Cotton RD&E Strategy Working Group

Cotton Sector Research Development and Extension Final Strategy

June 2011

Acronyms

BCA	Benefit-cost analysis
Cotton Australia	Cotton Australia
Cotton CRC	Cotton Catchment Communities Cooperative Research Centre
CSD	Cotton Seed Distributors Ltd
CRDC	Cotton Research and Development Corporation
CSIRO	Commonwealth Scientific and Industrial Research Organisation
QDEEDI	Queensland Department of Employment Economic Development and Innovation
FTE	Full time equivalent
IRR	Internal rate of return
NRM	Natural Resource Management
NSW DPI	New South Wales Department of Primary Industries
PIERD Act	Commonwealth Primary Industries and Energy Research and Development Act (1989)
PIMC	Primary Industries Ministerial Council
PISC	Primary Industries Standing Committee
R&D	Research and development
RD&E	Research development and extension
ROI	Return on investment

Acknowledgements

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Executive Summary

Context

The Cotton Sector RD&E Strategy was developed as part of the National Primary Industries Research Development & Extension (RD&E) Framework. The strategy was developed by a Strategy Working Group with assistance from GHD. The Working Group members include representatives from: Cotton Research and Development Corporation (CRDC); Cotton Catchment Communities Cooperative Research Centre (Cotton CRC); Cotton Seed Distributors (CSD); CSIRO; NSW Department of Primary Industries (NSW DPI); Queensland Department of Employment Economic Development and Innovation (QDEEDI); and Sydney University (on behalf of the Australian Council of Agricultural Deans).

The Cotton Sector RD&E Strategy sets out priorities for the sector's RD&E organisations and industry to cooperate on a national basis to address the strategic needs of the cotton industry by:

- Identifying key drivers for the cotton industry and associated RD&E;
- Defining a national set of priorities to guide RD&E investment;
- Analysing cotton RD&E capability against the priorities; and
- Considering and recommending options to improve cotton RD&E.

Drivers

The Australian cotton industry is a regionally based, market focused industry generating in excess of $1 billion of export revenue. Cotton is produced in regional NSW and Queensland by up to 1,000 growers, and employs up to 14,000 people depending on variable seasonal and market conditions. The productivity and sustainability of the cotton industry has improved significantly over the past 20 years through technology development and improved management practices.

The future of the industry is influenced by a number of critical uncertainties including: climate variability; water availability; competitiveness with food; product differentiation; grower dedication; and industry profitability. This means that while the cotton industry will continue, the size of the industry will vary year to year and growth is reliant on productivity gains, improved sustainability and market development.

The response to these challenges is to develop a vision outlining the preferred future which the industry can work collaboratively to. The vision is: **'Australia cotton, carefully grown, naturally world's best'**, with the attributes of differentiated, responsible, tough, successful, respected and capable.

A central component of the industry's success is a capable and effective network of RD&E organisations working with industry. The network faces challenges from a tight fiscal outlook and the need to maintain cotton specific capability, as well as drawing on a broad range of capabilities to deliver on an expanding suite of RD&E priorities.

RD&E Priorities

There are **five distinct RD&E priorities** for the cotton sector over the next 10-20 years which are discussed in no particular order of priority below. The priorities have the potential to individually and collectively improve the cotton sector while needing to be flexible to dynamically meet a range of social, climatic, market and regulatory conditions. There are challenges with maintaining a balanced portfolio of investment, focus (R vs. D&E) and capabilities across the priorities.

The first priority lies around **better cotton plant varieties** which have significantly contributed to the sector's successes to date and is an area of considerable RD&E capability. Improved plant varieties have the potential to improve the productivity, sustainability and quality of cotton into the future.

The second priority focuses on **farming systems** to improve production sustainability and the quality of cotton produced. This includes RD&E focused on: crop production and protection; water use efficiency; natural resource management (NRM); and systems integration at crop, farm and catchment scales. Improved farming systems have the potential to improve the productivity and profitability of cotton, as well as minimising environmental impact and enhancing the natural resource base.

Innovative, resilient and adaptive **people, businesses and communities** is crucial to the future success of the cotton sector. Building and sustaining the capacity of individuals and institutions, and working with them to adapt to change, will contribute to providing the future social fabric of the sector. This is an emerging RD&E priority with strong links to vocational training, regional development and structural adjustment.

There is a distinct RD&E priority around **product and market development**. The priority includes fibre processing; development of new cotton products (quality) and markets, and providing quality assurance that integrates fibre quality and sustainability. This priority will become increasingly important to maintain market/resource access, improve industry reputation and differentiate Australian cotton.

The final priority is RD&E **development and delivery**. This explicitly recognises that considerable and sustained effort is required to ensure that research knowledge is developed to deliver a range of products and services to cotton farmers, communities, markets and government.

Capability Analysis

Investment in cotton RD&E averages $30 million per annum and employs more than 160 Full Time Equivalent (FTE) people, with a mixture of cotton specific and broader expertise. While this represents a substantial investment and considerable capability, there are a number of challenges including:

- The strategic direction of cotton RD&E is largely determined by CSIRO, CRDC and the Cotton CRC who account for 80% of investment. Consequently, effective engagement of all stakeholders in the sector's RD&E strategy and investment is essential to ensure that all RD&E is aligned;

- Cotton RD&E cannot fully fund all the cotton specific and broader expertise required to achieve the five RD&E priorities, particularly if total investment declines;
- The roles and capacity for the farming systems, people, business and communities, and development and delivery priorities are less well defined and agreed upon. This is due to the broad scope, breadth of required expertise and range of players. The roles and capacity for the plant varieties, product and market development priorities are well defined and generally agreed;
- Coordinating frameworks are urgently required for the farming systems, people, business and community priorities. The Development and Delivery Model provides a conceptual foundation for the development and delivery priority, but requires buy-in and refinement by all the RD&E organisations to become operational; and
- Cotton RD&E is well served for infrastructure. Clustering human capacity and infrastructure can improve RD&E effectiveness (critical mass and linkages) and efficiency (less duplication, cost reduction and leverage). The benefit-cost of potential changes towards specialisation needs to be investigated and considered.

Options to Improve Cotton RD&E

The general opinion of stakeholders consulted is that cotton RD&E has delivered considerable and sustained benefits to industry, and is well organised and managed. The Cotton Sector RD&E Strategy is seen as an opportunity to develop an overarching strategy, owned by all, to guide future RD&E for which four options have been developed. The specific benefits stakeholders are seeking include establishing:

- The strategic context and RD&E priorities to guide decision making and improve alignment, and
- Effective partnerships to implement RD&E to clarify roles, optimise resources, increase collaboration and enhance innovation.

Option 1 – Status Quo

The status quo involves the continuation of current arrangements in cotton RD&E. That is, each organisation continues to develop and implement their own strategies in consultation with each other. Collaboration in strategy, investment and implementation occurs as opportunities arise.

The strength of this option is that it builds on the existing approaches and does not require change other than when opportunities arise. The weakness is that it does not proactively address future challenges, including potential lower levels of investment, the ability of organisations to maintain capacity, and fragmentation in approach across and within the priorities.

Option 2 – Cotton Innovation Network

The second option aims to improve collaboration through establishing a **Cotton Innovation Network** to provide strategic oversight, coordination and communication for cotton RD&E in four interdependent focal elements:

- Strategy and investment – coordination across cotton and with other sectors;
- Research and development – research strategies are sound and coordinated;
- Development and delivery – coordinates development and delivery of research; and
- Capability management – ensures capability is maintained and developed.

The network will consist of senior representatives from the major cotton RD&E organisations and chaired by Cotton Australia.

The strength of the option is that there is a formal network providing strategic oversight and coordination for each of the major functions associated with cotton RD&E. This provides flexibility and focus for each of the functions to evolve as required. The weakness is the network requires consensus and commitment to identify and implement changes that are realistic and which improve cotton RD&E. This will require time, effort, commitment and openness to identifying and negotiating change.

Option 3 – Capability Clustering and Specialisation

This option involves tighter integration of RD&E capability through clustering and specialisation to improve efficiency and effectiveness. This would involve identifying the required research clusters and establishing appropriate governance for their on-going development. This includes managing the clusters as whole of sector team to implement RD&E and on-going investment, and development in human capacity and infrastructure.

The strength of this approach is that it builds on current trends to proactively build and develop the capability required to deliver the RD&E priorities. On the other hand, the weakness of this option is the considerable effort required to identify and implement the adjustments.

Option 4 – Full Integration

The final option is based on the rationale that cotton RD&E is relatively small and that competition between RD&E organisations limits performance. Cotton RD&E investment and cotton specific capacity is pooled into a jointly owned institution similar to the Cotton CRC.

Under this option all cotton RD&E investment by the RD&E organisations would be pooled into a single fund. Cotton specific human capacity would be seconded to, and infrastructure leased, by the joint venture and potentially fully transferred in the future.

The strength of this option is that a single entity is responsible for cotton RD&E funds and cotton specific capacity that is on-going, dedicated and focused on cotton RD&E, and can effectively leverage the available resources. The key weakness is the

considerable effort required and barriers to be overcome in establishing the joint venture.

Preferred Option

Option 1 (status quo) is not preferred given that it does not address existing challenges facing cotton RD&E. Option 4 (Full Integration) addresses the existing challenges by creating a dedicated on-going joint venture which manages funds and key capabilities for the whole sector. While attractive, the scale of change is such that it is not feasible in the short to medium term.

Option 2 (Cotton Innovation Network) is a logical evolution of current arrangements, introducing strategic oversight and coordination of RD&E at a sectoral level by a network of senior representatives. This approach recognises that cotton RD&E is a loose federation of organisations where improvements require consensus, negotiation and consideration of sectoral as well as individual needs and circumstances. Maintaining momentum and commitment is essential to ensure fundamental drivers such as tighter fiscal futures, fragmentation, overlapping roles, and declining capacity are addressed over time.

Option 3 (Clustering and Specialisation) offers an alternative to the network approach through identifying, and then developing, research clusters to achieve the RD&E priorities. This approach proactively addresses the fundamental drivers facing cotton RD&E, particularly on-going structural change in the focus, capability and investment of RD&E individual organisations. However, it is not possible to identify the implications of any adjustment until further design and negotiation is completed.

Option 2 (Cotton Innovation Network) is preferred by the Working Group for implementing this RD&E strategy. The option is a logical improvement to cotton RD&E coordination that is realistic and sound. Opportunities for clustering and specialisation may emerge from the network over time. It is premature to commit to this at present, given the need to understand and negotiate the implications of any adjustment.

Implementation

The preferred option is shown in the diagram overleaf and will be implemented in four stages. The first **scoping stage** involves developing the Cotton Innovation Network's purpose, tasks, outcomes and governance to create an agreed terms of reference by September 2011.

The second **buy-in stage** involves each of the Cotton Innovation Network member organisations agreeing to the terms of reference by October 2011.

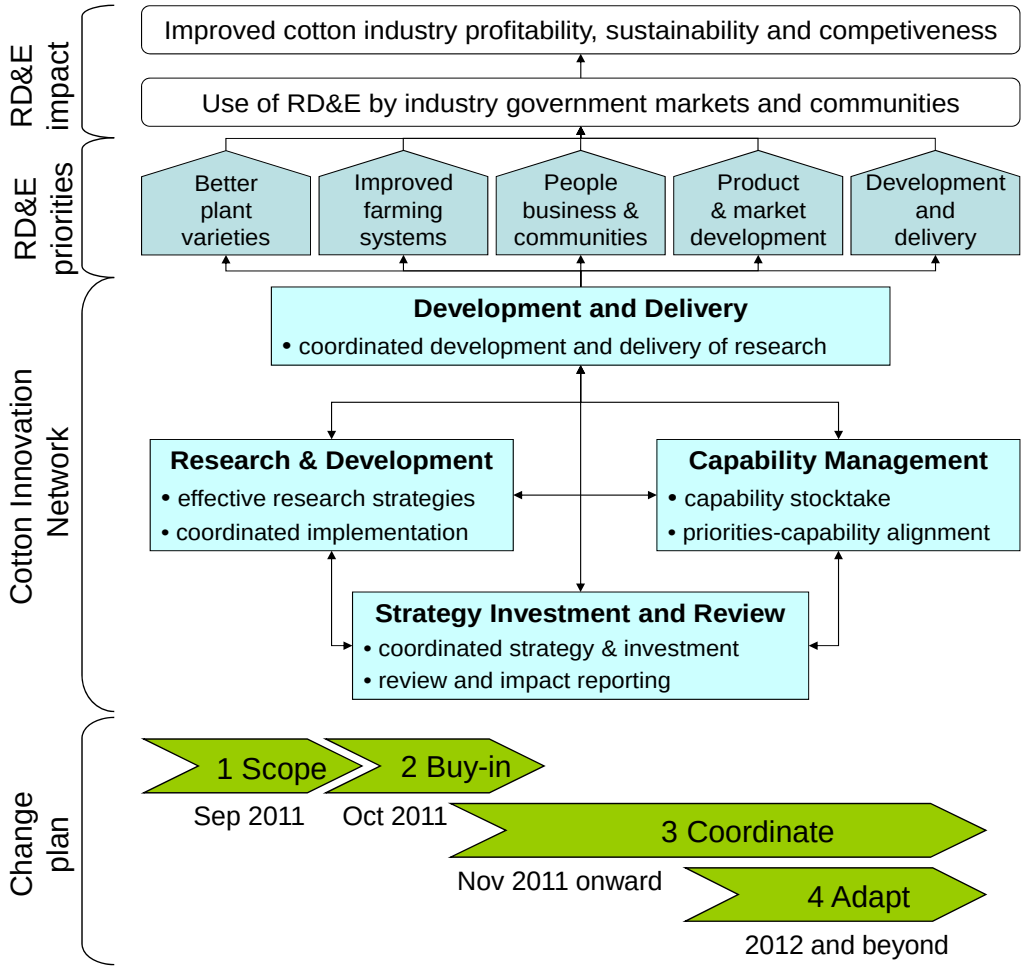
The third **coordination stage** focuses on establishing the network as a functioning entity and implementing immediate and practical coordination tasks identified for each element. In the first year the network will aim to meet formally with all members attending in order to:

- Develop a shared understanding of the Cotton Sector RD&E Strategy;
- Identify immediate actions to address critical issues;

- Facilitate coordinated investment across the sector for 2012-13; and
- Build strategic partnerships with other sectors and strategies.

The final **adaptation stage** involves on-going coordination across the four elements, revision of the RD&E Strategy, and adaptation of RD&E functions. It is premature to specify what the adjustments may be, however potential actions include: establishing new programs to optimise investment; strengthening research clusters to build critical mass and improve performance; and facilitating greater role clarity for RD&E organisations.

The challenge in implementing all the phases should not be under estimated. Implementation will progressively surface the key RD&E coordination mechanisms required and clarify the roles of RD&E organisation within flow on implications on investment and capability, impacting individuals and organisations. Detailed actions and critical success factors and associated key performance indicators are provided in the strategy.



Conclusion

The future success of Australian cotton and achievement of the 'Australian cotton, carefully grown, naturally world's best' vision will require RD&E to deliver on-going gains through the following **RD&E priorities** identified in the strategy:

- **Better plant varieties** – lifts on-farm performance
- **Improved farming systems –** sustainable production delivers quality cotton
- **People business and community –** proudly developing cotton and sustaining regional communities and environments
- **Product and market development –** competitive advantage through differentiation
- **Development and delivery -** maximising the potential of research

These gains will only be realised if the available funds and capability are aligned and coordinated. This will require an **effective and efficient collaboration** between RD&E stakeholders on; strategy & investment; R&D; capability management; and development and delivery.

The recommended **Cotton Innovation Network** will drive the required collaboration through creating a valuable, lean and realistic coordination function. Its high level membership will ensure **strategic coordination** and oversight across all cotton RD&E and with other sectors, while supporting operational and organisational **innovation and flexibility**. Staged implementation and representative governance ensures **improvements** are discussed and **agreed** prior to implementation; and the **network evolves** over time.

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1. Introduction

1.1 Context

Australia's rural Research Development and Extension (RD&E) system aims to improve the productivity, profitability, sustainability and global competitiveness of Australia's agriculture, fisheries, forestry and food industries, with benefits for individual businesses, the environment and wider community.

The Primary Industries Ministerial Council, with support from key stakeholders, agreed to establish a National Primary Industries Research, Development and Extension Framework (National RD&E Framework) and fourteen sector and cross sector strategies in April 2007. This includes the development of a RD&E strategy for the cotton sector, which will form a schedule to the National RD&E Framework Statement of Intent.

The cotton sector RD&E strategy sets out priorities for the RD&E organisations and industry to cooperate on a national basis to address the strategic RD&E needs of the cotton industry by:

- Defining a set of national priorities to guide research investment;
- Identifying gaps in national research capability on a regular basis, and mechanisms to address these gaps;
- Establishing a process to allocate resources across priority areas and the ongoing maintenance of national capability and effort;
- Establishing a process for monitoring and review of the system's effectiveness;
- Establishing a process for the management of intellectual property and innovation to maximise the benefits to Australia's primary industries, and
- Establishing a process to ensure research findings are readily available and adopted rapidly.

The cotton sector RD&E strategy aligns with, and has interests in, a number of these strategies, particularly grains, water use in agriculture, biofuels & bioenergy, and climate change.

1.2 Process and Stakeholder Consultation

The cotton sector RD&E strategy has been developed through a Working Group involving Cotton Research and Development Corporation (CRDC), Cotton Catchment Communities Cooperative Research Centre (Cotton CRC), Cotton Seed Distributors (CSD), CSIRO, Primary Industries Standing Committee (PISC) agencies, and cotton focussed universities (Appendix A).

The Working Group, with the assistance of GHD, developed the Cotton Sector RD&E Strategy through:

1. Reviewing existing documentation (Appendix B);
2. Consulting with the Cotton Sector RD&E Strategy Working Group and key informants (Appendix C);
3. Developing a discussion paper including a sector overview, RD&E priorities, RD&E resource audit, preliminary analysis of capability gaps & opportunities and identification of information gaps;
4. Conducting three stakeholder workshops (Appendix D); and
5. Preparing a Cotton Sector RD&E Strategy (This Report).

1.2.1 This Report

This report outlines the Cotton Sector RD&E Strategy as follows:

- **Sector Overview**: describes the scale, distribution, importance, trends of the cotton industry and associated, opportunities and threats;
- **Current resource analysis**: Current investment in cotton RD&E, public and private sectors, amounts, trends, focus. Current RD&E (human and infrastructure) capability including locations, focus, trends for both public and private sectors;
- **Future RD&E plan**: Establishes future strategic RD&E objectives and priorities for the cotton sector;
- **Capability analysis against the plan**: Compares information from current resource analysis and the requirements to address the future RD&E plan in order to identify future capability needs and gaps;
- **Change plan**: Develops a detailed change plan to establish and implement the new national RD&E sector strategy, including agreements between parties for capability and management arrangements and information sharing, including IP;
- **Consultation and approvals**: Describes and establishes consultation arrangements with stakeholders (PISC Agencies, Universities, RDCs, etc); and
- **Implementation arrangements**: Outlines timeframes and responsibilities, including monitoring, reporting and review.

