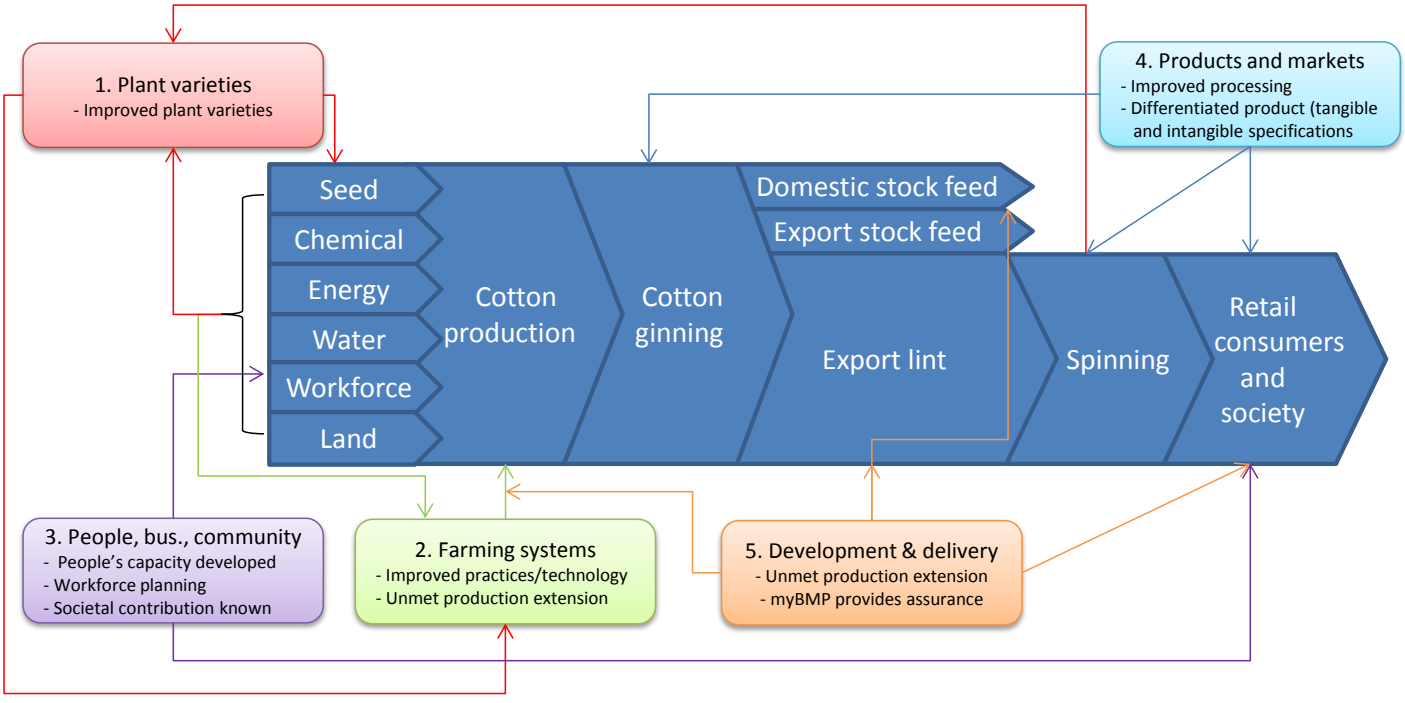
Cotton Research Pathways Overview

RD&E and the Cotton Industry 2029 Vision

Element	Achieving	Means	Measured by	Where RD&E
Differentiated	World leading supplier of an elite quality cotton highly sought in premium markets	Improved quality matched to markets	Trends in quality of crop and sales	Creates technologies and practices
Responsible	Producer and supplier of the most environmentally and socially responsible cotton on the globe	Globally demanded and demonstrated performance	myBMP grower adoption and market demand/recognition	Develops assurance systems
Tough	Resilient and equipped for future challenges	Sufficient resources &rate of innovation	Industry profitability and productivity	Unpacks what tough means
Successful	Exciting new levels of performance that transform productivity and profitability of every sector of industry	Continuous innovation through the supply chain	Financial, human and environmental health of firms & institutions	Creates technologies and practices
Respected	An industry recognized and valued by the wider community for its contribution to fibre and food needs of the world	Communication of value and open/ ethical issues management	Trends in stakeholder satisfaction	Unpacks what respect is
Capable	An industry that retains, attracts and develops highly capable people	Excellent firm HRM and coordinated WFP across industry	Workforce supply in greater than demand	Builds capacity

