COTTON EDUCATION KIT
INTRODUCTION

CURRICULUM LINKS
• Queensland
• New South Wales

CHAPTER 1
The Australian Cotton Industry

CHAPTER 2
A Sustainable Cotton Industry

CHAPTER 3
The History of Cotton

CHAPTER 4
The Cotton Plant

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How Cotton is Grown

CHAPTER 6
The Business of Cotton Farming

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Cotton Processing: from Gin to Fabric

CHAPTER 8
Cotton as a Competitive Commodity

CHAPTER 9
Cotton as a Consumer Product

CHAPTER 10
Careers in Cotton
Whether it’s ideas for incorporating agricultural contexts into the curriculum you’re after, some great classroom material, or information for a school project, all you need to know about cotton is right here in this book.

The content has been developed by Cotton Australia, the Australian cotton industry’s peak grower body, with input from a wide range of Australian and international sources. It is the story of a modern, sustainable agricultural industry that’s helping to clothe the world. This kit is the definitive guide for current, authoritative information on the Australian Cotton Industry.

Each chapter is linked to the Key Learning Outcomes in the QLD and NSW Senior Secondary Syllabuses to provide ideas for where cotton contexts may be incorporated into teaching programs in line with syllabus requirements. These will be updated as the curriculum evolves.

Although explicit curriculum links are made to the senior secondary syllabuses, the kit is suitable for students and teachers of a range of grades.

The content here is linked to other dynamic resources such as video, other websites, useful articles and photographic material.

Look for this symbol: ❌

Other Cotton Australia education resources are available by contacting us:

Via the web: www.cottonaustralia.com.au

By Phone: (02) 9669 5222

By Email: talktous@cottonaustralia.com.au

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Your feedback on how this resource could be improved would be most welcome, and we hope you enjoy learning all about cotton.
THE FOLLOWING TABLE PROVIDES IDEAS FOR HOW TO INCORPORATE SOME OF THE CONTENT AREAS AND THEMES IN THE EDUCATION KIT INTO THE QLD AND NSW SENIOR SECONDARY CURRICULUM. A LIST OF THE INDIVIDUAL SYLLABUSES THAT HAVE BEEN MAPPED AGAINST THE KIT ARE BELOW. THIS WILL BE UPDATED AS THE NATIONAL CURRICULUM IS ROLLED OUT AND COTTON AUSTRALIA WILL ENDEAVOUR TO MAKE THE CURRICULUM LINKS EXPLICIT FOR ALL STATES AND TERRITORIES.

**Blue:** NSW syllabus / **Maroon:** QLD syllabus

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SYLLABUS THAT HAVE BEEN ALIGNED TO THE EDUCATION KIT SO FAR

QLD AGRICULTURAL SCIENCE (2013)
NSW PRIMARY INDUSTRIES CURRICULUM FRAMEWORK STAGE 6 SYLLABUS (2011)
NSW AGRICULTURE STAGE 6 SYLLABUS (AMENDED 2009)
NSW DESIGN AND TECHNOLOGY (2009)
NSW TEXTILES AND DESIGN STAGE 6 SYLLABUS (2009)
QLD HOME ECONOMICS SENIOR SYLLABUS (2010)
NSW BUSINESS STUDIES (2010)
QLD BUSINESS ORGANISATION AND MANAGEMENT SENIOR SYLLABUS (2007)
NSW GEOGRAPHY STAGE 6 SYLLABUS (1999)
QLD GEOGRAPHY SENIOR SYLLABUS (2007)
NSW EARTH AND ENVIRONMENTAL SCIENCE (2002)
NSW SENIOR SCIENCE (2002)
QLD SCIENCE21 SENIOR SYLLABUS (2010)
CHAPTER 1
The Australian Cotton Industry
Naturally World’s Best
Cotton is a natural fibre grown on a plant. It’s produced so that the fibre can be made into products that consumers use every day, including jeans, t-shirts, sheets, and towels. Fibre from the cotton plant is made into yarn and fabric, the seed is fed to cattle and crushed for oil, and the rest of the plant can be made into mulch.

Cotton makes up just over a third of all the fibre sold globally, and is the world’s favourite natural fibre. Produced commercially in Australia since the 1960s, cotton has developed into one of our leading agricultural industries.

Cotton is grown under the Australian sun on about 1,500 farms from Emerald in the north of Queensland to Griffith in southern NSW. Most cotton farms grow an average of 467 hectares of cotton, are owned and operated by Australian families, and employ approximately eight staff.

Cotton is grown on some of the deepest and richest soils in Australia that have a unique capacity for storing water by swelling and shrinking in harmony with the natural wetting and drying cycles of their regions. Likewise, the agricultural community’s livelihood swells and shrinks with droughts and floods - and Australian cotton farmers have adapted to survive in what can be an unforgiving environment when the rains don’t come.

They have learned to make more from less - producing the highest yielding, highest quality, most environmentally-friendly cotton in the world. These farming communities are working with leading manufacturers and premium brands to differentiate their product, placing it into the hands of consumers all over the globe.

The world wants our cotton. Although a relatively small producer on the world scale, Australia is the world’s fourth largest cotton exporter, producing sustainable, high quality, low contaminant cottons that attract a premium on the world market. Continuous improvements in Australian cotton quality, particularly staple length and strength, means our raw product is increasingly being used for the production of premium quality fabric.

Over 150 regional communities from Emerald and Theodore in Central Queensland to Hillston and Hay in Southern NSW are reliant on cotton production, which underpins regional prosperity and social infrastructure in these communities. In a normal year the Australian cotton industry directly employs over 10,000 Australians and supports 4,000 businesses that rely on cotton.

Australian cotton farmers participate in a voluntary environmental program called Best Management Practices (myBMP), which ensures cotton is produced and manufactured with the highest environmental standards from the farm and beyond. Our innovative farm practices have seen water use efficiency double in the last 25 years, and Australian cotton growers deliver two to three times more cotton per land area than the global average.

Where is cotton grown?

Cotton is grown in around 75 countries of the world, between 45 degrees North and 32 degrees South.

The world’s biggest producers include China, USA, India, Pakistan, and Brazil. Australia is a relatively minor producer on the world scale but it is the fourth largest exporter growing between two and five million bales (227 kg per bale) each year, depending on price and the availability of water.

In Australia cotton is grown in southern, central and north-western NSW and central and southern Queensland. The major production area in NSW stretches south from the Macintyre River on the Queensland border and covers the Gwydir, Namoi and Macquarie valleys. In NSW cotton is also grown along the Barwon and Darling rivers in the west and the Lachlan and Murrumbidgee rivers in the south. In Queensland, cotton is grown mostly in the south in the Darling Downs, St George, Dirranbandi and Macintyre Valley regions. The remainder is grown near Emerald, Theodore and Biloela in Central Queensland. There are small plantings in the Burdekin region of Queensland and the Ord River area in Western Australia.
The Australian cotton industry produced a record crop in 2011/12, with more than 583,000 hectares planted, producing 5.3 million bales. The 2011/12 Australian cotton crop was estimated to be worth almost $3 billion.

Of this crop 66% was planted in NSW, with 34% in Queensland. 20% was dryland (relied entirely on rainfall) and the rest was irrigated using a variety of methods.

The amount of cotton planted each year varies depending on the weather, price and the availability of water. In other words, if dam storage levels are low at the beginning of the season or prices are low, growers will tend to plant less cotton.

While China and India may lead the world in total production of cotton, Australia produces more than double the cotton per hectare of both these countries. In fact Australia has produced the world’s highest cotton yields every year for over 20 years. Efficiency gains mean Australian cotton growers can now produce the same amount of cotton on fewer hectares than ever before.

So why do some countries produce higher yields per hectare than others? There are a combination of factors including:

- Variety selection
- Water availability
- Crop management, including nutrition and pest control

Plant breeding has been responsible for at least 50% of the yield increases seen in Australia, with 50% attributed to better water management.

In Australia, irrigated cotton produces much higher average yields than dryland cotton. For example average yield in 2011/12 under irrigated conditions was 9.2 bales/ha compared to 2.8 bales/ha under rain-fed conditions.

Australia is the fourth largest exporter of cotton in the world (behind USA, India and Uzbekistan) and is an important export industry for Australia’s economy.

In an average production year, the Australian cotton industry generates in excess of $1 billion in export revenue, is one of Australia’s largest rural export earners and helps underpin the viability of over 100 rural communities in NSW and Queensland.
Targeted research has proven to be the industry’s most valuable investment. Research funds are invested in four main areas:

- farming systems (soils, water, environment, pests)
- value chain (ginning, processing, spinning, retail)
- human capacity (attracting and retaining a strong workforce)
- biosecurity (reducing the threat of introduced pests and diseases)

Australia also has a world-class plant breeding program, led by the CSIRO, to develop new strains of cotton that are most suited to Australian, and even regional conditions.

The cotton R&D program is funded by Australia’s cotton growers who pay a compulsory levy of $2.25 per bale of cotton they produce. This is matched by the Australian Government. Individual cotton organisations (such as Cotton Seed Distributors and Cotton Australia) as well as individual growers also fund and participate in research projects for the betterment of the whole industry.

There are many organisations involved in cotton R&D such as the Cotton Research and Development Corporation (CRDC), the CSIRO and federal and state government departments.

This research investment has resulted in the Australian cotton industry being recognised as world leaders in the adoption of technology, innovation, environmental management and the production of premium quality cotton.

Less than 1% of the cotton grown in Australia is spun by local spinning mills – over 99% is sold and exported, largely to Asia.

China is Australia’s most important cotton customer, consuming approximately 70% of the crop. Other important markets for Australian cotton are Indonesia, Thailand, South Korea, Japan and Bangladesh.

<table>
<thead>
<tr>
<th>Country</th>
<th>Export (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>549,479,383</td>
</tr>
<tr>
<td>Indonesia</td>
<td>95,561,145</td>
</tr>
<tr>
<td>Thailand</td>
<td>73,254,903</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>40,871,464</td>
</tr>
<tr>
<td>Other</td>
<td>33,231,670</td>
</tr>
<tr>
<td>South Korea</td>
<td>31,989,557</td>
</tr>
<tr>
<td>Japan</td>
<td>1,646,478</td>
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<tr>
<td>Pakistan</td>
<td>15,553,739</td>
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<tr>
<td>Vietnam</td>
<td>11,265,494</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>6,542,649</td>
</tr>
<tr>
<td>Total</td>
<td>879,396,482</td>
</tr>
</tbody>
</table>

(source: ABARES)
ABOVE ALL, COTTON FARMERS ARE PEOPLE WHO LIVE AND WORK IN OVER 100 LOCAL, RURAL COMMUNITIES ACROSS NSW AND QUEENSLAND.

They provide jobs, their kids go to school and play sport in rural towns and they shop locally for agricultural supplies and services. Cotton growers are mostly family farmers who have lived and worked in their communities for generations.

The average Australian cotton farm:
• Is family owned and operated
• Provides jobs for eight people
• Grows 467 hectares of cotton
• Is run by experienced farmers with an average age of 39
• Grows other crops and often grazes sheep and cattle

An extensive system of production, harvesting and ginning provides countless jobs for mechanics, distributors of farm machinery, consultants, crop processors and other support services. Industries such as banking, transportation, warehousing and merchandising also benefit from a viable Australian cotton industry.
CHAPTER 2
A Sustainable Cotton Industry
Soil, water, plants, air and animals are all part of what makes a dynamic and healthy cotton farming system. As custodians of the land, Australia’s cotton farmers strive to find the delicate balance between producing fibre to clothe the world and responsible conservation of their resources.

For the last three decades, the Australian cotton industry has invested millions of dollars in improving its use of natural resources. These investments have been in research, development and delivery, on the farm and through the supply chain.

This enormous effort has paid off, with the Australian cotton industry now recognised internationally as a leader in sustainable cotton production and a model for change in other Australian agriculture industries.

A recent 2012 study “Australian Cotton Industry: Third Environmental Assessment” tracked improvements since 2003, and found the industry’s major achievements to include:

- Development of an integrated research, development and extension system delivered to growers via an online Best Management Practices program (myBMP)
- Substantial reduction in the use of chemicals, particularly insecticides and herbicides and the disappearance of serious off-farm impacts in rivers and wetlands
- Major gains in water use efficiency calculated at 3-4% per year
- Significant uptake of Integrated Pest Management (IPM)
- Major advances in cotton grower’s attitudes and action concerning natural resource management on-farm, particularly deep drainage, riparian vegetation management, groundwater conservation and delivery of ecosystem services

THIS CHAPTER WILL LOOK AT FOUR IMPORTANT AREAS OF SUSTAINABILITY IN THE AUSTRALIAN COTTON INDUSTRY: THE MYBMP PROGRAM, WATER, BIOTECHNOLOGY AND CLIMATE CHANGE.

Blog: Cotton Pickin – the Boggabri blog
Report: Australian Cotton Industry: Third Environmental Assessment
Lesson: Studies in Sustainability: The Cotton Industry in Northern NSW and Southern Queensland
**MYBMP: MANAGING THE ENVIRONMENT ON THE FARM**

*myBMP* is the Australian cotton industry’s environmental management program, a voluntary system for achieving best practice in the growing, ginning and classing of cotton. *myBMP* is a web based system that acts as a one-stop-shop for best practice and scientific information. It links supporting knowledge, data and resources to best practice principles and guidelines, allowing growers, ginners and classers immediate access to cutting edge research as well as support from industry and extension staff when there is an issue to solve or investigate.