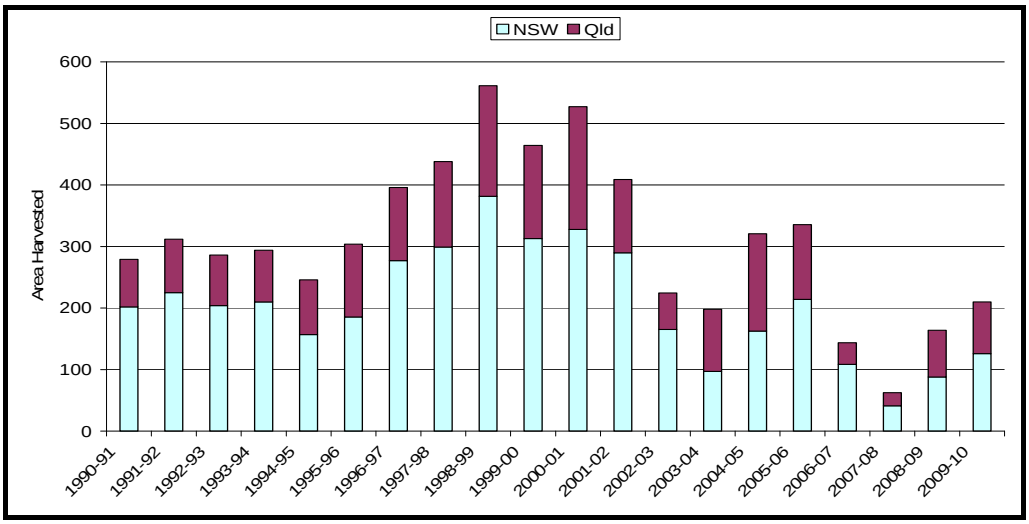
This strategy will be endorsed by the relevant cotton sector RD&E organisations and presented to the PISC R&D Sub-committee for approval in August 2011.

2. Sector Overview

2.1 Production

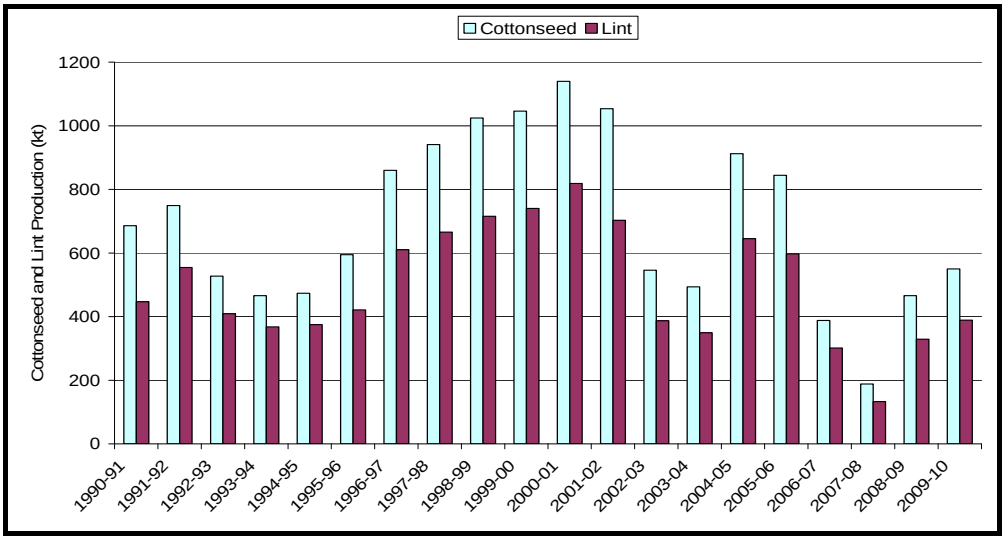
The Australian cotton industry has produced an average of 498kt of cotton lint and 698kt of cottonseed per annum from 309,000 hectares over the past twenty years. Production levels vary considerably due to water availability and to a lesser extent market conditions (Figures 1 and 2).

Figure 1 Area of cotton harvested in Australia



Source ABARES 2010a

Figure 2 Australian cotton lint and oilseed production



Source ABARES 2010a

The industry is concentrated in northern and central NSW, and southern and central Queensland. It provides an economic foundation for many regional communities, employing up to 14,000 people.

NSW produces approximately two thirds of Australian cotton in the: Macintyre; Gwydir; Namoi; Macquarie; Barwon; Darling; Lachlan; and Murrumbidgee River regions. Queensland accounts for approximately a third of cotton production, which is grown around the: Darling Downs; St George; Dirranbandi; Macintyre Valley Emerald; Theodore; Biloela; and Burdekin regions.

Cotton is mostly grown on mixed enterprise farms comprising summer and winter cropping and livestock typically ranging from 500 to 2,000 hectares in area. Cotton production is highly mechanised, capital intensive, technologically sophisticated, and requires a high degree of management skill. The number of farms growing ranges from 550 to more than 1,000, depending on seasonal and market conditions.

A sophisticated network of private and public sector organisations provide inputs and advisory services to cotton farmers. These include: Cotton Seed Distributors Ltd; consultants; agribusiness; State government agencies; Cotton Australia; Cotton CRC; CSIRO; and universities.

2.2 Processing and Markets

Australian cotton is export focused with more than 95% of the national crop exported, generating in excess of $1 billion in export revenue per annum over the last 20 years. Australia only accounts for 3% of global production, but is the third largest exporter of high quality cotton. Over 95% cotton exports are to Asia, mainly spinning mills in China, Indonesia and Thailand.

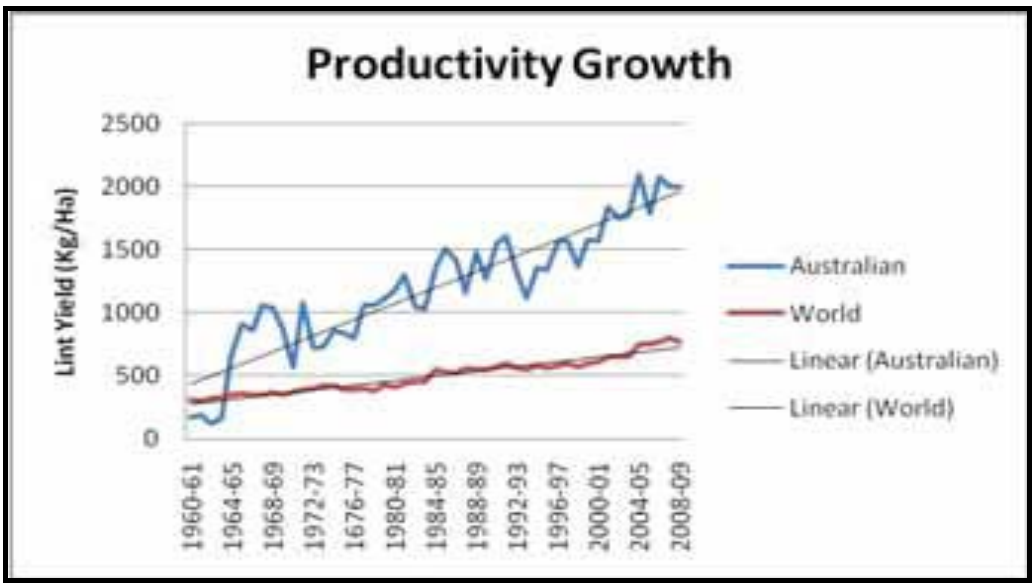
The post farm gate value chain includes cotton gins, product classing and supply chain logistics, and marketing of cotton lint and cottonseed oil. The major companies are: Duavant; Namoi Cotton; Cargill; Auscott; Queensland Cotton; and Weil Brothers.

2.3 Performance

The productivity and environmental sustainability of the cotton industry has improved significantly over the past 20 years through technology development and better management practices. These improvements underpinned the rapid growth of the industry in the 1990s, and assisted in maintaining global competitiveness and adapting to drought in the 2000s.

Australia produces the highest average yield for irrigated cotton in the world and its productivity growth outstrips competitors (Figure 3).

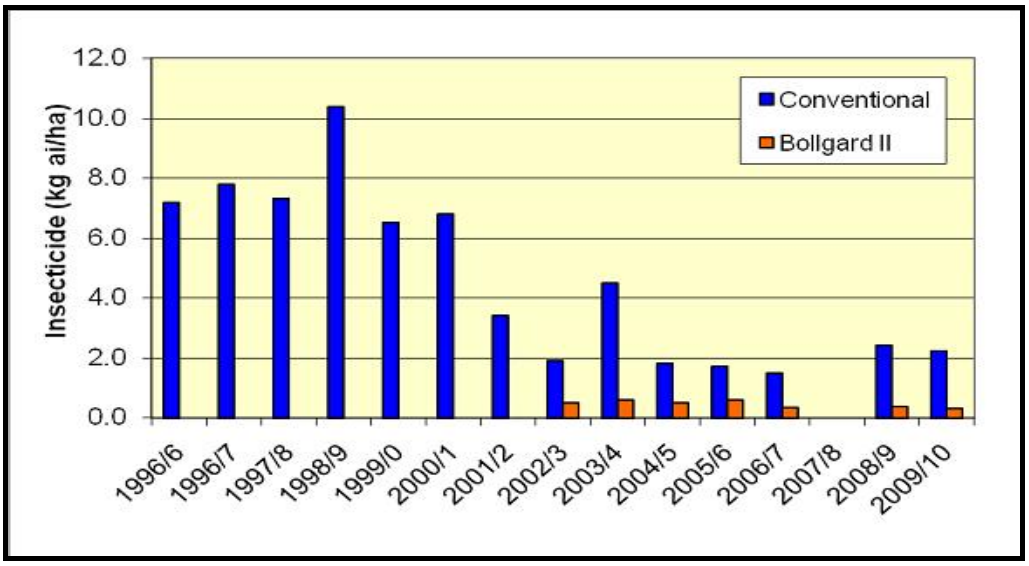
Figure 3 Comparative productivity growth in cotton production Australia vs. the world



Source: CRDC from International Cotton Advisory Committee data

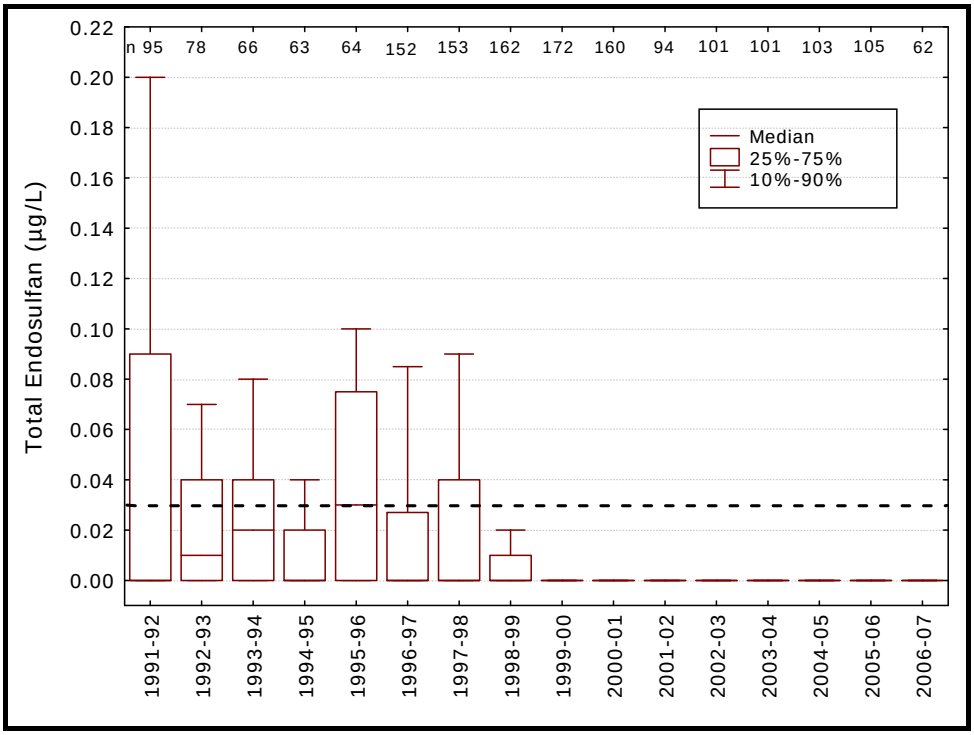
As mentioned above, the environmental sustainability of the industry has been improved through better management practices (including Integrated Pest Management) and the widespread adoption of genetically modified cotton (Bollgard II) which has greater pest resistance than conventional varieties. This has led a dramatic reduction in pesticide use and contributed to improvements in water quality (Figures 4 and 5).

Figure 4 Pesticide use in Australian cotton crops



Source: Greg Constable and Warwick Stiller (CSIRO)

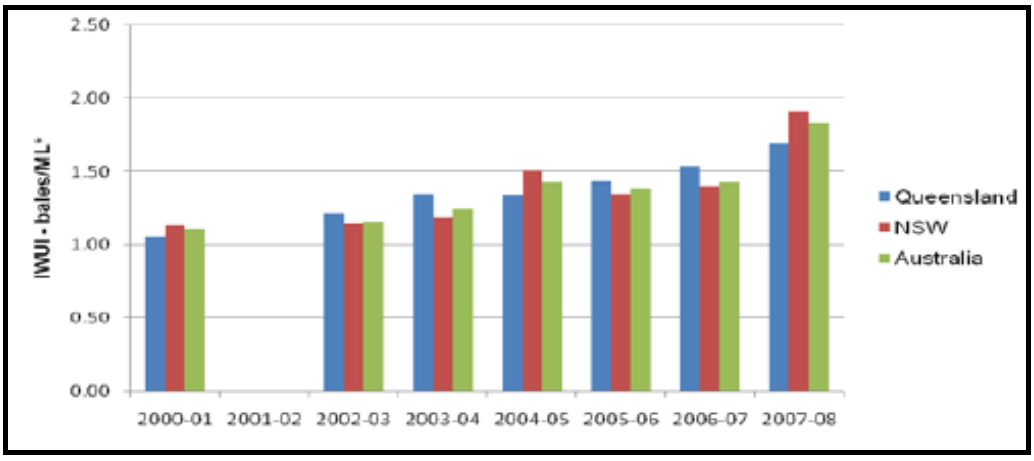
Figure 5 Box plot of total endosulfan concentrations in pesticide samples collected downstream of Keepit Dam from 1991-1992 to 2006-2007[1]



Source: Mawhinney, 2011

Water is a crucial component of cotton growing, as illustrated by the prolonged drought of the 2000s where production was severely limited by water availability. During that time, the water use efficiency of cotton production nearly doubled. Globally, Australia is a world leader in water use efficiency (Figure 6 and 7).

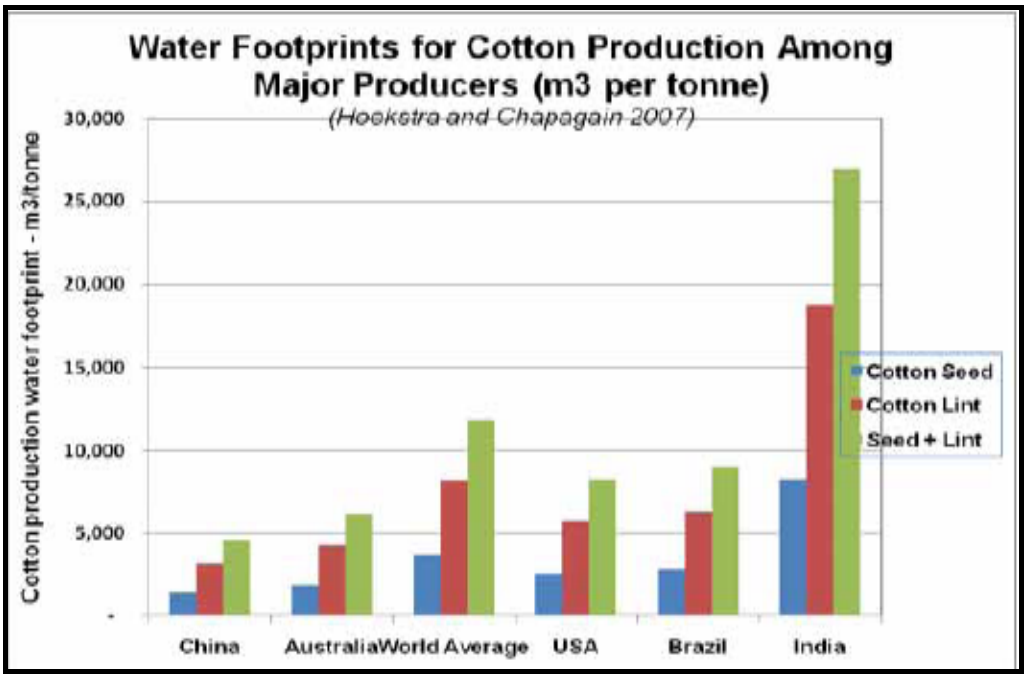
Figure 6 Estimated Irrigation Water Use Index (IWUI) for Australian Cotton 2001 to 2008



Source: CRDC (2010b) based on industry production and ABS water use data.

[1] The broken line represents the ANZECC and ARMCANZ (2000b) water quality trigger value for 99% ecosystem protection (0.03 µg/L).

Figure 7 Cotton production per mega litre of water



Source: Based on data presented in Hoekestra and Chapagain, 2007

Figure 8 Cotton t-shirt footprint cradle to grave

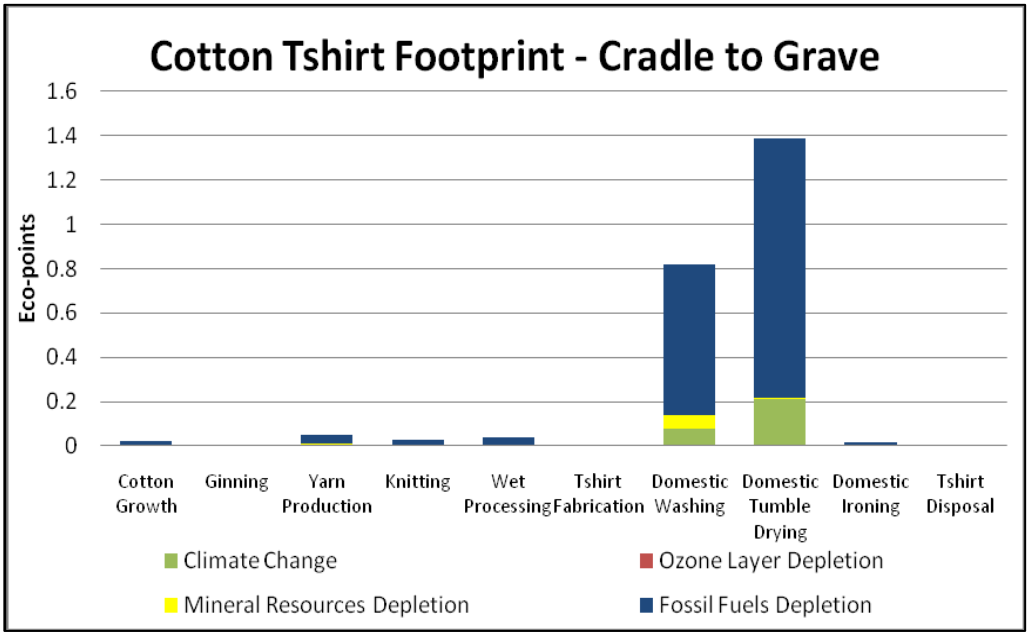


Figure extracted from Grace et al, 2009.

The following trends have been identified and considered in developing the cotton sector RD&E strategy.

