services.

Cotton Australia's head office is in Sydney and has regional staff in Narrabri, Toowoomba and many other regional locations where cotton is grown. Cotton Australia is funded by a voluntary levy of $1.50 on each bale of cotton produced by growers. Cotton Australia's strategic plan and annual report (containing further details on, corporate operations, employees, and financial statements) are available on the website **www.cottonaustralia.com.au.**

Cotton Australia's advocacy work often revolves around membership with other like-minded organisations in the agricultural sector. Together, issues are debated and policies and submissions are developed and presented to government. These organisations include The National Farmers' Federation, Queensland Farmers' Federation, National Irrigators' and NSW Irrigators' Council. The CRDC is a member of the Council of Rural Research and Development Corporations. Both organisations are members of the Australian Cotton Industry Council.

Cotton growers also pay a compulsory research and development levy ($2.25 per bale), which is matched by the Australian Government and managed by the Cotton Research and Development Corporation (CRDC) (**www.crdc.com.au**). CRDC's purpose is to enhance the performance of the Australian cotton industry and community through investing in research and development, and its application. CRDC's 2013 – 2018 Strategic Plan can be found at **www.crdc.com.au**

The CRDC head office is in Narrabri, NSW – the heart of one of Australia's major cotton growing regions. CRDC is a research and development partnership between the Australian Government and the Australian cotton industry. Further details on corporate operations, employment arrangements, research activities and financial statements can be found in the annual report, which is tabled in Federal Parliament and is available on the website **www.crdc.com.au**

Cotton Australia and the CRDC have established a joint environmental working group to oversee the cotton industry's sustainability report.

OUR ACTIVITIES

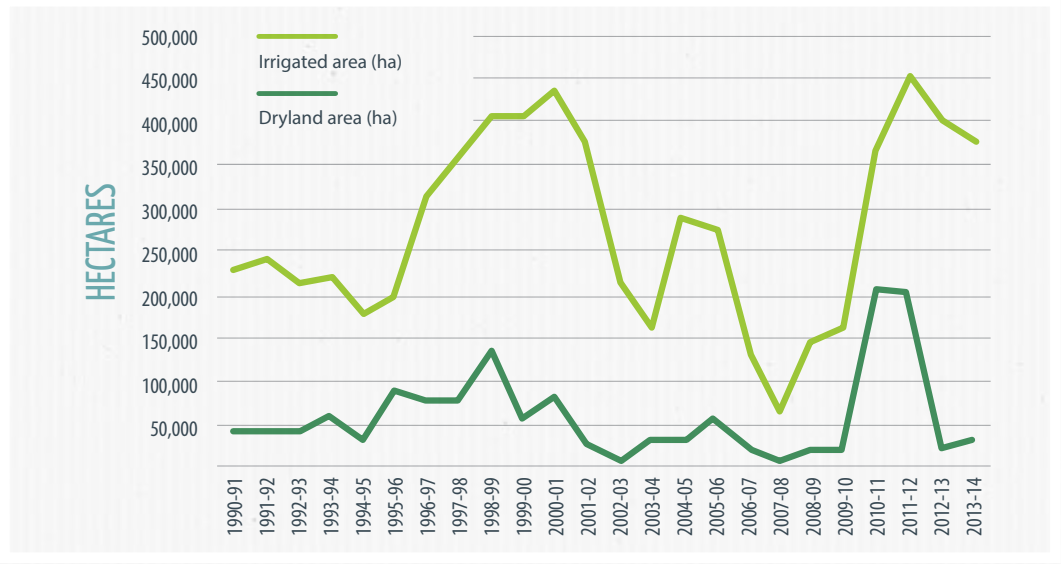
ECONOMIC CATEGORY

The economic aspects considered for this report are cotton production statistics, crop yield and quality, and its economic value to the economy.

PRODUCTION STATISTICS AREA OF COTTON PLANTED

The highly variable Australian climate has a significant impact on the cotton area planted and these fluctuations are shown for both irrigated and dryland cotton between 1990 and 2014 in Figure 8. For the last 10 years, on average, 84 percent of the Australian crop area was irrigated, while 16 percent was dryland. The irrigated planted area in 2013-14 was 382,850ha and the dryland area was 28,360ha, which was only seven percent of the total area due to drought conditions and the lack of any significant seasonal rainfall. The irrigated area peaked at 452,830ha in 2011-12, while it was at a record low in 2007-08 during the millennium drought.

Figure 8 The area planted to irrigated and dryland cotton in Australia 1990-2014



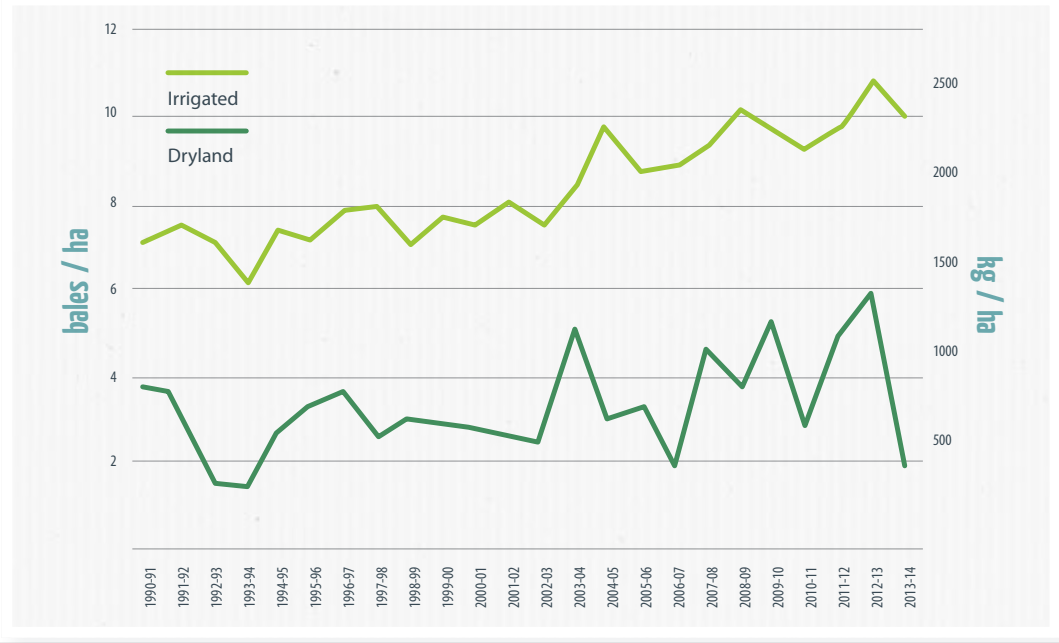
Source: Cotton Australia

Australian cotton bales ready for export. A bale of cotton lint weighs 227 kg. Each bale is tagged so it can be traced through the supply chain.

PRODUCTION STATISTICS CROP YIELD

For the past 10 years, the average irrigated crop yield was 9.60 bales/ha and for dryland cotton was 3.69 bales/ha (Figure 9). The irrigated yield for 2013-14 is estimated to be 9.96 bales/ha, while for dryland cotton yields are forecast to be around 1.93 bales/ha. Average irrigated crop yields exceeded 10 bales/ha for the first time in 2008-09 and reached record levels in 2012-13 at 10.73 bales/ha.

Figure 9 The yield of irrigated and dryland cotton 1990-2014

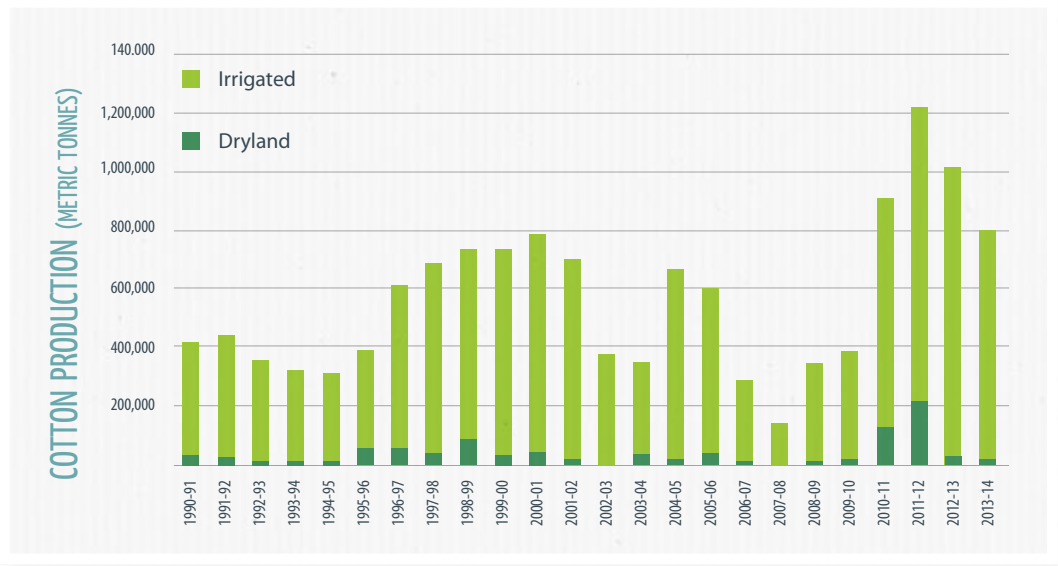


Source: Cotton Australia

PRODUCTION STATISTICS TOTAL AMOUNT OF COTTON PRODUCED

Figure 10 shows the total amount of cotton produced in Australia between 1990 and 2014. For the past 10 years the average annual amount of cotton lint produced in Australia was 641,806 metric tonnes (2,827,338 bales). Production reached a record high in 2011-12 at 1,215,870 metric tonnes (5,356,254 bales) and a low in 2007-08 at 136,831 metric tonnes (602,780 bales).

Figure 10 The total amount of cotton produced in Australia



Source: Cotton Australia

PRODUCTION STATISTICS FIBRE QUALITY

Australian cotton is viewed worldwide as an excellent quality fibre. It is usually purchased, primarily in the Asia-Pacific region, with the intention of producing high quality combed, ring spun yarns for use in the woven and knitted apparel sector. Fibre quality is affected by a large number of interacting factors including variety, seasonal conditions such as temperature and rain, crop management, harvesting and ginning. The industry has produced a number of resources to help farmers produce high quality cotton such as the *FIBREpak* manual[viii].

There are a number of characteristics that make up the cotton quality grade, but the most important are: length, strength, trash content, micronaire (a measure of fibre maturity and thickness) and colour. Annual data on the fibre quality parameters of the Australian cotton harvest can be found on the Australian Cotton Shippers site (**www.cottonshippers.com.au**).

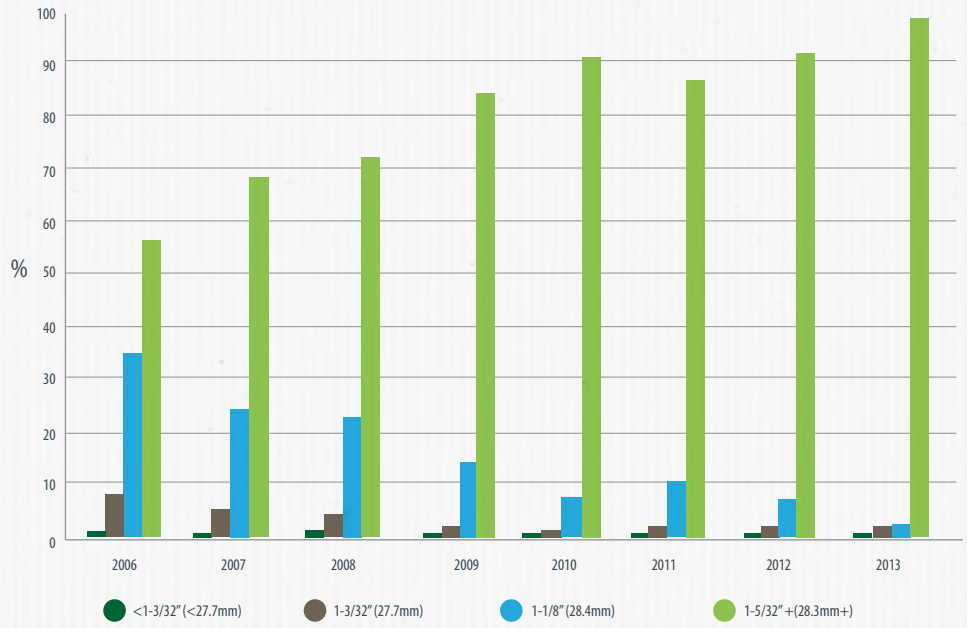
Figure 11 shows the trend in the Australian cotton crop fibre staple length. The market base length is 1 inch 1/8", which a significant proportion of Australia's cotton exceeds consistently. In 2006, 57 percent of Australia's cotton had a fibre length of 1 inch and 5/32" or more, which had risen to 97 percent by 2013.

THE WORD COTTON IS DERIVED FROM ARABIC WORDS THAT MEANT 'FINE TEXTILE'. COTTON IS A NATURAL FIBRE GROWING ON A PLANT AND IS RELATED TO HIBISCUS SPECIES.

Ongoing strategies to drive the industry's competitive advantage include:

- // Development of premium quality varieties.
- // Research to better understand management practices for fibre quality.
- // Improved cotton ginning processes.
- // Reducing contamination.
- // Development of new technologies to facilitate objective definition of fibre characteristics.
- // Partnerships including the Cotton LEADS program and Better Cotton Initiative.

Figure 11 The trend in Australian cotton crop fibre staple length 2006-2013. Fibre length has increased significantly.

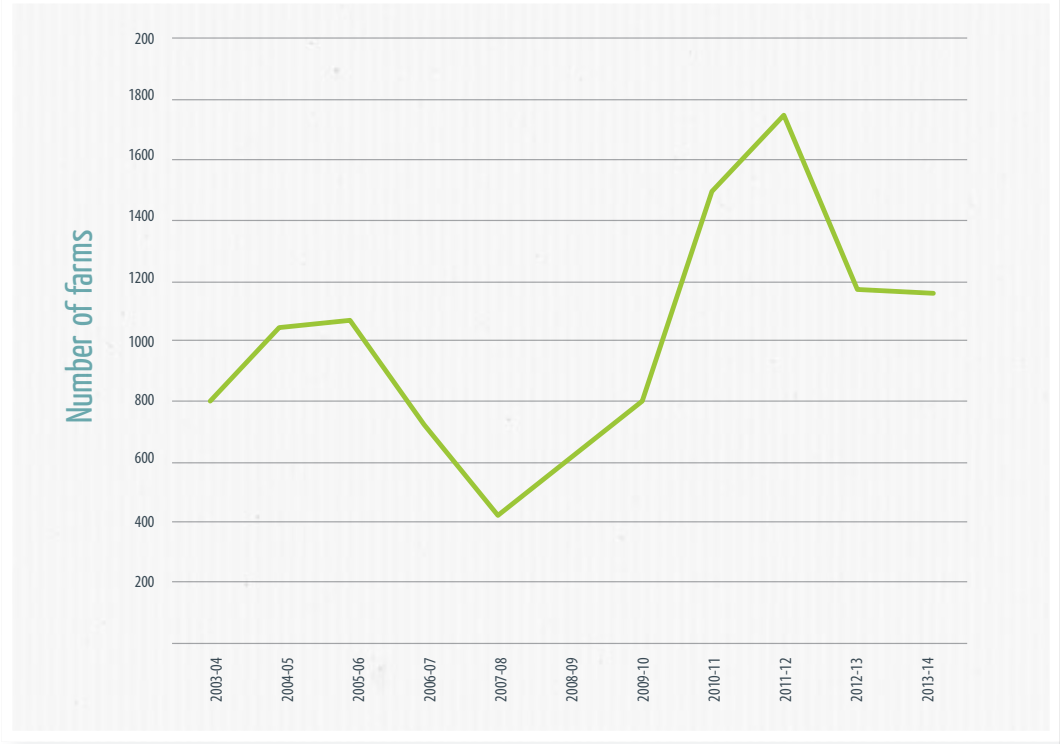


Source: Australian Cotton Shippers Association

PRODUCTION STATISTICS GROWER NUMBERS

The number of cotton farmers varies each year as a consequence of water availability and comparative crop prices of cotton and alternative crops such as sorghum and wheat. Figure 12 shows the number of cotton farmers in Australia is usually between 1200 to 1500. The Darling Downs region has the largest number of cotton farmers (300 to 400); however the Gwydir, Macquarie, Namoi and Border Rivers regions produce cotton from a smaller number of much larger farms. In the last few years many new farmers have entered the industry for the first time in the Murrumbidgee region of Southern NSW and some farmers in northern Victoria are also trialling cotton production.