**THE BEGINNINGS**

In the early 1990s, the Australian cotton industry came under fire for its environmental performance, particularly in relation to pesticide use. A coordinated response by the Australian cotton industry did more than address the immediate concerns - it transformed an entire agricultural industry. Unfortunately, some of the negative perceptions associated with this period of the cotton industry haven't been updated in some people’s minds, particularly the older generations. Cotton Australia and others continues to work hard to change these outdated notions.

The first step in tackling pesticide use was to initiate the first ever environmental audit of a whole agricultural industry in the southern hemisphere. A major finding was that the Australian cotton industry needed to improve its storage and application of chemicals and to improve grower education on these issues - thus, the Best Management Practices program was formed.

**INITIAL PROGRAM DESIGN**

A three year, $6 million research project provided the scientific basis for the initial Cotton Best Management Practices (BMP) program. BMP covered integrated pest management, on-farm chemical application management, the storage and handling of pesticides and petrochemicals, as well as farm design and land and water management. Best practices, risk assessments and action plans for improvements were included in a paper-based manual that growers worked through to identify areas of risk and improvement and implement action plans.

**A NEW ERA FOR BMP**

While the BMP system managed to completely transform the farming practices of the cotton industry, the industry decided it needed to put the program on-line to make it easier to update and use. The new, on-line *myBMP* system was launched in 2009/10.

It allows growers and industry to access the latest technical data, information and research, find solutions to challenges and provide a wide variety of tools to help growers operate at maximum efficiency.

Cotton farmers record, monitor and are audited in 11 key areas of farm operations:

- **BIOSECURITY:** the avoidance, management and control of pests and diseases
- **BIOTECHNOLOGY:** for GM cotton varieties
- **ENERGY AND GREENHOUSE GASES:** efficient use of energy inputs like fuel and fertilisers
- **FIBRE QUALITY:** for growing the best quality cotton possible
- **HUMAN RESOURCES:** managing staff and contractors
- **INTEGRATED PEST MANAGEMENT:** for weeds, pests and diseases
- **NATURAL ASSETS:** managing vegetative and riparian assets
- **PESTICIDE MANAGEMENT:** pesticide storage and use
- **PETROCHEMICAL STORAGE AND HANDLING:** petrochemical storage and use
- **SOIL HEALTH:** ensuring healthy soils for the long term
- **WATER MANAGEMENT:** water quality, efficiency of storage and distribution, dryland and irrigated farming practices

There are many benefits to the cotton industry's commitment to sustainability through *myBMP* - these include safer farm workplaces, healthier natural environments, reduced input costs, better run farm businesses and improved community health.

**www.mybmp.com:** a web-based resource for best practice in Australian cotton production for growers, researchers and industry

**Case Study:** meet the Brownlies, cotton growers at the cutting edge of Best Management Practices on their farm

**Fact Sheet:** Cotton's myBMP Environmental Program
The Australian cotton industry has achieved a 40% increase in water productivity over the last decade through a combination of better water monitoring, irrigation scheduling, evaporation control and improved irrigation techniques. Australia’s cotton industry is now considered the most water-efficient in the world, producing “more crop per drop” than any other nation at more than double the world’s average yields.

Appropriate varieties, a massive research effort, use of the latest technologies and cutting edge on-farm practices all combine to produce Australian cotton fibre that is farmed with less water per hectare than ever before. The Australian cotton industry now produces on average 1.9 bales of cotton per megalitre, compared to 1.1 bales per megalitre 10 years ago, representing a substantial improvement in productivity and water use efficiency.

Practical approaches to water use efficiency on the farm include:

- Zero and minimum till farming to help retain soil moisture
- Irrigation scheduling to ensure irrigation is only done as and when it is needed
- In-field capacitance probes to monitor and transmit soil moisture data from the field to a central computer to help schedule irrigations
- Thermal imaging and electromagnetic surveys to identify “leaky” dams, pipes and channels so they can be repaired
- Using new efficient methods of irrigating such as overhead lateral move sprinklers, bank-less channels, syphon-less channels and drip irrigation
- Growing cotton varieties that are suited to regional conditions and use less water. Mobile electromagnetic meters for easy and rapid assessment of soils for their suitability for irrigation construction
- Holding water on farm for shorter time periods to reduce evaporation
- Laser-leveling to ensure uniform, well drained fields using GPS guidance equipment
- Tail water recycling systems so that water is reused
- Reducing evaporation by shortening row lengths
- Positioning dams closer to cotton fields to reduce evaporation losses
- Deeper water storages and head ditches with smaller surface areas to reduce evaporation
- Avoiding water storage on farm by only purchasing water as it is needed
- Smaller water storage cells to reduce evaporation
- Not putting water directly into dry storages which soak up water
- Infield monitoring using probes to detect soil moisture levels
- Creating a ‘water budget’ to monitor water use
- Lining storages and channels with clay or non-porous materials to avoid seepage
- Covering water storages to reduce evaporation
- Mulching and stubble retention to help retain soil moisture, reducing the need for irrigations
- Permanent wheel beds to reduce soil compaction and increase water infiltration
- Avoiding water logging and over-watering
- Doubling the size of syphons
- Slowing the rates of water application to ensure water soaks into the root zone where it’s needed most, rather than running off
- Installing monolayers for evaporation mitigation on farm dams

Case Study: A report on the use of an ultra-thin film (polymere) on water storages to mitigate evaporation

Lesson: A HSC on-line activity analysing irrigation systems in the Murray-Darling Basin and assessing options for improved efficiency

Fact Sheet: Practical Approaches to Water Use Efficiency in the Australian Cotton Industry
Deeper head ditches to reduce evaporation

Accurate water metering delivers only what is needed to the fields

Neutron probes to measure soil moisture

Doubling the size of syphons

Irrigation scheduling to ensure water is only applied when the crop needs it

On-farm storages with evaporation prevention polymers (in the wind) – half the water is mirror flat and half has waves

Stubble retention to hold soil moisture

Monitoring syphon flow rates helps growers improve water management

Closed delivery systems reduce transmission losses and improve whole-farm water use efficiency

Below are 10 of the Australian cotton industry’s innovations in water-use efficiency that have significantly changed cotton production practices.
Biotechnology refers to the use of cotton varieties with transgenic or genetically modified (GM) traits. The use of biotechnology in cotton has made a significant contribution to the dramatic reduction in insecticides applied to Australian cotton crops - 85% in the last decade. In fact, this environmental reason is the main one for cotton growers to take up this technology on their farms.

Almost 100% of Australia's cotton crop is now grown with biotech varieties that require far less insecticides than conventional cotton plants. Across the world, transgenic varieties now account for 21% of world cotton area.

Apart from a dramatic reduction in pesticides, other benefits of biotechnology in cotton are:
- increased populations of beneficial insects and wildlife in cotton fields
- reduced pesticide run off
- improved farm worker and neighbour safety
- a decrease in fuel usage
- improved soil quality
- reduced production costs
- increased yield
- further opportunities to grow cotton in areas of high pest infestation

Australia was one of the first cotton producing nations (the other was the USA) to grow transgenic varieties, starting in 1996 with Ingard®. This first new strain of cotton was developed and trialed over many years before its limited release in 1996. In the 1996-97 cotton season, Ingard constituted 10% of the national crop and pesticide applications were reduced by over 50%.

Further research led to a variety of cotton with two genes that produces two different proteins in the leaves that are toxic to heliothis called Bollgard II®, introduced to Australia in 2004. Scientists isolated a protein that occurs normally in soil borne bacteria called Bacillus thuringiensis (Bt) that attacks only the heliothis insects. When the caterpillar ingests a small part of the cotton plant, the Bt protein disrupts the caterpillar's digestive system and it dies.

Scientists isolated a protein that occurs normally in soil borne bacteria called Bacillus thuringiensis (Bt) that attacks only the heliothis insects. When the caterpillar ingests a small part of the cotton plant, the Bt protein disrupts the caterpillar's digestive system and it dies.

Resistance to BT:

A very small number of heliothis caterpillars are naturally resistant to Bt and this can pose a problem. If these insects survived, they could breed with other resistant insects, creating a population of Bt resistant heliothis.

To combat this potential problem, the cotton industry and government regulators have developed Resistance Management Plans for each cotton region, along with thorough testing of every cotton crop throughout the growing season to monitor any potential problems.

Practical examples of strategies in these Resistance Management Plans include:
- planting conventional cotton alongside Bt cotton, so that large numbers of insects will survive and swamp the resistant insects during breeding to dilute the resistant population
- compulsory pupae busting to destroy insect nests
- the planting of “trap crops” that attract natural predators of heliothis in strips close to Bt cotton

These predators are then encouraged onto the cotton by a food spray, and in turn destroy the heliothis when they arrive.

There has been some misguided concern that transgenic cotton could fertilise wild cotton plants creating hybrids. However, researchers have measured pollen movement from transgenic crops and found that there is no possibility of this occurring, nor the widespread movement of pollen to other cotton.
Over the last decade cotton varieties have been developed with new features such as improved fibre quality, disease resistance, maturity and regional adaptability. Research is being undertaken to develop varieties that require less water and/or are drought tolerant and have better fibre qualities like increasing flame resistance and reducing wrinkles in fabrics. The use of transgenic cotton is a key component of growers’ Integrated Pest Management (IPM) strategies that use a combination of natural controls and pest-specific chemistry to further reduce pesticide use.

NEW VARIETIES IN THE PIPELINE

COTTON AND CLIMATE CHANGE

Cotton is an annual crop grown in regions that experience climate variability driven by El Nino/La Nina cycles. Consequently cotton growers have already developed highly efficient and flexible farming systems that can meet the challenges of climate change. Despite being a very small contributor, the Australian cotton industry has invested in climate change research to understand further opportunities for cotton farms to reduce or capture emissions.

Current estimates from the Australian Greenhouse Office (2006 Inventory) are that on-farm activities (excluding energy use) across agriculture are responsible for around 16% of Australia’s greenhouse gas emissions. This is more than the transport sector and second only to the electricity producing sector. Methane from livestock is the dominant agricultural greenhouse gas (70% of agricultural emissions) with nitrous oxide from farming activities representing approximately 12% of agricultural emissions.

Greenhouse Gas Emissions (GHG) from the Australian cotton industry are small, representing:
- Less than one third of one per cent of Australian agriculture’s GHG emissions (ranging from 0.16-0.29%)
- Approximately 0.15% of the nation’s total emissions in 2010/2011

The main sources of Greenhouse Gas Emissions that can be associated with cotton growing include:
- Nitrogen from fertiliser and organic nitrogen sources
- Carbon dioxide from soils (biological decomposition of crop and pasture residues which is increased by tillage and additional moisture and nutrient present in irrigated systems)
- Carbon dioxide from fuel and fertiliser (during planting, cultivation, harvesting, chemicals, pumping, fertilisers)

IMPACT ON AUSTRALIAN AGRICULTURE

Australia’s climate is inherently variable but specific climate change impacts are predicted to include increases in temperature and atmospheric carbon dioxide, decreases in rainfall and increased frequency of extreme weather events.

All major sectors in Australian agriculture are vulnerable to climate change, with potential negative impacts on essential natural resources, the amount and quality of produce and reliability of production.

Changes in the climate could have both positive and negative impacts on our ability to grow cotton. An increasing concentration in carbon dioxide levels could potentially increase photosynthesis and subsequent water use efficiency could in fact lead to higher crop yields. However, these benefits may be offset by declines in rainfall, increases in temperature and/or increases in atmospheric evaporation.
The cotton industry is funding or has funded a range of interesting climate change research projects including:

- Investigating the inter-relationship of potential impacts of changes in rainfall, carbon dioxide concentration, reduced water availability, lower humidity and increases in temperature.
- A number of projects to manage climate change on farm (e.g., plant breeding and nitrogen use efficiency).
- Measuring the level of greenhouse gas emissions (N2O / CO2) from different production systems.
- The development of calculators to assist farmers to estimate total greenhouse gas emissions.

Practical examples of cotton production practices to minimise emissions and manage soil carbon include:

- Improved water use efficiency which reduces pumping and waterlogging.
- A move to use of round modules which has led to energy reduction in harvest and handling through removal of some operations and machinery.
- Placing nitrogen at depth in cooler times in wet soils to maximise nitrogen efficiency (and thus minimise losses to the atmosphere).
- Assessing and optimising nitrogen fertiliser use and use of alternative sources such as legume rotations.
- Using lower emissions machinery and assessing and improving existing machinery and irrigation pumping performance.
- Alternative fuel sources.
- Improvements in soil management through stubble retention, reduced tillage and reduction in spraying operations.

Case Study: A Life Cycle Assessment of a 100% Australian Cotton T-Shirt, by one of Australia’s leading cotton scientists, Dr Peter Grace.