2.3.1 Food Security

The Australian cotton industry has identified three ways in which it can contribute to increasing food production and security demands. They are as follows:

- Continuing to drive productivity gains in crop outputs. For every two tonnes of cotton lint produced, three tonnes of cottonseed are also produced. Cottonseed and its by-products are major food and stockfeed ingredients;
- Continuing to drive the efficiency and resilience of the farming system. Cotton, as usually the most profitable crop, can drive the economics of a complementary farming system with grain crops; and
- Continuing to build the industry culture of innovation and learning. As a leading industry in productivity growth through innovation, the cotton industry can provide significant spill overs from the knowledge, practices and technology developed through cotton R&D for adaptation and application to the production of food crops.

2.3.2 Markets

Cotton is approximately 40% of the global fibre market and demand is anticipated to increase in line with population growth and increasing affluence.

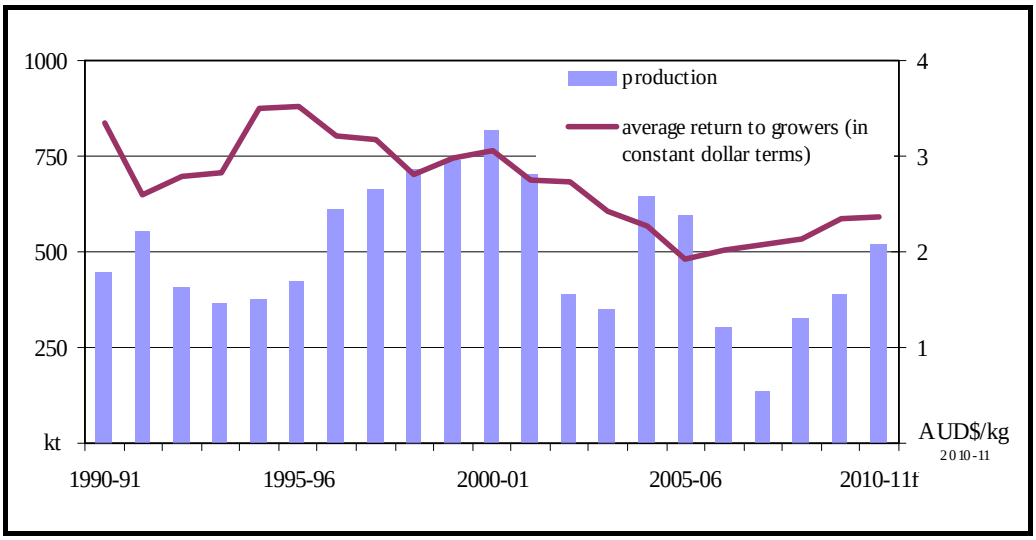
The world price of cotton fluctuates according to a range of factors including world economic conditions, trade negotiations, fashion, synthetic fibre price, weather and supply and demand.

Cotton prices, the Australian dollar exchange rate together with similar cotton types now being more available in Australia's traditional markets has increased market competition for Australian type cotton. A sustained focus on improved quality, price competitiveness and differentiation is required to maintain and build Australian cotton exports.

2.3.3 Growers

Cotton growers face on-going market and environmental pressures which influence the level of return from growing cotton (Figure 9). The sustained drought of the 2000s resulted in growers diversifying their production systems, and facing financial hardship due to water scarcity. This has led to cotton increasingly becoming a crop that is grown when conditions are suitable in a mixed farming system. There has also been an increase in the proportion of dryland cotton grown. Growers also face on-going cost price squeeze pressures and challenges in attracting labour. Water scarcity will continue to be a significant challenge due to climate and government policy into the future, despite the significant rains in all cotton regions in 2010.

Figure 9 Trends in cotton production and returns



Source: ABARES 2010b

2.3.4 Climate Change

Responding to the challenges of lower water availability and reliability, while remaining profitable, are key drivers for change on Australian cotton farms. Successfully responding to these drivers will give cotton growers the best chance to adapt to climate change, and reduce greenhouse gas emissions as a consequence.

In seeking to improve profitability, the Australian cotton industry recognises the connections between improved productivity, NRM, and addressing climate change. The first Australian Government National Research Priority, “An Environmentally Sustainable Australia”, has a specific priority goal of responding to climate change and variability; however, a range of its other priority goals relating to issues such water use, industry transformation and the reduction and capturing of emissions, have enormous applicability to the R&D effort to adapt to and/or mitigate the impacts of climate change within the Australian cotton industry. Similarly, this R&D addresses two of the Government’s Rural R&D Priorities: climate variability and climate change; and natural resource management (NRM). Hence, investment in climate change is embedded across the breadth of cotton industry R&D investments and not simply within discrete climate-focused research.

Cotton farmers have always had to adapt to climate variability as a normal part of their business. This means the focus on climate change has enhanced and broadened, rather than fundamentally changed R&D directions that have been followed for a number of years. This applies particularly since the introduction and ongoing expansion of the industry’s environmental management system, Best Management Practices (BMP).

Value Chain

BMP is being extended beyond the farm-gate to ginning, classing and storage, handling and shipping. Further development of improved ginning technology will lead to more energy-efficient ginning and reduced greenhouse gas emissions.

Farming Systems

On-farm cotton greenhouse gas emission abatement opportunities are addressed through improving fertiliser use, more efficient irrigation practices, better soil management (such as stubble retention and use of legume rotations crops), and energy use efficiency.

A range of decision support tools currently assisting in greenhouse gas abatement, include: an on-line cotton greenhouse gas and energy use calculator for producers; NutriLOGIC to aid in efficient fertiliser use; NUTRIpak to identify nutritional problems in soils and plants; and WATERpak to improve irrigation practices.

The National Climate Change Research Strategy for Primary Industries (CCRSPI), which involves all RDCs, Primary Industries Standing Committee agencies, CSIRO and several universities, has played an important role in identifying cross-industry climate change issues that require further R&D investment. It has also played an important role in coordinating the establishment of successful broad R&D collaborative programs and projects dealing with carbon emission and adaptation to climate change, funded under the Australian Government Department of Agriculture, Fisheries and Forestry's Climate Change Research Program.

Human Capacity

It is extremely important to develop and empower people within the industry to ensure best practice implementation and management of R&D outcomes in general, including those that impact on climate change mitigation or adaptation. For example, irrigation training courses and programs address the important issue of water use efficiency. New and innovative methods of providing training and education, including enhanced e-learning, are being developed.

2.3.5 Government

The future of cotton RD&E is significantly influenced by government policy on innovation/RD&E, water and climate.

The Murray Darling Basin Plan is likely to recommend a range of reductions in water available for consumptive use in Basin catchments where the majority of Australian cotton is grown. This will have an impact on the water available for cotton growing and flow-on impacts on growers and communities in cotton regions. As a result, it is likely there will be increased demand for RD&E that improves water use efficiency and support for grower, water management regime and community adaptation.

There will also be sustained pressure on the focus and level of government investment in cotton RD&E over the next decade. The Cotton CRC will end in either 2012 or 2017 depending on the success of the extension bid. Consequently, due consideration needs to be given as to how the Cotton CRC's investment and functions can be

sustained or adapted during the Cotton Sector RD&E Strategy's life cycle. It is also possible that the Commonwealth Government may reduce public investment in Rural Research Development Corporations, including the CRDC, based on the 2011 Productivity Commission Review. This will require the cotton industry to attract investment from other sources, or to reduce the level of RD&E.

Cotton RD&E also needs to align with other RD&E policy imperatives, including the National Strategic Rural Research and Development Investment Plan and an increased focus on impact assessment, collaboration and harmonisation across RDCs and government organisations.

Future government policy on climate change will also influence productivity and require adaptation strategies.

2.4 Future Cotton Industry Scenarios and Vision

2.4.1 Future Scenarios

In 2009 the CRDC commissioned Emergent Futures to work with a committee of cotton industry leaders to conduct scenario planning, and identify a 20 year vision for the industry based on the trends discussed in the previous section. Significantly, there is a high degree of uncertainty for these trends creating four potential scenarios for the industry:

Scenario 1: Food replaces fibre – competition between food and fibre

- Continued growth in population and affluence, results in increased demand for food and especially protein;
- Diminishing resources creates competition between food and fibre for resources; and
- Lack of coordinated global response to food crisis increases scale of problem and level of competition.

Scenario 2: Boom – water variability and availability not limiting

- Option A: The wettest of the Global Climate Models emerges, resulting in increased rainfall and runoff and improved water reliability. Continued population growth creates additional demand for increasing supplies of food and fibre; and
- Option B: The drier of the Global Climate Models emerges, resulting in reduced rainfall and runoff and lower, but more predictable, water availability. Coordinated global response to food crisis results in increased investment in agricultural R&D and infrastructure. Improved efficiencies overcome water availability and competition with food.

Scenario 3: Bust – water variability and availability significantly limiting

- Climate change induced high variations in rainfall: seasonal/regional/local;
- High variation in production in line with rainfall variation;

- Fewer dedicated cotton growers as production systems become more diverse and cropping systems to adapt to water variability; and
- Decline in production, quality and reputation leads to critical mass tipping point.

Scenario 4: Present day - projection of current situation

- Disruptive changes in water availability as a consequence of water reforms and policies;
- Variations in water availability between regions; and
- High competitiveness with food, retention of skilled people, but low profitability due to increasing cost of production.

2.4.2 Cotton Industry Vision

The cotton industry's response to these challenges is to develop a vision outlining the preferred future which industry can work collaboratively to. The vision is based on key elements which address the critical uncertainties influencing the industry (Table 1):

Vision: Australian cotton, carefully grown, naturally world's best

- **Differentiated -** world leading supplier of an elite quality cotton that is highly sought in premium market segments;
- **Responsible -** producer and supplier of the most environmentally and socially responsible cotton on the globe;
- **Tough -** resilient and equipped for future challenges;
- **Successful -** exciting new levels of performance that transform productivity and profitability of every sector of the industry;
- **Respected -** an industry recognised and valued by the wider community for its contribution to fibre and food needs of the world; and
- **Capable -** an industry that attracts and develops highly capable people.

Table 1 Underpinning elements of the cotton industry vision

Critical Uncertainty	Vision Elements
◗ Climate variability	◗ Resilience
◗ Water availability	◗ Technology, innovation, advocacy
◗ Competitiveness with food	◗ Premium for Australian cotton ◗ Improving productivity
◗ Competitiveness with man made fibre	◗ Improved quality traits ◗ Capitalise on natural, wearable ◗ Environmental footprint, carbon
◗ Product differentiation	◗ Very high, premium quality recognition, consistency of delivery ◗ People – knowledge and skills ◗ Uniquely Australian – the story
◗ Grower dedication	◗ Personal success (profitability), recognition (valued by community) ◗ Sense of belonging, identity as cotton grower
◗ Industry profitability	◗ High but not strong relationship between profit and choice (water is the key)

3. Current Resource Analysis

3.1 RD&E Stakeholders

The Australian cotton innovation system is a network consisting of the industry value chain (input suppliers, cotton growers, professional services, ginners, processors and marketers), local and peak industry bodies, committees and RD&E organisations. Major stakeholders include:

Commonwealth Scientific and Industry Research Organisation (CSIRO)

- National industry scientific organisation funded through own appropriation and a range of external sources; and
- Conducts cotton RD&E, provides RD&E capability (human capacity and infrastructure) and has partnerships with global biotechnical companies and state governments.

Cotton Catchment Communities Cooperative Research Centre (Cotton CRC)

- Third round CRC part funded by Department of Innovation Industry and Scientific Research (DIISR) with contributions from industry, government, NGOs and universities; and
- Fosters and invests in collaborative research and conducts cotton RD&E against its strategic plan using capabilities of participant and affiliated organisations.

Cotton Australia (Cotton Australia)

- The peak industry body representing cotton growers, funded through a voluntary levy. Nominated peak industry body under *PIERD (Primary Industries and Energy Research and Development) Act 1989* and provides executive support for Australian Cotton Industry Council (ACIC); and
- Involved in delivering myBMP (cotton best management practices).

Cotton Breeding Australia (CBA)

- Cotton Breeding Australia is an unincorporated joint venture between CSIRO and Cotton Seed Distributors to fund cotton breeding and targeted research. CBA operates with a 10 year horizon and includes mechanisms for formal review.

Cotton Research and Development Corporation (CRDC)

- Legislated and funded by the cotton levy and Department of Agriculture Fisheries and Forestry under the *Commonwealth Primary Industries and Energy Research and Development Act 1989*; and
- Invests in cotton RD&E according to its strategic plan.

Cotton Seed Distributors (CSD)

- Grower owned and controlled cotton planting seed company which commercialises varieties and provides targeted supports services to cotton growers;

- Invests in cotton breeding, research & development in partnership with CSIRO; and
- Provides extension services to growers focused clearly on cotton production and increasing economic returns.

NSW Department of Primary Industries (NSW DPI) and Queensland Department of Employment Economic Development and Innovation (QDEEDI)

- State government departments responsible for primary industries funded through own appropriations and range of external sources; and
- Conduct cotton RD&E and provide RD&E capability (human capacity and infrastructure).

Universities

- Includes Universities of: Sydney; New England; New South Wales; Technology Sydney; Charles Sturt; Southern Cross; Queensland; Southern Queensland; Central Queensland; Melbourne; Deakin; Adelaide; Western Australia; Australian National; and Tasmania; and
- Conduct cotton RD&E and provide capability (especially human capacity).

3.2 Investment

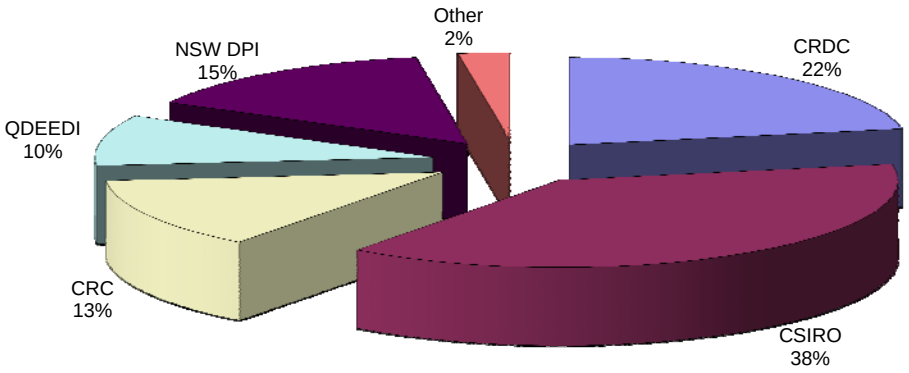
Public investment in cotton RD&E averages around $30 million dollars per annum. Table 2 provides a representative example of annual investment by facility and source for 2008-2009[2]. There is also private industry RD&E investment which is commercial-in-confidence or not available.

External funding is a significant source of income for CSIRO, QDEEDI and NSW DPI, who leverage more than 60% or more additional funding from the CRDC, Cotton CRC and other sources.

The largest sources of investment are CSIRO and CRDC who account for 39% and 23% respectively. The NSW and Queensland Governments account for 13% and 10% respectively while the Cotton CRC provides 13% (Figure 10).

[2] Does not include plant variety royalties and other commercial receipts.

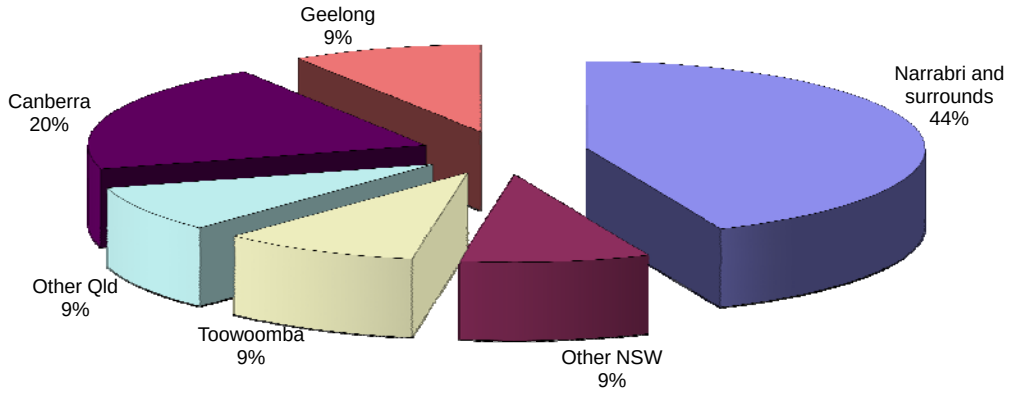
Figure 10 Sources of cotton RD&E investment



Source: Cotton Sector RD&E Strategy Working Group

Interestingly, 84% of R&E investment is concentrated at four locations: Narrabri; Canberra; Toowoomba; and Geelong (Figure 11).

Figure 11 Geographic distribution of cotton RD&E investment



Source: Cotton Sector RD&E Strategy Working Group

Table 2 Cotton RD&E investment 2008-2009

Facility	Source	State/Cwlth Government[3]	Cotton CRC[4]	CRDC[5]	Other industry/ external	Total
QDEEDI - Ayr Research Station	CSIRO	$ 251,000	$ 75,000	$ 75,000	$ -	$ 401,000
	QDEEDI	$ 215,000	$ 190,000	$ -	$ -	$ 405,000
QDEEDI – Ecosciences Precinct	QDEEDI	$ 518,000	$ -	$ 324,363	$ -	$ 842,363
NSW DPI, EMAI, Camden	NSW DPI	$ 540,915	$ -	$ 140,000	$ -	$ 680,915
CSIRO Black Mountain (PI and Ento)	CSIRO	$ 3,193,737	$ 833,644	$ 2,045,423	CiC	$ 6,072,804
QDEEDI - Dalby Office	QDEEDI	$ 398,000	$ 30,000	$ 179,898	$ -	$ 607,898
QDEEDI - Emerald Research Centre	QDEEDI	n/a	n/a	n/a	n/a	$ -
CSIRO - CMSE Geelong	CSIRO	$ 1,654,405	$ 295,310	$ 720,658	$ 45,487	$ 2,715,860
NSW DPI - Gunnedah	NSW DPI	$ 71,178	$ 74,425	$ -	$ -	$ 145,603
CSD - Various Locations	CSD	n/a	n/a	n/a	n/a	$ -
CSD Shenstone and Little Mollee	CSD	n/a	n/a	n/a	n/a	$ -
NSW DPI, Hay/Griffith	NSW DPI	$ 275,947	$ 74,425	$ -	$ -	$ 350,372
QDEEDI - Kingaroy Research Station	QDEEDI	$ 36,730	$ 30,000	$ 10,000	$ -	$ 76,730
NSW DPI, Moree	NSW DPI	$ 123,481	$ 74,425	$ -	$ -	$ 197,906
CSIRO Long Pocket	CSIRO	$ 159,000			$ 66,000	$ 225,000
NSW DPI - Australian Cotton Research Institute	CSIRO	$ 6,114,179	$ 345,061	$ 2,204,165	CiC	$ 8,663,405
(Centre of Excellence for Cotton, Pulses and Oilseed Improvements)	NSW DPI	$ 2,282,657	$ 1,243,963	$ 388,334	$ 445,560	$ 4,360,514
	CSD	n/a	n/a	n/a	n/a	$ -
NSW DPI - Tamworth Agricultural Institute	NSW DPI	$ 696,281	$ -	$ -	$ 55,000	$ 751,281
QDEEDI - Toowoomba (Tor St)	QDEEDI	$ 1,401,000	$ 555,898	$ 424,530	$ -	$ 2,381,428
QDEEDI -Toowoomba (Leslie Research Centre)	QDEEDI	$ 253,000	$ 50,000	$ 100,000	$ 50,000	$ 453,000
NSW DPI, Warren	NSW DPI	$ 110,214	$ 74,425	$ -	$ -	$ 184,639
NSW DPI, Tocal	NSW DPI	$ 239,681	$ -	$ -	$ -	$ 239,681
CSIRO, Griffith	CSIRO	$ 40,000			$ 65,000	$ 105,000
Total		**$ 18,637,990**	**$ 3,946,576**	**$ 6,612,371**	**$ 727,047**	**$ 29,923,984**

Source: Cotton Sector RD&E Strategy Working Group

[3] Inclusive of on-costs and corporate overheads

[4] Direct and via other organisations excluding CRDC

[5] Direct and via other organisations

3.3 Human Capacity

This section describes the human capacity and physical infrastructure of CSIRO, QDEEDI, NSW DPI and CSD involved in delivering cotton RD&E. Universities, CRDC, Cotton CRC (employed by the CRC) and Cotton Australia were not analysed.