Figure 12 The number of cotton farm units 2003-2014

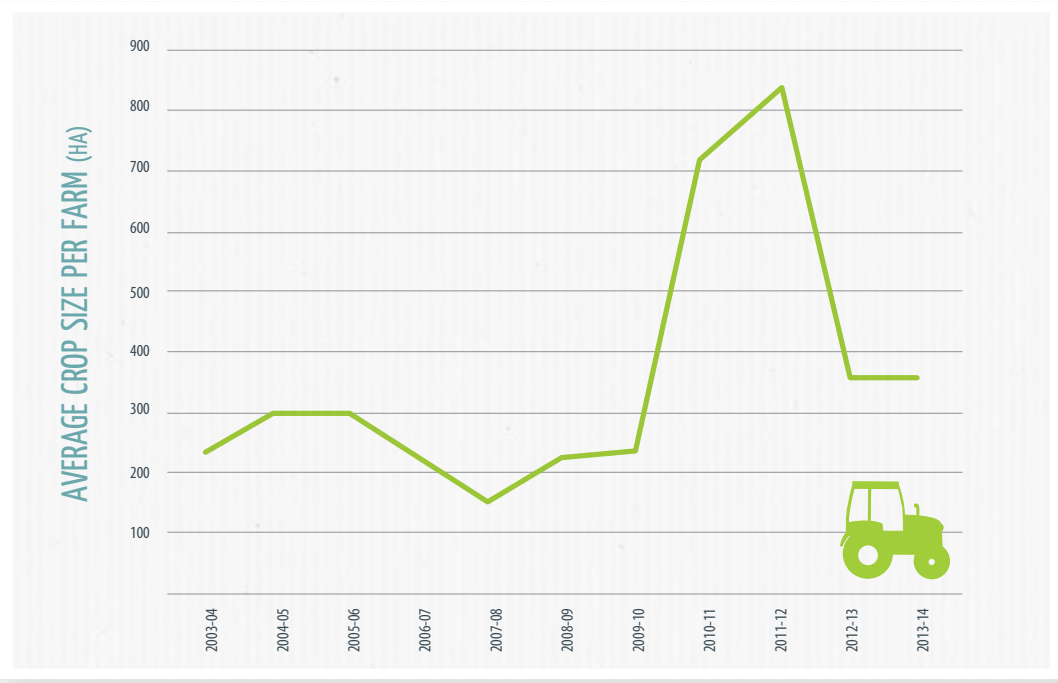


Source: Cotton Australia

PRODUCTION STATISTICS AVERAGE COTTON AREA PER FARM

The average cotton area per farm varies over time depending on seasonal conditions and crop prices (Figure 13). The average area per farm was 356ha in 2014. The five year average up to 2014 was 495ha. Following the drought of 2009 and some wet seasons in 2010 and 2011 the average cotton crop area per farm increased due to improved water availability.

Figure 13 The average cotton crop size per farm 2003-2014



Note 2014 is an estimate. (Source Cotton Australia)

PRODUCTION STATISTICS COTTON PRICE

Australian cotton prices vary due to the world cotton price (denominated in US dollars) and the Australian-US dollar exchange rate. Taking into account the world cotton price and currency exchange rates, Figure 14 shows the average price per bale of cotton received by farmers since 1990.

Prices have ranged from $300 to $600/bale. The all-time high was $758/bale in 1995 while the all-time low was $233/bale in 1986. Prices were also very high in 2011 due to a short term shortage of cotton in exportable locations. The average price for the last five years has been $396/bale. For the last two years prices have hovered around $440/bale.

Figure 14 The average price received per bale of cotton 1990 and 2014

Source: data from ABARES, 2014 estimate

Round module of picked cotton ready for transport, Moree, NSW

PRODUCTION STATISTICS GROSS VALUE OF COTTON LINT

The gross value of cotton lint produced in Australia since 1990 is shown in Figure 15. It has steadily increased with the exception of drought years. In 2007-08 production was at a record low $254 million and peaked again in 2011-12 at $2.9 billion. The forecast gross value for the 2014 crop is $1.9 billion, which means the five year average between 2009 and 2014 is $2 billion. These figures exclude cotton seed sales, which is forecast at $255 million in 2014.

Figure 15 The gross value of cotton lint production

Source: Data from ABARES, 2014 estimate

Warren, New South Wales

ECONOMIC VALUE REGIONAL GROSS VALUE OF COTTON PRODUCTION

Cotton is a major commodity and driver of the gross value of the total agricultural production in regions where it is grown. Table 1 shows the value of cotton production as a percentage of total agricultural production value in most of the local government regions in NSW and QLD where cotton is grown. In Queensland, a significant percentage of the regional gross value of agricultural income is from cotton: Emerald (24-38 percent), Balonne (32-58 percent), and Waggamba (30-46 percent). In NSW, Moree, Narrabri, Warren and Bourke Shires have had more than 50 percent their regional gross value of agricultural production from cotton, although this proportion varies depending on water availability for irrigation.

Table 1 The value of cotton production as a percentage of total agricultural production value in most local government regions in NSW and Queensland where cotton is grown

Local Government Area	1997[1] % of agricultural gross value production ($)	2001[2] % of agricultural gross value production ($)	2006[3] % of agricultural gross value production ($)	2011[4] % of agricultural gross value production ($)
QUEENSLAND				
Emerald	37.5	23.6	22.5	29.2
Bananna	22.2	13.7	10.4	6.2
Balonne	53.1	59.4	32.6	58.1
Wambo	29	25.9	19.4	38
Dalby	49.4	n/a	n/a	38.1
Jondaryran	27.3	18.7	12.5	35
Pittsworth	44.2	44	20.1	17.8
Chinchilla	8	4.8	2.7	16.9
Milmerran	35.8	20.5	15	18.1
Waggamba	30	35.2	34.5	45.6
The Darling Downs	n/a	n/a	10.9	20.4
NEW SOUTH WALES				
Moree	55	62.6	44.9	52.9
Narrabri	60.2	63.8	52.7	56.6
Walgett	28.6	41.8	23	25.9
Gunnedah	33	26.8	24.8	30
Narromine	26.1	37.5	18.4	16.6
Warren	49.7	57.3	27.4	20.9
Bourke	66.4	61.7	34.4	59.5
Carathool	0.6	n/a	2.7	11.6
Lachlan	n/a	n/a	2.1	1.6

Source: Figures compiled from data supplied by ABS from 1997 ABS Agricultural Census and 2001 Census[1,2]; ABS agricultural census 2006[3], ABS 2011-12 Agricultural Resource Management Survey 2011[4]). (Note Qld LGA changes by 2011.

AUSTRALIA'S SHARE OF THE GLOBAL LINT TRADE

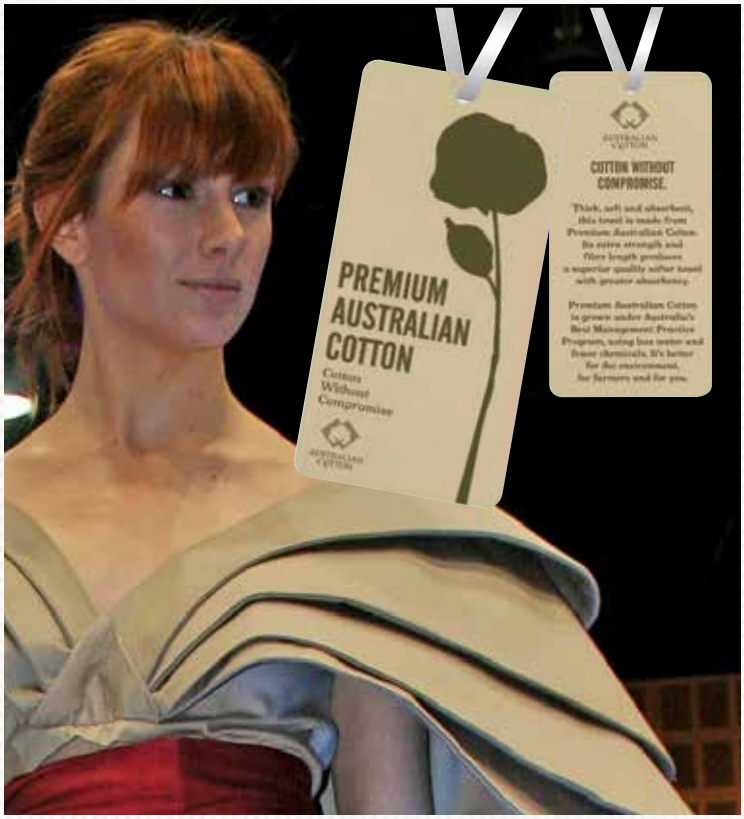
Australia produces around three percent of the world's cotton but is the third largest exporter (behind the US and India - Figure 2). Over 99 percent of Australia's cotton is exported. In an average year, Australia's cotton farmers produce enough cotton to clothe 500 million people.

AUSTRALIAN CUSTOMERS

The major buyers of Australian cotton are currently China (68 percent), Indonesia, Thailand, South Korea, Bangladesh and Japan. Australia has a reputation for producing high quality cotton. Australian cotton is marketed under a competitive market system by several major cotton merchants. Cotton growers use a sophisticated range of risk management and price hedging strategies to manage price and currency fluctuations, and there is no government intervention in the growing or marketing of the crop.

PROPORTION OF THE GLOBAL TEXTILE MARKET

Cotton's proportion of the global textile market is falling and is currently around 31 percent. This has fallen from 50 percent in the 1980s as shown in Figure 1.



PROFITABILITY

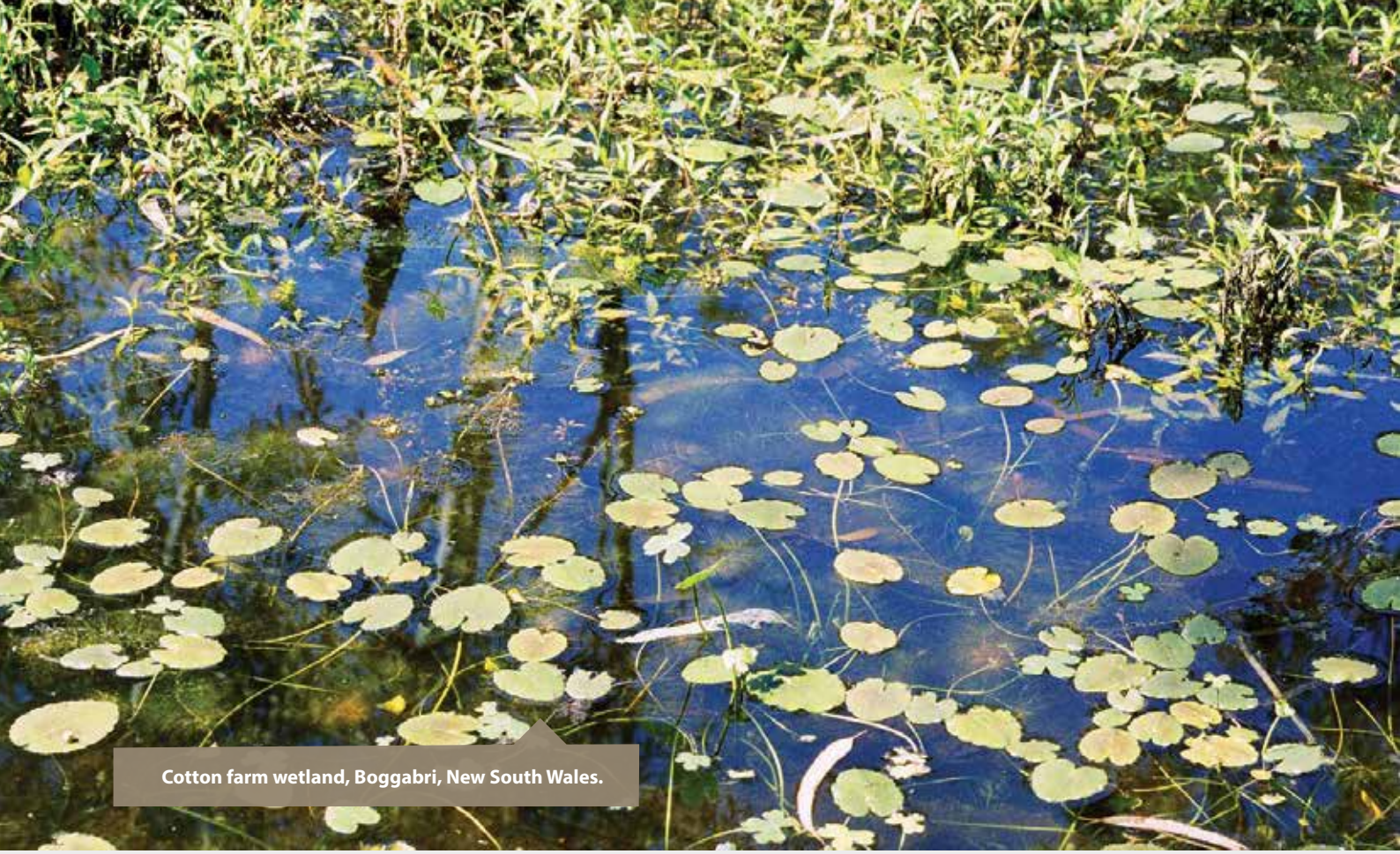
Farmers grow cotton because they believe it is the most profitable crop per unit area of land and water used. Boyce Chartered Accountants have been producing an Australian cotton crop comparative analysis since 1989 to track the economic performance of cotton farmers.

In it's 2013 analysis Boyce found the top 20 percent of farmers farm net profit was $1535/ha, while for the bottom 20 percent of farmers recorded a net loss of $407/ha. It found expenses per hectare continue to climb, in particular fertiliser and fuel/oil. The average grower in the sample had a profit of $410/ha after interest with growing expenses of $3808/ha, plus $389/ha in interest and bank charges. Based on these figures yields of 9.8 bales per hectare are required to cover expenses. A full report on the 2013 crop can be found on the Boyce Chartered Accountants website **www.boyceca.com**

In terms of profitability per megalitre of irrigation water returns, irrigators on average require 6.5 ML/ha of irrigation water, for a 10 bales/ha crop at $450/bale, the return is $692/ML. This has been considerably higher than returns for other broad acre irrigated crops.

Figure 16 Comparison of net farm profit (loss) for the average and top 20 percent of farmers

Source: Boyce and CRDC Australian Cotton Comparative Analysis 2013



Cotton farm wetland, Boggabri, New South Wales.

ENVIRONMENTAL CATEGORY

The material aspects within the environmental category are soil health, water use, groundwater, biodiversity, riparian land management, integrated pest management, pesticide use and greenhouse gas emissions.

SOIL HEALTH

Australian soils are often described as ancient, highly weathered and infertile. Cotton is grown on floodplains where the soils are younger and more fertile than most Australian soils. The major soil types on which cotton is grown are grey, brown and black Vertosols (around 75 percent), that are naturally fertile, have high clay content and strong shrink-swell capacities.

The cotton industry has invested in a substantial body of soil science research over the past two decades, which was recently summarised by researchers from The University of Sydney[ix]. The review covered soil mapping and characterisation, soil physical condition, salinity and sodicity, soil chemical fertility and soil carbon and biota.

SOIL HEALTH ORGANIC CARBON PERCENTAGE

The cotton industry conducted three medium-term farming systems trials from 1993 to 2005 at Warren NSW, Merah North NSW and Warra Qld. Research has found 50 to 70 tonnes of soil organic carbon per hectare in soils where cotton is grown. A review of cotton rotation experiments between 1970 to 2006 found soil organic carbon in most locations has decreased with time despite frequent sowing of rotation crops . It concluded that two to three kg/m^2 per year of dry matter needs to be returned to the soil to maintain or increase soil organic carbon, whereas most cotton based cropping systems typically return 0.8 to 1.2 kg/m^2 per year.