Cotton Research Pathways in the Cotton Supply Chain



BETTER PLANT VARIETIES RESEARCH PATHWAY

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

Research development and extension	Capability	Outcomes
Concept • Germplasm enhancement and pre-breeding linked to a high performing, breeding team. The development of highly productive, high fibre quality, varieties agronomically adapted with effective disease and pest resistance. **Elements** • Consistent and predictable funding ensuring a continuous effort across variable seasons and sites. • Forward-looking strategic plan with flexibility to address all circumstances including appearance of new and exotic disease and pest problems. • Effective and efficient combination of infrastructure, skills and capabilities. • Application of minimum critical mass of breeders with integrated germplasm development team to ensure consistent effort over time **Linkages** • Highly effective and close linkage between breeding and commercial seed production, marketing & field support teams, and industry. • Availability or development of novel GM traits locally or by multi-national companies for use by industry. • Effective stewardship of GM traits through monitoring of performance and impact on target pests.	**Human capacity** • Team of plant breeders and molecular biologists with integrated expertise in pathology, fibre, entomology, cell biology and biochemistry. • Efficient field and laboratory support teams skilled at either multi-site trialling or molecular biology. **Infrastructure** • Good field research site at Narrabri and a network of off-station sites for assessment of breeding material. • Modern molecular laboratory in Canberra. High throughput screening facilities for efficient marker assisted breeding. **Linkages** • National & international linkages around breeding, fundamental biology and development of cotton genome sequence and map. Local and national linkages with crop protection agronomy and fibre technology. • Farming systems (GxM) and product - marketing development. **Flexibility** • Cotton specific: experienced scientists with good strategic directions.	**Problem definition** • Need for commercial varieties with improved performance supporting Australia's reputation as a reliable supplier of consistent high quality cotton globally. – Changed fibre functionality (e.g. elasticity) reflecting consumer demand for fabrics. – Greater disease resistance. – Increased yield and fibre quality through better adaptation to abiotic stress giving WUE and heat stress tolerance. – Increased varietal specific management and strong regional fit to environment. – Continued improvement in insect control through deployment of next generation resistance to both leaf-chewing and sap-sucking insects. • Cotton becomes a more reliable summer crop for growers • Need to continuously evaluate opportunities to increase seed value (oil / meal) reflecting its importance as a 2nd product. **Benefit** • Cotton growers and regional economies with improved profitability. **Horizon and risk** • Breeding and trait cycles are both averaging about eight years so research teams need strategic activities over at least 15 year cycles. Risks include: – Appearance of new pests or diseases or investments in traits with insufficient market signal. – Availability of 3rd party owned technology / GM traits into the future. – Limitations on yield and fibre quality improvement.

IMPROVED FARMING SYSTEMS RESEARCH PATHWAY

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

Research, Development and Extension	Capability	Outcomes
Concept Targeted and integrated R, D&E to maximise productivity and profitability of cotton farming systems, including utilisation of BMPs to ensure industry responsiveness to changing climate, pest spectra or input costs. **Elements** Farming systems that maximise production and sustainability through the efficient use of resources • Improved understanding of resource utilization • Improved farming practices that maximize carbon accumulation and minimize energy consumption • Incorporation of complementary crops • Assurance cotton farming systems can adapt to climatic variability Crop protection practices that integrate genetic, cultural and chemical tools for management and biosecurity preparedness. • Improved understanding of the ecology of diseases and their interaction with farming systems • Improved understanding of the biology and ecology of weeds and insects to ensure that better management decisions • The integration of a range of control strategies (incl. biopesticides and semiochemicals) to reduce the reliance on any one strategy • Sustainability of transgenic technology in cotton farming systems • Awareness and preparedness for exotic pest, disease or weed incursions or emergence of new pests due to chemical resistance. Landscapes and biodiversity impacts are minimised through increased awareness of the benefits of landscape management. MERGE Ecology and native vegetation management in cotton farming systems **Linkages** • Effective linkage between Farming Systems R, D&E teams in NSW and Qld. • Effective linkages between researchers and the D&D team to facilitate the two way flow of information • Enhanced delivery pathways to facilitate rapid dissemination and uptake of information to industry • Strong linkages with grains, horticulture, plant biosecurity, water use and soils RD&E teams and National RD&E frameworks	**Human capacity** • Crop protection specialists with expertise in pathology, virology, microbiology, entomology, weed sciences, phytochemistry and molecular biology. • Farming systems specialists with skills in soil science, agronomy, irrigation, system analysis and economics • Extension teams to facilitate information transfer and uptake • Efficient field and laboratory support teams. • Consistent and predictable funding to ensure a continuous effort across variable seasons and sites. • Forward-looking strategic plan with flexibility to address all scenarios. • Effective and efficient combination of infrastructure, skills and capabilities. • Strategies to ensure that the industry can recruit, develop and retain staff in all key production areas **Infrastructure** • Key field research stations throughout NSW and Qld and a network of off-station sites for conduct of trials. • Modern laboratory facilities for diagnostics, research and pest monitoring. **Linkages** • To agencies and individuals with high level specialist skills in appropriate areas. • To plant breeders, private consultants and agribusiness professionals • To regulatory and government bodies • To D&D team to facilitate the flow of information to to facilitate practice change on farms • To commercial partners	**Problem definition** • Need for improved and sustainable farming systems to drive industry productivity and profitability. – New commercial cotton varieties to optimize resource efficiency – Improved soil environment for sustained production – Improved energy efficiency in the carbon economy – Improved natural resource and landscape management outcomes at farm and catchment levels – Maintenance of integrity of transgenic cotton. – Integrated management practices for endemic insect pests, diseases and weeds and pre-emptive strategies for exotics. – Minimize and manage resistance to herbicides, insecticides and fungicides – Manage the risk of greater regulation of insecticides, herbicides and fungicides **Benefit** • Cotton growers and regional economies with improved profitability. • The industry recognised for its land stewardship • Improvements in practices to reduce inputs, improve soil health, reduce emissions or sequester carbon • Improvement in integrated management practices • Improved resistance management strategies . • Improved life cycle analysis of cotton farming systems **Horizon and risk** • Long-term integrated solutions including rotations and integration into other farming systems. • Possible resistance or appearance of new pests, diseases or weeds