3.3.1 Distribution

There are 162.47 FTE (203 staff) delivering cotton RD&E. Of these, 58% have a national role and 60% are male. The major employer is CSIRO (Table 3) and more than 40% of staff is located in Narrabri and the immediate surrounding areas (Table 4).

Table 3 Cotton RD&E employers

Employer	Staff	%	FTE	%
Cotton Australia	1	0%	0	0%
Cotton CRC	1	0%	1	1%
CSD	15	7%	14	8%
CSIRO	101	48%	91.92	49%
QDEEDI	39	18%	28.15	17%
NSW DPI	54	26%	40.6	25%
Total	211	**100%**	165.67	**100%**

Source: Cotton Sector RD&E Strategy Working Group

Table 4 Geographic distribution of cotton RD&E staff

Location	Staff	%	FTE	%
Narrabri and surrounds	86	41%	79.65	48%
Other NSW	26	12%	17.8	11%
Toowoomba	27	13%	19.7	12%
Other Qld	18	9%	13.55	8%
Black Mountain	33	16%	22.57	14%
Geelong	19	9%	12.4	7%
Unknown	2	1%	0	0%
Total	211	100%	165.67	**100%**

Source: Cotton Sector RD&E Strategy Working Group

3.3.2 Expertise

Cotton RD&E expertise is concentrated in cotton breeding, on-farm production and to a lesser extent fibre processing (Figure 12). Conventional and biotechnology cotton breeding along with entomology account for nearly half of the FTE. A significant proportion of staff is technical officers, reflecting the large amount of field and laboratory work associated with cotton RD&E. In terms of specialisation, cotton breeding and fibre processing expertise is concentrated in CSIRO. On-farm production expertise is distributed across the various organisations (Figure 13).

Figure 12 Cotton RD&E expertise by classification

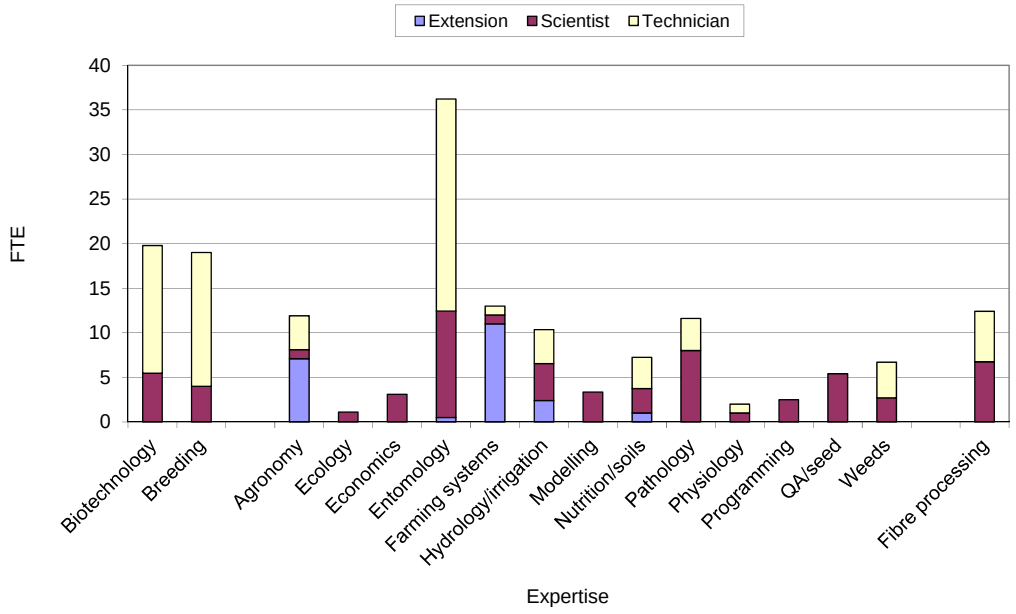
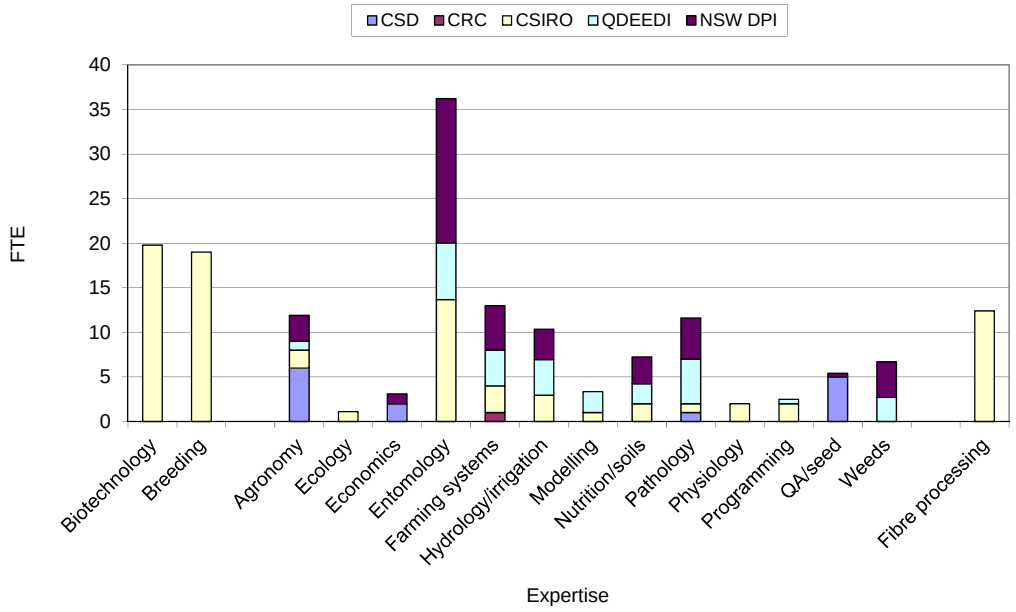


Figure 13 RD&E expertise by employer



Source: Cotton Sector RD&E Strategy Working Group

3.4 Infrastructure

The cotton RD&E infrastructure is located across more than 20 sites in four states (Table 5).

Table 5 Cotton RD&E facilities

Facility	Location	Tenants	Owner
Ayr Research Station	Ayr	CSIRO & QDEEDI	Qld Govt
Ecosciences Precinct	Brisbane	QDEEDI	Qld Govt
NSW DPI, EMAI, Camden	Camden	NSW DPI	NSW Govt
CSIRO Black Mountain (PI and Ento)	Canberra	CSIRO	Aust Govt
Dalby Office	Dalby	QDEEDI	Qld Govt
Emerald Research Centre	Emerald	QDEEDI	Qld Govt
CMSE Geelong	Geelong	CSIRO	Aust Govt
NSW DPI	Gunnedah	NSW DPI	NSW Govt
CSD – Regional Locations	Regional NSW and Qld	CSD	CSD
CSD Shenstone and Little Mollee	Wee Waa		CSD
NSW DPI, Hay/Griffith	Hay/Griffith	NSW DPI	NSW Govt
Kingaroy Research Station	Kingaroy	QDEEDI	Qld Govt
NSW DPI, Moree	Moree	NSW DPI	NSW Govt
Australian Cotton Research Institute	Narrabri	CSIRO, Cotton CRC and NSW DPI	NSW Govt
NSW DPI - Headquarters	Orange	NSW DPI	NSW Govt
Tamworth Agricultural Institute,	Tamworth	NSW DPI	NSW Govt
Toowoomba (Tor St)	Toowoomba	QDEEDI	Qld Govt
Leslie Research Centre	Toowoomba	QDEEDI	Qld Govt
CSIRO Griffith Laboratory	Griffith	NSW DPI	CSIRO
NSW DPI, Warren	Warren	NSW DPI	NSW Govt

Source: Cotton Sector RD&E Strategy Working Group

Offices, laboratories and glasshouses are distributed across the facilities with the strongest concentrations in Black Mountain, Narrabri, Toowoomba, Brisbane and Camden. The spinning and weaving facilities are in Geelong (Table 6).

Table 6 Cotton RD&E facilities key features

Facility	Features
Ayr Research Station	Offices; laboratories, glasshouses, field sites in a potential new cotton location
Ecosciences Precinct Brisbane	Offices; PC2 laboratories and glasshouses
NSW DPI, EMAI, Camden	Offices, PC 2 Laboratories, Glasshouses, meso houses,
CSIRO Black Mountain (PI and Ento)	Offices; PC2 laboratories and glasshouses
Dalby Office	farming systems, agronomy
Emerald Research Centre	Offices; laboratories, glasshouses, field site
CMSE Geelong	Ginning, spinning and weaving facilities
NSW DPI Gunnedah	Water management, Extension, Agronomy and Counselling
CSD - Various Locations	Extension and seed distribution (Dalby)
CSD Shenstone and Little Mollee	Seed production farm and seed delinting, treatment and laboratory
NSW DPI, Hay/Griffith	Offices and field sites
Kingaroy Research Station	Offices; laboratories, glasshouses, field site
NSW DPI, Moree	Offices; laboratories, field sites
Australian Cotton Research Institute	Offices; laboratories and glasshouses; meso houses, ACRI computer server network, Fields
NSW DPI - Headquarters	Offices; NSW DPI Executive, Policy Unit and Biosecurity
Tamworth Agricultural Institute,	Offices; laboratories, glasshouses, field sites
Toowoomba (Tor St)	Offices; laboratories and glasshouses; APSRU computer cluster and server
Leslie Research Centre	Offices, laboratories, glasshouses
CSIRO Griffith	Offices and laboratories
NSW DPI, Warren	Offices, Field sites
NSW DPI, Dubbo	Offices, Field sites
NSW DPI, Tocal	Education and training

Source: Cotton Sector RD&E Strategy Working Group

Table 7 Cotton RD&E facilities core role and future Intentions

Facility	Core role	Future intentions
Ayr Research Station	Farming systems, agronomy, cotton agronomy (CSIRO)	Leads in tropical farming systems and agronomy research Lead cotton agronomy in Burdekin. Link with grains and sugar industries.
Ecosciences Precinct	Pre-breeding and farming systems research	Participate in cotton pathology R&D
NSW DPI, EMAI, Camden	Insecticide Resistance Management research, Education and Training	Participate in cotton IRMS R&D, Undergraduate and Postgraduate training
CSIRO Black Mountain (PI and Ento)	Cotton biotechnology traits and genomics. Resistance management of insect tolerant transgenics	Lead development of new markers to assist breeding, understanding of genomics and incorporation of new traits. Lead assessment of Helicoverpa resistance to transgenics
Dalby Office	Extension	Unknown
Emerald Research Centre	Farming systems, agronomy	Unknown
CMSE Geelong	Fibre quality measurement and new technologies, enhanced ginning and processing technology	Lead development and commercialisation of new fibre quality measurement and ginning technology. Link with agronomic research on fibre quality.
NSW DPII Gunnedah	Water management, Extension, Agronomy and Counselling	Participate in Cotton Extension, IRMS, Water Management extension, Counselling of Rural farmers
CSD – Regional Locations	Seed distribution and extension	Maintain
CSD Shenstone and Little Mollee	Planting and seed production	Variety development incl. CSIRO JV
NSW DPI, Hay/Griffith	Extension, Agronomy, Water Use Efficiency, farming systems	Lead in Extension; Participate in Agronomy, farming systems and WUE
Kingaroy Research Station	Pre-breeding and farming systems research	Unknown
NSW DPI, Moree	Extension, Agronomy, Water Use Efficiency	Participate in farming systems and agronomy, WUE extension services
Australian Cotton Research Institute	Cotton breeding, agronomy, physiology, integrated pest management, farming systems, simulation modelling, applied entomology (Pest Management, Insecticide Resistance Management), pathology (Disease survey and Disease management), farming systems, weed management, economics, extension, Water Use Efficiency (WUE), Education and Training	Centre for IPM and AWM in cotton and agricultural crops. Lead cotton breeding, delivery of transgenics, physiology, agronomy, pest management and quantifying resistance to transgenics, IRM, pathology, farming systems, weed management, extension. Participate in climate change, emissions, sequestration, fibre quality assessment, link systems modelling, extension, economics, WUE, undergraduate and postgraduate training and on-farm modernization
NSW DPI - Headquarters	State Government policy and strategic planning	Coordinate biosecurity management
Tamworth Agricultural Institute, Tamworth	Insecticide Resistance Management research, Education and Training	Participate in cotton IRMS R&D, Undergraduate and Postgraduate training, IRMS strategies
Toowoomba (Tor St)	Systems modelling, pathology, farming systems	Leads in the Systems Modelling and predictive sciences. Participate in cotton pathology R&D
Leslie Research Centre	Pre-breeding and farming systems research	Lead in Weed Sciences R&D
CSIRO Griffith	Remote sensing for irrigation management	Continue as cotton expands in region
NSW DPI, Warren	Extension, Agronomy, Water Use Efficiency	Lead in Extension; Participate in Agronomy, farming systems and WUE, IRMS``

Source: Cotton Sector RD&E Strategy Working Group

4. Future RD&E Plan

4.1 Aligning Industry and Government RD&E Priorities

"*Continual investment in research and development (R & D) and innovation is vital for ongoing growth and improvement in the profitability and sustainability of Australia's agriculture, fisheries, forestry and food industries. R&D embraced by rural industries delivers benefits to individual rural business operations, to the environment and the wider Australian community. Rural industries' and producers' commitment to R&D and innovation is demonstrated by the higher than two per cent a year average productivity growth maintained during the past thirty years. To sustain these productivity gains continual investment, coordination and linkage of R&D across rural sectors and through the food production processing and marketing system is critical"* (DAFF, 2007).

To help guide investment in rural R&D, the Australian Government revised the national rural R&D priorities in 2007, in light of five challenges to be faced over the next five to ten years:

- Boosting productivity and adding value to rural production;
- Effective operation of supply chains and markets for existing and new products;
- Supporting effective NRM;
- Building resilience to climate variability and climate change; and
- Protecting Australia from biosecurity threats.

The rural R&D priorities complement, and are informed by, the Australian Government's national research priorities (DIISR, 2010) which highlight areas of particular national social, economic and environmental importance, and where a whole-of-government focus has the potential to improve research and broader policy outcomes. National research priorities address areas of strength, opportunity or need in Australian research.

Table 8 summarises the rural R&D priorities and related national research priorities. All of these priorities are relevant to the cotton sector, other than the preventative health care (healthy food production) component of the promoting and maintaining good health national priority.

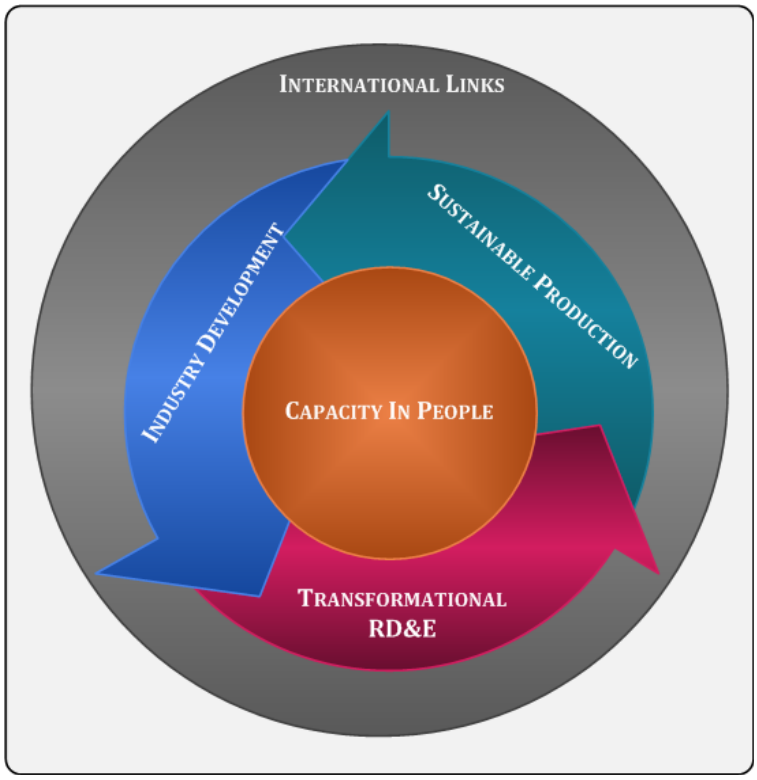
Table 8 National research and Rural R&D priorities

Rural R&D Priorities	National Research Priorities
Productivity and Adding Value Improve the productivity and profitability of existing industries and support the development of viable new industries	***Promoting and Maintaining Good Health*** Through strengthening Australia's social and economic fabric and preventive healthcare (healthy food production)
Supply Chain and Markets Better understand and respond to domestic and international market and consumer requirements and improve the flow of such information through the whole supply chain, including to consumers	
Natural Resource Management Support effective management of Australia's natural resources to ensure primary industries are both economically and environmentally sustainable	***An Environmentally Sustainable Australia***
Climate Variability and Climate Change Build resilience to climate variability and adapt to and mitigate the effects of climate change	
Biosecurity Protect Australia's community, primary industries and environment from biosecurity threats	***Safeguarding Australia***
Supporting the Rural Research and Development Priorities	
Innovation Skills Improve the skills to under take research and apply its findings	***Frontier Technologies for Building and Transforming Australian Industries***
Technology Promote the development of new and existing technologies	

Source: DAFF, 2007

The Australian Government, through the Rural Research and Development Council has developed a National Rural Research and Development Investment Strategy around five investment priorities (Figure 14).

Figure 14 National rural research and development investment priorities



Source: Rural Research and Development Council 2011

4.2 State Agency Cotton Sector RD&E Priorities

State governments describe their primary industries objectives in terms of driving state economic and regional development objectives and in protecting the natural resource base. The two major state government departments involved in cotton RD&E are Queensland's Department of Employment Economic Development and Innovation (QDEEDI), and the NSW Department of Primary Industries (NSW DPI).

4.2.1 NSW Department of Primary Industries

About 70% of Australia's cotton is grown in the state of New South Wales and contributes about $1.05 billion to the state's economy. As a result the cotton industry in NSW is an important contributor to the state's economic and regional development objectives. The Department's cotton RD&E priorities are:

- Provide RD&E capabilities, infrastructure and programs to address regional needs in NSW to complement and partner national programs;
- Improve long term productivity and net value of cotton in NSW;

- Maintain productive capacity of cotton resource base by enhancing natural resource management policy in NSW;
- Develop new technologies that enable better productivity of cotton to enable long term sustainability of the cotton industry;
- Develop effective biosecurity programs to minimize biosecurity risk to the cotton industry;
- Build the capability of the cotton industry sector to adapt and grow and provide jobs and investment to regional NSW; and
- Assist the regional and rural NSW communities and industries to respond, adapt and capture opportunities in future environmental change scenarios.