In Figure 17, an example is shown in 2(b), where a decrease in carbon levels between 1994 and 2001 was followed by an increase. The cropping sequence from 2000 to 2002 included irrigated and fertilised wheat, which was in turn followed by irrigated sorghum. These cereal crops returned 2.5 kg/m^2 of organic matter and the cotton return was 0.3 kg/m^2. Other research on rotations with wheat, faba beans and vetch has found soil organic carbon increased throughout a 10-year monitoring period where stubble was retained[xi] .

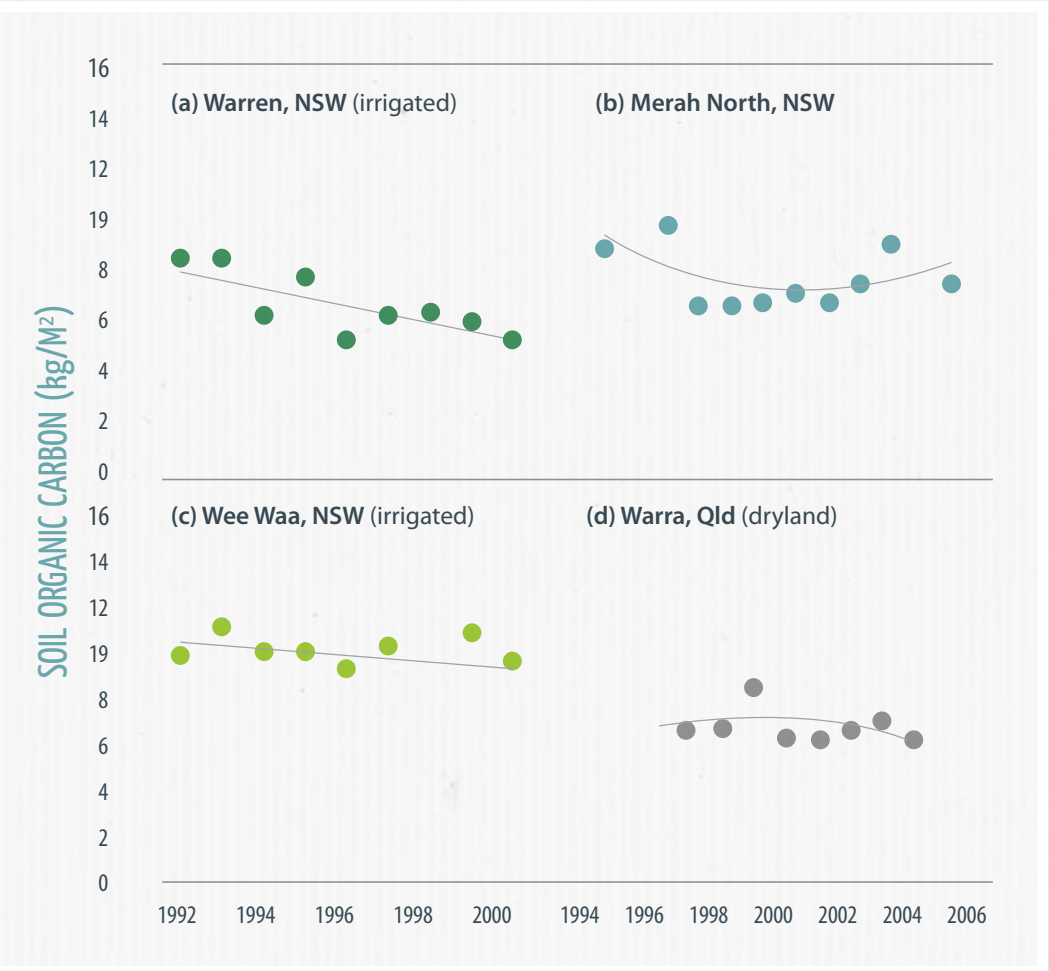
To improve soil carbon management, the industry:

// Conducts soil carbon workshops for farmers and advisors.

// Has commissioned new research at The University of New England on soil biology.

// Continues its ongoing R&D investments on managing soil carbon.

Figure 17 Variation in soil organic carbon in the 0-0.6m depth with time in irrigated and dryland cotton farms in NSW and QLD



Source: Hulugalle and Scott 2008

Soil pit field days allow farmers to discuss soil structure.

SOIL HEALTH PRACTICE CHANGE

The main changes in management of cotton soils over the past 30 years have been an overall reduction in tillage, widespread adoption of controlled traffic-permanent bed farming systems and increased application of nutrients in response to higher crop yields and the need for fertiliser replacement of nutrients.

Crop rotations vary considerably due to regional climatic and soil type differences as well as the prevailing price of cotton and alternative crops. Most farmers (75 percent) produce two or less cotton crops before breaking with an alternate crop or fallow[xii]. Wheat is the most common rotation with cotton. Other rotation crops (in declining order of use) are chickpea, sorghum, barley, maize, mungbean, faba bean, canola, soybean, vetch, sunflower, French white millet, canary seed and lab lab.

In the 2011 grower survey 58 percent of farmers reported a decrease in cultivation over the previous five years, while 34 percent said it was similar, and eight percent reported it had increased while 97 percent of farmers incorporated their crop stubble rather than burn it[xiii].

The number of machinery passes for a crop varies considerably, from one to 10 passes. There were on average five workings for back-to-back cotton and four workings for cotton following a rotation or fallow. In total 52 percent of farmers used soil testing to aid fertiliser decisions and 39 percent used manures or composts in their nutrition program[xiv]. Controlled traffic farming systems were in use on over 90 percent of farms to reduce soil compaction and to retain permanent beds[xv].

Other practice changes include the use of precision agriculture and associated technologies such as remote sensing, geographic information systems, yield mapping, variable rate applications and soil sensors such as electromagnetic induction.

CSIRO lysimeter research at Narrabri investigating deep drainage and soil solute movement.

SOIL HEALTH SALINITY

Soil salinity is the presence of soluble salts in the landscape and soil solution. Soil salinisation is a recognised risk for irrigated cotton as a consequence of excessive deep drainage which can create rising water tables. Irrigation-induced salinity is not a widespread problem[xvi]. However it remains a risk, so monitoring is ongoing. The Cotton CRC, CRDC, Natural Heritage Trust and The University of Sydney worked collectively to map the soils where cotton is grown in Australia as part of a series of projects titled "Understanding the salinity threat in the irrigated cotton growing areas of Australia." Biophysical data is available in seven irrigated cotton growing areas (Toobeah QLD, Ashley, Wee Waa, Gunnedah, Trangie, Warren and Bourke in NSW)[xvii].

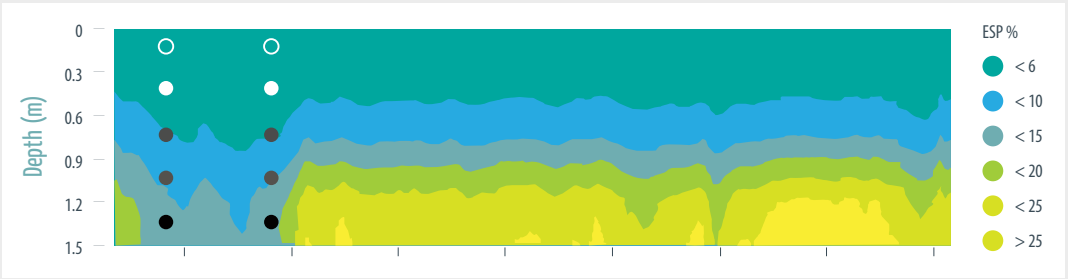
At the farm scale, farmers' soil tests can be used to monitor salinity trends while many farmers now undertake electromagnetic (EM) surveys to improve their irrigation and soil management.

In-field deep drainage has been the focus of much research which has found typical figures have reduced significantly to on average 100 to 200mm/year with a very large range (zero to 900mm/year)[xviii]. This 2013 review reported that deep drainage is now better managed than in the past. Irrigation management needs to balance leaching requirements and deep drainage to minimise potential root zone salinity as well as off-site salinity impacts[xix].

The major soil types on which cotton is grown are grey, brown and black Vertosols (around 75 percent), that are naturally fertile, have high clay content and strong shrink-swell capacities.

SOIL HEALTH SODICITY

Soil sodicity refers to the proportion of sodium cations held on the clay particles surface. Sodicity is an inherent property of many Australian soils, and sodic soils occupy 23 percent of the total area of Australia[xx]. Much of Australia's cotton crop is grown on soils with high subsoil sodicity and some soils also have surface layers that are considered sodic (exchangeable sodium percentage (ESP) greater than six). High sodium levels cause soil dispersion and hence create soil structure problems and change the chemistry of the soil solution which alters the availability of nutrients to the plant. As the level of sodium in the soil increases, there is a corresponding decrease in the uptake of phosphorus and potassium by the cotton plant, with these nutrients reaching deficient levels as the crop matures[xxi]. The amelioration required to reduce sodicity impacts continues to be the focus of current industry funded research projects in the cotton and grains industries.



The spatial distribution of exchangeable sodium percentage down a soil profile near Moree, NSW. In this case higher sodicity levels are apparent below 60cm[xxii].

WATER USE EFFICIENCY AND PRODUCTIVITY

Water is critical to the cotton industry to maximise crop yields and fibre quality. While dryland crops are successful in some regions and seasons, irrigation enables high-yielding cotton to be grown in a wider range of regions more of the time. Increasingly there is more competition for water due to the rising demand from other crops, mining, urban communities and environmental flows. It is imperative farmers continue to strive to improve water use efficiency and productivity.

Agriculture is a major user of water and the cotton industry uses about 10 to 15 percent (1500-2000 gigalitres (GL)) of the water used for irrigation in Australia depending on seasonal conditions. This water is used according to licences and water sharing plans issued by state governments. The water reform process has reduced water allocations available for irrigation, particularly in the Murray Darling Basin.

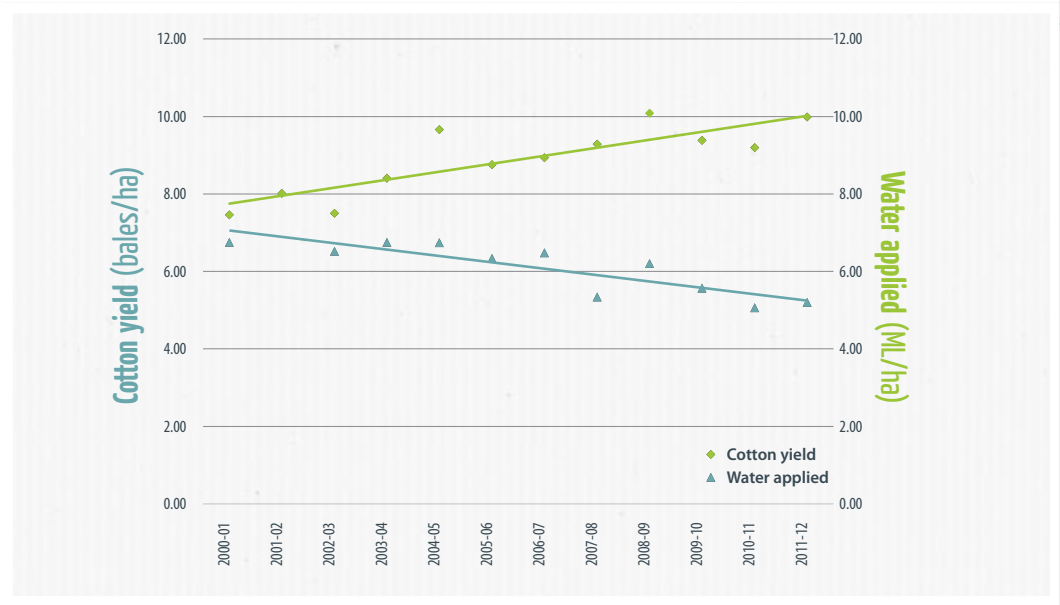
The majority (at least 80 percent) of the Australian cotton area is irrigated using gravity surface irrigation systems. A recent scientific review found on average over 23 years cotton crops utilise six to seven megalitres (ML) per hectare of irrigation water depending on the amount of seasonal rain received. The seasonal evapotranspiration of surface irrigated crops averaged 729mm over this period[xxiii].

WATER USE IRRIGATION WATER USE INDEX

The Irrigation Water Use Index (IWUI) is one way to measure water productivity. The IWUI is the amount of cotton produced per megalitre of irrigation water applied. However, it can vary from year to year depending on the amount of rainfall, which reduces irrigation needs.

Figure 18 shows the lint yield per hectare of cotton has been increasing, while at the same time the average total amount of irrigation water applied has decreased. Despite both wet and dry seasons during this time the irrigation water use index has increased significantly between 2001 and 2012.

Figure 18 Irrigated cotton yields and irrigation water applied in Australia 2001-2012



Source: Roth et al 2013

WATER USE GROSS PRODUCTION WATER USE INDEX

The water use efficiency and productivity of the Australian cotton industry has been measured as part of several studies in the past 20 years. The Gross Production Water Use Index (GPWUI) is the more meaningful water use index for comparing water use between farms or seasons. The GPWUI includes irrigation, rainfall and water stored in the soil and is the best measure for long term seasonal comparisons.

There is an improving trend in this index with the average GPWUI showing a 40 percent improvement over the decade between 2003 (0.79/bales/ML) and 2010 (1.14 bales/ML). This has been achieved by both yield increases and more efficient water management systems. The whole farm irrigation efficiency index improved from 57 percent to 70 percent, while the crop water use index is above three kg/mm/ha, high by international standards [xxiv].

The established industry benchmarks indicate that Australian cotton irrigators using conventional furrow surface irrigation systems are aiming to produce greater than 1.1 bales per ML (greater than 250 kg/ML) of the total water used (total water includes: irrigation water applied, in season rainfall and used soil moisture).

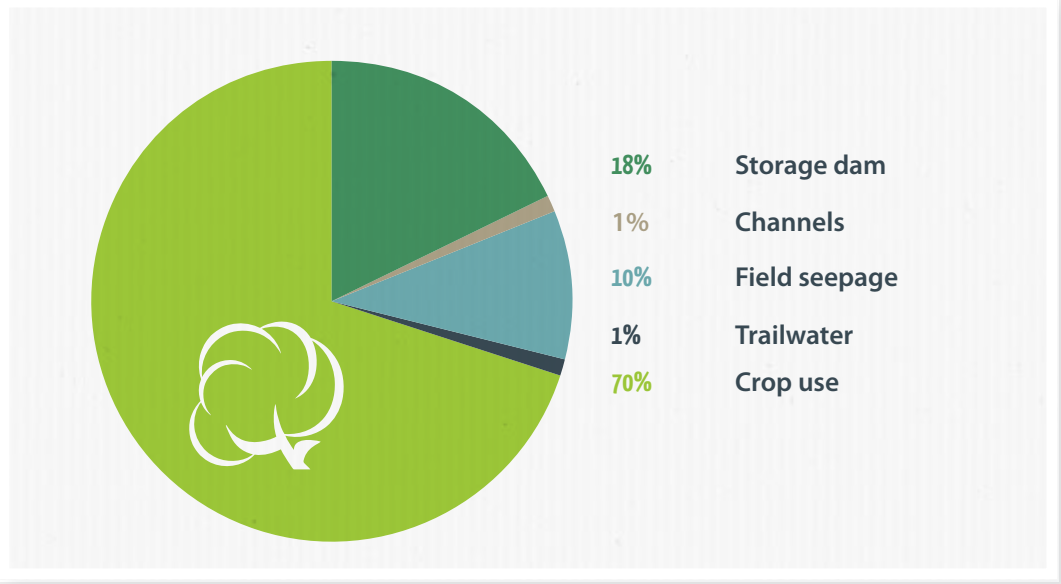
WATER USE WHOLE FARM IRRIGATION EFFICIENCY

Whole Farm Irrigation Efficiency (WFIE) reflects the irrigation system efficiencies. That is, it shows the amount of irrigation water that was used by the plant as a percentage of total irrigation water inputs to the farm. Therefore, inefficiencies in an irrigation system will result in a percentage of total water not being used by the crop.

During the late 1990s, the WFIE was around 57 percent, whereas in the latest industry-wide data collected 10 years later the WFIE rose to around 70 percent. This indicates that there is now less on-farm water losses and more of the water is used by the crop.