Fact Sheet: Cotton and Climate Change.
CHAPTER 3
The History of Cotton
WORLD COTTON HISTORY
A BRIEF SUMMARY

COTTON HAS A VERY LONG AND INTERESTING HISTORY IN THE WORLD AND IS ONE OF THE OLDEST KNOWN FIBRES. THE WORD COTTON COMES FROM AN ARABIC WORD ‘QUTUN’ OR ‘KUTUN’ USED TO DESCRIBE ANY FINE TEXTILE AND SOME OF THE EARLIEST FABRIC RELICS FOUND IN EXCAVATIONS OF ANCIENT CIVILISATIONS WERE COTTON.

Archaeologists found cotton fabric 5,000 years old at Mohenjo Daro, an ancient town in the Indus River Valley of West Pakistan, and similarly aged examples have been found in Egypt and Mexico. Although the cotton plant is thought to have initially grown wild in East Africa, it was first cultivated in the country now known as Pakistan where its early uses were as a textile for clothing, bindings for sandals and harnesses for elephants. The Greek historian, Herodotus (484 – 425 BC) wrote about a tree in Asia that bore cotton ‘exceeding in goodness and beauty the wool of any sheep.’ Cotton was widely used in the ancient civilisations of Mesopotamia, Egypt and the Indian sub continent. Early Mediterranean traders, the Ionians and Phoenicians introduced cotton materials to Europe.

Over the next 2,000 years, cotton, wool and silk became the preferred fibres for fine fabrics across the developed world. In less developed and warmer countries where cotton farming, home spinning and village industry were interlocked - cotton was dominant, and still is, 2,000 years later. In more developed countries the surge in cotton consumption was triggered by the Industrial Revolution of the late 18th Century. Spinning mills sprang up in places like Manchester which led to ports like Liverpool becoming major cotton shipping centres. With access to slave labour and new Upland types of cotton, the American colonies, soon to become the USA, provided much of the raw cotton. With lower production costs, cotton became more affordable and its popularity soared. During this period, specialty cotton including Egyptian, Sea Island (Caribbean and South East USA) and Tanguis (Peru) became highly prized for use in very soft and fine fabrics.

However, the American Civil War changed things; European nations were forced to look for other sources of supply and the British looked to their then colonies, including Australia.

Fact Sheet: World Cotton History

A contrast in spinning technology

Arkwright’s Spinning Frame, invented in about 1767, enabling cheap production of cotton cloth.

And the modern day version – Australian Cotton being spun in Dongying Hongyuan Textile mill (China) photo by John Hamparsum
Cotton has a relatively long history in Australia – native varieties have grown here for many thousands of years. However, although cotton was introduced to Australia with the First Fleet, it did not establish itself even as a minor commercial crop until the 1850’s. Then the American Civil War started. Gins were built, and relatively large areas of cotton were grown around centres such as Beaudesert, Caboolture, Ipswich and Central Queensland.

But when international trade returned to normal, Australian cotton production declined, falling to a total of 15 acres in 1886. In the early 1900’s it reappeared and production gradually rose to 50,000 acres in 1924, and after a temporary decline, to 60,000 acres in 1936. In this pre-war period there were cotton gins at Rockhampton, Wowan, Gladstone, Gayndah, Dalby and Brisbane.

Following World War II production again fell to around 2,500 acres. But with the availability of better mechanical cotton pickers, and an increased Commonwealth bounty, production again rose to reach 20,000 acres in 1960. Up until this period, cotton was regarded as a low input dryland crop or as a pioneering crop for recently cleared land. Irrigation was rare, yields marginal, and fibre quality poor and variable – then things changed!

The modern era of Australian cotton began. Despite some opinion to the contrary, the modern era did not have a singular origin. Cotton farmers in various areas of Southern and Central Queensland concurrently began addressing cotton as a higher input, better managed, irrigated crop. At the same time what is now the Australian Cotton Research Institute was established near Narrabri following the completion of Keepit Dam.

Research quickly focused on cotton as an exciting possibility. In these critical first three years, and before his transfer to wheat research, a Hungarian plant breeder, Nick Derera, provided the foresight to develop those possibilities. In this pioneering effort he was assisted by the farm manager Tom Lawler, and a young agronomist, Ralph Schulzé. News of these promising early results was picked up by the media as far away as California. Two cotton farmers from near Merced, California, Paul Kahl and Frank Hadley, were so impressed that in early 1961 they came to Australia to see for themselves! They were soon to be followed by others and as a result a cohort of American cotton families emigrated to the Wee Waa district and other areas. It was the unique blend of American “know how” and practical Australian innovation that made these early efforts so successful.

Meanwhile, in Queensland, progressive farmers in the Lockyer, Callide-Dawson and Condamine valleys were successfully developing irrigation and sound crop management. New irrigation areas at St. George and Emerald were also providing opportunities for successful cotton trials and expansion.
An interactive timeline chronicling the history of Australia's cotton industry and some of its leading organisations including Cotton Australia.
A RECORD CROP IN 2011/12 OF 5.3 MILLION BALES, ESTABLISHES INDUSTRY RECOVERY AFTER ALMOST A DECADE OF DROUGHT
CHAPTER 4
The Cotton Plant
THE COTTON PLANT

Produced on a plant, cotton is a member of the Hibiscus family and is botanically known as Gossypium hirsutum or Gossypium barbadense. By nature it is a perennial shrub that reaches a height of 3.5 metres. Commercially it is grown as an annual and only reaches a height of 1.2 metres.

The most common type of cotton grown in Australia is Gossypium hirsutum, more commonly known as American Upland. It is a leafy, green shrub that briefly has cream and pink flowers that become the ‘fruit’ or cotton bolls. There are also 17 native Gossypium species that are all members of a distinct group found exclusively in Australia.

HOW COTTON GROWS

It takes about four to 14 days for seedlings to appear after seeds are planted, depending on temperature and moisture levels. The cotton seedling grows into a young plant, sending down a long taproot to find water and nutrients. This taproot can grow as deep as 1.5 metres.

The first two leaves that are visible on the young cotton plant are seedling leaves called cotyledons. They are useful for absorbing sunlight into the plant. The sunlight is then converted through a process known as photosynthesis, into nourishing carbohydrates that will help the plant grow. In about two to four weeks they turn over the photosynthetic task to true leaves (leaves produced subsequent to the cotyledons) which continue the feeding process for the duration of the plants’ life.

The first flower buds (called squares) appear within about 35 days. As the squares develop, the bud swells and begins to push through the bracts until it opens into an attractive flower. This happens after a further 25 days, when the first creamy-white, hibiscus-like flowers appear. The cotton plant continues to produce squares and flowers for about half the growing season. The last productive flower opens about three to four months after planting.

Cotton flowers only stay open for 24 hours. During this short time the flower must be fertilised to produce the seed that has the cotton fibre or lint attached. Fertilisation takes place when pollen from the anther (male part) is transferred to the stigma (female part) of the flower. Over the one to two days after pollination the flowers change colour from white to pink to red, mauve or purple and the petals fall.

The fruit, called bolls, then begin to develop. These green, immature bolls are a segmented pod containing approximately 32 immature seeds from which the cotton fibres will grow. The boll is considered a fruit because it contains seeds.

Individual cells on the surface of the seeds start to elongate the day the pink flower falls off (abscission). The fibres grow, mature and thicken for the next month, forming a hollow cotton fibre inside the boll which becomes approximately the size of a small fig.

Bolls reach full size about 25 days after the petals fall. After a further 35 to 55 days, the bolls naturally burst open along the boll’s segments or carpels and dry out, exposing the underlying cotton segments called locks. These dried carpels are known as the bur, and it’s the bur that will hold the locks of cotton in place when fully dried and fluffed, ready for picking. When most of the bolls are open the crop is ready to pick.

An average boll will contain nearly 500,000 fibres of cotton and each plant may bear 15-20 bolls. The growing season from emergence to picking is about 180 days.

The Beginning of the Boll
photo by Helga Twelbeck

Part of the cotton plant

STAGES IN THE COTTON PLANT CYCLE

1ST DAY SEED PLANTED
5-10 DAYS SEEDLING EMERGES
40-50 DAYS FLOWER BUDS FORM
70-80 DAYS FLOWERING COMMENCES
100-105 DAYS COTTON BOLLS BEGIN TO FILL
120-130 DAYS COTTON BOLLS START TO OPEN
150-160 DAYS COTTON BOLLS FULLY OPEN AND READY FOR PICKING
AFTER PICKING COTTON PLANTS ARE MULCHED BACK INTO THE SOIL READY FOR THE NEXT CROP
COTTON’S GROWTH CYCLE

COTTON IS AN ANNUAL, SUMMER CROP. IT PREFERENCES HOT SUMMERS WITH LOW HUMIDITY AND LONG HOURS OF SUNSHINE. IN GENERAL, COTTON GROWS QUICKER AS THE AVERAGE TEMPERATURE RISES AND THE LONGER AND HOTTER THE SEASON, THE GREATER THE YIELD.

AUSTRALIA’S COTTON GROWING SEASON LASTS APPROXIMATELY SIX MONTHS, STARTING IN SEPTEMBER/OCTOBER/NOVEMBER (PLANTING) AND ENDING IN MARCH/APRIL/MAY (PICKING) – DEPENDING ON THE REGION.

A NUMBER OF ENVIRONMENTAL FACTORS CAN AFFECT THE GROWTH OF COTTON, PARTICULARLY IN THE EARLY STAGES, INCLUDING HEAT SHOCK, COLD SHOCK, SAND BLASTING, HAIL DAMAGE AND WATER LOGGING.

Fact Sheet: Cotton’s Growing Cycle

A typical Australian cotton growing season

Time-lapse footage of cotton bolls
COTTON GROWER’S CALENDAR

**AUGUST/SEPTEMBER**
- Soil prepared for planting, weeds removed, nutrients added if necessary
- Soil moisture levels checked, pre-watering if necessary

**SEPTEMBER/OCTOBER/NOVEMBER – PLANTING**
- Soil temperature checked
- Cottonseed planted when soil is warm enough for satisfactory seed germination and crop establishment (i.e. soil temperature reaches 14°C at a depth of 10cm for at least three days)
- Cotton seeds emerge 1-2 weeks after planting

**NOVEMBER/FEBRUARY GROWING SEASON**
- Flower buds develop a few weeks after the plant starts to grow, then flowers appear a few weeks later. The flowers then fall off leaving a ripening seed pod that becomes the cotton boll (the fruit)
- Ongoing checks for pests, soil moisture level tests and weed removal
- On irrigated cotton farms the initial irrigation (watering) is usually followed by a further four to five irrigations, at two to three week intervals, from mid-December to late February. This differs depending on the region and on natural rainfall levels
- Approximately fourth months of growing is needed for the cotton bolls to ripen and split open
- Cotton growers use a range of natural and soft chemical options to control the pests that attack cotton (called Integrated Pest Management, or IPM)

**MARCH/APRIL/MAY DEFOLIATION, PICKING AND TRANSPORTATION TO GINS**
- Crop checked by agronomists to make sure it is ready to pick
- Large mechanical cotton pickers are used to pick the crop
- Growers usually choose to pick the cotton crop once most bolls have opened and fully matured. It is extremely important that cotton is picked dry or discoloration may occur and reduce quality
- Cotton is packed onto trucks and sent to the ‘gin’ where it is ginned – a process separating lint (raw cotton fibre), cottonseed and trash
- The cotton lint is tightly pressed into bales, each weighing 227kg - these are then sent to ports for shipping to overseas markets

**MAY-AUGUST (OFF-SEASON)**
- Classing and marketing activities undertaken
- Growers plant winter crops and/or graze sheep and cattle
- Growers make improvements on-farm for next season
- Farm maintenance

Experience the ups and downs of being a cotton farmer via this blog from young grower Bess Gairns
CHAPTER 5
How Cotton is Grown
GROWING CONDITIONS

Cotton can be grown either as dryland (relying on rainfall) or as irrigated cotton (requiring supplemented water supply).

**Dryland cotton requires:**
- Full soil moisture profile at the start of the season
- Rainfall during the summer months
- Long periods of heat with low humidity

**Irrigated cotton requires:**
- A reliable water supply
- Irrigation water from rivers or underground
- Long periods of heat with low humidity

The higher the average temperature and amount of direct sunlight during the growing season, the faster the crop will grow and develop. The longer and hotter the growing season, the higher the potential yield. Irrigated cotton is better suited to low rainfall environments because the farmer has more control over the level of moisture in the soil. The quality of the cotton is also less likely to be affected by rainfall when the bolls open (rain on open cotton bolls can cause discolouration).

Water availability and local climate are the most significant contributing factors to the distribution and type of cotton grown in Australia and the rest of the world.

**PREPARING THE LAND**

The first step in growing any crop is to prepare the land. Cotton, particularly irrigated cotton, requires a great deal of land preparation. It takes time to get the soil and the general lay of the land ready for cotton growing.

Soil preparation starts immediately following the last cotton crop. Most farmers now leave their cotton stubble standing in the field and mulch it back into the soil to add valuable nutrients. This also helps the soil retain moisture by reducing evaporation.