4.2.2 Queensland Department of Employment Economic Development and Innovation

QDEEDI invests in cotton RD&E to ensure profitable and sustainable primary industries in Queensland. Agri-Science Queensland within QDEEDI creates the conditions for food and agricultural businesses to succeed by providing research and development and associated services that enable Queensland agribusinesses to transform science and innovation into sustainable economic outcomes. This is achieved through research and development, technology adoption, policy and industry development advice, capacity building and training and science support.

Agri-Science Queensland within QDEEDI has a targeted RD&E program that focuses on:

- Innovative insect, disease and weed management in production systems that reduce chemical usage, environmental damage and production costs in our farming systems;
- Innovative technologies and climate systems modelling that develops innovation in agricultural systems and provides tools and scenarios to support future sustainability and global competitiveness;
- Farming systems and sustainability to reduce the environmental impact of agricultural production through the use of advanced farming technologies and improved water use efficiency;
- Soil and plant nutrition research to maximise yields and protect the soil resource ensuring future sustainability and minimal environmental impact; and
- Biosecurity Queensland within QDEEDI delivers an RD&E program that underpins tropical biosecurity and emerging threats. It focuses on the whole biosecurity continuum, prevention of exotic threats, preparedness, surveillance, response and recovery from exotic incursions.

4.3 Commonwealth Scientific and Industrial Research Organisation RD&E Priorities

CSIRO has a core strategic objective of delivering on national challenges. This is achieved by exploring new horizons, conducting science with impact and harnessing the wide skills across CSIRO as well as partnering and collaborating with other agencies. Examples of national challenges include: water; energy; climate change; health; and industry development. Broad areas of R&D relevant to the cotton industry include:

- Providing practical solutions to help Australia adapt to climate change;
- An Australia safe from emerging and future biological threats;
- Substantially increased social, economic and environmental benefits from finite water resources; and
- Integration of environmental sustainability expertise with world leading research in agricultural productivity as well as focusing on higher value agricultural products.

These broad areas of research are addressed in research on plant breeding and biotechnology, post harvest processing, crop agronomy, pest management and ecology. Research is based in Canberra, Narrabri, Brisbane, Adelaide, Geelong and Toowoomba.

CSIRO makes major contributions to the cotton industry in a range of areas, particularly: breeding plants for improved yields; improving fibre quality; improving pest resistance; managing cotton crops; and developing cost-effective and environmentally friendly approaches to insect and weed control.

CSIRO's cotton RD&E priorities are:

- Development of new varieties with improved yield, fibre quality, disease/pest tolerance and improved techniques for processing and measuring lint quality;
- Development of instrument and sensor technologies to measure fibre quality;
- Provision of market information and perceptions on Australian fibre quality (from the textile sector's perspective);
- Development of knowledge of crop nutrition, physiology, pest ecology and management to generate integrated crop management systems;
- Deployment and development of management strategies for transgenics with enhanced pest and herbicide tolerance;
- Participation in development (and extension) of new markets (niches) for Australian cotton;
- Understanding of interactions between production systems, catchments and landscapes on issues such as riparian zones, ground and surface water, landscape scale pest ecology and management; and
- Underpinning support for implementation/adoption of new technologies, varieties and management systems.

4.4 Universities Cotton Sector RD&E Priorities

Universities have two priorities, the provision of education and training and the conduct of high quality research. They also prioritise community outreach. In the context of the cotton industry, university priorities lie in the provision of education and training in agriculture and related disciplines, and as suppliers of agronomic, environmental and economic research. The universities currently estimate a national under-provision of agricultural and related graduates of the order of 1,000 per annum, and this will particularly impact the cotton and other high-tech agribusinesses in the next decade. Increasing the number of agricultural and related graduates is a key priority. The science excellence profiles of universities largely drive their research directions. Fortunately, the universities envisage world-leading research challenges in sustainable agriculture which are in concert with those of the cotton industry, and they foresee increased investment in and prioritisation of field-based research (at least one university has plans for a chair in cotton agronomy).

The major Universities involved in cotton RD&E are the Universities of Sydney, New England, NSW, UTS, Southern Queensland and Queensland.

4.5 Cotton Research and Development Corporation RD&E Priorities

The CRDC is a partnership between the Australian cotton industry and the people through the Australian Government and is established under the *PIERD Act (1989)*. The CRDC vision is a globally competitive and responsible cotton industry, and the Corporation provides leadership and investment in research, innovation, knowledge creation and transfer.

The Corporation coordinates a national strategy and allocates funds through a five year strategic R&D plan. The current plan *"The Quest for Sustainable Competitive Advantage 2008-2013"* establishes three goals with associated strategies and outcomes.

Goal 1 - Add value to the Australian cotton industry with premium products in improved routes to market

Strategies

- Develop contemporary knowledge and intelligence about products, markets and supply chains;
- Develop improvements in current products;
- Facilitate the development of novel products;
- Advance cotton product processing; and
- Facilitate the development of objective measurement of Australian cotton fibre.

Outcome

- High quality consumer-preferred Australian cotton products in the world marketplace.

Goal 2 - Cotton in a highly productive farming system with improved environmental performance

Strategies

- Build the industry's understanding of climate and natural resource challenges;
- Enhance the capacity of the industry to adopt resilient and adaptive farming systems ; and
- Protect industry from bio-security threats.

Outcome

- A more resilient, profitable and competitive cotton farming system.

Goal 3 - A culture of innovation and learning

Strategies

- Identify, understand and plan for future industry capacity needs;
- Improve human resource development and capacity; and
- Enhance capacity to innovate.

Outcome

- Innovative people in the cotton industry and community, creating a sustainable industry and viable regional communities

4.6 Cotton Catchment Communities Cooperative Research Centre RD&E Priorities

The Cotton CRC is a registered company formed through the collaboration of private sector, federal and state government agencies, industry associations and Universities. The Cotton CRC aims to provide high quality collaborative research, education and adoption activities which benefit the Australian cotton industry, regional communities and the nation over seven years (2005-2012). The major outcomes sought are outlined below.

- Enable cotton industry to improve profitability and sustainability of production by:
  - Adoption of improved integrated management systems for cotton pests (insects, weeds and diseases);
  - Development of new tools to address crop management challenges;
  - Improving on-farm water use efficiency;
  - Optimising crop nutrition inputs and soil management practices; and
  - Developing cotton farming systems which have enhanced resilience and adaptive capacity to climate variability and change.

  - Increase adoption of new knowledge and enhanced decision-making capability of people working in, or with, the cotton industry, its catchments and communities by:
  - Extension and knowledge within the cotton BMP framework; and
  - Education and training to provide a flexible development path for all levels of the industry.
- Identify, understand and plan for future industry capacity needs by:
  - Scoping and determining future human resource needs;
  - Investigating best practice for attracting, developing and retaining people;
  - Encouraging and assisting development of rural and cotton industry action plans; and
  - Investigating alternative methods for research and development.
- Improve human resource development and capacity by:
  - Supporting initiatives which encourage adaptiveness to change;
  - Targeting investments in human capacity to meet future needs; and
  - Leveraging industry development and establishing strategic partnerships.
- Enable mutually beneficial interactions between industry and communities by:
  - Identifying opportunities and strategies for enhancing the flexibility and resilience of cotton communities, including labour and regional business resources;
  - Gaining a greater understanding of the social and economic conditions of cotton growing communities; and
  - Identifying strategies which enable rural communities and industry to understand, address, and contribute to future natural resource policy issues.
- Best practice cotton enterprises delivering sustainable ecosystems and reduced impacts on catchments through:
  - Integrated management of river flows to ensure profitable irrigation industries and the sustainable ecological condition of floodplain river ecosystems;
  - Integrated and sustainable management of groundwater resources;
  - Improving on-farm water quality to deliver both farm and catchment benefits;
  - Improving the assessment, management and monitoring of biodiversity and ecosystem service resources in cotton growing catchments; and
  - Enabling decisions on natural resource management by growers and catchment bodies to be informed by science-based, best practice knowledge.
- Enable the industry to produce high quality consumer-preferred cotton by:
  - Securing Australia's reputation as a supplier of quality cotton fibre;
  - Preserving fibre quality through improved processing;
  - Developing new technologies to facilitate objective definition of fibre characteristics;

- Identifying the agronomic impacts on fibre quality and spinnability;
- Developing complementary options for value adding to irrigation water through aquaculture; and
- Securing the technical foundation on which an Australian cotton brand can be built.

4.7 Cotton Australia Cotton Sector RD&E Priorities

Cotton Australia is the peak industry body representing cotton growers, funded through a voluntary levy. Cotton Australia is nominated peak industry body under the *PIERD Act (1989)*, and provides executive support for the Australian Cotton Industry Advisory Council.

Cotton Australia's RD&E priorities are outlined in the 2009-2013 Strategic Plan under Research Direction and Industry Stewardship as follows:

Goals

- Provide direction on grower driven research, development and extension to CRDC;
- Work with relevant research organisations to achieve a coordinated common objective to cotton research;
- Ensure Australian cotton conference continue as the key dissemination point for research outcomes;
- Lead industry stewardship initiatives; and
- Contribute to securing ongoing cotton industry R&D funding.

Outcomes

- Increased return to growers from investment in research and development;
- Research has direct applicability to cotton growers;
- Growers receive and adopt research outputs to enhance their business viability and profitability;
- Demonstrated social, economic and environmental outcomes of industry funded R&D; and
- Secure and sustainable structure for cotton industry R&D funding.

Strategy

- Establish and maintain an integrated R&D structure that ensures all stakeholders are represented;
- Conduct a proactive annual research needs analysis process;
- Build and maintain working relationships with CRDC and other research stakeholders;
- Communicate outcomes of research via Australian cotton conference and other avenues;

- Maintain stewardship programs to ensure longevity of technologies e.g. biosecurity;
- Identify, implement and promote effective pathway for BMP; and
- Lobby governments to secure R&D funding.

4.8 Cotton Seed Distributors Cotton Sector RD&E Priorities

Cotton Seed Distributors (CSD) is a grower owned entity whose aim is to provide to every cotton grower the highest net return potential from the cotton varieties CSD produces.

CSD works closely with CSIRO (Plant Industry) to have available the best possible varietal performance in conventional material and in the transgenic market, combine the attributes of the conventional varieties with the best possible biotechnology performance.

Further, CSD utilises the most modern technologies and infrastructure to bring forward the highest quality planting seed possible, in the quantities and time frames required, for all growers.

4.9 Cotton Breeding Australia Cotton Sector RD&E Priorities

Cotton Breeding Australia is an unincorporated joint venture between CSIRO and Cotton Seed Distributors to fund cotton breeding and targeted research. Both parties contribute $2 million per annum for research, with CSD also co-funding the cotton breeding work previously co-funded by the Cotton Research and Development Corporation (CRDC).

Key areas for the breeding and research program include yield/quality improvements, drought and climate change tolerance, water use efficiency and disease tolerance.

4.10 Cotton Industry RD&E Priorities

The proposed industry vision is “Australian cotton, carefully grown, naturally world’s best”. Based on the components of the vision described in section 2, industry’s RD&E priorities are:

- Improving the resilience, productivity and profitability across the cotton value chain;
- Reducing the environmental footprint of the cotton industry; and
- Improve the human capability to achieve the above.

When the RD&E vision is considered from value chain perspective there are a range of issues which inform what the RD&E priorities might be (Table 9).

Table 9 Value chain issues

	Pre-farm gate			Post farm gate		
Element	Resources ⇨	Users ⇨	Outputs ⇨	Supply chain ⇨	Markets ⇨	Consumers
Description	Natural resources Human capital Infrastructure	Farm enterprises Practices Varieties	Fibre, seed and oil	Processing Distribution Marketing	Domestic Export	Domestic Export
Issues	Access Sustainability Variability Biosecurity	Profitability Sustainability	Quality Quantity Productivity	Scale Efficiency Quality	Quality Price Access Differentiation	Preferences Trends Social licence
	Profitability, sustainability, competitiveness, productivity and resilience					

At the pre-farm gate end, the priorities are about improving profitability and resilience through better plant varieties and practices which:

- Improve natural resource use - more from less and managing pests, diseases, weeds, pollution (CO2e, nutrients, chemicals etc) biodiversity effectively; and
- Increase enterprise production, productivity and quality.

At the post farm gate end the priorities are about:

- Ensuring farm gate outputs meet market quality standards for existing and newly created premium markets; and
- Improving processing, logistics and marketing.

4.11 Cotton Sector RD&E Priorities

The cotton sector is **regionally based and market focused**. As such, the future industry success of the sector lies around ensuring that cotton meets the needs of cotton farmers, (regional) communities, government and markets in terms of sustainability, competitiveness, productivity and profitability. The role of RD&E is to generate knowledge which can be applied to improve cotton plants, farming systems, catchments, communities and markets.

There are **five distinct RD&E priorities** for the cotton sector over the next 10-20 years. They are based on the industry drivers (section 2.4) vision (section 2.5) and the cotton RD&E goals of the key stakeholders discussed in the previous sections. The priorities have the potential to individually and collectively improve the cotton sector while needing to be flexible and managed dynamically meet a range of social, climatic,

market and regulatory conditions. There are challenges with maintaining a balanced portfolio of investment, focus (R vs. D&E) and capabilities across the priorities.

The first priority lies around **better cotton plant varieties** which have significantly contributed to the sector's successes to date, and is an area of considerable RD&E capability. Improved plant varieties have the potential to improve the productivity, sustainability and quality of cotton into the future.

The second priority focuses on **farming systems** to improve production sustainability and the quality of cotton produced. This includes: RD&E focused on crop production and protection; water use efficiency; NRM; and systems integration at crop, farm and catchment scales. Improved farming systems have the potential to improve the productivity and profitability of cotton as well as minimising environmental impact and enhancing the natural resource base.

Innovative, resilient and adaptive **people, businesses and communities** is crucial to the future success of the cotton sector. Building and sustaining the capacity of individuals and institutions and working with them to adapt to change will contribute to providing the future social fabric of the sector. This is an emerging RD&E priority with strong links to vocational training, regional development and structural adjustment.

There is a distinct RD&E priority around **product and market development**. The priority includes: fibre processing; development of new cotton products (quality) and markets; and providing quality assurance that integrates fibre quality and sustainability. This priority will become increasingly important to maintain market/resource access, improve industry reputation and differentiate Australian cotton.

The final priority is RD&E **development and delivery**. This explicitly recognises that considerable and sustained effort is required to ensure that research knowledge is developed to deliver a range of products and services to cotton farmers, communities, markets and government.

Cotton Sector RD&E Vision

Collaborative innovation between investors, providers and industry delivers a range of tactical, applied and strategic RD&E on human capability, plant varieties, practices and market development. These can significantly improve the economic and environmental performance of the industry to sustain vibrant cotton communities.

4.11.1 Better Plant Varieties – lifts on-farm performance and product value

Outcome

Industry has access to a range of genetics and traits in varieties with better performance and qualities that enhance competitiveness in global markets.

Focus Areas

- Maintain an effective **breeding program** to achieve optimum varieties with key biotechnology traits:
  - Range of varieties for irrigated and dryland production across growing regions;

  - Improved quality (fibre and segments) to meet market requirements;
  - Water use efficiency and drought tolerance;
  - Higher yields from irrigated and dryland cotton (adaptability); and
  - Disease and pest tolerance.
- Focus **gene discovery** and germplasm enhancement on key traits that benefit the industry and have access to commercial traits.

4.11.2 Improved Farming Systems – sustainable production delivers quality cotton

Outcome

Cotton farming systems grow high quality, profitable and sustainable cotton, and are integrated into the farming enterprise and landscape through improved practices, productivity and resource management.

Focus Areas

- Improve the **water use efficiency** of cotton crops and irrigation systems.
- Improve cotton crop production, stewardship and protection through:
  - Nutrition and soil health (including rotations and tillage);
  - Pest and disease management (endemics);
  - Biosecurity (exotics); and
  - Maintain effective **stewardship** of plant variety traits.
- Improve resource management through:
  - Providing ecosystem services (natural resource conservation);
  - Reducing C02 equivalent emissions (adapt and ameliorate); and
  - Limiting energy, nutrient, chemical and water losses.
- **Integrate research** at the farm, industry and catchment system scales.

4.11.3 People, business and community – proudly developing cotton and sustaining regional communities and environments

Outcome

An industry supported by a skilled, innovative, sustainable and adaptable workforce.

Focus Areas

- Invest in the **capacity of people** and businesses across the cotton supply chain;
- Invest in RD&E to understand the contribution of cotton **communities** and work with them to **innovate** and **adapt** to market, regulatory, structural and environmental change and enhance cotton's social licence; and
- Building and maintaining RD&E investment, governance and capability to provide **RD&E capacity** to significantly contribute to cotton's sustainable development.

4.11.4 Product and Market Development – competitive advantage through differentiation

Outcome

Improve cotton lint and cottonseed oil yield and quality to enhance existing and develop new products and markets.

Focus Areas

- Ginning equipment;
- Fibre quality assessment;
- Supply chain logistics;
- Market research; and
- Ability to demonstrate the triple bottom line performance of cotton production systems, enterprises and industry to successfully negotiate, sustain and build access to markets and natural resources.

4.11.5 Development and delivery – maximising the potential of research

Outcome

The cotton sector improves through the delivery of products and services based on the on-going development of new and existing research.

Focus Areas

- Increase the **adoption of cotton research** through focused "development and delivery" to improve the profitability, productivity, sustainability and competitiveness of the cotton sector; and
- Improve and maintain **myBMP** to provide best practices to cotton farmers and provide quality assurance to markets, communities and government.

5. Capability Analysis against the Plan

5.1 Roles in Cotton RD&E

The roles of individual organisations and partnership mechanisms can be analysed in relation to two key functions: strategy and investment; and implementation (Table 10). **Strategy and investment** covers how the industry establishes its strategy and allocates resources to the identified priorities. **Implementation** is how the conduct of RD&E is organised.

The current roles of key cotton RD&E organisations, as nominated by themselves, are described for each RD&E priority using the following National RD&E Framework definitions:

- **Major** – lead RD&E for this priority. A national leadership role where there is a major priority for the relevant government and the government endeavours to give a high priority to funding research, including infrastructure, for that sector;
- **Support** role where they undertake some research, but the major activity is provided by another government jurisdiction or party; and
- **Link** where they undertake little or no research but access information and resources from other jurisdictions or parties to meet industry needs through D&E.

5.1.1 Strategy and Investment

Strategy development for cotton RD&E is predominantly defined by CRDC, Cotton CRC and CSIRO. This does not mean that industry and other RD&E organisations do not play a role in strategy development for the sector. Indeed, they are actively involved developing the CRDC, Cotton CRC and CSIRO strategies. The way these three organisations develop strategy and the fact they account for 80% of investment means their planning plays a key role in defining the sector's RD&E strategy.

The CRDC and Cotton CRC define the cotton sector strategy through the requirement to periodically develop strategies and investment plans, in consultation with industry and RD&E stakeholders. The CRDC develop a five year strategic and annual investment plan in consultation with stakeholders. The Cotton CRC, while holding annual strategic reviews, works to deliver against the stated outcomes in its contract (2005) with the Commonwealth Government and participants. The Cotton CRC is essentially a seven year partnership between the RD&E stakeholders. Due to its length and the requirement for stakeholders to commit their investment for seven years, the Cotton CRC's priorities significantly shape the sector's RD&E strategy.