The losses are due to evaporation and seepage across the fields, conveyance system (channels) and on farm water storages and their proportions are shown in Figure 19[xxv]. This study and others have shown that storage evaporation is the largest water loss component on cotton farms.

Figure 19 Whole farm water balance



Source: Wigginton 2012

WATER USE PRACTICE CHANGE

The improvements in water use are the result of significant practice change and plant breeding. Examples of farm management changes include:

// 70 percent of farmers use soil moisture probes, up from 40 percent in 2006 (highest of all agriculture industries in Australia).

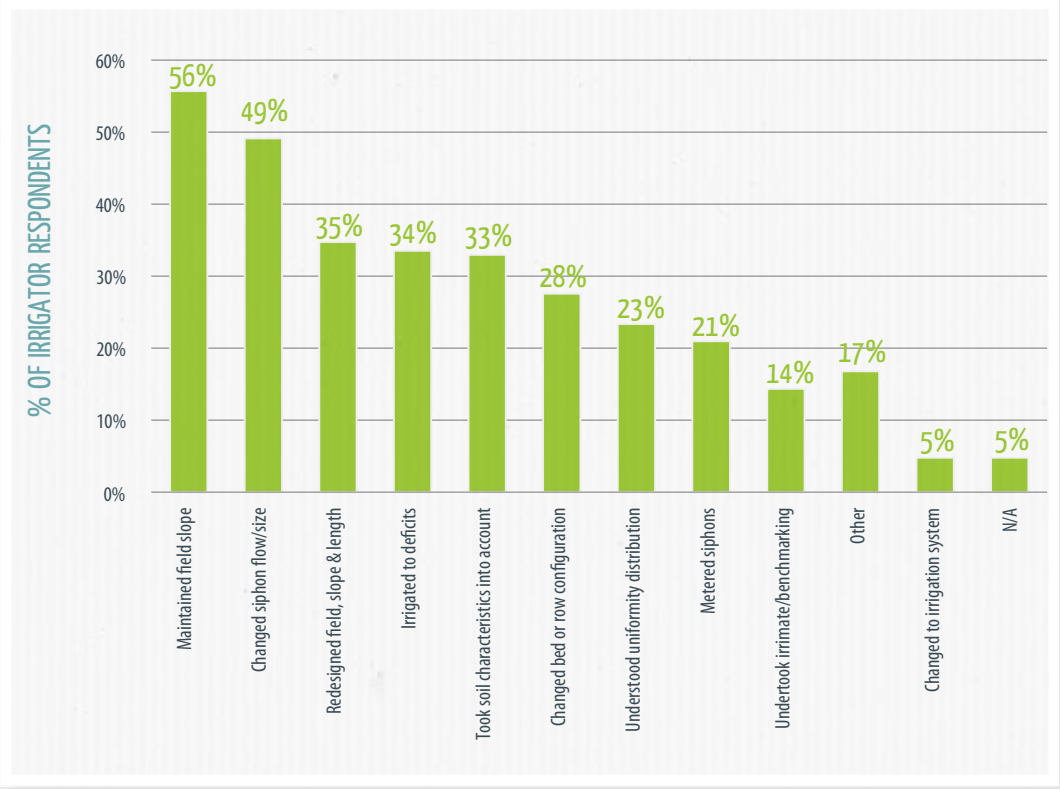
// 96 percent of irrigators have improved their furrow irrigation system or changed to an alternate irrigation system.

// 49 percent of irrigators had made changes to the flow or size of their siphons.

// 35 percent have redesigned fields.

// Other practices include irrigating to deficits, better accounting of soil variations, changed bed shapes, using irrigation scheduling probes, furrow irrigation system optimisation evaluations, pump optimisation and reducing distribution losses (Figure 20)[xxvi].

Figure 20 Water use practice change strategies applied by cotton farmers



Source: Cotton Grower Survey 2011

Farmers are changing to alternative irrigation systems such as centre pivots and lateral move systems and it is expected there will be an increasing number of these machines in the future. These systems achieve labour and water savings (about 30 percent) but have significantly higher energy costs associated with water pumping and machine operation. Drip irrigation has been extensively tried in a variety of locations where it has resulted in 20 to 30 percent water savings, but yields have been shown to both increase and decrease compared to surface irrigation systems. Drip irrigation systems have significantly higher capital and running costs compared to surface irrigation systems.

GROUNDWATER LEVELS

Groundwater is an important resource underpinning a significant proportion of agricultural production and communities in regional Australia. It is estimated about 15 percent of the water used for cotton irrigation comes from groundwater sources, however this figure can be higher especially in dry years when there is a scarcity of surface water availability.

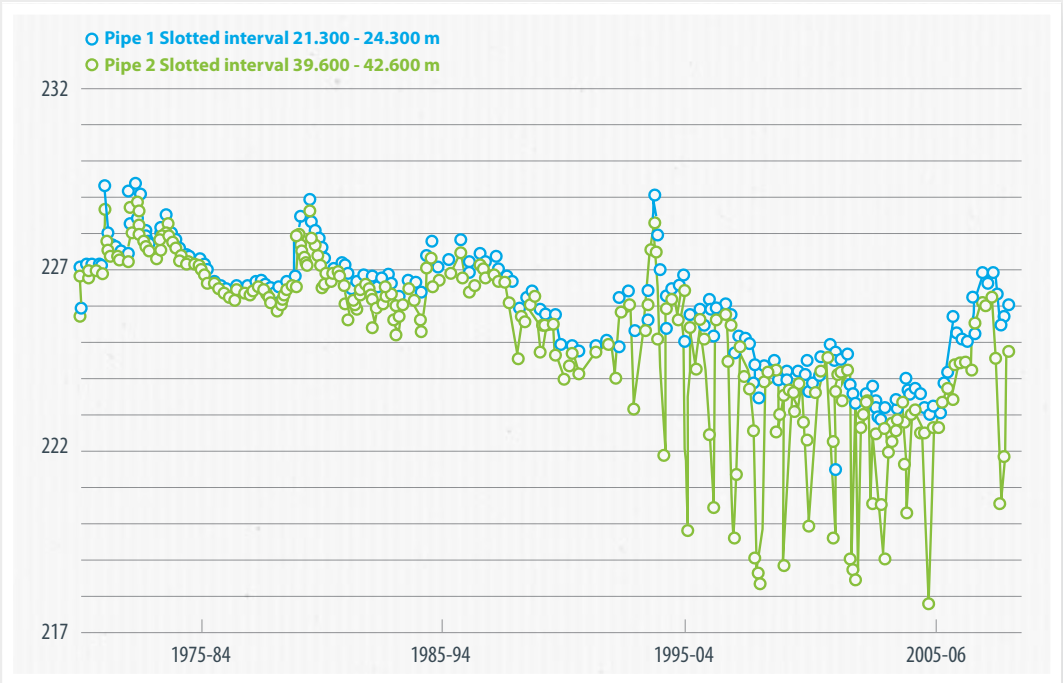
Water quality monitoring forms an important part of industry stewardship of natural resources

Groundwater is used in some specific locations where cotton is grown. These include the Murrumbidgee (Darlington Point to Hay), Lachlan (around Hillston), Macquarie Valley (near Narromine), Namoi Valley (Gunnedah to Burren Junction), Gwydir Valley (near Moree), Great Artesian Basin eastern recharge zone (near North Star) and the Condamine Alluvium on the Darling Downs.

Water sharing plans in Queensland and NSW determine an irrigator's water allocation. Groundwater levels have been monitored for many years and detailed data can be obtained from state government water management agencies.

In some regions groundwater levels have declined, while in others they have risen. For example in the Namoi Catchment there is about 45 years of groundwater data from 458 groundwater level records. One of these hydrographs is shown in Figure 21. It shows figures for Maules Creek near Boggabri, NSW (**http://waterinfo.nsw.gov.au/pinneena/gw.shtml**). While there was drawdown of the aquifer, favourable climatic condition and flooding resulted in good aquifer recovery from 2010 through 2012.

Figure 21 An example hydrograph of groundwater levels in the Namoi Valley



The UNSW research team installing groundwater quality monitoring equipment.

Falling or rising groundwater levels and salinisation are management risks. The cotton industry is committed to investigating and monitoring its groundwater and has been participating and funding extensive groundwater research in recent years.

Many of these research projects were done by The University of NSW (UNSW). The projects sought to quantify the exchange of surface and sub-surface water in the Namoi Catchment, taking detailed measurements along the Namoi River reach between Gin's Leap and Narrabri. A three-dimensional groundwater model was developed that provides insights on recharge pathways, groundwater contributions to river base flow, impact of irrigation extractions, and water quality responses to climatic variability. River and groundwater interactions were found to be highly dynamic and can change rapidly with the onset of pumping or during flooding[xxvii].

There has been considerable community interest in the Condamine Alluvium groundwater levels. A report on temporal trends of groundwater levels in the Condamine Catchment between 2007 and 2013 shows the consistent trend of declining water levels, which occurred for several decades in most parts of the Condamine Catchment, but ceased in the late 2000s. In most bores in the Condamine Catchment, current groundwater levels are higher by 1.5 to 8.5 metres than the levels recorded in 2010. In other bores, groundwater levels stabilised since 2007. These trends are a cumulative result of enhanced recharge during summer 2007/08 and summer 2010/11 flood events and restrictions, on water pumping in the Condamine Groundwater Management Area[xxviii].

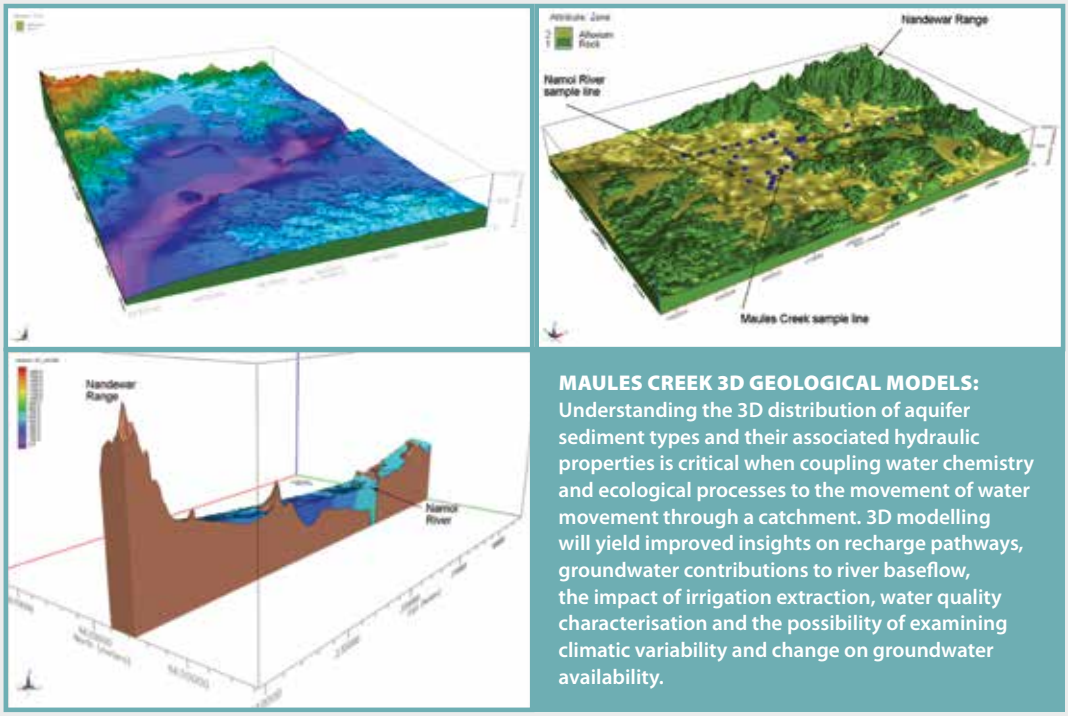
GROUNDWATER QUALITY

Monitoring groundwater quality is essential for the sustainable use of the resource. In addition to monitoring by state governments the cotton industry has funded specific research and development projects for groundwater quality as well as projects to encourage farmers to monitor their own groundwater quality[xxix]. The proportion of farmers monitoring groundwater quality has increased significantly since 2006 (Table 2).

Table 2 Results from cotton grower surveys in 2006 and 2011 in relation to irrigators monitoring groundwater quality

Year	2006	2011
Irrigators monitoring groundwater quality	20%	62%

Research is studying water movement and quality in the Namoi Valley.



MAULES CREEK 3D GEOLOGICAL MODELS: Understanding the 3D distribution of aquifer sediment types and their associated hydraulic properties is critical when coupling water chemistry and ecological processes to the movement of water movement through a catchment. 3D modelling will yield improved insights on recharge pathways, groundwater contributions to river baseflow, the impact of irrigation extraction, water quality characterisation and the possibility of examining climatic variability and change on groundwater availability.

Source: Cotton CRC

Riparian land on a cotton farm near Theodore, Queensland

BIODIVERSITY AND RIPARIAN LAND

The cotton industry is located along riverine areas, floodplains and wetlands associated with major inland rivers of the northern Murray Darling Basin (MDB) and Fitzroy Basin. The northern MDB differs from the southern basin as it is hotter, has higher rates of evaporation, less predictable flow and more frequent and longer periods of very low flow. Rivers can also experience large flood events in response to the summer rainfall, which in turn have produced the fertile floodplains where cotton is grown.

The *Murray Darling Basin Plan* became law in November 2012. The Plan was the culmination of a lengthy period of refinements and iterations through consultations and negotiations with states, local governments, catchment management bodies, community, peak industry groups, and indigenous and environment groups. The Plan provides a coordinated approach to water use across the MDB's four states and the Australian Capital Territory. It limits water use at environmentally sustainable levels by determining long-term average sustainable diversion limits (SDLs) for both surface water and groundwater resources.

BIODIVERSITY NATIVE VEGETATION AREA PER FARM

Farms where cotton is grown have a variety of other land uses such as growing wheat and other crops, grazing cattle and sheep, native vegetation and billabongs.

The 2010-11 cotton grower survey found on average (across respondents from all regions) that cotton farms have approximately 40 percent of their land dedicated to cultivation (of which cotton accounted for approximately one third of the area in 2011) and 42 percent dedicated to native vegetation (Figure 22)[xxx]. This survey found fifteen percent of farmers had re-vegetated parts of their farm and on average 63 percent of cotton farms had riparian land with an average length of their river frontage of nine kilometres.

The 2013 cotton grower survey found cotton production accounted for 18 percent of the farm land area (16 percent irrigated, two percent dryland) and the native vegetation (ungrazed) was 5 percent[xxxi]. In this survey the average farm area was 3,494ha, consisting of 1,200ha irrigation area of which 657ha was planted to cotton, 1,721ha of dryland farming country, 1,618ha of grazing country and 363ha of native vegetation that was ungrazed.

There is considerable variation across growing regions as depicted in Figure 23, such as in Southern NSW, where farms had a larger proportion of the farm developed for irrigation.

UNE researchers monitoring native vegetation and carbon storage areas on cotton farms.