On an irrigated cotton farm, fields are leveled and graded such that they have a precise slope or grade. This is done to enable water to flow from the top of the field to the bottom of the field in a controlled way. If the field isn’t sloped enough or is uneven, then water can lie around and waterlog the soil or if too steep, the water will run off too quickly and not soak into the soil profile. It is important that the slope enables the water to flow slowly down the field watering all the plants evenly. A tail drain is constructed at the end of the field to recycle the excess run-off water.

**SOIL TYPES AND ACHIEVING HEALTHY SOILS**

Cotton is predominantly grown on cracking, self-mulching clay soils found on flood plains adjacent to rivers. These soil types expand and contract depending upon the water content of the clay.

Growers test the soil a few months prior to planting to check nutrient levels and how much fertiliser may be required. Nitrogen is the main nutrient needed by cotton plants, and it can be applied in the form of anhydrous ammonia, a liquid that, when directly applied to the soil, changes back into a gas and clings to soil particles for the plants to use later. Nitrogen can also be applied in granular form. Nitrogen can be added to the soil three months before planting. Cotton also needs many other nutrients such as phosphorus, potassium, sulphur and zinc.

Growing only one type of crop in a field can lead to a deficiency of nutrients and the build-up of soil diseases and pests. Most growers rotate crops to avoid these problems. For example, a grower might decide to plant cotton in a field for three years, wheat the next year, and then plant a legume crop or leave the field crop-free (fallow). This process is called crop rotation. Irrigated cotton growers usually rotate their cotton crop every three or four years.
PLANTING
Cotton seed is planted in the spring as soon as the soil is warm enough to be sure of satisfactory seed germination and crop establishment. The soil is warm enough when the temperature reaches 14 degrees Celsius at a depth of 10 cm for at least three days in a row.

In northern NSW, the right soil temperature is usually reached in late September or early October. In Central Queensland, it is likely to occur up to a month earlier and in Southern NSW, up to a month later.

On irrigated crops, cotton is sown with 6, 8, 10 or 12 row precision planters that place the seed at a uniform depth and interval along rows generally one metre apart (rows planted one metre apart are known as a ‘solid’ configuration). Seeds are planted about 10 - 12 seeds per metre, four centimetres deep, into the soil on top of the rows (mounds) which are typically spaced one metre apart.

Another way that Australia’s cotton farmers maximise yields and fibre quality and save water and fertiliser is to reduce the number of plants by planting in “skip rows”.

This is achieved by leaving a configuration of rows of cotton bare of seed or ‘skipped’.

There are three common options for skip row planting, and these have become more common and easier due to the flexibility of modern harvesting equipment;
- Single Skip - every third row is skipped (therefore the field has 66% plant population)
- Double Skip – two adjacent rows are planted and then 2 are skipped (50% plant population)
- Super Single – every third row is planted alone (33% plant population)

A recent variation of solid and skip row planting configurations in irrigated cotton systems is to plant evenly spaced rows 1.5 metres apart (creating a plant population of 66% of a standard solid planting).
WATERING BY IRRIGATION

While not all cotton crops rely on irrigation water, this is a major component of growing a cotton crop.

**MANAGING THE CROP**

Producing a high quality, high yielding, water efficient cotton crop requires careful management throughout the season. The following section outlines some of the most important things to manage throughout the growing season.
WHAT IS IRRIGATION

Irrigation means moving water mechanically from one place to another for agriculture. Irrigation generally occurs in Australia where the rain falls at a different time to when the crops need it. Water for irrigation comes from rivers or underground supplies (huge underground lakes from which water is pumped via bores).

State Governments construct dams to hold water and then stringently control the allocation of and access to water. Irrigation farmers are issued a licence to access a defined volume of water each year. They pump the water from rivers or underground water supplies onto their farms where it is usually held in on-farm storages until it’s needed.

In the case of cotton growers (who plant a crop each year), the available water supply for irrigation changes each year depending on how much rain there’s been and how much water is in the dams. Water distribution for domestic use, stock, the environment and permanently planted crops (such as fruit trees) always have priority over cotton farms.

Cotton growing therefore requires careful water management. Well-designed and well-built systems combined with careful application ensure that a minimum amount of water is used, and that there are many safeguards against wastage. Usually the land in an area that uses irrigation is flat (often on a flood plain) allowing the water to be easily moved from the natural source to the irrigated area.

Careful design of irrigation systems is important to ensure:
- water travels down a field at just the right speed to water, but not waterlog, the plants
- that all run-off water is collected and recycled for re-use in the next irrigation
- maximum water savings

TIMING OF IRRIGATIONS

To really get the crop growing well from the early stages, there needs to be adequate moisture in the soil before the crop is even planted. If there isn’t enough water in the soil from recent rains, growers can either add a little extra water before cottonseed is planted or they can add the water just after the seed is planted. This is called “watering up” the crop. This initial irrigation is usually followed by a further four to five irrigations at two to three week intervals, from mid-December to late February.

The time the crop really needs water the most is during January and February. This is when the temperatures are highest and the fruit on the plants is starting to mature and fill. The timing of these irrigations is crucial to achieve high yields (quantity) and high quality cotton fibres.

Blog: Read this blog to hear from cotton farmer Bess Gairns about how to use probes on the farm

MEASURE TO MANAGE: WATER USE EFFICIENCY

Water is a cotton grower’s most precious resource, and so everything is done to conserve moisture to get the most out of every drop. Australia’s cotton industry is now considered the most water-efficient in the world.

One of the key ways for growers to save water is to only water the cotton plants when they need it. Fields are equipped with soil moisture probes (called capacitance probes) at regular intervals that electronically measure how much moisture is in the soil. This data is sent back to the farmer’s computer system in the office, where an assessment is made about whether or not that particular field needs watering. It’s a very measured, scientific approach that has made a huge difference to the way cotton farmers manage their water.

This is a probe to measure soil moisture. It contains a telemetry unit, data logger and solar panel. The moisture probe is in the ground below and generally has sensors at specific intervals in the soil profile, every 10cm for about 120cm.
MOST OF AUSTRALIA’S COTTON IS GROWN UNDER FLOOD IRRIGATION SYSTEMS, SYSTEMS THAT HAVE IMPROVED THEIR WATER SAVING CAPACITY DRAMATICALLY IN THE LAST 20 YEARS USING A RANGE OF TECHNIQUES.

COTTON GROWERS ARE MORE AND MORE USING OTHER FORMS OF IRRIGATION THAT OFFER EVEN GREATER WATER SAVINGS. IN SOME Areas, ON SOME SOIL TYPES, THESE METHODS ARE NOT SUITABLE – COTTON FARMERS USE THE BEST COMBINATION OF IRRIGATION TOOLS AND TECHNIQUES THAT SUIT THEIR LOCAL CONDITIONS, SOME OF THE NEWER FORMS OF IRRIGATION ARE DRIP, BANKLESS CHANNELS AND THROUGH THE BANK.

**TYPES OF IRRIGATION**

**DRIP IRRIGATION**

Drip irrigation is an option for use particularly in sandy soils (where water disappears quickly) and extremely hot regions (where evaporation occurs quickly). Drip infrastructure (pipes and dripper mechanisms) is laid beneath the surface, deep enough to not be disturbed by cultivation machinery, but at a level enabling the delivery of water directly to the plant roots. Drip irrigation ensures maximum efficiency of water allocation, although the cost is much greater.

**BANKLESS CHANNELS**

Bankless irrigation is a system of overflowing the head ditch into a paddock with the grade running in the opposite direction to a typical raised bed irrigation and syphon system. The excess water then drains back into the head ditch and on to the next bay.

**THROUGH THE BANK**

This is a syphon-less irrigation system, one of a number that’s been extensively trialed in the Australian cotton industry. Pipes are inserted through the channel banks, with “gates” to better control water flow into the furrows.

**Case Study: An innovative “bankless channels” approach to irrigation by Cotton Growers of the Year “Bullamon Plains” in St George Queensland**

Bullamon Plains in St George QLD has a bankless channel irrigation system to conserve water.

**Case Study: The Saunders family are cotton growers who’ve embraced a new form of irrigation technology, “through the bank”**

The Saunders’ at St George Queensland have designed and constructed an automated surface irrigation system that added a variable-rates-of-flow function into a syphon-less watering set up.
The Doolins at North Star NSW have installed overhead pivots that saw yields improve from seven bales per hectare to 12 bales per hectare.

**Case Study:** Young cotton farming couple Simon and Sandy Doolin have dramatically increased yields with their overhead irrigation system.

**OVERHEAD PIVOTS OR LATERAL MOVE IRRIGATORS**

Overhead pivots, also called lateral move irrigators are large sprinkler-like irrigation systems that water the cotton plants from above, rather than below. The plants are 'sprayed' with water that is released along the arms of the pivot or lateral move. They require a lot less water than flood irrigation, providing great water efficiencies.

**CROP WATER REQUIREMENTS**

Cotton uses about the same amount of water as other summer crops, is drought and heat tolerant and uses less water than rice, maize, soybeans and many vegetable crops. Cotton’s average irrigation requirement is 5.2 megalitres per hectare (5.2 ML/ha), compared to rice (10.1ML/ha), nurseries, cut flowers and turf (4.2 ML/ha) and fruit and nut trees. (4 ML/ha).

**AVERAGE IRRIGATION REQUIREMENT (MEGALITRES/HECTARE)**

- **RICE** 10.1
- **MAIZE** 8-9
- **SOY BEANS** 6-8
- **COTTON** 5.2
- **NURSERIES, CUT FLOWERS, TURF** 4.2
- **MUNGBEANS** 4
- **JAPAN** 3.5-4.5
- **SUNFLOWERS** 2-5

**Fact Sheet: Cotton and Water**
NUTRITION

Just like any living thing, cotton plants need “food” to grow well. It’s important to find the right balance of delivering nutrients to the plant at various stages of its growth, without overdoing it.

To do this, cotton growers need a sound knowledge about plant nutrient requirements and demands and an understanding about soils. Decisions about application of fertilisers are made with consideration of a large range of other factors including crop rotations, stubble management and irrigation practices.

Cotton growers develop a fertiliser program but before that can happen, a grower needs to:

- Determine soil nutrient status through soil sampling
- Calculate expected crop nutrient requirement
- Implement a fertiliser use plan considering – type, rate, application, frequency, timing
- Monitor crop nutrient status via leaf (and petiole) analysis
- Develop a long-term crop nutrition and soil health management plan

The main nutrients that a cotton crop requires are:

- Nitrogen
- Phosphorous
- Legumes
- Potassium
- Zinc
- Iron

The above information was extracted from the Australian Cotton Production Manual 2011-2012, CRDC.

CONTROLLING WEEDS

The cotton farm can be home to a wide range of weed species. Many of these weeds are native and were present before cotton was first grown in these areas. Many more weed species, however, are introduced and have successfully established on cotton farms.

Some of these weeds are of little importance, but most compete with cotton and are routinely controlled on cotton farms. Over 200 weed species are currently considered to be weeds of significance on cotton farms.

Weeds reduce the productivity of the cotton plants by competing for food (nutrients), water and sometimes light. If the weeds put too much pressure on the cotton plants, the quality and yield of the cotton is reduced.

Weeds may also provide a haven for pests and diseases, attracting them to the crop. During harvesting, weeds can choke up the machinery and contaminate the crop, and a contaminated crop means extra time spent in cleaning and processing and additional ginning costs to the growers. Weeds can also cause contamination of the cotton and discolouration of the cotton lint.

There are many different types of weeds found in cotton areas, and they vary between the regions. Some of the common ones are noogoora burr, nutgrass, anoda weed, sesbania and cowvine.

Growers spend a lot of time and effort controlling weeds, using several methods including:

- Cultivation – digging up weeds between the rows of cotton using a machine called a cultivator
- Herbicides – sprayed to kill weeds before planting and during the season
- Chipping – weeding by hand using a hoe-like tool, which is time consuming and labour intensive. This is a much less common practice in the modern cotton industry.

MANAGING DISEASES

Diseases affect the quality of the cotton lint as well as the productivity of the cotton plant. Different diseases attack different parts of the cotton plant — the leaves, stem, bolls and roots. Disease may even cause the plant to lose its flower buds and bolts, resulting in no cotton being produced at all.

Cotton can be affected by a range of diseases. The most serious ones in Australia are:

- **Bacterial Blight**, a bacterial disease that causes dark green angular spots on the underside of the leaf. It may also affect young developing bolls
- **Fusarium Wilt**, a common fungus that infects plants via the root system. It blocks the plant’s ability to take up water
- **Verticillium Wilt**, a common fungus that infects plants via the root system. It blocks the plant’s ability to take up water

There are three main ways to combat disease:

1. **Rotation and Fallow**

   Since diseases can build up in the soil when the same crop is grown year after year, crop rotation is a common method of prevention. Rotating or changing the crops in a field every few years means diseases don't get a chance to settle in, breaking their cycle. Growers may also let a field lay ‘fallow’. A fallow field is a field that is being rested, with no crops in it at all.

2. **Plant Breeding**

   Cotton scientists have also developed resistant or tolerant cotton varieties that are able to fend off certain diseases. By introducing these new stronger varieties growers can get rid of diseases without having to use other methods.