The current level of investment in cotton RD&E is around $30 million per year and is likely to be similar, or even lower, in the future. Investment will decrease by approximately 15% if the Cotton CRC ceases in 2012 and new funds are not sourced from industry or government. A further decease will also occur if CSIRO, QDEEDI, NSW DPI and the universities seek greater cost recovery from funding bodies such as CRDC.

Table 10 RD&E roles of key stakeholders

RD&E Priorities	*Cotton Australia*		*Cotton RDC*		*Cotton CRC*		*Cotton Seed Distr.*		*CSIRO*		*QDEEDI*		*NSW DPI*	
	Strategy & invesment	*Implemen-tation*	*Strategy & invesment*	*Implemen-tation*	*Strategy & invesment*	*Implemen-tation*	*Strategy & invesment*	*Implemen-tation*	*Strategy & invesment*	*Implemen-tation*	*Strategy & invesment*	*Implemen-tation*	*Strategy & invesment*	*Implemen-tation*
Plant Varieties	***Link***	***Link***	***Link***	***Link***	***Link***	***Link***	***Major***	***Support***	***Major***	***Major***	***Link***	***Link***	***Link***	***Link***
Breeding program	Link	Link	Link	Link	Link	Link	Major	Support	Major	Major	Link	Link	Link	Link
Focused trait research	Link	Link	Link	Link	Link	Link	Support	Support	Major	Major	Link	Link	Link	Link
Improved Farming Systems	***Link***	***Link***	***Major***	***Link***	***Major***	***Major***	***Support***	***Support***	***Major***	***Major***	***Major***	***Major***	***Major***	***Major***
Water use efficiency	Link	Link	Major	Link	Major	Major	Support	Support	Major	Major	Major	Major	Support	Support
Crop prod'n stewardship & protection	Link	Link	Major	Link	Major	Major	Support	Support	Major	Major	Major	Major	Major	Major
Sustainable NRM	Link	Link	Major	Link	Major	Major	Link	Support	Major	Major	Major	Major	Major	Major
System integration	Link	Link	Major	Support	Major	Major	Link	Support	Major	Major	Major	Major	Major	Major
People business & community	***Link***	***Link***	***Major***	***Link***	***Major***	***Major***	***Support***	***Link***	***Support***	***Support***	***Support***	***Support***	***Major***	***Major***
Capacity building cotton people	Link	Link	Major	Support	Major	Major	Support	Link	Link	Link	Support	Support	Major	Major
Community innovation & adaptation	Support	Support	Support	Link	Major	Major	Link	Link	Support	Support	Support	Support	Support	Support
RD&E capacity	Support	Support	Major	Link	Major	Major	Support	Support	Major	Major	Support	Support	Major	Major
Product & Market Development	***Major***	***Major***	***Major***	***Support***	***Support***	***Support***	***Link***	***Link***	***Major***	***Major***	***Link***	***Link***	***Link***	***Link***
Ginning equipment	Link	Link	Major	Link	Support	Major	Link	Link	Major	Major	Link	Link	Link	Link
Fibre quality assessment	Link	Link	Major	Link	Support	Major	Link	Link	Major	Major	Link	Link	Link	Link
Supply chain logistics	Link	Link	Major	Link	Link	Link	Link	Link	Major	Major	Link	Link	Link	Link
Product development	Link	Link	Major	Major	Support	Support	Support	Support	Major	Major	Support	Support	Support	Support
Market research	Major	Major	Major	Major	Link	Link	Link	Link	Major	Major	Link	Link	Link	Link
Demonstrating sustainability	Major	Major	Major	Support	Support	Support	Link	Link	Link	Link	Link	Link	Link	Link
Development & Delivery	***Support***	***Support***	***Major***	***Support***	***Support***	***Support***	***Support***	***Support***	***Major***	***Major***	***Support***	***Support***	***Support***	***Support***
Plant varieties	Link	Link	Link	Link	Link	Link	Major	Support	Major	Major	Link	Link	Link	Link
Farming systems	Link	Link	Major	Support	Major	Major	Support	Support	Major	Major	Major	Major	Major	Major

Table 11 provides a breakdown of RD&E expenditure against the five proposed cotton sector RD&E priorities. When these allocations are weighted against the 2008-2009 investment data (excluding commercial in confidence CSD data):

- Approximately 20% of R&D expenditure is on plant varieties by CSIRO and CSD;
- Nearly half of total expenditure is on improved farming systems and is 70% or greater for CRDC and NSW DPI;
- Expenditure on the people, business and community, and product and market development priorities is less than 10%; and
- Development and delivery expenditure is approximately 16%.

Table 11 Proportion of RD&E expenditure by priority

Priorities	CSD	CRDC	Cotton CRC	CSIRO	QDEEDI	NSW DPI
Plant varieties	70%	0%	0%	44%	0%	0%
Improved farming systems	5%	71%	58%	29%	40%	70%
People, business & community	0%	4%	6%	6%	20%	11%
Product & market development	5%	14%	9%	13%	0%	0%
Development and delivery	20%	11%	28%	8%	40%	19%
	100%	100%	100%	100%	100%	100%

Source: Cotton Sector RD&E Strategy Working Group

Plant Varieties - Strategy and Investment Roles

The strategy and investment roles in the plant varieties priority are well established, with CSIRO leading, CSD supports and their partnership Cotton Breeding Australia providing a specific funding mechanism. The other organisations link as required, by aligning farming systems RD&E with variety developments.

Farming Systems - Strategy and Investment Roles

All of the RD&E organisations have a major strategy role in farming systems RD&E which accounts for a significant proportion of expenditure other than Cotton Australia and CSD. Strategy and investment associated with this priority includes farming system, business and catchments scales R&D and integration between the scales and RD&E expertise. This makes prioritisation, goal alignment and role clarification for the whole sector and individual organisations challenging.

People, Business and Communities - Strategy and Investment Roles

The strategy role for the people, business and communities varies between the focus areas within the priority. The Cotton CRC and NSW DPI have identified a major role in capacity building[6], and QDEEDI plays a supporting role.

Only the Cotton CRC has a major role in community innovation and adaptation. This means another organisation will need from 2012 onwards, to take the major role if the Cotton CRC rebid is unsuccessful. The supporting and linking roles for the other organisations reflects the lower degree of importance relative to the other priorities.

RD&E capacity is a major role for Cotton CRC, CSIRO and NSW DPI who employ a large proportion of the staff and own much of the infrastructure. The support role for QDEEDI reflects changing priorities for the Queensland government. While the respective and link support role for CSD and Cotton Australia reflect their lower level of investment in capability.

Product and Market Development Strategy and Investment Roles

The major strategy role in product and market development is led by CRDC and CSIRO, which reflects their priorities and capabilities. Cotton Australia also has a role in market research.

A key linkage is the supporting role played in product development by QDEEDI, NSW DPI, CSD and Cotton CRC. This is to ensure that product quality requirements are integrated into on-farm RD&E.

A critical gap is leadership on demonstrating sustainability, where only Cotton Australia and CRDC have identified major roles. This will be an increasing priority given the importance of maintaining market and resource access.

Development and Delivery Strategy and Investment Roles

The strategy and investment role for development and delivery priority is complex due to distributed responsibility, embedded nature and integrative function. This creates considerable challenges in coordinating development and delivery strategy and investment between and within RD&E organisations.

The integrative function is about how the research from the other priorities is developed into a suite of products and services which are then delivered to potential users. This involves deciding on which users should be targeted and the appropriate suite of products and services. The responsibilities for these decisions are distributed across all the cotton RD&E organisations in line with their identified roles for the other four priorities. At the same time, the decisions are embedded at both the strategic (investment) and implementation (operational) levels within each organisation. At a strategic level, this involves deciding on the focus and level of investment in development and delivery. This includes specific development and delivery initiatives, such as myBMP. At the implementation level the focus, effort and approach to development and delivery is often decided at a project level and varies considerably.

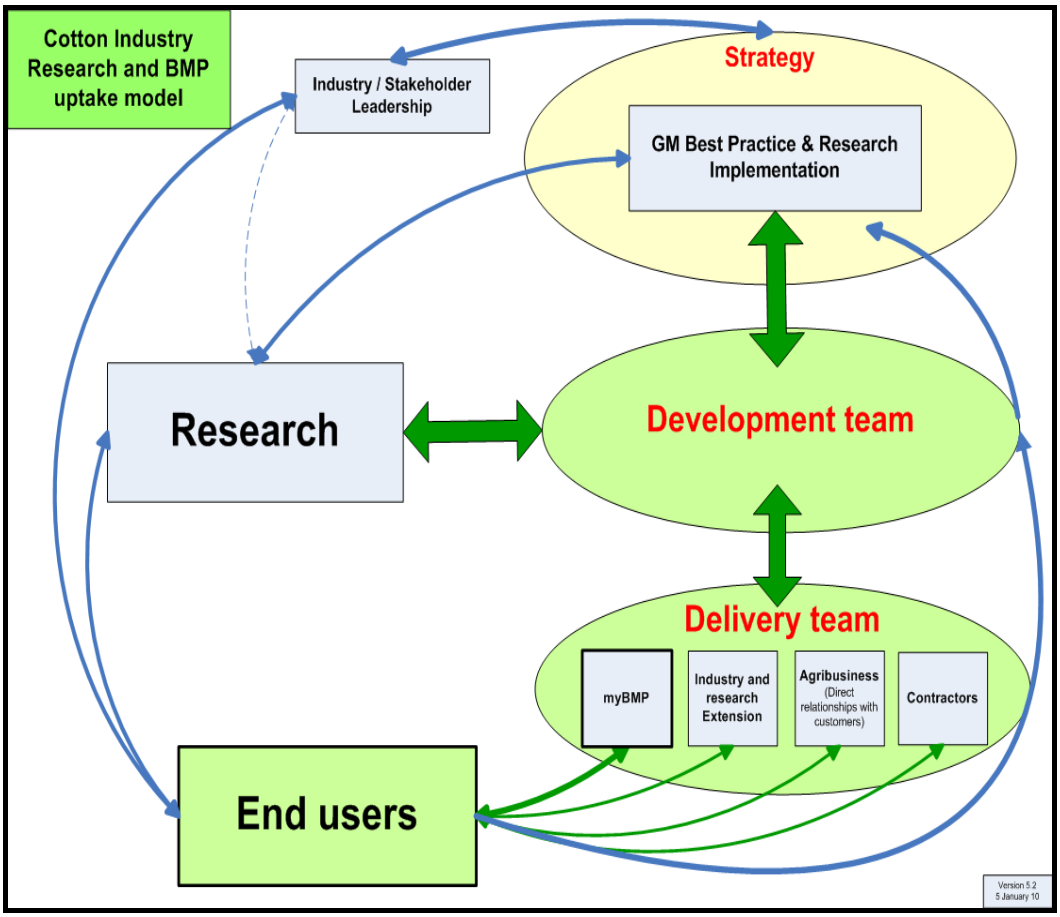
[6] This does not include extension which is covered in the development and delivery priority.

A rigorous, transparent and agreed framework is required given that all the RD&E stakeholders have major or supporting role in development and delivery.

A Development and Delivery Model is currently being developed by the Cotton CRC and CRDC to provide this framework (Figure 15). The model has the potential to improve coordination and the impact of cotton RD&E in both strategy and investment, and implementation. It is based on the principles that:

- Research increasingly requires development/integration to create useful knowledge products and services;
- Knowledge products and services are provided by a complex network of public and private organisations; and
- Public investment should focus on market failure.

Figure 15 Development and delivery conceptual model



Source: Cotton Catchment Communities Cooperative Research Centre

5.1.2 RD&E Implementation

Plant Varieties Implementation Roles

For the plant varieties there is a clear definition of roles, where CSIRO leads, CSD supports and others link.

Farming Systems Implementation Roles

The farming systems priority is more complex with CSIRO, Cotton CRC, NSW DPI and QDEEDI all playing major R&D roles. This creates both challenges in competition and coordination to optimise and focus the available capacity on RD&E priorities. Much of the R&D is participatory in nature, and has extension embedded in projects which creates unavoidable overlap with the development and delivery.

Integration is crucial to improving the quality of RD&E and leveraging capability. This will require integration of research and expertise between focus areas in the farming systems and other priorities as well as with other sectors is crucial.

An organising framework is required that facilitates coordination, specialisation and integration of research and capability.

People Business and Community Implementation Roles

This capacity building focus area covers people involved across the whole supply chain. At present this is a mixture of grower focused extension, led mainly by the Cotton CRC and NSW DPI with support/links from QDEEDI, CSD and CSIRO.

Responsibility for community innovation and adaptation is also distributed across the RD&E organisations. CSIRO has considerable research capability and QDEEDI, NSW DPI and Cotton Australia play an important role in areas such as drought management and structural adjustment. The Cotton CRC also has a suite of projects in this area.

A coordinating framework is required to provide tighter integration which can be achieved through the Development and Delivery Model.

RD&E capacity is the responsibility of all the RD&E stakeholders. The distribution of capacity against the RD&E priorities is discussed in the following section. The key challenges RD&E organisations face in building and maintaining capacity include:

- Attracting suitable staff due to market competition and funding cycles;
- Creating career paths that retain and develop staff; and
- Maintaining capability that is not currently funded and may be required in the future.

Product and Market Development Implementation Roles

Product and market development is led by Cotton Australia, Cotton CRC, CSIRO and CRDC under the Premium Cotton Initiative. Cotton Australia is active in market development as the peak industry body. CSIRO leads the technology development of cotton products, which also includes market research. The Cotton CRC has a suite of product development projects.

Cotton Australia, CRDC and Cotton CRC play a leadership role in demonstrating industry sustainability to markets, communities and government through myBMP and sustainability reporting. CSIRO also has capability in sustainability monitoring and reporting frameworks.

Development and Delivery Implementation Roles

The development and delivery implementation roles are distributed and creates are fragmentation where multiple RD&E organisations have overlapping responsibilities, approaches and capability. The challenges are similar development, delivery strategy and investment roles as previously discussed. An organising framework is required which could be provided by the Development and Delivery Model.

5.2 Human Capacity

Cotton RD&E maintains a suite of cotton specific expertise in cotton plant development, production and processing. This is complemented by a wider range of expertise held by CSIRO, QDEEDI, NSW DPI and others (such as stage agencies and universities not reported in this document). The capability of each is generally aligned with the roles identified in the previous section.

All cotton RD&E organisations report similar challenges in attracting, maintaining and developing capacity, which include:

- Having sufficient depth (experience and coverage) in expertise;
- Attracting and retaining capacity due to location, competition and tenure;
- Maintaining capacity when cotton investment priorities change; and
- Balancing developing cotton expertise against other priorities.

5.2.1 Plant Varieties Capacity

Cotton RD&E has well developed expertise in cotton varieties which is mostly held by CSIRO, CSD and their biotechnology company partners. The major challenges relate to succession and increasing competition between biotechnology companies to provide cost effective traits which improve cotton production, profitability and sustainability.

5.2.2 Farming Systems Capacity

In managing the future requirements for farming systems, RD&E capacity is more complex due to the need to integrate user demands, R&D lags, a mixture of cotton specific and wider expertise and research, development and extension from a paddock to landscape scales.

Cotton production expertise is distributed across CSIRO, QDEEDI, NSW DPI and universities, who also hold wider expertise that can be used for cotton and other RD&E. This creates challenges in optimising the use and development of the available expertise. Improved coordination between organisations, greater clustering (e.g. co-location, joint projects) and potentially specialisation by individual organisations can

increase efficiency and effectiveness, reduce duplication, sustain critical mass and improve role clarity.

R&D extension responsibility and capacity is currently distributed across all the cotton RD&E organisations, creating a complex and at times confusing operating environment. An organising framework is required to improve extension outcomes through better role definition, focused investment and improved governance. This could be provided by the development and delivery concept.

5.2.3 People, Business and Communities Capacity

Building capacity across the cotton supply chain, like the farming systems priorities, requires an organising framework to focus RD&E capacity.

There is limited cotton specific expertise in community innovation and adaptation held by the cotton RD&E organisations and there is a range of other organisations can provide capacity as well. An organising framework would assist in identifying and focusing capacity in this area.

Building RD&E capacity is more a function of cotton RD&E strategy and investment, rather than expertise, given the number of experienced RD&E managers in the sector. Potential improvements include:

- Developing whole-of-sector RD&E priorities in a participatory manner;
- Greater role clarification;
- Explicitly and transparently considering capacity requirements in strategy; and
- Longer term investment commitment.

5.2.4 Product and Market Development Capacity

The technological expertise associated with product and market development is largely held by CSIRO. This is appropriate provided CSIRO maintains strong international linkages and the RD&E is appropriately managed.

Capacity relating to brand management and demonstrating sustainability does not need to be cotton specific. This can be sourced as required, provided a small core expertise is maintained.

5.2.5 Development and Delivery Capacity

All the RD&E organisations have development and delivery capacity. This includes a combination of extension, communication, and product and service development expertise held by researchers, and specialist development and delivery staff.

Development and delivery capacity is being rebuilt after extension capacity was reduced in response to lower investment in recent times. This is surfacing questions regarding what level of capacity and expertise is required and how it should be organised.