Figure 22 Land use mix across all cotton farms surveyed 2011

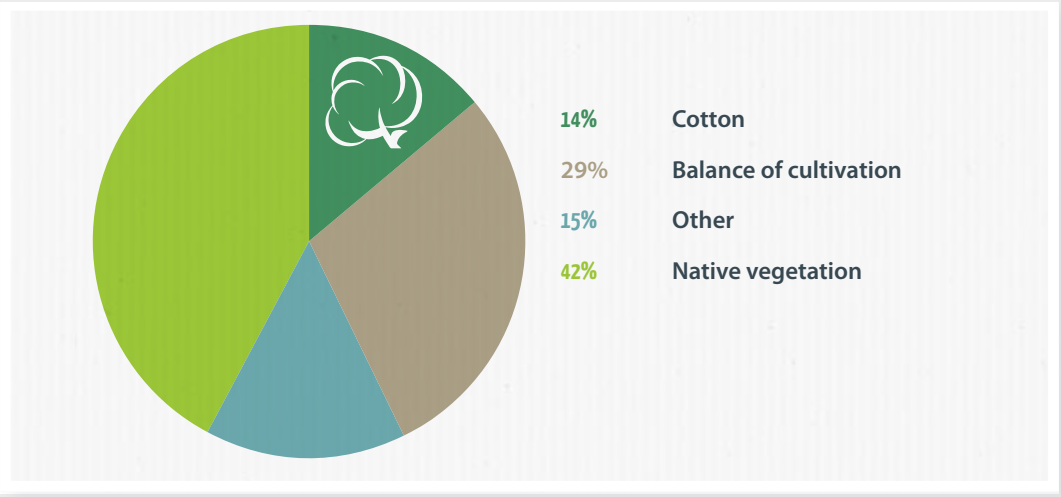
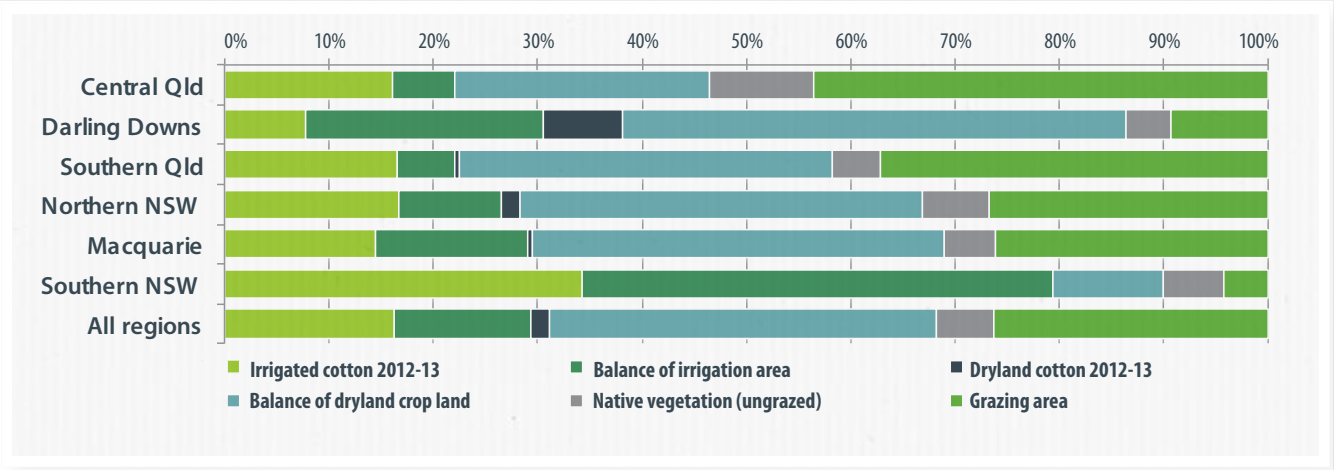


Figure 23 Average proportion of land use types on cotton growing farms surveyed by region 2013



Note: Responses from Central QLD are predominately in the Dawson-Callide region. Farms in the Emerald Irrigation Area typically have the majority of the farm used for cotton production and would differ from what is presented here. (Source 2013 Cotton Grower Survey).

Spotlighting activities enable families to learn more about the farm environment,the role of ecosystem services and local inhabitants such as bats, birds, and insects.

ACTION ON THE GROUND – SNAPSHOT

In a recent project for the Australian Government's Caring for Country Program across three cotton growing valleys, 84 cotton farmers adopted activities contributing to the ongoing conservation and protection of biodiversity in 37,296ha of natural vegetation, controlling pigs, planting habitat for beneficial insects and enhancing habitat for native and bats.

Activities such as lady beetle, bird and bat workshops, spotlighting nights and a kayak wildlife discovery tour on the Namoi River attracted strong interest from local farming families and prompted a number of participants to install nesting boxes on their properties to enhance habit for native birds and bats.

VEGETATION CONDITION AND CONNECTIVITY

The cotton industry is currently working to better understand the condition and connectivity of natural vegetation on cotton farms. Several studies have investigated wildlife and their habitats on cotton farms over the years and found, for example:

- // More than 42,000 birds representing 45 species were found on farm water storages in the Gwydir Valley[xxxii].
- // 153 bird species were found in natural vegetation in the Namoi Valley[xxxiii].
- // 450 species of invertebrates have been recorded in one cotton field during the summer[xxxiv].

Beneficial species like spiders are used to control pests.

INTEGRATED PEST MANAGEMENT PERCENTAGE OF GROWERS USING IPM PRACTICES

Management of insect pests has been a key challenge for cotton farmers in Australia. From the 1960s to 1990s, cotton farmers relied almost exclusively on regular application of insecticides that generally had a limited range of modes of action. This inevitably led to pesticide resistance in the pests, secondary pest outbreaks, destruction of natural enemies and increased risks from off farm movement and environmental concerns.

To address the need for better pest management options the cotton industry funded significant research and practice change projects, including training to encourage integrated pest management (IPM) adoption by farmers.

Each year the industry produces the Cotton Pest Management Guide (found at www.crdc.com.au). The Cotton Pest Management Guide contains the latest thresholds, products and techniques for managing specific pests.

IPM practices include:

// Use of transgenic crop traits in varieties.
// Soft chemistry options that preserve beneficial species.
// Use of crop spray thresholds.
// Insecticide Resistance Management Strategy.
// Trap and refuge crops.
// Regular insect crop scouting (twice weekly).
// Crop rotations.
// Weed control.
// Native vegetation.

Results from the Crop Consultants Australia survey of IPM practices for the 2012-13 season found a high adoption of IPM practices (Table 3).

Table 3 Adoption of IPM practices by cotton farmers

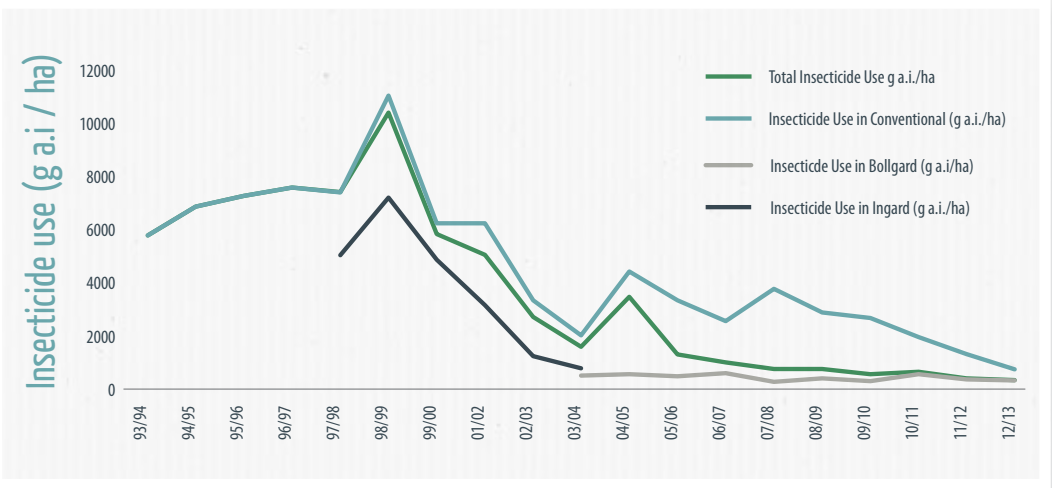
The industry's recommended sampling strategies are used to monitor pest abundance and plant damage.	99%
The industry's recommended thresholds are used when making pest control decisions.	86%
The IRMS is followed when selecting insecticides/miticides.	94%
Pesticide selection aims to conserve beneficial insects whenever possible.	93%

Extensive research is conducted to reduce pesticide use and ensure safe stewardship of transgenic cotton

CROP PROCTECTION INSECTICIDE USE

The use of chemical insecticides in the cotton industry has declined from almost 1000 tonnes of active ingredient per annum to less than 50 tonnes[xxxvii]. The 2012-13 season is the sixth consecutive cotton season of strong downward trend in insecticide use, measured in terms of grams of active ingredient applied per hectare. Comparing the five year averages for the periods 2008-2013 and 1998-2003, the cotton industry has achieved an 89 percent reduction in insecticide use. A scientific overview of these pesticide use changes and water quality outcomes was published by The University of Sydney in 2013[xxxviii].

Figure 24 Historical insecticide use on cotton

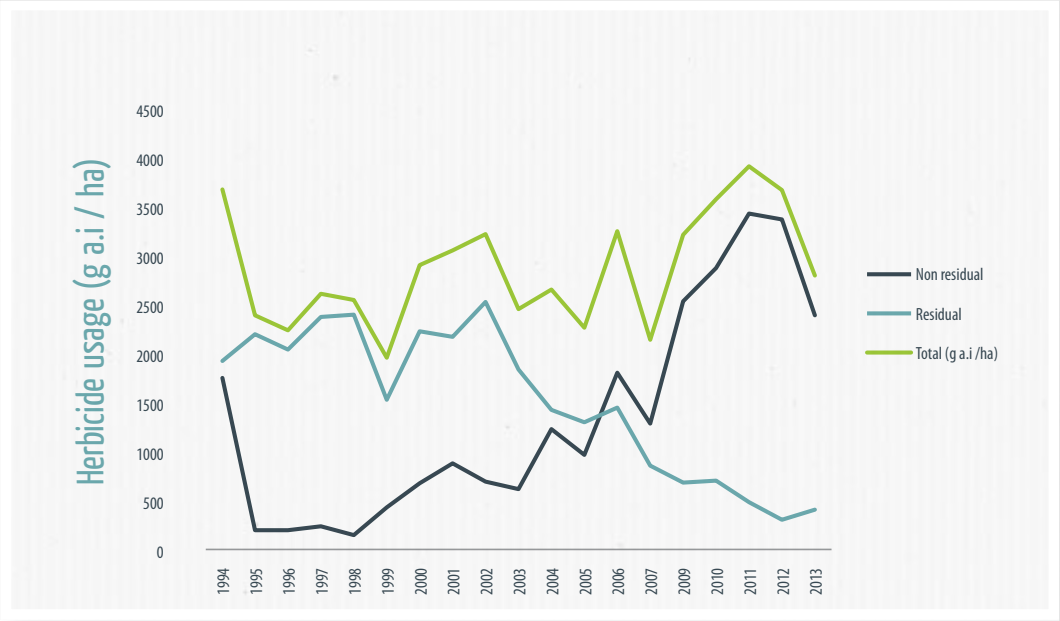


Source: CCA 2013

CROP PROCTECTION HERBICIDE USE

Total herbicide usage in Australian cotton fields is shown in Figure 25 as well as the residual and non-residual herbicide use. Since 2004-05 there has been an increase in non-residual glyphosate based herbicides, which corresponds with the introduction of herbicide resistant traits in cotton varieties. Concurrently, the use of residual herbicides which have a higher environmental risk quotient such as trifluralin, diuron, fluometuron and prometryn has dropped significantly.

Figure 25 Herbicide usage in cotton.



Source: CCA 2013

CROP PROTECTION USE OF GENETIC MODIFIED TRAITS

One of the most significant changes in the Australian cotton industry has been the introduction of genetically modified (GM) cotton. Australia's first transgenic cotton, Ingard® was grown in 1996. It contained a single gene from the soil bacterium *Bacillus thuringiensis* (B*t*) which expressed Cry1Ac protein that provided protection against the key insect caterpillar pests, *Helicoverpa armigera* and *H. punctigera*. In 2003, Bollgard II® technology varieties became available to cotton farmers for planting, which expressed two B*t* proteins (Cry1Ac and Cry2Ab). Prior to the release of Bollgard II® there was a 30 percent cap in the transgenic crop area that could be planted, which was removed in 2004 and the uptake of the technology has steadily increased to 96.6 percent of the national crop in 2013-14 (Figure 26).

The first genetically modified herbicide-tolerant cotton was introduced after a period of research and cultivar development under regulatory permits in 2000. There has been a steady increase in the area planted to Roundup Ready® and its successor Roundup Ready Flex® as shown in Figure 26, up to 99 percent of the national crop in 2013-14.

The cotton industry has been funding research as part of its stewardship of GM crop trait use. The management of potential pest and weed resistance risks is ongoing and one of the highest priorities for the Australian cotton industry.

CSIRO Publishing has recently reported scientific reviews on:

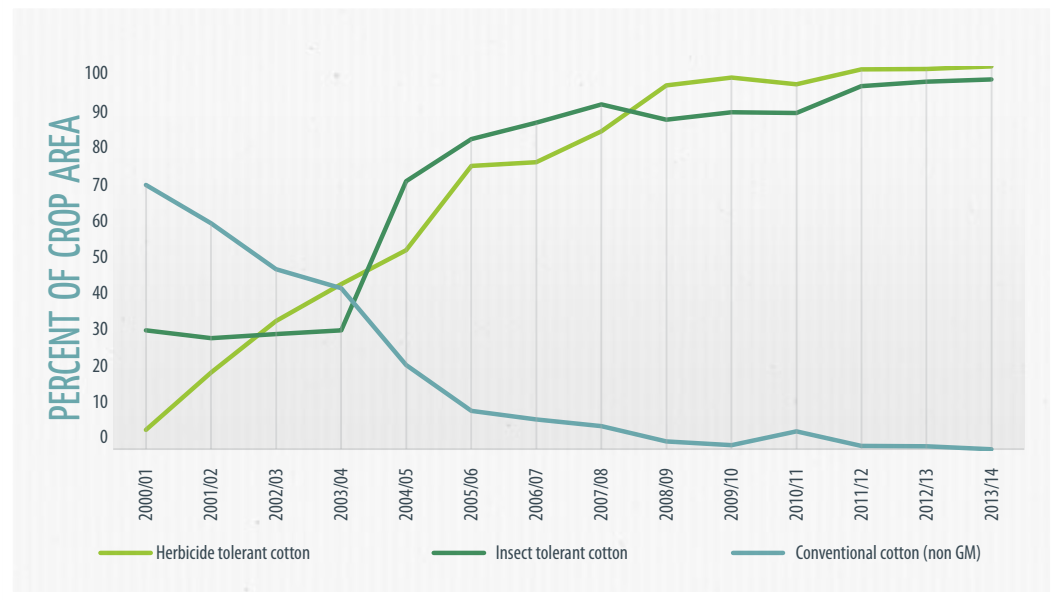
// Integrated pest management in the transgenic era[xxxix].

// Changes in weed species since the introduction of glyphosate–resistance cotton[xl].

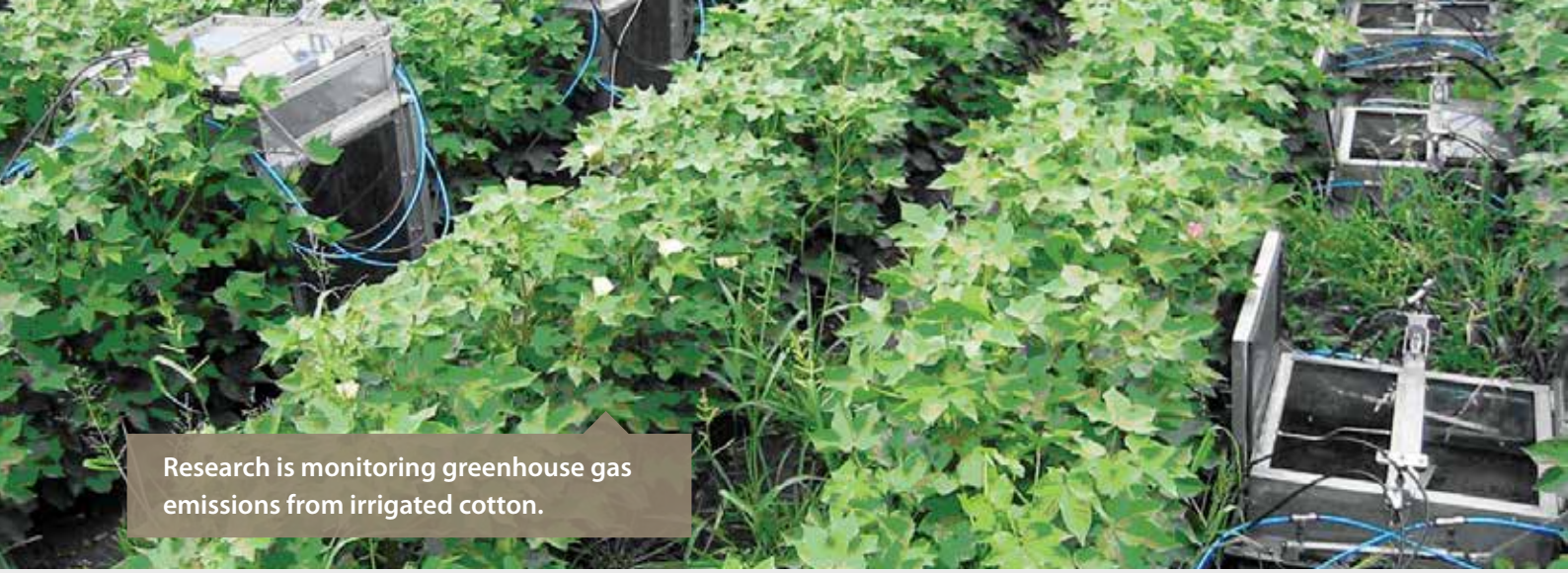
// Managing glyphosate resistance[xli].