3. **Fungicides**

   A fungicide is a chemical that kills fungi. Most planting seed sold in Australia has been coated with a fungicide to protect it during its early days in the soil.

For all there is to know about the weeds that affect cotton production in Australia, WeedPak, developed by our very own researchers

A comprehensive summary of the diseases that affect cotton plants in Australia, as well as how to manage them.
HEALTHY COTTON CROPS ARE UNFORTUNATELY VERY ATTRACTIVE TO INSECTS THROUGHOUT THEIR WHOLE GROWING PERIOD. AS COTTON IS A LUSH GREEN AND BUSHY PLANT, MANY INSECTS LOVE TO ATTACK IT.

OVER 100 DIFFERENT TYPES OF PESTS ATTACK COTTON WHICH MAKES CROP PROTECTION AN IMPORTANT PART OF A COTTON GROWER’S JOB. IF THESE “BAD” BUGS ARE LEFT UNMANAGED, THE CROP IS BADLY DAMAGED AND MAJOR YIELD AND QUALITY LOSSES ARE THE RESULT.

The following are the main insects that affect cotton production, requiring control measures in most regions in most seasons:
- Heliothis caterpillar (Helicoverpa punctigera or Helicoverpa armigera)
- Green mirid (Creontiades dilutes)
- Two spotted mite (Tetranychus urticae)
- Cotton aphid (Aphis gossypii)
- Whitefly (Bemisia tabaci)

CONTROLLING INSECTS

The worst and most common cotton pest is the Heliothis. Heliothis caterpillars can attack the plant at any stage throughout the season. They feed on the tender growing points and can cause squares (flower buds) and young bolls to drop off the plant. They can also bore into large bolls and allow diseases to enter.

Combating insects
There are many methods used to control insects to ensure high yields and good quality cotton is produced. Using a combination of these methods is known as Integrated Pest Management (IPM), a widely recognised best practice in agricultural insect control.

Some of the methods used to control insect pests include:
- Encouraging beneficial insects into the crop, such as ladybirds, spiders, wasps and ants, to eat the pests
- Regular monitoring of insect populations and crop damage
- Use of transgenic cotton such as Bt cotton (Bollgard II) that is resistant to heliothis
- Alternating pesticides to reduce the chance of pesticide resistance
- Crop rotation to kill the Heliothis pupae living in the soil
- Ploughing the field after harvesting to destroy the Heliothis pupae (pupae busting)
- Biological sprays containing viruses or the naturally occurring soil bacterium Bacillus thuringiensis (Bt) that produces proteins toxic to heliothis
- Management of crops to promote early maturity
- Keeping non-crop areas free from weeds, volunteer cotton and other crops

A combination of all of these things has seen a reduction in insecticide use of 87% since 2003, with some cotton crops not sprayed at all these days. Pest control is a major focus of the cotton industry’s environmental program called myBMP, which sets out the latest research and best practice guidelines for controlling insects.

If there’s a pest or beneficial insect to be found in cotton, it’s in this Pests and Beneficials Guide developed by the Cotton Research and Development Corporation.
Once the cotton crop has matured and ripened, it is treated with a defoliant before it can be picked (or harvested).

When enough bolls have opened naturally, the cotton is tested to see if it is ready to be defoliated and picked by cutting open the bolls and looking to see if the seeds inside are fully formed. Defoliant is applied to the cotton plants to help the green leaves dry and fall off and to help any of the remaining unopened cotton bolls to open. The plant itself is not killed and the cotton can be picked cleanly without the leaves staining the lint. This practice enables the grower to hasten the opening of the cotton bolls which can then be picked in a short period of time. It is essential that the crop is harvested before weather and rain can damage or ruin its quality and reduce yield.

Once defoliated, the cotton crop is ready to be harvested.

Cotton picking usually occurs in February to March in Queensland and late March to April in NSW. Cotton picking was once done by hand (and still is in some developing countries) and was therefore a very labour intensive task. Today, it is carried out by large harvesting machines, but still requires significant labour during this busy time of the season. Cotton farmers sometimes own their own picking machinery, but can also use contract harvesters to pick their crop. Additional, casual labour is needed on the farm at this time of year and this is often hard to come by - cotton farmers often use seasonal workers and backpackers to help lighten the load.
**Two Picking Methods**

**Boll Buggies’ and Module Builders**

Traditional mechanised cotton pickers can harvest 2, 4, 6 or 8 rows at a time and cost approximately A$500,000 to buy new. The seed cotton is stripped from the bush with a series of rotating combs and then emptied into a tractor-drawn bin called a ‘boll buggy’. When the boll buggy bin is full it is emptied into a ‘module builder’. The module builder sits at one end of the cotton field and distributes and compresses the cotton to build a large freestanding stack or ‘module’ that contains about 13 tonnes of seed cotton. A module is 11-12m long, 2.5m wide and 2.5m high. The seed cotton in the module consists of lint (fibre) and seed. Modules are covered with plastic tarpaulins to prevent rain damage. They are transported to the gin on either specially designed trucks called chain beds or on normal flat bed trucks where they are stored until they can be ginned (or processed).

**Round Bale Pickers**

The newest cotton picking technology is an all-in-one machine designed to provide a cotton picker with the ability to build modules while harvesting the crop. These modules are round rather than rectangular and are built and left at intervals all over the cotton field. The round module picker can pick the cotton, compress it into a round module, wrap it in plastic and sit it on the field in a much shorter timeframe than traditional pickers – and using far less labour.

The round module pickers cost approximately A$750,000 to buy new and over 80% of the Australian cotton crop is now picked with this method.

The ins and outs of cotton production from planning to in-season agronomy and getting the crop to market is in the Cotton Production Manual.

The myBMP website is the cotton industry’s portal for best practice information in all aspects of cotton production. There’s even an educators login!
CHAPTER 6
The Business of Cotton Farming
THE NATURE OF A COTTON FARM BUSINESS

All cotton farm businesses are different. There are large corporate farms, small family farms, publicly listed cotton agri-businesses and a mix of everything in between.

What we do know is that the average Australian cotton farm:
- Is family owned and operated
- Provides jobs for eight people
- Grows 467 hectares of cotton
- Is run by experienced farmers with an average age of 39
- Grows other crops and often grazes sheep and cattle

GOALS OF A COTTON FARM BUSINESS

Because in most cases a cotton farm is not just a cotton farm but grows other crops and often grazes sheep, beef or other livestock, the goals of a cotton enterprise vary from farm to farm.
- To grow high yielding cotton crops (so that there’s more cotton to sell at the end of the season)
- To grow high quality cotton crops (to attract premium prices on the world market)
- To maximise profits across the farm operation
- To keep operating costs to a minimum
- To run an efficient operation
- To ensure a safe working environment for staff and contractors
- To minimise impacts on the natural environment

Most Australian farms are family owned and operated.
STAKEHOLDERS IN A COTTON FARM BUSINESS

- FAMILY
- WORKERS (FULL-TIME AND PART-TIME)
- CONTRACTORS (FOR EXAMPLE SUPPLY PICKING, AERIAL WORK, TRANSPORT COMPANIES AND AGRONOMY SERVICES)
- FINANCIAL INSTITUTIONS (BANKS, FINANCIERS)
- ACCOUNTANTS
- LAWYERS
- COTTON MARKETING ORGANISATIONS
- GINNING COMPANIES
- RURAL SUPPLY COMPANIES (EG SEED, FERTILISER, MACHINERY, FUEL)
- GOVERNMENTS THAT REGULATE THE BUSINESS OF FARMING
- INTERNATIONAL CUSTOMERS (EG SPINNING MILLS, CONSUMERS)

COTTON GROWERS HAVE A LOT ON THEIR MIND!

- Workplace health and safety
- Weeds and Diseases
- Equipment maintenance and upgrades
- Pests, weeds and diseases
- Cotton industry commitments
- Access to education
- Training
- New varieties
- Sustainability
- Crop selection and rotation
- Scheduling irrigations
- Transporting the crop
- Ginning contracts
- Commodity markets
- Yields
- Profitability
- Weather
- High quality crops
- Government Regulations
- Energy costs
- Consumer Demand
- Drought, floods
- Succession planning
- Health and mental health
- Finding workers
- Interest rates and finance
- Insurance
- myBMP
- Time for family
ORGANISATIONAL STRUCTURE

While every farm is different, the following charts gives an indication of the types of structures typical in a family owned and operated Australian cotton farm (this forms most of the industry) and also a corporate farm.

FAMILY FARM STRUCTURE

- **Farm Owners** (Farm Work and Office Admin)
- **Right-Hand Person/Manager**
- **Hands-on Farmers**
- **Casuals**

**Industry Interaction**
- Research updates
- Field day/farm walks
- Conferences/workshops
- Cotton Grower Association
- Training

**Service/Product Providers**
- Chemicals
- Fuel
- Banking
- Technologies
- Agriculture hardware
- Contract harvesting
- Aerial application
- Earthmoving
- Surveying

**Consultant/Argonomist**
- Insect monitoring
- Irrigation scheduling
- Plant mapping
- R, D + E

**Merchants**
- Marketing
- Ginning

**Farming duties:** GPS, irrigation, planting, cultivating, payroll, budgeting, plant operation, workshop, accounts, chemical application, OHS/WHS, human resource management, infrastructure repair and maintainance (channels, gates, roads, pumps etc.)

EXAMPLE OF CORPORATE FARM STRUCTURE

- **Board**
- **Human Resources**
- **CEO**
- **Finance**
- **Regional Manager**
- **Farm Manager**
- **Workshop Manager**
- **Livestock Manager**
- **Agro-nomists**
- **Farm Hands**
- **Irrigators**
- **Seasonal Workers**
- **Farm Admin Manager**
- **Mechanics**
- **Welders**
- **Fitters**
- **Spare Parts**
- **Trainee Agronomist**
- **Bug Checkers**
- **Secretary**
- **Accountant**
- **Trainee/Apprentice**

FACTORS TO CONSIDER WHEN GROWING A COTTON CROP

Cotton is a difficult crop to grow well and requires experienced farmers who pay lots of attention during the season. Cotton growers need to take into consideration a large range of factors to get high yielding, high quality cotton that is water efficient and can be sold for a top price. They must be great planners, innovators, managers and decision makers.

Considerations include:
- Government regulations
- Weather
- Sustainability
- Increased input costs
- High quality crops
- Occupational health and safety
- Weeds and diseases
- Business management
- Succession planning
- Technology upgrades
- Pest control
- Managing contractors
- Marketing
- Yields
- Consumer demand
- Disease control
- Farm labour
- Ginning contracts
- Training
- Equipment maintenance and upgrades
- Farm hygiene
- Time for family
- Community
- Transporting the crop
- Interest rates
- Crop selection and rotation
- Commodity markets
- New varieties
- Health and mental health
- Energy costs
- Climate change
- Finance
- Insurance
- Access to rural doctors
- Access to education
- Drought, floods
THE MAIN BUSINESS FUNCTIONS OF A COTTON FARM

<table>
<thead>
<tr>
<th>FUNCTION</th>
<th>FACTORS TO CONSIDER</th>
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| **SETTING UP THE FARM FOR COTTON PRODUCTION** | • Costs associated with irrigation infrastructure, laser levelling of fields etc  
• Commitment to cotton production – it’s a difficult crop to grow and the farmer must be equipped with knowledge and know-how in order to make it work from a business perspective |
| **FINANCING YOUR CROP** | • Relative to other summer crops, the costs of growing cotton is higher  
• Farm budgeting is essential  
• Finance must be arranged with banks/lending organisations or arrange for crop credit well prior to planting (before ordering seed)  
• Hail presents a significant risk to summer crop production including cotton. This may affect the financial position in relation to growing costs and marketing positions. It is important that hail insurance coverage is discussed with an experience broker in cotton insurance |
| **OPERATIONS** | • The cost of production  
• Inputs and outputs  
• All of these must be carefully budgeted and planned for |
| **HUMAN RESOURCES** | • Attracting and retaining staff  
• Engagement and conditions of employment and management  
• Training  
• Safety  
• Working with contractors  
• Relationships with neighbours |
| **SELLING THE CROP/MARKETING** | • Cotton has unique marketing parameters based around fibre quality  
• Premium and discount sheets should be discussed with an experienced cotton merchant/marketer  
• Current state of the world market for cotton (supply and demand)  
• Current world prices  
• Forward-selling of cotton crops can occur before crops are sown, up to three years in advance - this needs to be planned for |

HUMAN RESOURCE MANAGEMENT

The Australian agriculture sector is currently experiencing a labour and skills shortage, driven by an aging workforce, low attraction rates and strong competition from the resource sector. This is being felt in the cotton industry, which is facing the challenge of attracting and retaining core staff, on-farm labour (unskilled and skilled), and access to professional advisers and service providers.

The problem has recently been driven by rapid expansion of the industry following years of drought, and the resources boom in some regions. Other factors such as poor public perception/image of rural towns, lifestyle and work are also thought to contribute to the problem.

Given the current skills and labour shortages, many growers are relying on overseas workers to fill gaps. Overseas workers have played a small but important part in the Australian agricultural industry for quite some time, helping farmers at peak times when local labour is difficult to access.