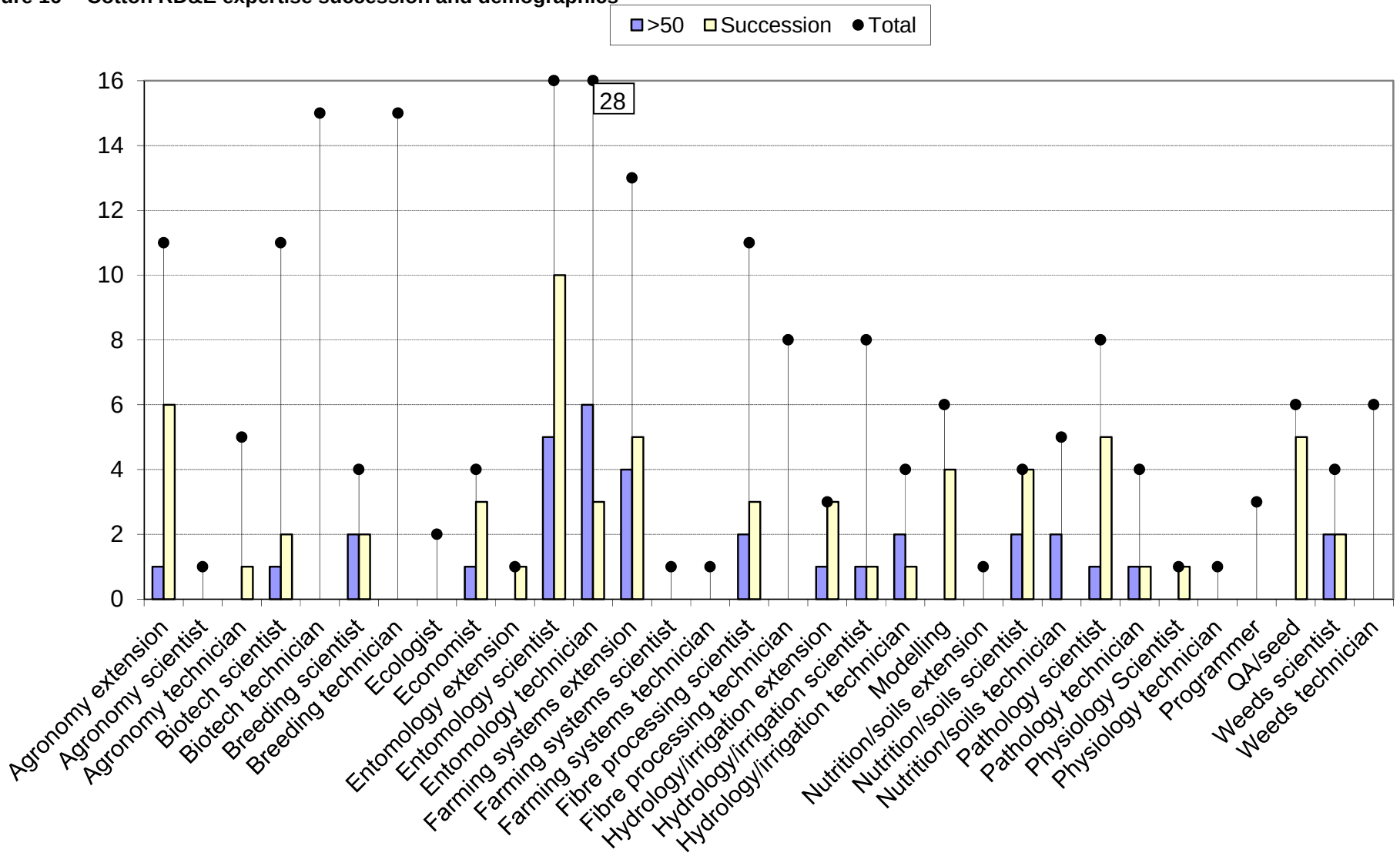
Succession and Demographics

Much of the expertise required for cotton RD&E is specialised and benefits from experience gained through sustained focus and effort over time. Consequently, the sector faces risks in maintaining capability due to demographics or concentration of expertise in a small number of people. Figure 16 indicates positions most at risk[7] are:

- Agronomy extension – 67% of positions (5 CSD and 1 NSW DPI) require succession planning, including one CSD staff member who is greater than 50 years of age;
- Breeding scientist – 50% of positions (2 CSIRO) require succession planning, including one staff member who is greater than 50 years of age;
- Economist – 75% of positions (3 CSD and 1 NSW DPI) require succession planning, including one NSW DPI staff member who is greater than 50 years of age;
- Entomology extension – 1 position (QDEEDI) requiring succession planning;
- Entomology scientist – 63% of positions (8 QDEEDI and 2 CSIRO) require succession planning, including one in CSIRO who is greater than 50 years of age;
- Hydrology/irrigation extension – 100% of positions (2 NSW DPI and 1 QDEEDI) require succession planning, including one staff member (NSW DPI) who is greater than 50 years of age;
- Hydrology/irrigation technician – 50% of positions (2 QDEEDI) require succession planning, one of who is greater than 50 years age;
- Modelling – 80% of positions (4 QDEEDI) require succession planning;
- Nutrition/soils scientist – 100% of positions (2 QDEEDI, 1 CSIRO and 1 NSW DPI) require succession planning, including two staff members (1 CSIRO and 1 NSW DPI) who are greater than 50 years of age;
- Pathology scientist – 63% of positions (4 QDEEDI, 1 CSD) require succession planning including one staff member (CSD) who is greater than 50 years of age;
- Physiology scientist – 100% of the positions (1 CSIRO) require succession planning;
- QA/seed – 63% of positions (5 CSD) require succession planning; and
- Weeds scientist – 100% of positions (3 QDEEDI, 1 NSW DPI) require succession planning, including two staff members (QDEEDI) who are greater than 50 years of age.

[7] Criteria for expertise risk is 50% people in positions are greater than 50 years of age or require succession planning

Figure 16 Cotton RD&E expertise succession and demographics[8]



[8] Source; Cotton Sector RD&E Working Group

5.3 Infrastructure

Cotton RD&E is well served by a range of infrastructure including glasshouses, laboratories, field sites, offices and IT systems, most of which RD&E organisations are committed to maintaining and developing into the future (Table 7 on page 13).

Key considerations in utilising and developing the available infrastructure to achieve the five RD&E priorities include:

- Building a critical mass of cotton RD&E capability (staff capability and infrastructure) by concentrating resources in a limited number of locations;
- Operating from locations where non-cotton RD&E occurs to build critical mass, facilitate interaction and generate cost efficiencies; and
- Increasing the attractiveness of cotton RD&E by locating staff in larger towns with better facilities.

5.4 Analysis Key Points

- The strategic direction of cotton RD&E is largely determined by CSIRO, CRDC and the Cotton CRC who account for 80% of investment. Effective engagement of all stakeholders in the sector's RD&E strategy and investment is essential.
- Cotton RD&E cannot fully fund all the cotton specific and broader expertise required to achieve the five RD&E priorities, particularly if total investment declines.
- The roles and capacity for the plant varieties and product & market development priorities are well defined and generally agreed.
- The roles and capacity for the farming systems, people, business and communities, and development and delivery priorities are less well defined and agreed due to the broad scope, breadth of required expertise and range of players.
- Coordinating frameworks are urgently required for the farming systems, people, business and community priorities. The Development and Delivery Model provides a conceptual foundation for the development & delivery priority, but requires buy-in and refinement by all the RD&E organisations to become operational.
- Cotton RD&E is well served for infrastructure and has access to considerable, relevant expertise. Clustering human capacity and infrastructure can improve RD&E effectiveness (critical mass and linkages) and efficiency (less duplication, cost reduction and leverage). The benefit-cost of potential changes towards specialisation need to be investigated and considered.

6. Change Plan

6.1 What Should this Strategy Do?

The general opinion of stakeholders consulted is that cotton RD&E has delivered considerable and sustained benefits to industry and is well organised and managed. The Cotton Sector RD&E Strategy is seen as an opportunity to develop an overarching strategy, owned by all, to guide future RD&E. Specific features and benefits stakeholders are seeking include:

- Establishing the strategic context:
  - Identify the key industry and RD&E drivers and their implications for RD&E; and
  - Show how cotton RD&E fits with national and other industry RD&E.
- RD&E goals/objectives/priorities:
  - Articulate the strategic direction for cotton RD&E – shared goals.
- Industry and RD&E vision and priorities (10-20 years) – high level signposts to inform decision making:
  - Major strategies and short (specific) to long term (general) outcomes – focus decision making and demonstrating achievements based on ROI and risk.
- Effective RD&E delivery:
  - Should be described and managed as a partnership;
  - Clarify and recognise the roles, responsibilities and contributions of major RD&E stakeholders, and provide transparency on decision making – strategic and operational clarity;
  - SWOT analysis of cotton RD&E to identify what needs to continue and what needs to be improved;
  - Define and integrate the mechanisms through which D&E delivers benefits to growers from research to ensure outcomes are achieved;
  - Provide information to finance, promote and attract people to cotton RD&E in order to attract resources; and
  - Avoid duplication, efficiency and build strategic linkages with RD&E in other sectors – do more with less.

6.2 Potential Improvements to Cotton RD&E Functions

There are five interdependent functions associated with cotton RD&E which can be improved to enhance effectiveness and efficiency:

- Strategy and investment– scope and approach to developing and funding strategy;
- Research – integrated research strategies & effective implementation frameworks;
- Development and delivery – coordinated research development and delivery;

- Capability – management of human capacity and infrastructure; and
- Review – monitoring, evaluation and reporting of RD&E for accountability and improvement.

6.2.1 Strategy and Investment Improvements

At present the whole-of-sector RD&E strategy is a combination of each RD&E organisation's RD&E plans, which are developed in consultation with each other. The strategies of CSIRO, Cotton CRC and CRDC are the most significant. Effective consultation is essential to ensure coordination and that each organisation understands the implications of the other plans.

Investment covers the sourcing and allocation of funds. Collective action can increase total funds as was achieved with the Cotton CRC. There are also risks associated with variable income due to levy collections, government funding cuts, and the ability to establish the next round of the Cotton CRC. The key allocation challenges are associated with balancing competitive-dedicated funding approaches, and long to short term investment. Potential improvements include:

- Each organisation strengthening its consultation strategy to improve coordination and commitment;
- Increasing the pooling of funds to increase leverage and reduce competitive behaviour through establishing a partnership framework (including other sectors) for each RD&E priority; and
- Increasing dedicated long term funding commitments to increase RD&E productivity through stronger RD&E provider capability.

6.2.2 Research Improvements

Current research varies in effectiveness across the five priorities. Implementation for the plant variety, and product and market development RD&E priorities are effective. However research for farming systems, people, businesses and communities; and development and delivery priorities, which are linked, are more complicated and evolving.

The critical issue is the presence of effective and owned framework(s) which integrate priorities and implementation arrangements through articulating:

- Research priorities, roles and responsibilities;
- Linkages to development and delivery;
- Governance and adaptation management (coordination and communication);
- Investment criteria/prospectus; and
- Implementation schedule and arrangements.

It is likely that a series of frameworks will be required to reflect the specific research strategies and stakeholders for each priority.

6.2.3 Development and Delivery Improvements

Coordination of research development and delivery is distributed across RD&E organisations, programs and projects. The function is currently being redeveloped after a period of lower investment.

The critical issue is the presence of an effective and owned single framework which integrates priorities and implementation arrangements through articulating:

- Research priorities, roles and responsibilities;
- Linkages to research;
- Governance and adaptation management (coordination and communication);
- Investment criteria/prospectus; and
- Implementation schedule and arrangements.

A single framework is required to ensure that all development and delivery is coordinated, and strategically and operationally aligned to maximise the potential benefits of research for industry.

The Development and Delivery Model provides a reasonable starting point for the development and delivery framework, which links with the research framework to create an overarching implementation structure.

The key challenge for both the research and development and delivery frameworks is getting buy-in, and ensuring that the collective and individual consequences are understood and agreed to. It will be important to each RD&E organisation to agree to the concept first, given that individual organisation's ability to commit and implement will vary and may take time.

6.2.4 Capability Management Improvements

Responsibility for managing capability lies with individual organisations and will inherently create tensions with funding bodies.

The RD&E priorities and implementation frameworks (i.e. research and development and delivery) will provide the foundation for capability decision making for individual RD&E organisations based on agreed roles and responsibilities. At the sectoral level potential improvements include:

- Explicit consideration of capability in RD&E strategy and investment;
- Clustering capacity at specific locations and/or organisations;
- Sharing capability, including exchanges, with other RD&E sectors; and
- Targeted undergraduate and post graduate initiatives.

6.2.5 Review Improvements

Effective consistent and comparable RD&E monitoring is essential to improved collaboration and coordination. This should occur at the following phases of the RD&E cycle:

- Strategy and Investment – common approach to determining risk and return (e.g. ROI, BCA, IRR); and
- Implementation – input-output reporting and impact evaluation.

The overall approach should be consistent with the national approaches being developed and promoted by PISC, Council of RDCs and the Rural R&D Council.

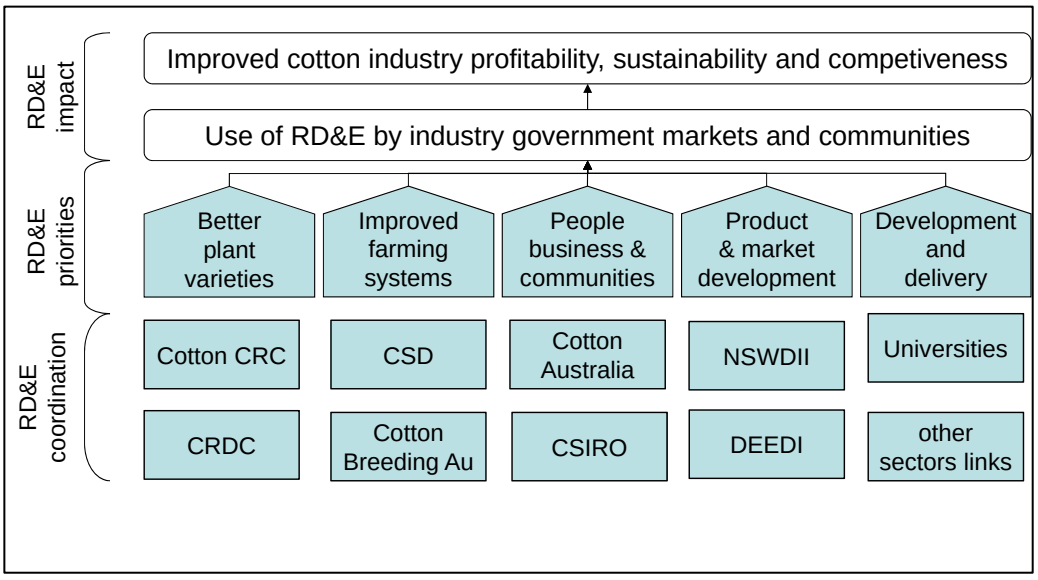
6.3 Options to Improve Cotton RD&E

Four options have been identified based on the potential improvements discussed above.

6.3.1 Option 1 – Status quo option

The status quo involves the continuation of current arrangements in cotton RD&E. That is each organisation continues to develop and implement their own strategies in consultation with each other. Collaboration in strategy and investment and implementation occurs as opportunities arise.

Figure 17 Status quo option



The strength of the option is that it builds on the existing approaches and does not require change other than when opportunities arise. The weakness is that it does not proactively address future challenges, including potential lower levels of investment, the ability of organisations to maintain capacity, and fragmentation in approach across and within the priorities. On this basis it is not recommended.

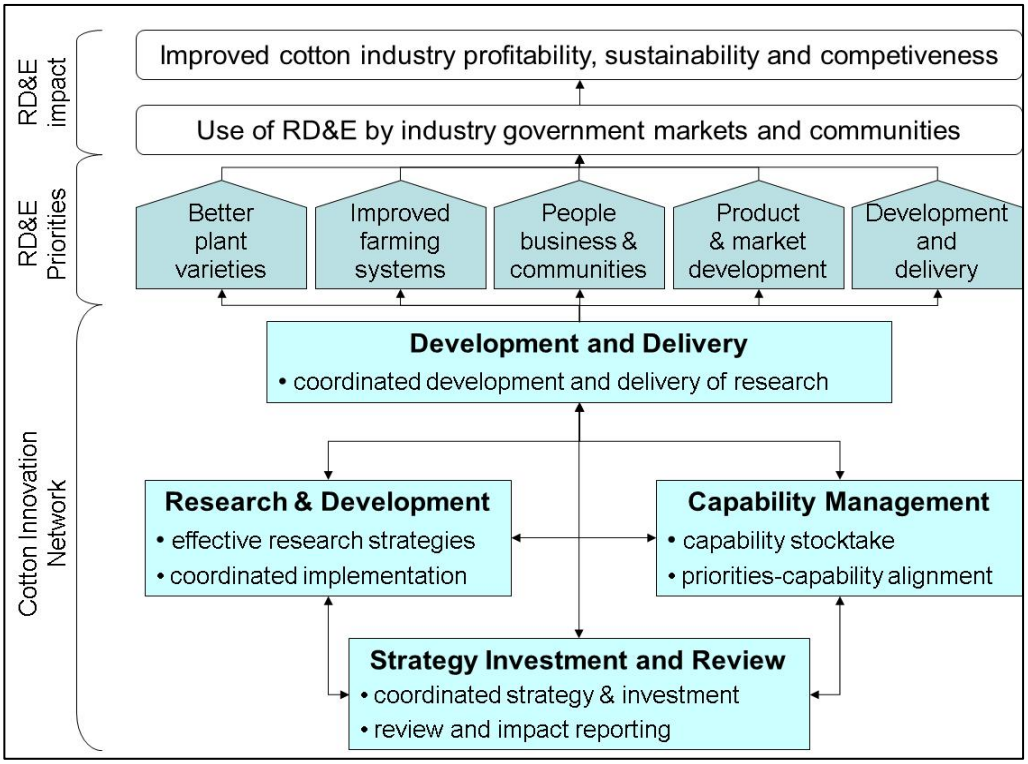
6.3.2 Option 2 – Cotton Innovation Network

The second option establishes a network responsible for strategic oversight, coordination and communication of cotton RD&E. This aims to improve cotton RD&E

through enhanced collaboration on the four interdependent functions; strategy and investment; implementation; capability management and review.

The network will consist of senior representatives from the major cotton RD&E organisations, and chaired by Cotton Australia. Senior representation is required to maintain a strategic focus and on-going commitment to the network and its operations. The advantage of Cotton Australia chairing the network is that it represents the key beneficiaries of cotton RD&E, is committed to the sector, and is independent relative to other cotton RD&E organisations. The key foci and outcomes for the network are shown in (Figure 18) and discussed below.

Figure 18 Cotton Innovation Network option



Strategy and Investment focuses on determining RD&E priorities for the cotton sector and aligning priorities and investment with other sectors and with cotton RD&E organisations. The key responsibilities are:

- Establishing the cotton sector RD&E priorities in consultation with the whole sector;
- Aligning priorities between cotton RD&E organisations to clarify roles and optimise investment;
- Facilitating engagement with stakeholders in each organisations strategy processes;
- Leading alignment and strategic partnerships and investments with other sectors, and

- Reviewing progress towards achieving the cotton RD&E priorities and facilitating integrated analysis, reporting and promotion of triple bottom line impacts of RD&E.

The **Research and Development** focuses on ensuring research strategies are aligned with the RD&E priorities; integrated across priorities; and linked to development and delivery. The key responsibilities are:

- Establishing focus areas and the research strategies for each of the priorities other than development and delivery. This includes reviewing existing strategies and identifying new research focus areas; and
- Aligning the roles between the RD&E organisations, including links outside the sector and internationally.

Capability Management focuses on ensuring cotton specific and broader human capacity and infrastructure is maintained and developed. Key responsibilities are:

- Triennial stocktake of capacity;
- Facilitating role clarification between RD&E organisations; and
- Coordinated recruitment and human capacity development across the sector.

Development and Delivery focuses on coordinating the development of research into products and services for delivery to growers, agri-business, markets, government and communities. Key responsibilities are:

- Establish and evolve a Development and Delivery coordination framework;
- Coordinate development delivery roles and responsibilities across the sector;
- Implement whole of industry development and delivery initiatives such as myBMP; and
- Facilitate innovation and capacity building in development and delivery across the sector.

The strength of this option is that there is a formal network providing strategic oversight and coordination for each of the major functions associated with cotton RD&E. This provides flexibility and focus for each of the functions to evolve as required.

However, the weakness is the network requires consensus and commitment to identify and implement changes that are realistic and improve cotton RD&E. This will require time, effort, commitment and openness to identifying and negotiating change.