// Pesticide use and water quality[xlii].

Figure 26 The proportion of cotton crop area planted to genetically modified traits



Source: Cotton Australia

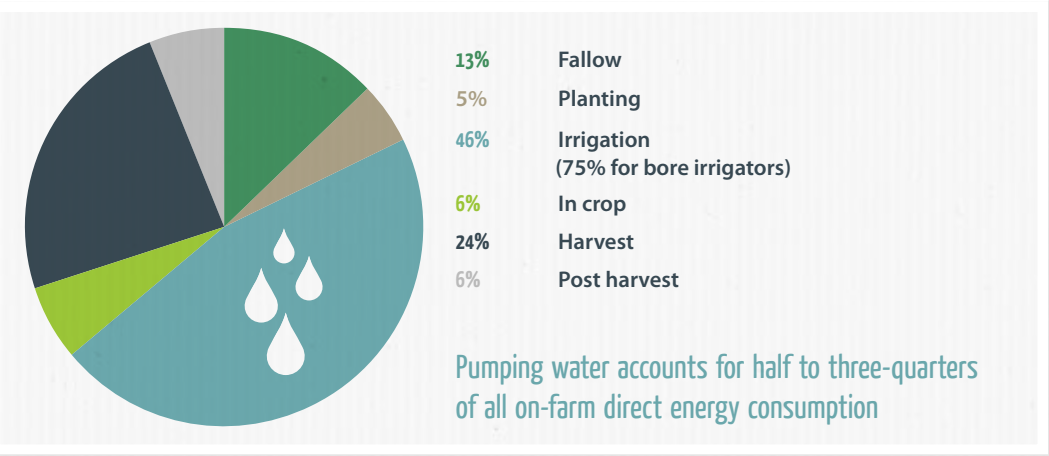


Research is monitoring greenhouse gas emissions from irrigated cotton.

GREENHOUSE GAS EMISSIONS ENERGY USE

Energy use is a major priority for the cotton industry. Research has found that pumping water accounts for 50 to 75 percent of the energy costs on farms depending on the water source (Figure 27)[xliii]. Crop harvesting and managing crop fallows are also major uses of energy on cotton farms.

Figure 27 Average distribution of energy use for irrigated cotton production on-farm.



Source: National Centre for Engineering in Agriculture.The University of Southern Queensland

Table 4 shows the energy consumed on average was 10.9 GJ per ha at a cost of $310/ha, which had greenhouse gas emissions of 1,091 kg CO_2e per ha [xliv]. Diesel is the major (80-90 percent) source of energy on cotton farms with the balance being electricity.

Table 4 Energy consumed, greenhouse gas emissions and cost of energy per hectare and per bale.

	per Ha	per bale
GJ OF ENERGY	10.9	1.18
kg $C0_2e$	1091	119
COST $	310	34

Cotton growers forum on measuring irrigation pump performance.

Australian cotton farmers will continue to improve energy efficiency and reduce greenhouse gas emissions through innovations such as:

// Measuring and changing irrigation pump performance

// Fuel-efficient farm machinery

// Controlled traffic systems

// Minimum-tillage systems.

To help farmers identify their potential for saving energy costs, the industry has developed protocols and web based tools known as EnergyCalc (**https://kmsi.usq.edu.au**) for measuring and assessing on-farm energy use. These tools allow farmers to evaluate their energy performance and identify potential energy savings. Individual assessments have led to energy cost savings as high as 30 percent. Cotton Australia and the NSW Irrigators Council are currently working with the NSW Office of Environment and Heritage on a project to help farmers with these assessments.

GREENHOUSE GAS EMISSIONS NITROGEN USE

The principal sources of greenhouse gas emissions on mixed cotton farming enterprises include carbon dioxide, methane and nitrous oxide. Nitrogen fertilisers are a major source of greenhouse gas emissions, particularly nitrous oxide, and the industry continues to invest in research, demonstration trials and decision support tools focused on improving nitrogen use efficiency. Greenhouse gas inventory tools for cotton and mixed farming properties are available online at **www.isr.qut.edu.au** while another carbon calculator management tool is available online **www.coolercarbon.com.au**

Nitrous oxide emissions are being measured on irrigated cotton farms and emissions can be reduced through modifying farming practices such as reducing tillage, minimising use of groundwater which requires more pumping, improving rainfall soil-moisture storage, rotation crops, optimising irrigation design and scheduling and adjusting fertiliser placement to deeper in the soil.

Efficient nitrogen fertiliser use requires farmers to optimise nitrogen inputs with respect to soil fertility, crop biology and economic response. Farmers are able to determine the economic optimal rate by combining soil, leaf and post-harvest seed analyses. The nitrogen use efficiency is the ratio of nitrogen applied (kg/ha) and crop yield (kg/ha) and an optimum range is between 13 and 18[xlv]. Industry surveys have found that many farmers are not achieving this, but there is also quite a degree of regional variation. To improve nitrogen use a number of strategies are now being implemented including:

// An industry-wide project to monitor and demonstrate best practice.

// Crop nutrition research.

// Training for advisors and farmers.

RESEARCH ON CARBON FOOTPRINT OF FARMS

The Australian cotton industry is developing a carbon (C) footprint calculator for cotton farms. The calculator determines carbon sequestration and emissions associated with agricultural production (irrigated and dryland crops and grazing enterprises), as well as the net primary productivity and carbon sequestered by native vegetation. The calculator will demonstrate how farmers can be carbon neutral, or even better, be carbon positive. A case study illustrating the carbon footprint of a cotton farm near Wee Waa NSW has been developed, using an holistic approach that takes into account the carbon sequestration and greenhouse gas emissions associated with cotton production as well as the net primary productivity and carbon sequestered by native vegetation. This case study demonstrates that it is possible to achieve a carbon positive cotton farming operation.

In soils and native vegetation commonly found on the Namoi floodplain on average, river red gum plant communities store a total of 216 tonnes of carbon per hectare, coolibah vegetation types store almost half of this carbon with 100 tonnes per hectare, while grasslands store approximately 40 tonnes of carbon per hectare. Depending on relative land-use proportions, carbon emissions from cotton farms can be offset by native vegetation, potentially allowing cotton farmers to achieve carbon neutrality[xxxvi].

The cotton industry is currently working to better understand vegetation on cotton farms - both the ecosystem services it provides such as carbon storage, erosion control, natural pest control and biodiversity value; as well as how we can improve the management practices of riparian lands to contribute towards their health. *my*BMP, the industry's best management practice program has a specific module dedicated to the best management practices of these natural assets on cotton farms.

Many initiatives encourage the participation of young people and women in industry activities and decisions.

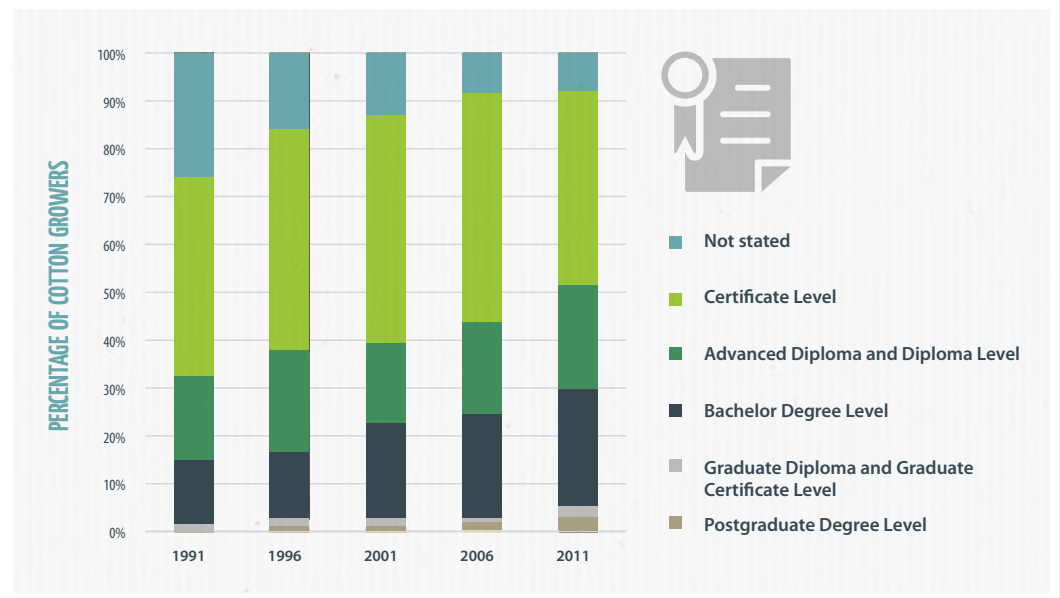
SOCIAL CATEGORY

Key social aspects for the cotton industry include education levels, demographics, employment, health, social capital, research and development and legal compliance.

EDUCATION HIGHEST POST GRADUATE SCHOOL QUALIFICATION OF COTTON GROWERS

Education can be used as a measure of the human capital of the cotton industry. Figure 28 shows the highest post school qualification obtained by cotton growers between 1991 and 2011. The major trend over the period is that the number of cotton growers with a diploma level or above qualification has risen from 30 percent in 1990 to 50 percent in 2011. The number of growers holding a bachelor degree rose from 13.5 percent to 24.1 percent between 1991 and 2011. The majority of cotton growers' highest post school qualification is an advanced diploma (22.2 percent) or certificate level (40.6 percent) qualification. These qualifications are higher than other agricultural sectors and above the average Australian population.

Figure 28 Highest qualification of cotton growers from ABS Census data 1991-2011



Source: Data from 1991, 1996, 2001, 2006, 2011 ABS Census

CRDC AND COTTON AUSTRALIA ARE MAKING MAJOR INVESTMENTS IN TRAINING, EDUCATION, SCHOLARSHIPS AND PROFESSIONAL DEVELOPMENT

Since 1994 the cotton industry has partnered with The University of New England to develop and deliver the only specialised university level qualification in cotton production in Australia. The course is delivered mostly at the Graduate Certificate qualification level for growers, advisors, marketers and agribusiness. Approximately 200 students have graduated from the course. The four units taught are Applied Cotton Production, Cotton Protection, Cotton and the Environment, and Cotton Farming Systems.

The future of Australian science and agriculture is dependent on young people. A number of schools and universities are hosted on farms and the Australian Cotton Research Institute.

EMPLOYMENT NUMBER EMPLOYED – FARMS, INDUSTRY, REGIONAL

The specific number of people employed by the cotton industry is difficult to estimate. This is because most farms have mixed farming systems involving other crops and livestock. Agribusinesses also tend to work with other sectors. Cotton Australia estimates the number of people employed by the cotton industry in a non-drought year is 10,000 people.

Cotton production is one of the leading employers in most places where it is grown. It is a high input annual crop for products and services and therefore generates many permanent and casual jobs and has traditionally provided some of the best salary packages in agriculture. Cotton is also a knowledge intensive industry so there are a high number of service businesses in cotton regions. Employment includes on farm jobs such as irrigating and machinery operation, fertiliser and chemical sales, aerial and ground spraying services, machinery and spare parts sales and service, engineering services, transport companies, oil seed crushers, cotton gins, marketers, agronomists and scientists.

The 2013 grower survey found respondents employed on average 6.6 people per farm (1.6 employees/100 cotton hectares, with a highly variable range in different regions). Of these, on average 2.4 employees first joined the farm in 2012 and 1.8 of these employees had no prior experience in cotton production. The farm workforce varies from farm to farm. However, as an indication:

// 63 percent of the permanent staff are employed full time.

// Three percent of staff hold 457 visas (Temporary Skilled Work).

// Eight percent of staff are employed on a permanent part time basis.

// 65 percent of casual staff hold 417 visas (Working Holiday)[xlvi].

Nearly all farms also use contractors for tasks such as picking, spray application, and module transport.

Several studies on employment linkages with regional cotton communities and the national economy were published by the Cotton Catchment Communities CRC between 2006 to 2012[xlvii].

The new round module cotton pickers have reduced labour needs on farms. In the last three years there has been a rapid adoption of these new pickers, which in 2013 were used to harvest 82% of the national crop area. The major motivations for the initial decision to use these new pickers is the ability to pick crops more quickly, a decrease in labour needs and less workforce health and safety risks.

Changes in technology have influenced employment levels in the cotton industry. For example, Bollgard® transgenic cotton requires less spraying and crop checking compared to conventional varieties. Another significant trend as a result of Roundup Ready® transgenic cotton has been the decrease in manual cotton chipping for weed control. This has resulted in less casual employment for itinerant, student and indigenous workers. Employment is also changing with changes to irrigation systems from surface irrigation to drip or overhead systems which usually require less but more skilled labour.

WORKPLACE HEALTH AND SAFETY

Farming has a number of workplace health and safety risks. Between 2001 and 2013 seven cases of work-related serious injury and fatality on cotton farms were identified[xlviii]:

// Aeroplane.

// Cotton picker.

// Dam drowning (child).

// Farm ute.

// Module builder (x2).

// Water pump.

From 2008-09 to 2011-12 the cotton industry had approximately 30 short-term injury claims (zero to four days) per year. This is similar to the grain industry. The cotton industry also experience around half the number of serious (five-plus days) claims (35/year) when compared to grain production. There are around 2,000 claims (zero to four days) and 3,000 (five-plus days) per year across all Australian agriculture. Cotton represents less than 0.02 percent of all claims in agriculture for injuries less than four days and five-plus days[xlix].

***my*BMP modules on pesticide application, pesticide storage, integrated pest management, petrochemical storage and a new module specifically on human resources and safety management are explained to industry personnel through a variety of platforms including farm workshops.**

Sprains and strains accounted for around one-third of both short term (zero to four days) and serious (five-plus days) injury claims. Open wounds (without amputation), followed by contusions, foreign bodies and fractures were common in claims of zero to four days duration. For the more serious injuries (five-plus days), apart from sprains and strains, fractures, open wounds and contusions were most common .

There have been a number of changes relating to safety innovations on cotton farms including:

// Reduction in vehicle and on-farm traffic risks.

// Safer irrigation systems.

// Changes in cultivation technology.

// Changes in pesticides and application technology.

// Changes in harvest technology.

// Adoption of gene technology.

// Adoption of WH&S management systems.

CRDC and Cotton Australia continue to place a high emphasis on farm health and safety and have a number of strategies in place including:

// *my*BMP modules on pesticide application, pesticide storage, integrated pest management, petrochemical storage and a new module on human resources and safety management.

// IPM strategies for crop management.

// Partnership in the Primary Industries Health and Safety Partnership to undertake RD&E activities to improve the:

  // Physical health of farming workers and their families.

  // Mental health of farming families.

  // The safety of the work environment and practices in farming and fishing industries.

// Major display at the 2014 Australian Cotton Conference with professional medical staff who conducted health checks on 241 people.

DEMOGRAPHICS GROWER AGE

Cotton grower, Brett Bidstrupp and Murray Boshammer from Total Agricultural Services Pty Ltd, Dalby, QLD.