PEOPLE BUSINESS AND COMMUNITY RESEARCH PATHWAY

Outcome: R&D supporting an industry with a skilled, innovative, adaptable workforce and sustainable communities

Research development and extension	Capability	Outcomes
Concept • Goal (over 3 years) to shape the current loose amalgam of projects into a coherent program that researches the social dimension of the cotton industry and builds individual, business and community capacity through improved coordination and targeted extension. **Elements** • Monitoring, evaluating and reporting industry performance – Environmental assessments every 3-5 years including adapting assessment frameworks to include emerging methodologies and community expectations – Socio-economic assessments that identify and monitor industry progress towards achieving the cotton 2029 vision elements (resilient, responsible, tough, successful, respected and capable) • Workforce planning and development – Labour market analysis to identify cotton's need – Facilitating coordination of WFP policies and development programs (with stakeholders not in Cotton Innovation Network) • Leadership and social capital – Targeted leadership programs – Support community/industry organizations to build social capital through local problem solving **Linkages** • Other cotton strategy research pathways and R&D capability management • Rural, education, development, community, environmental, indigenous and health RD&E and related policies and programs at national and state scales	**Human capacity** • Education, sociology, psychology, economics and environmental disciplines • Systems analysis and demographics • Community development • Participatory and facilitatory approaches • Leadership and governance • Program management **Infrastructure** • Coordinated approach between CA and CRDC • Appropriate process for commissioning; – Expertise not held in Cotton Innovation Network – Local problem solving by community and industry groups (facilitated capacity building with grants) **Linkages** • VET sector, leadership and education • Regional, indigenous, community development, health, mining • CMA/NRM • CGAs • Wincott • Community groups • Private and tertiary sector to provide flexibility and capability required (not cotton specific)	**Problem definition** • Industry workforce – Industry faces skills and labour shortages influenced by boom and bust cycles – Coordinated capacity building policies and programs to develop attract people, develop skills and retain labour in the cotton industry • Cotton in the economy and society – Industry reputation affects cotton's social licence and freedom to operate – Increased evidence based understanding of cotton's role and contribution to the economy and society • Strengthening social capital – Cotton communities want to understand how to adapt to on-going market and environmental and policy pressures – Develop individuals and community organizations' capabilities and leadership skills to contribute to their own business, community and industry benefit **Benefits** • Build capabilities of people to contribute to their own business and community • Strengthened cotton communities • Cotton's contributions and value understood and supported by sound information to enhance industry R&D decision making and reputation **Horizon and risk** • Benefits may be lagged and/or intangible • Ability to provide cost-effective, timely and relevant information and services • Requires coordination structures that engage stakeholders outside of Network