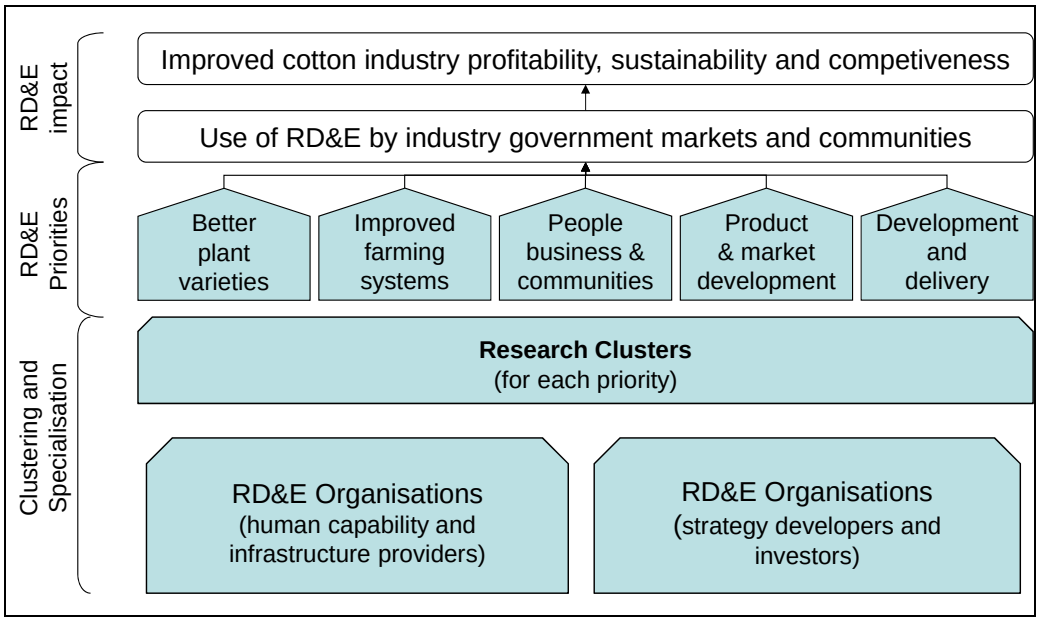
6.3.3 Option 3 – Capability Clustering and Specialisation

This option involves tighter integration of RD&E capability through clustering and specialisation to improve efficiency and effectiveness through:

- Improving clarity of organisational purpose;
- Reducing overlaps and conflicts;
- Building a critical mass of capability; and
- Creating more attractive career opportunities and better development pathways.

This would involve identifying the required research clusters and establish appropriate governance for their on-going development. This includes managing the clusters as whole of sector team to implement RD&E and on-going investment and development in human capacity and infrastructure (Figure 19).

Figure 19 Clustering and specialisation option



An important consideration will be integrating role definition and clarity between research clusters and RD&E organisations, which might include joint governance, concentrating in fewer locations and specialisation. Additionally, investment may need to be targeted as longer term, larger projects to research clusters to facilitate their formation and commitment to on-going development.

The strength of this approach is that it builds on current trends to proactively build and develop the capability required to deliver the RD&E priorities. A staged approach of forming the clusters as cross organisational coordinating frameworks (e.g. for each RD&E priority) before establishing more formal governance arrangements will allow the appropriate mechanisms and adjustments to be tested, refined and agreed to.

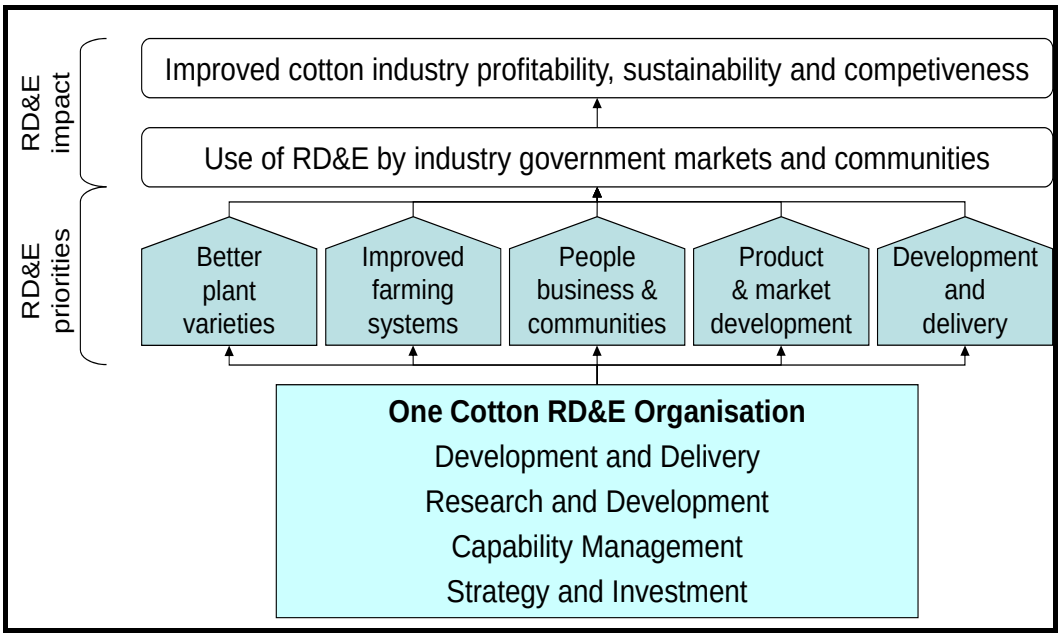
The weakness of this option is the considerable effort required to identify and implement the adjustments. Specialisation may create challenges in deploying the available capacity across the whole sector (e.g. QDEEDI staff working in NSW) and siloing leading to less collaboration and integration. There are also risks and costs associated with identifying, managing and adapting the research clusters.

6.3.4 Option 4 – Full Integration

The final option is based on the rationale that cotton RD&E is relatively small and that competition between RD&E organisations limits performance. Cotton RD&E investment and cotton specific capacity is pooled into a jointly owned institution similar to the Cotton CRC.

Under this option all cotton RD&E investment by the RD&E organisations would be pooled into a single fund. Cotton specific human capacity would be seconded to and infrastructure leased by the joint venture and potentially fully transferred in the future (Figure 20).

Figure 20 Full integration option



The joint venture would be responsible for building strategic partnerships and investments with other sectors. The available funds would then be allocated in line with the RD&E priorities. This involves commissioning RD&E from the cotton specific capability held by the joint venture, as well as other RD&E organisations. The joint venture governance would come from a board representing the cotton RD&E organisations and have a dedicated management team.

The strength of this option is that a single entity is responsible for cotton RD&E funds and cotton specific capacity that is on-going, dedicated and focused on cotton RD&E and can effectively leverage the available resources.

The key weakness is the considerable effort required and barriers to be overcome in establishing the joint venture. There are also risks that the existing RD&E organisations lose flexibility and control, leading to potential exit from cotton RD&E.

6.4 Preferred Option

Option 1 (status quo) is not preferred given that it does not address existing challenges facing cotton RD&E. Option 4 (Full Integration) addresses the existing challenges by creating a dedicated on-going joint venture which manages funds and key capabilities for the whole sector. While attractive, the scale of change is such that it is not feasible in the short to medium term.

Option 2 (Cotton Innovation Network) is a logical evolution of current arrangements, introducing strategic oversight and coordination of RD&E at a sectoral level by a network of senior representatives. This approach recognises that cotton RD&E is a loose federation of organisations where improvements require consensus, negotiation and consideration of sectoral, as well as individual needs and circumstances. Maintaining momentum and commitment is essential to ensure fundamental drivers such as tighter fiscal futures, fragmentation, overlapping roles and declining capacity are addressed over time.

Option 3 (Clustering and Specialisation) offers an alternative to the network approach through identifying and then developing research clusters to achieve the RD&E priorities. This approach proactively addresses the fundamental drivers facing cotton RD&E, particularly on-going structural change in the focus, capability and investment of RD&E individual organisations. However, it is not possible to identify the implications of any adjustment until further design and negotiation is completed.

Option 2 (Cotton Innovation Network) is preferred by the Working Group for implementing this RD&E strategy. The option is a logical improvement to cotton RD&E coordination that is realistic and sound. Opportunities for clustering and specialisation may emerge from the network over time. It is premature to commit to this at present given the need to understand and negotiate the implications of any adjustment.

7. Implementation Arrangements

The Cotton Innovation Network will be implemented in four stages:

1. **Scoping** – developing the key elements of the network;
2. **Buy-in** – formal agreement to the network by each RD&E organisation;
3. **Coordination** – initial implementation; and
4. **Adaptation** – on-going coordination and facilitating adaptation, if required.

7.1 Scoping

Scoping involves establishing the purpose, tasks, outcomes for the key elements and governance of the network. The scoping phase will be completed after the PISC RD&E Sub-Committee agree to the Cotton Sector Strategy and the RD&E organisations members agree to the key elements and governance of the Cotton Innovation Network.

The key elements associated with the preferred option relate to the RD&E functions that the network will strategically oversee and coordinate, that is: strategy and investment; research; development and delivery; and capability management.

The purpose, key tasks and associated outcomes for each element are described below.

7.1.1 Strategy and Investment

Purpose

- Coordinate cotton RD&E strategy and investment; and
- Build strategic partnerships and investment with other strategies and sectors.

Outcomes

- Agreed framework for coordinating and consultation on cotton RD&E strategy and investment; and
- Partnership frameworks with grains and cross-sector (e.g. climate change and water use in agriculture) RD&E strategies.

Tasks

- Establish a timeline for consultation and coordination on cotton RD&E strategy and investment that aligns the planning cycles of each RD&E organisation;
- Establish an in-principle agreement with the Grains and Water Use in Agriculture RD&E Strategies documenting shared goals, outcomes, potential collaborations and a coordination mechanisms; and
- Establish a mechanism for coordinating with NRM and climate change sectors.

7.1.2 Research and Development Framework

Purpose

- Coordinate cotton research and development.

Outcomes

- Agreed framework(s) for coordinating cotton research and development.

Tasks

- Articulate the existing and emerging research strategies underpinning the focus areas in the plant varieties, farming systems, people, business and communities, and product and market development strategies;
- Identify the research clusters (human capacity and infrastructure) that are required to deliver on each focus area over the next five years;
- Establish coordinating mechanisms (new and existing) for each research cluster; and
- Establish a common approach to RD&E investment analysis and impact monitoring and evaluating RD&E.

7.1.3 Capability Management Framework

Purpose

- Coordinate cotton RD&E capability management.

Outcomes

- Agreed framework for coordinating cotton RD&E capability management.

Tasks

- Conduct gap analysis of roles and capabilities against the Research & Development and Development & Delivery Frameworks;
- Develop plan for aligning roles, filling gaps and transferring excess capability;
- Establish timeline for on-going coordination of capability management;
- Create capacity building plan for cotton RD&E; and
- Scope triennial capability stocktake.

7.1.4 Development and Delivery Framework

Purpose

- Coordinate cotton RD&E development and delivery.

Outcomes

- Operational Development and Delivery framework;
- Coordinate development delivery roles and responsibilities across the sector;

- Implement whole of industry development and delivery initiatives, such as myBMP; and
- Facilitate innovation and capacity building in development and delivery across the sector.

Tasks

- Establish an agreed framework for coordinating Development and Delivery which integrates and aligns existing research and development, and delivery programs; and
- Adaptive management of framework.

7.1.5 Network Governance

The network will be a formal committee for cotton sector RD&E collectively established and operated by cotton RD&E organisations. It will also be recognised as the entity responsible for the Cotton Sector RD&E Strategy by the PISC RD&E Sub-Committee, replacing the Working Group.

Membership will include the following cotton sector RD&E organisations, that is: Cotton Australia; Cotton RDC; Cotton CRC; CSD; CSIRO; QDEEDI; NSW DPI; and a Council of Agricultural Deans representative(s) on behalf of universities. Representatives from the Department of Agriculture Fisheries and Forestry, rural RD&E organisations and other organisations may also participate in the network as required.

Each member organisation will be entitled to one formal representative who should occupy a board or executive position in their organisation. This will ensure appropriate representation by decision makers from the member organisations, and reflects the strategic, rather than operational, focus of the network. Other member organisation representatives will participate in the network and its activities as required.

The network will be chaired by a Cotton Australia Board member to provide independence, and maintain the network's focus on achieving the cotton sector RD&E priorities.

7.2 Buy-in

Once the network elements and governance have been designed, they should be formally agreed to by the RD&E organisations. This involves each member organisation signing the network terms of reference (elements and governance) by October 2011.

7.3 Coordination

This stage focuses on establishing the network as a functioning entity and implementing immediate and practical coordination tasks identified for each element.

In the first year, the network will aim to meet formally with all members attending in order to:

- Develop a shared understanding of the Cotton Sector RD&E Strategy;
- Identify immediate actions to address critical issues;
- Facilitate coordinated investment across the sector for 2012-13; and
- Build strategic partnerships with other sectors and strategies.

7.4 Adaptation

The final stage involves on-going coordination across the four elements, revision of the RD&E Strategy, and adaptation of RD&E functions. It is premature to specify what the adjustments may be, however potential actions include:

- Establishing new programs to optimise investment;
- Strengthening research clusters to build critical mass and improve performance; and
- Facilitating greater role clarity for RD&E organisations.

7.5 Monitoring Reporting and Review

The challenge in implementing the change plan should not be under estimated. Implementation will progressively surface the key RD&E coordination mechanisms required, and clarify the roles of RD&E organisations with flow-on implications on investment and capability, impacting individuals and organisations. Critical success factors and associated key performance indicators are listed in Table 13.

Table 12 Critical success factors and key performance indicators

Critical Success Factor	Key Performance Indicator
PISC agencies commit to the Strategy	◗ Sign-off by PISC agencies to Cotton Sector RD&E Strategy ◗ PISC accept Strategy
Formation of Cotton Innovation Network	◗ Agencies agree to terms of reference
Network functions effectively	◗ Member actively participate and support network ◗ Cotton RD&E improves ◗ Members value network

8. Approvals

8.1.1 Cotton Australia

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.2 Cotton Cooperative Research Centre

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.3 Cotton Seed Distributers

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.4 Cotton Research and Development Corporation

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.5 CSIRO

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.6 Department of Agriculture Fisheries and Forestry

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.7 Department of Employment Economic Development and Innovation

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
4. Endorsed		
5. Endorsed with comments		
6. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.8 Department of Primary Industries

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

8.1.9 University Sector

Does this agency have an interest in the Cotton Sector RD&E Strategy?	Yes	No
Agency Position (please circle and provide comment for options 2 or 3 if chosen)		
1. Endorsed		
2. Endorsed with comments		
3. Not Endorsed with comments		
Name		
Position		
Signature		

Appendix A

Cotton Sector RD&E Strategy Working Group

Name	**Organisation**
Mr Bruce Finney	Cotton RDC Narrabri
Mr Philip Armytage	Cotton CRC Narrabri
Dr Robert Mensah	Department of Primary Industries Narrabri
Dr Lewis Wilson	CSIRO Plant Industry Narrabri
Dr Emma Colson	Department of Employment, Economic Development and Innovation Toowoomba
Dr Alex McBratney	University of Sydney representing Council of Agricultural Deans Sydney
Mr Stephen Ainsworth	Cotton Seed Distributors Wee Waa
Mr Greg Kauter	Cotton Australia Sydney

Appendix B

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Appendix C

Key Informants Consulted

Name	**Organisation**
Philip Armytage	Cotton CRC
Ken Flower	Cotton CRC
Trevor Gibson	NSW Department of Primary Industries
Dr Lewis Wilson	CSIRO Plant Industry,
Dr Emma Colson	QDEEDI
Dr Alex McBratney	University of Sydney representative for all Universities
Stephen Ainsworth General Manager	Cotton Seed Distributors
Greg Kauter	Cotton Australia
Rohan Boehm	Cotton RDC
Bruce Pyke	Cotton RDC
Burce Finney	Cotton RDC

Appendix D

Stakeholder Workshops

Cotton Sector RD&E Strategy Workshop - Friday 15 October 2010

Purpose

- Establish the RD&E objectives and change plan (RD&E objectives – capability alignment) for the cotton sector RD&E strategy
- Identify additional information and sources required to complete the cotton sector RD&E strategy

Agenda

- Introduction
  - Purpose of the cotton sector RD&E plan and workshop
- RD&E objectives
  - Develop agreed RD&E vision and objectives for the cotton sector
- Gap analysis
  - What are the gaps in capability required to deliver the RD&E objectives
- Change plan
  - Identify improvements to RD&E to ensure the sector has the required capability to deliver the RD&E objectives
- Additional information
  - What additional information is required to complete the plan
- Next steps
  - Agreed actions

Attending

- Angela Bradburn – GHD
- Bruce Finney – Cotton Research and Development Corporation
- Bruce Pyke - Cotton Research and Development Corporation
- Delia Dray – Department of Primary Industries

- Emma Colson – Department of Employment Economic Development and Innovation
- Greg Kauter – Cotton Australia
- Jan Paul van Moort - GHD
- Ken Flower – Cotton CRC
- Lewis Wilson - CSIRO
- Peter Ottesen – Department of Agriculture Fisheries and Forestry
- Robert Mensah - Department of Primary Industries
- Trevor Gibson - Department of Primary Industries

Apologies

- Alex McBratney – University of Sydney
- Philip Armytage – Cotton CRC
- Stephen Ainsworth - CSD

Cotton Sector RD&E Strategy Workshop – 1 December 2010

Purpose

- Review the draft cotton sector RD&E strategy
- Identify actions to complete the strategy and submit to PISC

Agenda

- Introduction
  - Purpose of the strategy
  - Overview of the workshop
- RD&E Priorities
  - Review four RD&E priorities and associated outcomes and focus areas
- Gap Analysis
  - Confirm accuracy of data used
  - Review implications of gap analysis
- Change Plan
  - Review proposed improvements
  - Scope implementation of improvements
- Approvals
  - Identify approvals required and timing for each organisation
- Next Steps
  - Actions arising

- Timing for submission to PISC

Attending

- Bruce Finney – Cotton Research and Development Corporation
- Emma Colson – Department of Employment Economic Development and Innovation
- Greg Kauter – Cotton Australia
- Jan Paul van Moort - GHD
- Julie Reynolds – GHD
- Lewis Wilson - CSIRO
- Philip Armytage – Cotton CRC (by telephone)
- Robert Mensah - Department of Primary Industries
- Stephen Ainsworth - CSD
- Trevor Gibson - Department of Primary Industries

Apologies

- Bruce Pyke - Cotton Research and Development Corporation
- Delia Dray – Department of Primary Industries
- Alex McBratney – University of Sydney
- Peter Ottesen – Department of Agriculture Fisheries and Forestry

Cotton Sector RD&E Strategy Workshop – 4 March 2011

Purpose

- Develop the preferred change plan option
- Agree on implementation arrangements
- Determine task to finalise the strategy

Agenda

- Introduction
  - Workshop purpose and approach
  - Overview of current change plan options
- Change Plan Option Selection
  - Confirm the outcome sought from the Cotton Sector RD&E Strategy
  - Review the four current options against the outcomes
  - Develop the preferred change plan option
  - Review four RD&E priorities and associated outcomes and focus areas

- Change Plan Option Scope
  - Scope the preferred option outcomes, structures, processes and roles and responsibilities
- Change Plan
  - Review proposed improvements
  - Scope implementation of improvements
- Implementation Arrangements
  - Establish the short, medium and long term implementation tasks and responsibilities
- Next Steps
  - Agree on additional information to be included in strategy and tasks and responsibilities
  - Agree on how individual organisations will sign-off on the strategy

Attending

- Bruce Finney – Cotton Research and Development Corporation
- Emma Colson – Department of Employment Economic Development and Innovation
- Greg Kauter – Cotton Australia
- Jan Paul van Moort - GHD
- Julie Reynolds – GHD
- Lewis Wilson - CSIRO
- Philip Armytage – Cotton CRC (by telephone)
- Robert Mensah - Department of Primary Industries
- Trevor Gibson - Department of Primary Industries

Apologies

- Bruce Pyke - Cotton Research and Development Corporation
- Delia Dray – Department of Primary Industries
- Alex McBratney – University of Sydney
- Peter Ottesen – Department of Agriculture Fisheries and Forestry
- Stephen Ainsworth – Cotton Seed Distributers

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