Whilst skilled migration can deliver labour for emerging shortages in short time frames, it can only complement Australia’s domestic training arrangements which must deliver the backbone of Australia’s skilled labour needs. For the cotton industry, a commitment to our local workforce and communities remains a priority.

Cotton growers attract employees using a range of tools including word-of-mouth, employing school students as schools based trainees, using recruitment specialised labour hire companies and internet sites such as gumtree.com.au or head-hunting promising employees. They use a range of strategies to retain staff which may include attractive salary packages, training, flexible working arrangements, mentoring, opportunities to have a stake in the business and/or promotion.

The cotton industry’s labour force is critical to sustaining the industry’s competitive advantage. Innovative, resilient and adaptive people, businesses and communities are crucial to the future success of the industry and needs to be supported by processes for attracting, retaining and developing people.

The cotton industry’s labour force takes into account on-farm labour, as well as the service industry and supply chain, which represent an extensive network of input and advisory providers that support cotton farmers such as agronomists, researchers, consultants, agribusiness, State government agencies, Cotton Australia, CSIRO, and universities. The dynamics of the industry’s labour varies depending on factors such as season, location and business size.
Cost of production is a very important factor in making a cotton farm business profitable. Cotton growers work hard to minimise their costs of production in order to maximise profits. Unfortunately, the cost of production is continually on the rise and this, coupled with the fact that Australian cotton growers pay premium prices for inputs (due to geographic isolation) means that growers need to always be looking for ways of becoming more efficient. Rising costs of production is a major issue facing Australia’s cotton growers.

Below are a series of graphs illustrating the rising costs of production for Australia’s cotton growers.
To manage costs of production, cotton growers develop detailed farm budgets that detail operating costs and expected profits. These are based on experience and historical data, local information as well as information provided by the cotton industry and government departments. Costs vary year to year and even season to season, so these budgets need to be updated regularly to make sure everything is on track for a profitable season.

The graphs on this page show some data relating to operating costs and profits for an average Australian cotton farm. Please note however that numbers vary widely from farm to farm.
MARKETING

Australian raw cotton is marketed under a competitive market system with several major international and local cotton merchants operating in the Australian market. Cotton growers have a range of options for the delivery, processing and sale of their cotton, including:

- Sell directly to a merchant or ginner (also known as a processor). The grower sells the cotton before it has been processed. The merchant or ginner then sells and ships the seed and lint separately.
- Deliver to a ginner who retains the cottonseed, with the grower receiving the lint to be sold separately via international markets.
- Grower retains ownership of both cottonseed and lint and, after paying a processing fee, sells both cottonseed and lint independently.

PRICE OPTIONS

A number of factors can influence the price of cotton. These include the amount of cotton available for purchase (i.e. how much cotton growers supply to the market) and the quantity of cotton that processors need or wish to purchase (i.e. the amount they demand). The price is also dependent on the futures price on the New York Stock Exchange and the exchange rate of the US dollar.

Farmers can choose to sell their cotton lint in a number of ways:

1. **Cash market** — The price of cotton on world markets fluctuates daily. When growers have cotton ready for sale, they can sell it at the daily or ‘spot’ price.
2. **Forward contract** — Using the cash market involves a certain amount of price risk, i.e. that the spot price will fall when the grower is ready to sell. To help insure against this risk, the grower can negotiate a forward contract with a buyer. This agreement sets out the price, quantity and quality of cotton the grower has to deliver on a specified future date. Therefore, the grower can know how much the crop can be sold for even before it has been planted.
3. **Seasonal pool** — Growers commit a certain proportion of their cotton production to a pool of cotton. An agent is responsible for selling the cotton in the pool on behalf of all the growers. The price received by the growers for their cotton is the average of all sales made from that pool in that season.
4. **Minimum price pool** — ensures that the farmer gets at least the seasonal pool price. If the prices go higher growers receive higher fees.
5. **Call pool** — farmers must promise an amount of cotton for the pool but this cotton can be traded using ‘futures’ and ‘options’ methods of sale, where amounts traded are simply written down as potential sale orders on paper.
6. **Balance of crop** — bales not sold using any of the above methods are sold at an agreed price.

COTTONSEED MARKETING

Cottonseed is marketed differently to the fibre. Growers have two options when selling their seed:

1. They may sell it to a company that has a ‘seed pool’ (a stockpile of seed purchased from a number of different growers). This type of company either sells the seed as stock feed, or crushes it to make oil.
2. Growers can sell their seed to small private traders who on-sell the seed here in Australia or overseas.

Some growers grow a portion of their crop purely for planting seed — the seed used to plant future crops. Planting seed is specially grown under contract to seed companies. The emphasis is on producing healthy, high quality seed rather than lint. Growers must ensure that there is no contamination by weeds or cross breeding with other varieties of cotton. These crops are picked and ginned separately to maintain purity in the different varieties.

PROFITABILITY

For the cotton farm to be profitable the grower needs to maintain high yields and minimise costs. That means farming carefully by constantly monitoring water needs and use, pest numbers and such things as soil quality. It also means developing and implementing good marketing strategies for selling cotton into the world market. For irrigated cotton the availability and cost of water is one of the key factors influencing profitability.

WORLD PRICES

World prices for cotton fluctuate daily according to world demand and supply and can vary from season to season between approximately $350 and $600 per bale for Australian cotton.

AUD BALE PRICE – AVERAGE ANNUAL

Fact Sheet: The Economics of Cotton in Australia
CHAPTER 7
Processing: from Gin to Fabric
Cotton gins are factories that complete the first stage of processing cotton – separating the lint from the seed. Gin is short for en-“gin”. In Australia gins are located in cotton areas to avoid costly transport.

Before the gin was invented, the lint and seed were separated by hand. It took one person a whole day to separate only half a kilo of the lint from the cottonseed. Modern gins can separate and bale about 230,000 kilograms of cotton in one day.

THE GINNING PROCESS

The seed cotton arrives at the gin in round bales or modules. The first step in the ginning process is where the cotton is vacuumed into tubes that carry it to a dryer. Cotton must be ginned with a moisture level of 5%. The cotton is dried out if it is too wet or water is added if it is too dry to ensure the correct moisture level. Next, the cotton goes through several stages of cleaning equipment to remove leaf trash, sticks, dirt and other foreign matter.

After cleaning, the cotton is then ready for separation in the gin stand. The gin stand removes the seed from the lint. In Australia, most cotton is ginned with saw gins where fast moving circular saws grip the fibres and pull them through narrow slots.

The raw fibre, now called lint, has any remaining trash removed and makes its way through another series of pipes to a press where it is squashed into bales under very high pressure. Each bale weighs 227kg. Samples are taken from each bale for classing and the bales are wrapped in stretchy white cotton fabric to protect the lint. They are now ready for transport to one of the ports for shipping into overseas markets.
THE SEEDS MAKE UP ABOUT 55% OF THE SEED COTTON WEIGHT THAT COMES FROM THE FARMS. THEY ARE VERY VALUABLE AND ARE USED FOR A VARIETY OF PRODUCTS SUCH AS OIL, PLASTICS, STOCK FEED, COSMETICS AND MARGARINE. THEY MIGHT ALSO BE USED AS SEEDS FOR THE NEXT COTTON CROP.

 PRODUCTS FROM GINNING
WHEN THE SEED COTTON IS PROCESSED IN THE GIN, THREE PRODUCTS RESULT — COTTONSEED, LINT AND TRASH.

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LINT
LINT MAKES UP APPROXIMATELY 35% OF THE SEED COTTON WEIGHT. ONCE THE LINT HAS BEEN SEPARATED IT IS COMPACTED INTO BALES FOR EASY TRANSPORTING. THE COTTON BALES ARE THEN MOSTLY TRANSPORTED DIRECTLY TO AUSTRALIAN PORTS FOR EXPORT TO OTHER COUNTRIES TO FURTHER PROCESS (SPIN) THE COTTON.

TRASH
THE REMAINING 10% OF THE SEED COTTON IS CLASSED AS WASTE PRODUCT OR TRASH. COTTON FIBRE WASTE CAN BE USED IN ETHANOL MANUFACTURING OR IN PRODUCTS THAT CLEAN UP OIL SPILLS. IT CAN ALSO BE USED AS A FERTILISER.
TRADITIONAL CLASSING METHOD

The more traditional method of testing cotton quality involves using specially trained ‘classers’ who manually examine the cotton fibres. This testing involves the classer taking a sample from each bale of cotton and assessing it by:

- Colour (bright or dull, white or grey)
- Trash content (the amount of stalk, leaf or dirt)
- Character (whether the sample has a smooth or lumpy appearance)
- Staple (length of fibre)
- Strength of the fibres

Manual classers still largely determine the leaf, extraneous matter and preparation grades of cotton.

CLASSING

AFTER THE COTTON IS GINNED, A SAMPLE IS TAKEN FROM EACH BALE AND SENT AWAY TO CLASSING ROOMS TO HAVE IT GRADED FOR ITS QUALITY. THE COTTON FIBRE IS SORTED INTO DIFFERENT QUALITY-BASED GRADES (OR CLASSES). THE HIGHER THE CLASS, THE BETTER THE QUALITY OF THE COTTON FIBRE, AND THE HIGHER THE PRICE THAT WILL BE PAID.

PROCESSING COTTONSEED

Cottonseed is separated from the lint during the ginning process. Before the seed can be crushed for oil extraction or used for planting future crops, it must be delinted. This means removing any excess lint still attached to the seed. These final short fibres (linters) are used to make many industrial and domestic products.

After the linters are removed, the hull (the hard shell covering the seed) is removed. Inside the hull is the kernel – the really valuable part of the seed. To produce oil, the kernels are flattened using rollers and then cooked at very high temperatures.

The kernels are squeezed and crushed and the oil flows out. This oil is then processed and refined further, turning it into a light yellow, tasteless, odourless oil. Cottonseed oil is used in the manufacture of products such as vegetable oil, margarine, soap and cosmetics.

The excess hulls and leftover kernels can be used to feed animals such as pigs, cattle and poultry.

COTTONSEED VERSUS OTHER OILSEEDS

World Oilseeds Production

source: USDA

Million of tons

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MODERN CLASSING METHOD - HVI TESTING

High Volume Instrument (HVI) testing is a machine-based method that can quickly and accurately check the quality and exact value of cotton fibres. The technique originated in the USA and Australian companies have also contributed to the world’s knowledge about HVI testing.

An HVI test print-out includes information relating to the following areas:

- Colour grade (relating to any visible impurities and the degree of whiteness)
- Length (the price of cotton is roughly proportional to staple length. Australian crops typically produce 28mm (1.15 inch) staple if irrigated, but shorter from a dryland crop).
- Micronaire (the fineness of the cotton that affects how quickly it can be spun)
- Trash and dust (the number of trash and dust particles that are in the cotton)
- Strength (if the cotton is stronger it can be used in smaller quantities)
- Length (fibre length)

At the end of the classing process each 227kg bale of cotton carries a classing description. This grade will decide whether the cotton is sold for a higher or lower price, known as premium or discount.

Grading categories are set in each individual country and are revised and updated, usually on an annual basis. In Australia, the classing grades are determined by the Australian Cotton Shippers Association.

Australia has an enviable reputation on the world market as a reliable supplier of very high quality cotton, and can command a premium price for this reason. A recent study found new varieties from CSIRO’s cotton plant breeding program had improved yield, HVI quality and are showing superior textile performance attributes.
**SHIPPING THE COTTON TO MARKET**

Once the cotton is ginned and pressed into bales it is loaded on to trucks and trains and sent to port for shipping, mostly to overseas markets. Over 99% of Australia’s cotton is sent overseas, with only a very small spinning industry left in Australia – it’s almost non-existent.

The main ports for Australian cotton are in Brisbane and Sydney. The cotton bales are warehoused, and once they’re sold and ready to be shipped are loaded into large shipping containers.

The main customers for Australian cotton are spinning mills located in south east Asia - China is Australia’s largest buyer of cotton.

**SPINNING TO PRODUCE YARN**

Historically, cotton was spun by hand using spinning wheels - this practice is no longer used to produce commercial quantities of cotton yarns, but the method is still practiced as an artisan craft by some.

Cotton arrives at a spinning mill in bales. Most often these mills process a range of different types of fibres including cotton and man-made fibres including polyester and nylon.

At the textile mill, the cotton is put through a number of processes, depending on the setup in the spinning mill and the desired quality of the yarn to be produced.

1. **OPENING, BLENDING AND CLEANING**
   
   The bales are laid down in a row (called a laydown), opened and blended through a range of machines. This ensures a consistent blend of fibres. The blended fibre is then put through more machines to loosen the fibre tufts and to remove leaf, sticks, boll parts, bark and seed fragments.

2. **CARDING**
   
   Next, the fibre is fed into a carding machine which is often referred to as “the heart of the spinning mill.” The carding machine individualises, aligns and further cleans the fibres before pulling them into a single, continuous, loose rope called sliver.
DRAWING
Drawing is the process where the fibres are blended, straightened and the number of fibres reduced to achieve a desired density. It also improves the evenness of the sliver.