PRODUCT & MARKET DEVELOPMENT RESEARCH PATHWAY

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

Research development and extension	Capability	Outcomes
Concept • R&D supports the long-term industry objective of becoming the producer and supplier of the most environmentally and socially responsible high quality cotton on the globe Elements • A research strategy that systematically connects plant genetics, agronomy, material science, processing, supply chain, waste, socio/environmental management and market research for efficiency, quality and value gains. • Providing information on intangible and tangible aspects of cotton that supports industry to develop and adopt assurance systems as they develop. • Funding supports capability and infrastructure required to drive scientific and technical initiatives in support of fibre quality and new cotton end-use research. • International research collaboration where this best supports the outcome and industry. Linkages • Strong linkage with cotton industry R&D including plant breeding, farming systems, people, development and delivery, *my*BMP, environmental footprint and industry traceability and marketing initiatives. • Close relationships with the international cotton community including fibre quality researchers, commercial spinners and textile machinery and instrument manufacturers. • Communication with major apparel brand-owners regarding changing market needs including sustainable production certification schemes and CSR agenda. • On-going liaison with environmental regulators to inform cotton R&D	Human capacity • Team of experienced and focused materials, agricultural and biological scientists, and engineers. Team is well supported by laboratory, technical trade staff, market and supply chain expertise. • Skills in value chain - market assessment and assurance out-sourced. • Succession plans developed for securing core R&D skills. Infrastructure • Industry scale ginning, spinning and textile processing equipment, supported by well-equipped workshop. • Specialised instrumentation to measure standard and non-standard fibre properties including moisture, strength, maturity and fineness. • Collaboration to expand capacity and/or access and evaluate new technologies in fibre science and processing Linkages • Excellent linkage with local cotton breeders and crop physiology scientists. • Effective linkages with industrial market chain both within Australia and internationally. • Capability provides technical stewardship of high quality Australian fibre in overseas (and local) markets. Flexibility • Capability can be applied to problems at any point along the supply chain • Capability can be applied to other fibres, materials and industries.	Problem definition • Gentler ginning technology resulting in globally recognized reliably consistent, high quality Australian export cotton specifications • Application of new fibre test methods, such as measuring fibre fineness, maturity and elongation, to differentiate Australian cotton from other export growths. • Understanding differences in the cellulose structure of Australian cotton fibre and connecting these with an understanding of cellulose synthesis. • Technical support of Australian fibre in customer mills. • Product traceability and supply chain logistics improved through innovation in information technologies and management systems Benefits and beneficiaries • A collectively focused, well-resourced research collaboration producing world leading science that improves industry best practices, systems and performance. • Improved reputation, competitive advantage and commercial potential for Australian cotton in key markets. • Australian researchers, cotton growers, ginners, merchants and customers of Australian cotton. • Consumers - access to sustainably produced food and fibre Horizon and risk • Horizons aligned and extend with strategic objectives of industry; longer term objectives extend 10+ years from concept. • Changes to international textile and Australian cotton industry operating environment include tangible and intangible elements • Changes to strategic R&D objectives • Research outputs of technologies, practices and industry initiatives, such as *my*BMP, not adopted or supported by end-users. • Risks to industry marketing approaches from volatility in production

DEVELOPMENT & DELIVERY RESEARCH PATHWAY

Outcome: the cotton sector improves through the delivery of products and services based on the ongoing development of new and existing research

Research development and extension	Capability	Outcomes
Concept • Increase the adoption of the results of cotton research and innovation through focused "development and delivery". • Development and Delivery services the unmet cotton R&D information needs of growers and the industry to improve practices, productivity, competitiveness and environmental performance. Elements • Access to R&D information and specialist technical R&D knowledge. • Local facilitation support for R&D information access where demand is not met commercially. • Inclusive of delivery of R&D through the *my*BMP program and its ongoing improvement. • Facilitation of industry R&D communication between researchers, growers, crop consultants, agribusiness, NRM and industry organisations. • Capacity to respond to emerging or emergency issues. Linkages • Strong connections to farming systems R&D and human capacity initiatives within people business and community priorities • Multiple complimentary delivery pathways by which information and knowledge exchange occurs. • Agribusiness • Crop consultants • Grower groups • Grains industry RD&E • NRM organisations • Government programs	Human capacity • Implemented by a team of skilled professionals responsible for integrating, developing and extending the results of industry R&D. • Team is well supported by technical, knowledge management, IT and marketing expertise. • Resourced through an unincorporated joint venture of principle investors and managed in conjunction with members of the Cotton Innovation Network. Infrastructure • Limited requirements resourced by principle investors Linkages • Agribusiness • Crop consultants • Grower groups • NRM organisations Flexibility • Capability can support government programs e.g. NRM water use efficiency, CFI and emergency response issues e.g. biosecurity, natural disaster	Problem definition • Development and Delivery campaigns that service the priority needs of individual growers, consultants, cotton regions and the industry. • Impact measured by adoption of research, BMPs and changes in industry performance measures. Benefits and beneficiaries • An efficient and effective pathway for the delivery of the results of industry R&D and innovation. • A profitable and competitive industry responding to market and community needs • An industry evidencing its responsibility for improving environmental performance • The Australian cotton industry maintains a social licence to operate. • Research organisations can focus resourcing emphasis on research. Horizon and risk • Horizons aligned and extend with strategic objectives of Cotton Innovation Network and principle investors; 5+ years from concept. • Changes to Australian cotton industry operating environment including boom and bust cycles that impact resourcing of capability • Research outputs of technologies, practices and industry initiatives, including *my*BMP, not adopted or supported by agribusiness, crop consultants and end-users. • Supporting, rather than crowding out the development of commercial service • Servicing regional D&D demands