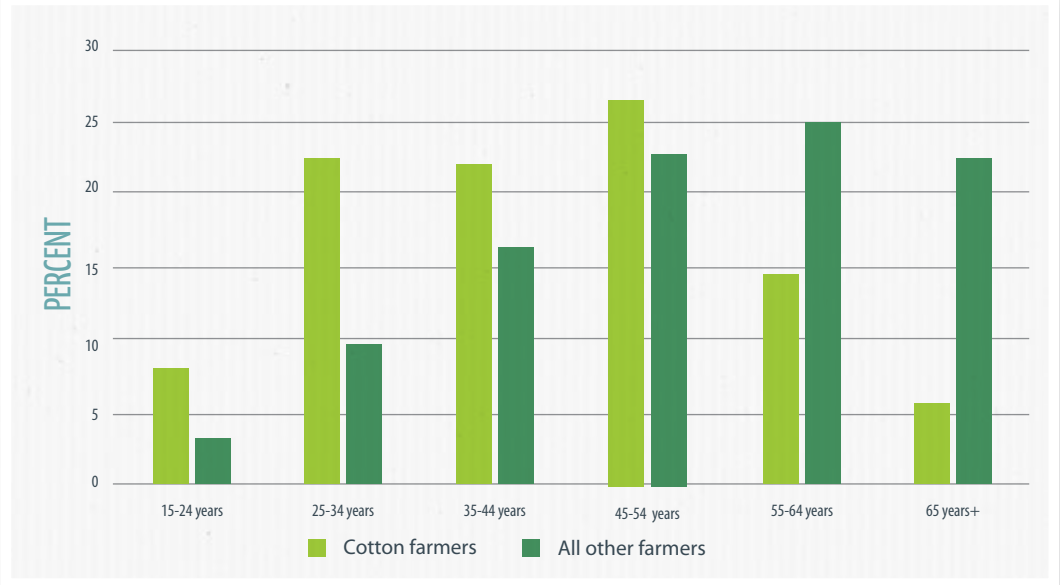
Overall cotton growers are much younger than farmers in other agricultural industries in Australia (as shown in Figure 29). For example, 20 percent of cotton growers are aged 55 years and over while 45 percent of all other farmers are aged 55 years or over. There are many initiatives to encourage the participation of young people in the cotton industry. These include:

// Leadership training course and scholarships for young leaders.

// Summer scholarships for undergraduates to undertake R&D projects.

// Annual industry award for achievement by a young person (35 years or younger).

Figure 29 The age of cotton farmers and other farmers in Australia during 2011



Source: ABS 2011 Census

DEMOGRAPHICS GENDER PARTICIPATION

Traditionally agriculture has been an industry involving more males than females in the workplace. The cotton industry has actively encouraged women to participate at all levels of the industry. The current CRDC Board of Directors Chair is female and Cotton Australia has also had women undertake the role of Chair of the governing board and have had one to two female board members for the past five years. Women occupy a number of senior positions in the industry, as well as undertaking roles such as agronomists, researchers and cotton marketing. Table 5 shows the proportion of women working in key industry organisations is currently around 60 percent.

Table 5 The proportion of female staff in industry organisations (2014)

ORGANISATION	FEMALE (%)
Cotton Australia staff	67
CRDC staff	64
CottonInfo Team	60

Source: Cotton Australia annual report 2014, CRDC annual report 2013

Crop Consultants Australia is the major membership body for professional crop growing advisors. Overall, 12 percent of the membership is female, with most of the older members being male. Within the less than 35 years demographic, 50 percent of the membership is female, with a recent influx of female agronomists entering the industry.

In 2000, a 'women in cotton' organisation known as WinCott was formed. WinCott has enabled a women's network to develop, and strengthen the linkages and participation of women within the industry. There are currently 400 members.

Figure 30 Women in cotton (WinCott) membership numbers.

Most Australian cotton farms are family owned and operated.

SOCIAL CAPITAL COTTON CONFERENCE DELEGATES

Social capital refers to features of social organisation such as networks, and co-operation for mutual benefit. The cotton industry is often described by others as a highly connected industry. One metric of this is the delegate numbers of the Australian Cotton Conference.

The Australian Cotton Conference is jointly organised by Cotton Australia and Australian Cotton Shippers Association. The Conference has been operational for 34 years.
The biennial conference is the cotton industry's most important event drawing a delegate base that spans researchers, cotton farmers, suppliers, cotton merchants, spinning mills, brand owners and supply chain partners together into one forum.

Seventeen conferences have been held and it is one of the largest conferences of any agricultural industry in Australia. Table 6 lists the delegate numbers for the last eight conferences. The decline in 2008 was due to the ongoing drought, however cotton industry leaders were pleased with the continued strong attendance.

Further information about the 2014 conference is available on the conference website **www.australiancottonconference.com.au**

Table 6 Australian cotton conference delegate numbers

YEAR	2000	2002	2004	2006	2008	2010	2012	2014
Delegate numbers	1413	1392	1478	1302	896	998	1586	1816

Some other examples of industry networks include:

// Australian Cotton Industry Council.

// Crop Consultants Australia.

// Cotton Innovation Network.

// Regional Grower Associations.

// Australian Cotton Shippers Association.

// Association of Australian Cotton Scientists.

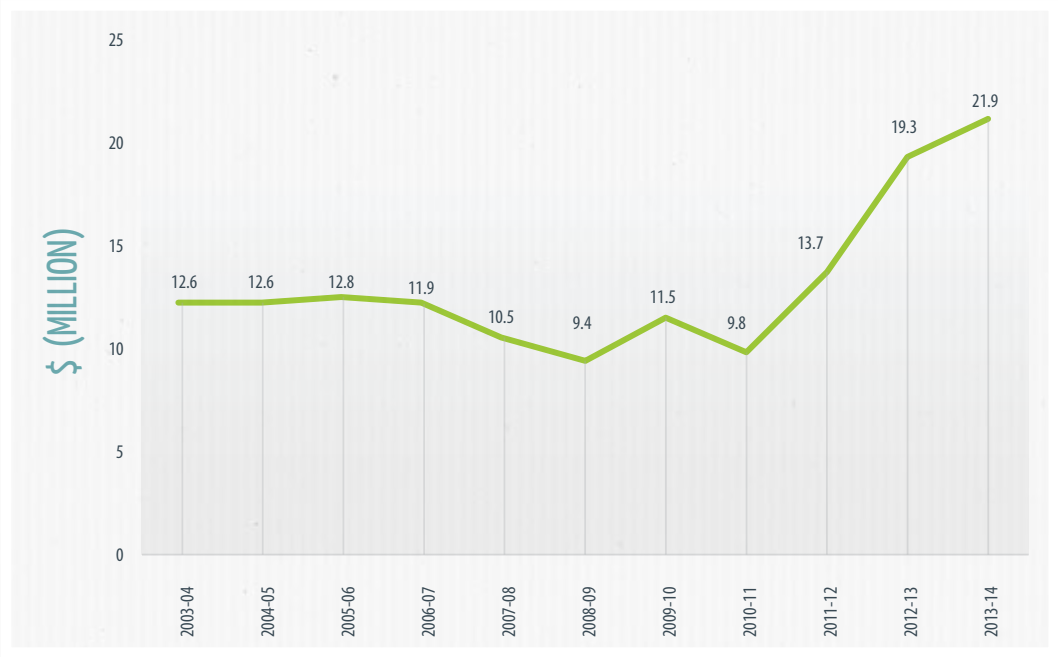
INNOVATION INVESTMENT IN R&D

The Australian cotton industry has always invested in research and development. Over the past 24 years, the Cotton Research and Development Corporation has invested $200 million in RD&E on behalf of Australian cotton growers and the Australian Government – delivering an estimated minimum $1.4 billion benefit back to growers on their farms, and twice that value to the wider community.

Cotton growers pay a $2.25 per bale research and development levy, which is matched using various formulas by the Australian Government. The CRDC does not spend all its income each year. Cash reserves are kept and used during low income years caused by drought to reduce the variation in the research and development expenditure budget.

Expenditure levels have generally been around $11 million per year, although they have been less in drought years and more recently in response to increased production around $20 million per year (Figure 31). The annual reports of CRDC provide comprehensive details on the cotton industry's research and development activities (**www.crdc.com.au**).

Figure 31 Research and development expenditure by the Cotton Research and Development Corporation 2003-2014.



The cotton industry has also been an active participant in the Australian Government's Co-operative Research Centre Program. The triumvirate of cotton-based CRCs concluded in 2012 after 18 years of significant investment and collaboration. Over 400 research project reports can be found at **www.cottoncrc.org.au**

In 2012 the Cotton Innovation Network was formed to co-ordinate the cotton industry's research and development activity and ensure a collaborative and cohesive approach to achieving our industry's long term goals. The key participants in cotton research are all represented in the Cotton Innovation Network. The network includes representatives from the NSW Department of Primary Industries, CRDC, Cotton Seed Distributors (CSD), CSIRO, the Commonwealth Department of Agriculture, Queensland Government's Department of Agriculture, Fisheries, Forestry and universities.

Computers, smart phones and tablets are used widely for accessing information.

INNOVATION GROWERS ADOPTING TECHNOLOGIES

Australian cotton growers are innovative and rapidly adopt new technologies:

// 99 percent adoption of transgenic traits for insect and weed management.

// 82 percent adoption of new round module pickers.

// 70 percent using soil moisture probes for irrigation scheduling.

// 90 percent using satellite navigation systems in tractors.

// 84 percent use a smart phone or tablet for accessing information about their farming system.

Source Cotton Grower Surveys 2011, 2013.

LEGAL COMPLIANCE AND RESPONSIBILITY

Australia's cotton industry is regulated by a strict legislative framework which is applied at federal, state and local government levels.

The Australian cotton industry's *my*BMP program helps Australian cotton growers keep track of their legal obligations in operating their farm businesses. Of the approximately 600 'check' items growers can use to evidence their use of industry best practice, around 180 provide evidence of legal compliance. Legislation affects all aspects of operations such as:

// Conditions of employment for staff and the protection of their safety in the workplace.

// Standards for transporting farm machinery and cotton modules on public roads.

// Storage and handling of pesticides and petrochemicals on-farm.

// Weather conditions for the application of pesticides.

// Licensing arrangements for access and use of transgenic traits.

// Mechanisms and timing of access to water for irrigation and the on-farm retention of overland flows.

// Management of trees and native vegetation.

CRDC and Cotton Australia had no fines imposed by government regulatory agencies. It is not possible to report the number of fines imposed on the cotton farms as the data by government regulatory agencies is not available.

Australia's workers are protected by workplace health and safety, discrimination and labour law and regulation. Domestically, this strong legislative framework (Fair Work Act, 2009) ensures minimum employment conditions and enterprise and or collective bargaining rights. Legislation also ensures children are not engaged in child labour. Australia is also engaged in international efforts to combat exploitative child labour practices, primarily through the International Labour Organisation (ILO) as well as through United Nations human rights fora, and the activities of the United Nations Children's Fund (UNICEF).

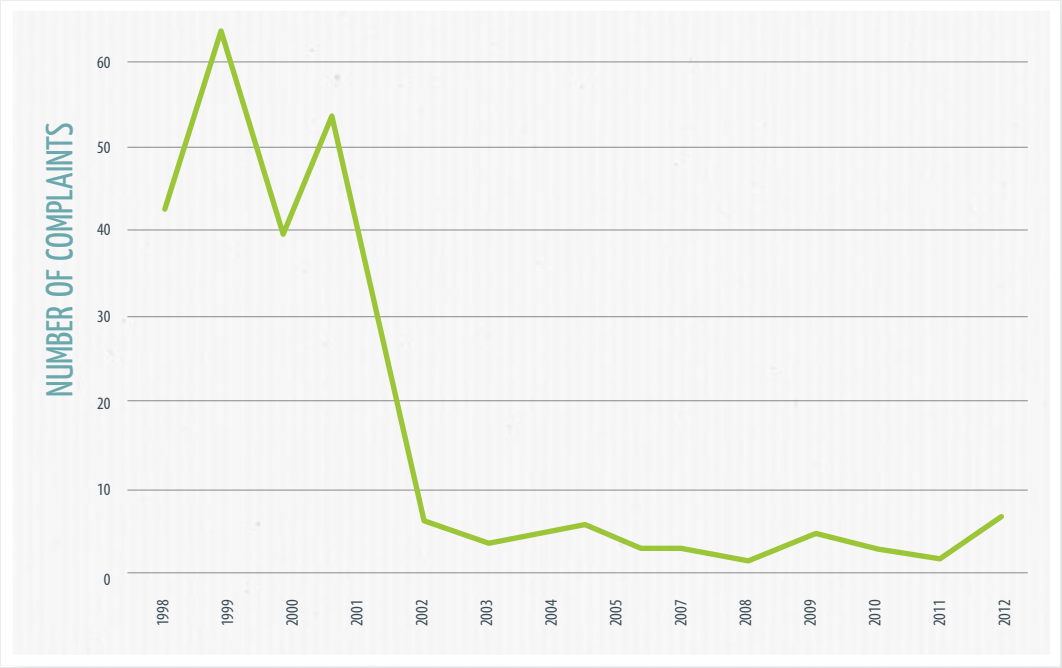
The Office of the Gene Technology Regulator (OGTR) approves and monitors the use of biotechnology, and the Australian Pest and Veterinary Medicines Authority (APVMA) regulates the registration and use of pesticides. Other legislative and monitoring agencies include the Federal Departments of Environment, Agriculture and Employment, Food Standards Australia New Zealand (FSANZ), state Environmental Protection Authorities, the Fair Work Ombudsman and Safe Work Australia.

The industry has just commenced a campaign to control road side cotton weeds as part of its biosecurity responsibility.

In terms of responsibility, the number of complaints received about cotton production has reduced over the last decade. For example, complaints to the NSW Environment Protection Authority (1998-2012) are shown in Figure 32. There has been a dramatic drop in the number of complaints since 2001.

This can been attributed to a number of linked factors including the implementation of the Cotton Best Management Practice program, increased legislative requirements, greater use of transgenic cotton varieties and a reduction in the crop area due to the drought, although this has expanded again since 2009.

Figure 32 Complaints about cotton growing to the NSW EPA.



OUR REPORT

REPORT BOUNDARY

This report focuses on Australian cotton farms. As discussed in the report there are up to 1500 independently and privately owned cotton farms in Australia. Cotton Australia and the CRDC have been working together to ensure the Australian cotton industry is a global leader in sustainable and responsible agriculture.

The report's standard core GRI disclosures focus internally on Cotton Australia and CRDC as it is not possible to report on these metrics for 1500 individual farms. The economic, environmental and social sustainability performance information relates to Australian cotton farms, which are external to Cotton Australia and CRDC. The process for determining the aspect boundaries vary and are discussed in the economic, environmental and social categories. The boundary is usually the immediate farm, cotton growing region or water catchment.

This report does not include coverage of post-farm gate activities of the supply chain such as cotton ginning, shipping, spinning and textile manufacture, although reference is made to linkages in the cotton value chain. With the exception of cotton ginning these activities are carried out overseas by a range of independent corporations. As discussed in the report, linkages with the supply chain are being strengthened.

Cotton production on farms forms part of the overall supply chain for clothes, fabrics and products people use. Having an appropriate, ethical and sustainable supply chain is important for Australian cotton production.

DEFINING MATERIAL ASPECTS AND SUSTAINABILITY INDICATORS

The purpose of sustainability indicators for the Australian cotton industry is:

// To demonstrate economic, environmental and social credibility to supply chain, markets, government and policy makers and community (domestically and globally).

// To guide research priorities and investment to enable practice change and continual improvement.

// To evaluate outcomes of research investments.

// To benchmark current performance and trends over time at the farm and industry scale.

// To inform and respond to policy development.

A comprehensive inventory of potential sustainability indicators was developed and published which reviewed the material issues of stakeholders and the literature as well as compiling data from a wide suite of published and unpublished research and monitoring data sets to provide and overall picture of the sustainability issues and trends of the Australian cotton industry[v].

This set of potential sustainability indicators was assessed and updated by the cotton industry's Environmental Assessment Working Group, taking into account recent developments in international supply chain sustainability initiatives such as the Better Cotton Initiative, Cotton LEADS™, and the Social, Environmental and Economic Performance of Cotton Production (SEEP) Panel of the International Cotton Advisory Committee.

Farm landscape monitoring, Mungindi.

A list of more than 100 potential sustainability indicators was compiled. These indicators were then prioritised using an objective ranking system which scored indicators against six selection criteria (Table 7). Development of the final list of indicators took into account those of material interest to stakeholders, international sustainability initiatives, CRDC and Cotton Australia's strategic plans.