COMBINING
This process removes any final waste from the cotton and makes it finer, stronger, smoother and more uniform compared to carded yarns. Combed yarns are also more expensive than carded yarns because there’s an extra processing step and there’s more waste.

ROVING
In preparation for ring spinning, the sliver is condensed into a finer strand known as a roving, before it can be spun into yarn. The roving frame draws out the sliver to a thickness of a few millimetres and inserts a small amount of twist to keep the fibres together. This is then wound on to a bobbin in readiness for spinning yarn.

SPINNING
There are three main spinning systems used commercially to produce cotton:

RING SPINNING
Ring spinning was perfected as a process by the end of the 19th Century. There are currently 213 million ring spindles installed worldwide that account for about 80% of all short-staple yarn production.

Ring spinning draws out the roving and inserts a twist into the fibres by a rotating spindle and winding the yarn onto a bobbin simultaneously. It’s a comparatively expensive process due to slower production speeds and additional processes.

ROTOR SPINNING
(also known as open-end spinning)
This was introduced in the mid-1960s. Today, there are over 9 million rotors installed worldwide which account for about 30% of short-staple yarn production.

Silver is fed into the machine and combed and individualised by the opening roller. The fibres are then deposited into the rotor where air current and centrifugal force deposits them along the groove of the rotor where they are evenly distributed. The fibres are twisted together by the spinning action of the rotor, and the yarn is continuously drawn from the centre of the rotor. The resultant yarn is cleared of any defects and wound onto packages.
AIR-JET SPINNING

This was developed in the 1960s but was not commercially successful until the 1980s. There are currently about 500,000 airjet spinners installed world-wide.

Sliver is fed into the machine and is further drawn out to the final count and twist is inserted by means of a rotating vortex of high pressured air. The resultant yarn is cleared of any defects and wound onto packages ready for use in fabric formation.

(These spinning processes are summarised from the FIBREpak, a guide to improving Australian Cotton Fibre Quality)

Figure 1, 2 and 3 – courtesy of short Staple Manufacturing, McCreight, Feil, Bosterbaugh and Backe and FIBREpak

MANUFACTURING FABRICS

AFTER THE COTTON LINT HAS BEEN SPUN INTO YARN IT IS THEN WOVEN OR KNITTED INTO FABRIC.

Woven Fabrics

Weaving is the oldest method of making yarn into fabric. While modern methods are more complex and much faster, the basic principle of interlacing yarns remains unchanged.

Weaving is done on a machine called a loom. Before the weaving can start, the loom needs to be set up with warp yarn. Warp yarn runs up and down the loom. Weft yarn is then woven (or sewn) over and under the warps from side to side. A torpedo-like implement at very high speeds does the weaving and can produce an almost endless variety of fabrics. Some of these machines carry the yarns across the loom at rates in excess of 2,000 meters per minute! The resulting fabric is particularly strong.

There are three basic weaves with numerous variations, and cotton can be used in all of them. The plain weave, in which the filling is alternately passed over one warp yarn and under the next, is used for gingham, percales, chambray, batistes and many other fabrics.

The twill weave, in which the yarns are interlaced to form diagonal ridges across the fabric, is used for sturdy fabrics like denim, gabardine, herringbone and ticking.

The satin weave, the least common of the three, produces a smooth fabric with high sheen. Used for cotton sateen, it is produced with fewer yarn interlacings and with either the warp or filling yarns dominating the “face” of the cloth.
**MOST FABRICS ARE FINISHED TO MAKE THEM LOOK AND FEEL MORE ATTRACTIVE. THIS IS THE FINAL STEP IN THE MANUFACTURING PROCESS.**

**KNITTED FABRICS**

Knitting fabric from cotton yarn is a simpler process than weaving. Knitting involves forming loops with one or more single continuous yarns and joining each loop to its neighbours to form a fabric that's stretchy, like t-shirt material.

Lengthwise rows of loops, comparable to the warp yarn in woven goods, are called wales. Crosswise rows, comparable to filling yarns, are known as courses.

Most cotton is knit on circular machines which have needles fixed to the rim of a rotating cylinder. As the cylinder turns, the needles work their way from stitch to stitch producing a tubular fabric.

Depending on the width of fabric desired, a modern knitting machine might use over 2,500 needles. The number of needles varies according to the type of machine used and the fabrics produced.

The flat knitting machine is another basic type. Designed with a flat bed, it has dozens of needles arranged in a straight line and produces a knit fabric that is flat, similar to woven fabric. A flat knitting machine makes over one million stitches a minute, and can be set to drop or add stitches automatically in order to narrow or widen the fabric at certain points to conform to specific shapes. Knitting machines can be programmed to produce a wide variety of fabrics and shapes.

**FABRIC FINISHING**

Most fabrics are finished to make them look and feel more attractive. This is the final step in the manufacturing process.

Cotton fabrics, as they come from the loom in their rough, unfinished stages, are known as greige goods. Most undergo various finishing processes to meet specific end-use requirements.

Some mills, in addition to spinning and weaving, also dye or print their fabrics and finish them. Others sell greige goods to converters who have the cloth finished in independent plants.

Cotton finishing processes are numerous and complex, reflecting today's tremendous range and combination of colours, textures and special qualities. In its simplest form, finishing includes cleaning and preparing the cloth, dyeing or printing it and then treating it to enhance performance characteristics.

There are literally hundreds of ways to finish off cotton fabrics to change its look and feel. More than one finish can be applied to a single cotton fabric and there are more innovations introduced all the time.

Some examples of cotton finishes include:

- **SCOURING** this process removes microdust
- **BLEACHING** this produces an off-white colour
- **GASSING** this produces a smooth finish to the fabric
- **STENTERING** this prevents the shrinkage and wrinkling of knitted or woven fabrics
- **SANFORISING** this prevents the shrinkage of woven fabrics
- **CALENDERING** fabric is given a final press to produce different effects
- **DYEING** colour can be added to the yarn or the fabric. Fabric can also be printed to apply colours and patterns
- **PERMANENT PRESS** this finish prevents the need for frequent ironing
- **WATER REPELLENCY** this finish ensures water is repelled not absorbed
- **FIRE RETARDANT** finishes such as cotton proban
GENERAL STEPS IN MANUFACTURING COTTON TEXTILE GOODS

- Raw Cotton
- Fibre Preparation
- Spinning
- Yarn Formation
- Warping
- Sizing
- Weaving
- Knitting
- Fabric Formation
- Preparation
- Dyeing
- Finishing
- Wet Processing
- Cutting
- Fabrication
- Sewing
- Finished Goods

Cotton is the world’s most widely used natural fibre and still the undisputed “king” of the global textiles industry.

This is textile dyeing machinery, one of the many finishes that can be applied to cotton.

Fact Sheet: Processing, Exporting and Marketing Australian Cotton

FIBREpak: A guide to improving Australian Cotton Fibre Quality

Photo by Hayley Cacciamiga
CASE STUDY: THE STORY OF DENIM

A BRIEF HISTORY OF DENIM

Denim was first made in the 16th Century at a place called Nimes in France. The name ‘denim’ comes from the French words ‘serge de Nimes’ (fabric of Nimes). Indian sailors were wearing a similar fabric at about the same time. It is also said that Columbus was using denim sails when he first discovered America.

For a few hundred years denim was mainly used as durable work clothing. Around the 1940s denim started to be used in different clothing forms such as wet weather gear and sports clothes. It was not until the 1970s that denim started to become fashionable, particularly with American youth.

JEANS

During the Gold Rush of the 1850s in the USA, a man called Levi Strauss, unsuccessful at finding his own gold, became rich by making denim pants for more successful miners. This is where the name Levi comes from.

Jeans however, were around a long time before Levi Strauss made his denim pants on the American Gold Fields. Jeans, like denim itself, go back to the 16th Century (about 400 years or so) when Italian sailors at the Port of Genoa wore denim trousers with a particular cut. The word ‘jeans’ comes from ‘Genes’, the French word for Genoa. Indian fishermen and sailors were wearing similar trousers called dungarees. Jeans were called “waist overalls” or “overoverall” before 1860 when Levi Strauss changed it to its popular name of “jeans”.

The original jeans were a natural pale stone colour and not indigo (blue). Eventually the leaves of the Indigo fera plant were used to dye the fabric a deep blue.

While styles have changed dramatically jeans have shown remarkable resilience and over the years has become an expression of popular culture. In the 1960s flares, painted, stone-washed and marbled jeans were the rage. By the 1980s, stretch jeans, skin-tight jeans and later designer jeans were fashionable. In the 90s ripped and aged jeans were commanding a premium. Today styles and prices vary with one company in Japan charging around $2000 per pair!

Jeans have, over the years had to compete with trousers made with other fibres including lycra, teflon, nylon and corduroy with cargo pants providing the greatest challenge of recent times. However, despite this the dominance of denim has persisted for more than half a century and today 62% of all consumers say they love jeans.

Both jeans and denim continue to evolve as textile technologists develop new finishes and treatments. One such example is STORM DENIM™, a product that is a water-repellent while not inhibiting cotton’s natural ability to breathe.

Cool denim facts

• One bale of cotton can make 266 pairs of denim jeans
• There exists 0.27 pairs of jeans for every man, woman and child on earth
• One denim manufacturer says it takes 17 minutes to make a pair of jeans
• Jeans could be found in some form in the middle ages
ONE BALE OF COTTON CAN MAKE 266 PAIRS OF DENIM JEANS

The making of weSC Denim Jeans – cutting, sewing, stitching and manual treatment

Momatoro Jeans Japan

Case Study: Storm Denim Technology, new ways with denim
CHAPTER 8
Cotton as a Competitive Commodity
COTTON’S SHARE OF THE WORLD FIBRE MARKET

Cotton is the biggest selling natural fibre in the world, accounting for around 32% of the world fibre market compared to wool at just less than 4%. Over the past 30 years natural fibres have lost market share to synthetic fibres. Between 2005 and 2009 cotton’s share in fibre production worldwide fell from 35.7% to 31.7%.

Despite cotton’s fall in the share of the world fibre market, consumption of cotton is increasing overall due to increases in population growth.

The main cotton producing countries in the world are China, India, USA, Pakistan, Brazil and Uzbekistan. These countries account for nearly 80% of world production.

Australia is a relatively small producer, but is the fourth largest exporter in the world cotton marketplace, behind USA, India and Uzbekistan. China, Brazil and India process almost all their cotton locally.

China is the world’s largest cotton producer AND the world’s largest consumer of fibre, with a share of around 25% of global cotton production in 2009/10.
Cotton has a number of competitors on the world market, synthetic fibres being the main one. Synthetic fibres are man-made fibres made from polymers produced artificially, in contrast to natural fibres made from naturally occurring polymers such as cellulose (from plants) and proteins (from animals). Synthetic polymers come from petroleum for example coal or oil.

Cotton’s share of the world fibre market is falling. In the 1960s 70% of fibre consumed was cotton. Since then cotton’s percentage market share has dropped continuously while man-made fibre consumption has risen.

A number of strategies are used globally, nationally and locally to position Australian cotton against its competitors including:

- Joining with other countries to position cotton globally through the International Forum for Cotton Promotion and
- Branding compliant Australian Cotton as BMP (Best Management Practices) cotton to appeal to the buyers demanding environmental accountability, traceability and transparency.

The International Forum for Cotton Promotion (IFCP) exists to help encourage increased consumer demand for cotton and promote cotton’s qualities and sustainability attributes. Cotton Australia, government departments and industry bodies from other countries participate. IFCP members are committed to a unified approach to promoting generic cotton to appeal to the consumer and their love of cotton and compete against man-made fibre industries who are increasingly promoting their products claiming misleading environmental credentials.

IFCP supports all cottons and opposes dissemination of exaggerated and misleading information by those attempting to secure competitive advantage at the cost of other cottons. Speaking with one voice, at a consumer level, about the positive aspects of cotton and its end use (comfort, softness, durability, versatility and value) as well as the industry’s environmental, economic and social benefits is key to this.
POSITIONING AUSTRALIAN COTTON IN THE WORLD MARKET

One of the ways that the cotton industry is able to differentiate Australian cotton from those of other countries is on its documented environmental credentials. While the Best Management Practices Program (myBMP) allows the cotton industry to monitor and improve its performance, it is also a powerful marketing tool.

A small but influential segment of the consumer market are demanding greater traceability, environmental accountability and ethical labour standards across the supply chain. Marks and Spencer, one of the United Kingdom's largest retailers, for example, has committed to becoming the world's first sustainable major retailer by 2015 by which time, only clothing that can traced and proven to be produced to a certain environmental standard will be stocked in their stores. Australian BMP cotton is positioned to meet this consumer demand.

Each and every bale of Australian BMP cotton that is shipped is verified and sanctioned as being produced on a BMP accredited farm that is practicing the highest levels of cotton production in terms of sustainability, safety and quality.

The traceability system that the Australian cotton industry has in place means that a brand owner can verify and trace an article of clothing from apparel manufacture, knitting or weaving, spinning, ginning, right back to the farm and even the field where that cotton was grown in Australia.

At farm level each module or round bale is marked with appropriate growing information (such as variety, farm and field etc.) Once the module is ginned, this information is transferred to bale tag identification and the data can be verified throughout the ginning, classing and shipping process.

Once a BMP shipment has been authenticated by Cotton Australia, a BMP certificate is issued with the shipment so the receiver can be sure it comes from a fully accredited farm.

Manufacturers in the textile supply chain must be registered and licenced with Cotton Australia to use the BMP Cotton Mark or BMP Cotton Blend Mark on their products.

The Australian BMP Cotton trademark is not transferable. This allows all products that use the trademark to be identified, verified and the quality and integrity of the product (both finished and unfinished) to be safeguarded.

Many companies find the Australian BMP Cotton license to be a valuable marketing tool in approaching manufacturers, brands and retailers for business. Once approved by Cotton Australia, customers buying qualifying product from supply chain licensees can become licensees with the right to use the trademark to promote their own Australian BMP Cotton products.

MARKETING CASE STUDY – DRI.GLO TOWELS: ICONIC BRAND WARMS TO AN AUSSIE-GROWN STORY

Australian Weaving Mills’ (AWM) Dri-Glo towel range is one of Australia’s iconic homewear brands. AWM has been in Australia since 1930 and is the only company to manufacture towels in Australia.

AWM recently rediscovered the magic of local manufacture and the great story of Australian cotton production producing the first batch of 100 percent Australian premium cotton towels made from the premium variety Sicala 350B and grown using Best Management Practices at St George, Queensland.

The range was initially pitched to retailers where the response was ‘fantastic’ according to AWM Marketing Manager Bronwyn Morgan. She says the company hopes to bring its ‘Australian Made’ story up to a new level, by adding the ‘Australian-grown’ tag as well.

Traceability is a concept that is becoming more important in today’s market place and AWM’s market research shows this.

“Consumers want to trust a product and if you can show your product has real honesty – like the iconic Dri-Glo brand does – we’re not about to put something into our product our consumers can’t trust,” she explains.

“Being able to honestly feature Glenn Rogan in our campaign consolidates the ‘grass roots’ angle of the products and is a real story to tell that we feel Australians can relate to.”

“They will know what this product ‘honestly’ is – that is where this traceability we now have is important,” Bronwyn said.
Some clothing and other products are labeled as containing organic cotton. The economic, social and environmental conditions in Australia are such that there is practically no organic cotton grown in the country. In fact organic cotton accounts for only 0.2 percent of the entire world’s cotton production. That is to say all of the cotton labelled as organic by the various certification authorities could fit on two average sized cargo ships a year.

The bulk of organic cotton production comes from Zambia, Zimbabwe and countries in the Middle East and South East Asia, where certification standards can be poor.

Organic cotton is cotton certified organic by bodies in individual countries. Standards vary greatly between countries with some retailers like Patagonia setting up their own systems outside nationally certified registers. The onus is on the consumer to check claims by first verifying the country in which the cotton was grown and then the certification standards of that country. To add an additional layer of complexity, to produce ‘organic cotton textiles’, certified organic cotton should be manufactured according to organic fibre processing guidelines which again, change according to the country in which the clothing is manufactured.

This leaves the system open to interpretation. In fact there is speculation that some cotton marketed as organic may not be considered as such by a commonly agreed set of criteria.

Although the definition is contested, organic cotton may be defined as cotton that is grown without the use of any synthetically compounded chemicals (ie, pesticides, fertilisers, defoliants, etc.) and is grown from non transgenic cotton seed. Generally certified organic cotton can only use naturally occurring chemicals such as Bt sprays, rotenone and naturally occurring pyrethroids to control pests and organic acid-based foliar sprays (eg, citric acid) as well as nitrogen and zinc sulphate in harvest preparation.

Organic is not necessarily sustainable though it’s often marketed as such. Organic cotton is currently not a sustainable option for most growers looking to pass on their farming techniques. When we grew organic cotton we were using modern varieties and practices to produce the same amount of cotton as the organic cotton we grew in the early 1990’s. To break it down into numbers, we can grow about 2 bales per megalitre today using modern varieties and farming techniques. When we grew organic cotton, we were achieving about 0.5 bales per megalitre.”

Sam Coulton, Goondiwindi Cotton Company, former grower of organic cotton

“Organic cotton requires more intensive seasonal labour which is difficult to source, expensive for growers and can create OH&S issues in terms of safety. Countries that grow organic cotton tend to have access to cheap labour.

Organic cotton yields far less than modern cotton varieties meaning it takes more land and inputs to produce the same amount of cotton.

Organic cotton requires more water per kg of fibre product than modern varieties.

“In terms of water use efficiency, the cotton we are growing on our farm today is about 4 times more productive than the organic cotton we grew in the early 1990’s. To break it down into numbers, we can grow about 2 bales per megalitre today using modern varieties and farming techniques. When we grew organic cotton, we were achieving about 0.5 bales per megalitre.”

Ben Coulton, Getta Getta Pastoral Company, Goondiwindi

Organic cotton requires more water per kg of fibre product than modern varieties

“Organic cotton is currently not a sustainable option for most growers looking to pass on their farming techniques. When we grew organic cotton we were using modern varieties and farming techniques. When we grew organic cotton, we were achieving about 0.5 bales per megalitre.”

Ben Coulton, Getta Getta Pastoral Company, Goondiwindi

Many of the practices used in some organic cotton production are also used in producing modern Australian varieties. In fact, the myBMP program goes far beyond the standards required under some organic cotton certification systems. It may be in the future that organic cotton is grown in Australia however, profitability and sustainability will drive producer decisions as will consumer demand.

www.bmpcotton.com.au puts forward the arguments for choosing Australian cotton grown with myBMP best practice principles

Australian Weaving Mills is one of the first Australian retailers to develop a line of 100% Australian, 100% myBMP certified cotton products

Cotton farmer Glenn Rogan at Rogan Pastoral Co explains his involvement in developing environmentally sustainable products for the market

How Australia’s myBMP cotton stacks up against the organic market
CHAPTER 9
Cotton as a Consumer Product
COTTON REMAINS THE WORLD’S FAVOURITE NATURAL FIBRE, WITH A HUGE RANGE OF DESIRABLE CHARACTERISTICS INCLUDING VERSATILITY, APPEARANCE, PERFORMANCE AND ABOVE ALL, NATURAL COMFORT.

Cotton is used to produce thousands of useful products from sheets and towels, tarpaulins and tents, pharmaceuticals and medical supplies - even astronauts’ inflight space suits.

In the United States of America, textile mills consume approximately 7.6 million bales of cotton a year. Of this, about 57% is converted into clothing, more than a third into home furnishings (bedspreads to window shades) and the remainder into industrial products (e.g. medical supplies, industrial thread and tarpaulins.)

The Properties of Cotton
Cotton has many special properties including the following remarkable characteristics:

- Stains can be easily removed from cotton
- Cotton is a good conductor of heat. In other words, it draws heat away from your skin to keep you cool, making it very comfortable to wear
- Cotton becomes stronger when wet
- Cotton absorbs moisture easily and can take up to one-fifth of its weight in water
- Cotton’s strength and absorbency make it an ideal fabric for medical and personal hygiene products such as bandages and swabs
- Cotton is very versatile – it can be blended, coated, finished, is dry cleanable, machine washable and easy to print
- Cotton is not easily damaged by sunlight and is therefore often used in the manufacture of curtains, tents and tarpaulins
- Cotton breathes easily as a result of its unique fibre structure. This attribute makes cotton more comfortable to wear than artificial fibres unable to provide ventilation
- The cool properties of cotton are ideal for the Australian environment. Australians are one of the highest cotton consumers in the world due to our climate and lifestyle

COTTON FIBRE MAKES FAVOURITE PRODUCTS LIKE T-SHIRTS AND ALSO HAS INDUSTRIAL USES LIKE TENTS, ARMY UNIFORMS AND HOSPITAL SHEETS

COTTON SEED IS USED FOR CATTLE FEED AND CRUSHED TO MAKE COTTONSEED OIL FOR SOAP, MARGARINE, COSMETICS AND PHARMACEUTICALS

COTTON IS KNOWN FOR ITS VERSATILITY, PERFORMANCE AND NATURAL COMFORT

COTTON IS A FOOD AND A FIBRE CROP. WE COOK WITH COTTONSEED OIL THAT’S FLAVOURLESS AND LOW IN CHOLESTEROL

COTTON CAN ABSORB UP TO 27 TIMES ITS OWN WEIGHT IN WATER

COTTON IS THE WORLD’S FAVOURITE NATURAL FIBRE
IT DATES BACK AT LEAST 7,000 YEARS MAKING IT ONE OF THE WORLD’S OLDEST KNOWN FIBRES.

COTTON IS A FOOD AND A FIBRE CROP. WE COOK WITH COTTONSEED OIL THAT’S FLAVOURLESS AND LOW IN CHOLESTEROL

COTTON CAN ABSORB UP TO 27 TIMES ITS OWN WEIGHT IN WATER
Cotton lint is spun then woven or knitted into fabrics such as velvet, corduroy, chambray, velour, jersey and flannel.

About 60% of the world’s total cotton harvest is used to make clothing, with the rest used in home furnishings and industrial products.

Well known cotton products include denim jeans, socks, towels, t-shirts, bed sheets and underwear.

More unusual uses of cotton fibre include tents, car tyre cord, fishnets and book binding.

Over half the weight of unprocessed cotton (seed cotton) is made up of seed, a valuable by-product of fibre production.

One tonne of cottonseed yields approximately 200kg of oil, 500kg of cottonseed meal and 300kg of hulls.

Global cottonseed production can potentially provide the protein requirements for half a billion people per year and many billions of other animals.

The most common uses of cottonseed are oil for cooking and feed for livestock. Cottonseed is pressed to make cottonseed oil. Cottonseed can be made into a meal and is a popular feed for cattle and livestock as it’s a great source of energy.

Cottonseed oil can also be used in a range of industrial products such as soap, margarine, emulsifiers, cosmetics, pharmaceuticals, rubber, paint, water proofing and candles.

Cottonseed oil is cholesterol free, high in poly-unsaturated fats and contains high levels of anti-oxidents (vitamin E) that contribute to its long shelf life.

Cotton linters are fine, very short fibres that remain on the cottonseed after ginning. They are curly fibres typically less than 3mm long.

Linters are used in the manufacture of paper (such as archival paper and bank notes) and as a raw material in the manufacture of cellulose plastics.

Linters are commonly used for medical supplies such as bandages, cotton buds, cotton balls and x-rays.

Fact Sheet: Interesting Cotton Facts

Case Study: American cotton marketing giant Cotton Incorporated is constantly finding new and innovative applications for cotton fabrics

Case Study: Nothing is wasted. See how recycled textile fibres are being used as reinforcements for polymer composites.
CHAPTER 10
Cotton Careers
If you haven’t yet considered a career in agriculture, now’s the time to start. With the Earth’s population set to reach over 10 billion in the next 90 years, a skilled and efficient workforce needs to be ready to meet the challenges of feeding and clothing the world.

The Australian cotton industry offers keen people a chance to build a career in a fast-paced and dynamic industry whether they are male or female, live in the city or country, come from a farming background or not.

The cotton industry offers employment in a vast array of areas of the agribusiness sector. These include research and development, financial services, ginning, warehousing, marketing, classing, shipping and policy and advocacy. Some of the occupations that make up the cotton industry are shown below.
OUR COTTON FARMERS LEADING THE WAY!

Syphon changing is part of general cotton farm operations during the season.

Senior Industry Development and Delivery Officer, Susan Maas, Emerald.

The Managing Director and His Right Hand Man.

The team at Merrilong Pastoral Company, Spring Ridge NSW.

Water Use Efficiency consultant, Olive Hood.

Young grower, Will Kirkby Jnr - Moree.

Dreams can come true in Agriculture.

I grow cotton and you wear it by Richie Quigley, young grower.

More information on working in Australia’s dynamic cotton industry, including career pathways, the training available and cotton as a lifestyle choice.

G’Day, I’m Richie. Let me tell you about my backyard.

Dreams can come true.
Links to additional information and teaching resources:

Cotton Australia
www.cottonaustralia.com.au
Australian Cotton Shippers Association
www.austcottonshippers.com.au
CSIRO
www.csiro.au/display/CSIROpedia/Genetically-modified-cotton-varieties
Cotton Research and Development Corporation
www.crdc.com.au
Cotton Seed Distributors
www.csd.net.au

COTTON UNITS AND LESSONS
K-2 Introduction to Cotton
3-6 Introduction to Cotton
STAGE 1: Cotton Farmers Love Ladybirds
STAGE 1: Watch It Grow
STAGE 4: Water Waste Not Want Not

STAGE 4/5: Multiplying by Dividing

STAGE 6: Studies in Sustainability the Cotton Industry in Northern NSW and Southern Queensland

PRESENTATIONS
The Australian Cotton Story (Primary)
www.youtube.com/watch?v=cbKh1Xtfmao&featur=youtu.be
How to Grow a Pair of Jeans
A Typical Australian Cotton Growing Season
The Visual Story of Cotton
www prezli.com/7zjuk06rqzq/vLvisual-story-of-cotton

Please feel free to share your presentations for different subjects at
www.cottonaustralia.com.au/contact-us