Table 7 Selection criteria and ranking for materiality of sustainability indicators

SELECTION CRITERIA	
1	Materiality (a) (relevance to cotton industry stakeholders)
2	Materiality (b) (relevance to external stakeholders including market, government, community)
3	Cost-effectiveness of data collection
4	Technical difficulty of data collection
5	Data integrity / confidence
6	Accuracy in data collection

From the list of more than 100 indicators, 45 have been shortlisted as high priority material aspects for the cotton industry to collect, collate and report on to form the basis of this report.

ENVIRONMENTAL Sixteen environmental indicators were identified as high priority.
ECONOMIC Sixteen economic indicators were identified as high priority.
SOCIAL Thirteen social indicators were identified as high priority.

These priority indicators are listed in Table 8.

Table 8 Material sustainability aspects and indicators for the Australian cotton industry

KEY ASPECT	ECONOMIC INDICATOR
Cotton industry production statistics	1. Planted area (ha) - Irrigated
	2. Planted area (ha) - Dryland
	3. Yield (bales / ha) - Irrigated
	4. Yield (bales / ha) - Dryland
	5. Fibre quality
	6. Metric tonnes of cotton produced
	7. Grower numbers
	8. Average / median farm size
Economic value	9. Cotton price / bale
	10. Gross value of the cotton produced in Australia ($)
	11. Cotton exports
	12. Cotton's % of region gross value
	13. Australia's % share of global cotton lint trade
	14. Cotton proportion of global textile market
Profitability	15. Gross margin / ha
	16. Income / ML water
KEY ASPECT	**ENVIRONMENTAL INDICATOR**
Soil health	1. Organic carbon %
	2. Practice change.
	3. Soil sodicity
On farm water use efficiency and productivity	4. Gross Production Water Use Index
	5. Irrigation Water Use Index
	6. Practice change
	7. Whole farm water use efficiency (%)
Groundwater	8. Groundwater levels
	9. Groundwater quality
Biodiversity / riparian	10. Area of native vegetation managed under best practice
	11. Vegetation condition and connectivity
IPM	12. Growers using integrated pest management practices
Chemical use	13. Herbicide use
	14. Insecticide use
GHG emissions	15. Energy use
	16. Nitrogen use efficiency
KEY ASPECT	**SOCIAL INDICATOR**
Education	1. Highest post school qualification of cotton growers
Employment	2. Number of people employed on farms
	3. Number of people employed - industry
	4. Number of people employed - regional
Workplace health and safety	5. Workers receiving regular health and safety training
	6. Workers health & safety programs in place
Demographics	7. Grower age
	8. Gender participation in industry
Social capital	9. Australian Cotton Conference delegate numbers
	10. Financial membership in regional Cotton Grower Associations
Innovation	11. Investment levels in R&D
	12. Growers adoption of technologies
Legal compliance & responsibility	13. Fines imposed upon cotton SMEs by regulatory authorities

A variety of forums are held. This one was in Emerald where farmers, advisers, researchers, CRDC and Cotton Australia discussed farming systems R&D.

STAKEHOLDER ENGAGEMENT

The Australian cotton industry has a range of stakeholders and is committed to an open dialogue with them. Stakeholders include:

// Cotton growers.

// Cotton ginners.

// Cotton marketers.

// Cotton shippers and buyers.

// The agribusiness and banking sectors.

// Commonwealth, state and local government.

// Research and development providers.

// Community groups.

The cotton industry regularly engages with stakeholders through a variety of platforms such as formal meetings, workshops, networks, surveys, advisory panels and research projects. The basis and frequency for engagement of stakeholders is determined by the issues.

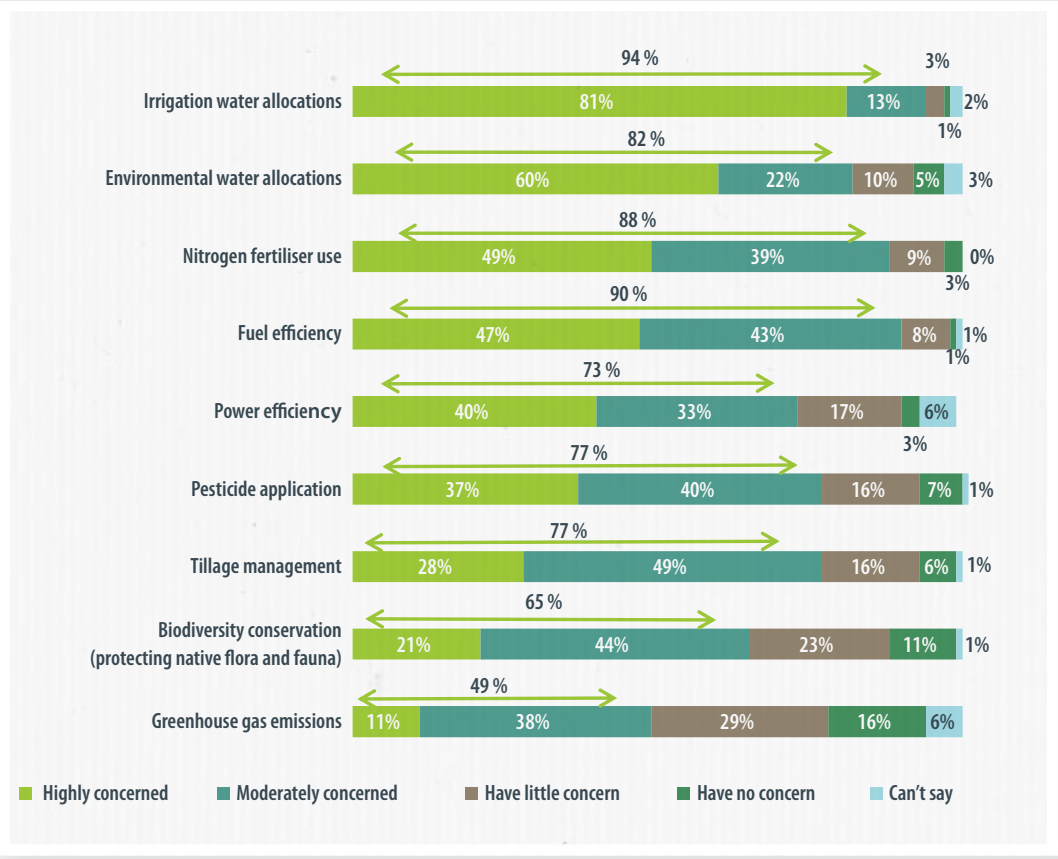
An understanding of stakeholder attitudes is important as they influence the social licence or right to farm cotton. In order to understand community and stakeholder concerns the cotton industry has undertaken a number of attitudinal studies in cotton communities and Australian cities. These studies have shown that community members are concerned about pesticide use and application, water use, soil health and salinity, land clearing and changes to biodiversity, river and groundwater quality, use of genetically modified crops, waste management, weeds, greenhouse emissions and energy use. These studies have also found geographic variation in community attitudes with differences in both positive and negative feelings.

In 2012, the cotton industry completed its third independent environmental assessment of Australian cotton growing[vi]. The study period of the assessment was 2003-2012 as it appraised the cotton industry's implementation of the recommendations of the second environmental audit in 2003[vii] and the cotton industry's progress since then.

The first independent environmental audit of the cotton industry was conducted in 1991. The third environmental assessment represented the continuation of the cotton industry's commitment to undertaking comprehensive independent environmental assessments, a process unique in agricultural industries in Australia. The third environmental assessment included meetings, site inspections and a survey of industry/non industry stakeholders and some focus groups in the city.

Growers were asked about their current environmental concerns and their responses indicate that the priorities are those issues that have the greatest implications for the survival and profitability of their cotton growing enterprise - water, fertiliser and fuel availability or use (Figure 33).

Figure 33 Grower concerns in terms of environmental issues



Source: Cotton Environmental Assessment Grower Survey 2012

Integrated Pest Management Field Day southern NSW.

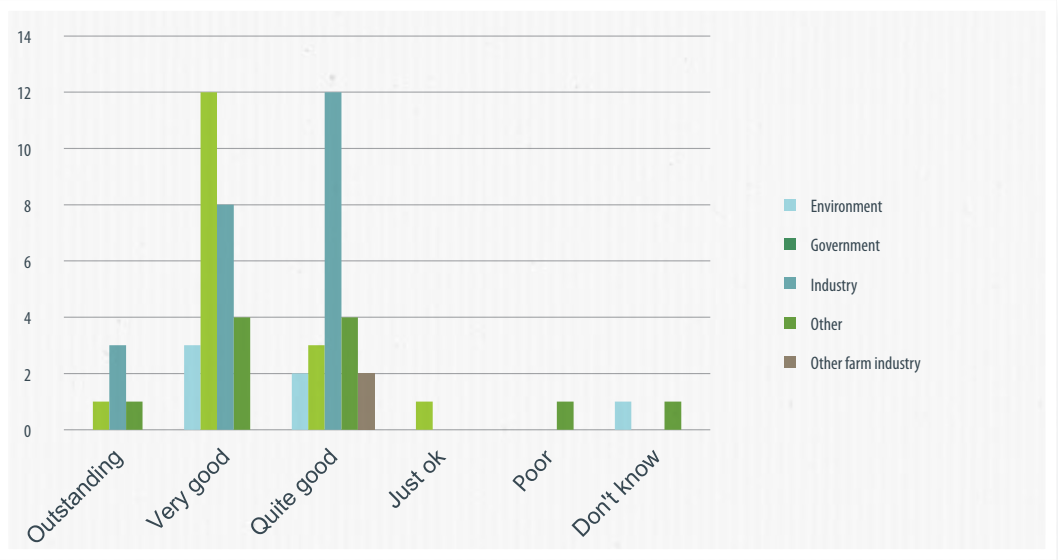
As part of the environmental assessment in 2012, stakeholders were also asked to nominate the three main environmental issues they believe the industry needed to act on immediately. Water use was ranked as the first main issue, greenhouse gas emissions as the second main issue and soil health as the third main issue. Chemical use and energy efficiency also rated prominently (Figure 34). When asked what environmental issues respondents see as becoming important over the next three to five years in terms of impacting on cotton growing, water was again ranked by most as the first main issue and again by those as the second main issue by those that ranked something else as the first main issue. Energy use, carbon emissions and coal seam gas extraction were rated prominently.

Figure 34 Stakeholder perceptions on future environmental priorities for industry

Source: Cotton Environmental Assessment Stakeholder Survey 2012

These stakeholders were also asked how they would rate the cotton industry's overall performance. A large proportion of respondents rated the cotton industry's performance as 'quite good' or 'very good', with few respondents rating performance to be below 'just okay'. Most individuals identified the industry's performance to be 'very good'. The perception of the cotton industry's performance selected by each type of stakeholder group is shown in Figure 35.

Figure 35 Stakeholder perceptions of industry's overall environmental performance.



Source: Cotton Environmental Assessment Stakeholder Survey 2012

The Australian Cotton Industry Third Environmental Assessment 2012 made six recommendations for the industry to improve its environmental performance:

1. Develop a strategic and risk management approach to environmental management and performance.
2. Continue to improve *my*BMP.
3. Improve contact databases.
4. Deliver evidence-based reporting of environmental performance.
5. Engage in market-based initiatives.
6. Research how people use contemporary media.

This report has been prepared as part of the industry's response to the Third Environmental Assessment.

Namoi River floodplain, Burren Junction.

STAKEHOLDER FEEDBACK ON THE INDICATORS FOR THIS REPORT

As part of preparing this report feedback was sought from key cotton industry stakeholder organisations. Each organisation was asked to rank the indicators according to importance to their organisation and/or constituents and list any indicators they considered were missing.

Feedback was also sought at the Better Cotton Initiative stakeholder workshop (November 2013) and by inviting comments directly from eleven organisations in May 2014, including the National Farmers' Federation, CSIRO, WWF, Murray Darling Basin Authority, and the Global Reporting Initiative.

The cotton industry Environmental Assessment Working Group considered the feedback and included revisions to the final list of priority material aspects and indicators. Overall, this reduced the number of indicators from 47 to 45. There were also several potential indicators which were raised by stakeholders as missing from the list which have not been included in the current report. These included erosion, eco-toxicity, significance of native vegetation, surface water quality and a more detailed analysis of employment and professional development. It was considered that there is currently not enough data to enable the industry to report against these indicators in 2014, however they warrant further exploration for future sustainability reports.

REPORT PROFILE

This is the first formal sustainability report of the Australian cotton industry and has been prepared using the Global Reporting Initiative G4 Guidelines. It builds on a history of previous disclosures such as published annual reports, research and development project outputs, and three independent environmental audits and assessments.

In line with core principles of sustainability, the report draws on long-term data sets, where possible, up to the present 2014 cotton crop. The future planned reporting cycle is intended to be biennial. A separate Global Reporting Initiative Context Index has been prepared as an Appendix. Current policy is not to have the entire report externally assured. Most of the data sets are from published scientific reports which have received external assurance reviews. The financial statements of CRDC and Cotton Australia have also had an independent external audit.

GOVERNANCE

Cotton Australia is a not for profit company limited by guarantee. The members of Cotton Australia include all cotton grower associations, cotton ginning companies and some service industry members (Cotton Seed Distributors Ltd and Crop Consultants Inc). It is governed by a board of 10 elected non-executive directors by its members at the annual general meeting (for three-year terms). The board chairman is elected by the board. The board is responsible for establishing strategic directions and targets, approving and monitoring policies, plans and budgets, and ensuring compliance with legal obligations and corporate governance. The chief executive officer is appointed by the board who is responsible for day to day management and implementation. Cotton Australia's strategic plan and annual report containing further details on corporate governance and operations are available on the website **www.cottonaustralia.com.au**

The Cotton Research and Development Corporation (CRDC) is a research and development partnership between the Australian Government and the Australian cotton industry. The corporation was established in 1990 under the Primary Industries and Energy Research and Development Act. The corporation is accountable to the Australian Government through the Minister for Agriculture. The Minister appoints the chair and five to seven non-executive directors of the governing board. The roles and responsibilities of directors are set out in the board charter, which includes a governance statement, conduct and ethical standards provisions. The board appoints an executive director who is responsible for the day to day management of corporation activities. Further details on governance and corporate operations can be found in the annual report, which is available on the website; **www.crdc.com.au**

The governing boards of both Cotton Australia and the CRDC are responsible for decision-making on economic, environmental and social impacts. The governing boards have established an Environmental Assessment Working Group which consists of senior staff from both organisations to implement policy and actions to improve the sustainability of Australian cotton production. The Environmental Assessment Working Group and boards both consult with stakeholders on sustainability matters and in the case of the Working Group, it provides its feedback to the boards on its findings and a recommended response.

ETHICS AND INTEGRITY

The *Cotton Industry's Vision 2029* includes a core element of responsibility. This vision specifically commits to producing the most socially responsible cotton in the world.

Cotton Australia's core values are:

// RESPECT To respect the views, opinions and concerns of others at all times.

// OPENNESS To ensure that information is available and accessible to members, staff and by all other parties.

// INTEGRITY To operate with honesty, decency and courage.

Cotton Australia's staff policy document commits the organisation and its staff to ethical, legal and moral standards. These standards cover practice areas including work health and safety, anti-discrimination and -harassment, parental rights, remuneration, training and professional development. Furthermore, Cotton Australia's board members are subject to a code of conduct that aligns themselves and the organisation to the best interests of members (ie growers). This code of conduct is on par with common standards for agriculture and industry associations.

Likewise CRDC's policy documents outline expectations for ethical and legal behaviour in all its operations. Many of CRDC policies are outlined in its published annual report. This includes policies on governance, workplace health and safety, equal employment opportunity, harassment, and disabilities.

The cotton industry adopts precautionary approach principles to its operations:

INTERNALLY **Through a risk management framework and policies overseen by the governing boards of CRDC and Cotton Australia.**

EXTERNALLY **For cotton farms through the *my*BMP program, which includes risk-assessment processes as part of its modus operandi.**

The myBMP farm management system includes a specific module on human resources and workplace health and safety. The module provides guidance for farmers to meet their legal obligations around employing staff, and to put in place procedures that help optimise employee productivity in a safe environment. The module focuses on all aspects of employing staff, whether they be family members, employees or contractors. It offers practical ways to improve the ability to attract, retain, manage and protect staff.

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* Further details are in the published annual reports of Cotton Australia and CRDC.

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