

**Queensland's Department of Agriculture,
Fisheries and Forestry (DAFF)
Agricultural research, development and extension plan**

Contributing to the 2040 vision to double Queensland's agricultural production

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Have your say

The Queensland Government has set a clear, ambitious target to double Queensland's agricultural production by 2040.

The purpose of this plan is to describe how the Queensland Department of Agriculture, Fisheries and Forestry (DAFF) agricultural research, development and extension (RD&E) will contribute to achieving this target.

Going forward, Queensland's agriculture, fisheries and forestry industries are confronted with significant challenges. Research, Development and Extension (RD&E) is well known for contributing to a range of technological advances and expertise that leads to productivity growth.

To maximise returns on funding and expenditure, the Queensland Government will increasingly encourage partnerships and collaborative opportunities with other research, investment, and extension providers (including other universities) to leverage co-investment and capabilities from local, national and international sources.

The Queensland government believes that effective and targeted RD&E will steer the next wave of productivity growth in Queensland agriculture.

We encourage your comments on this RD&E plan. Your feedback will help inform the development of a final RD&E plan to support the future prosperity of Queensland agriculture, fisheries and forestry sectors in the coming decades.

How to provide your feedback

Please send your written submission by:

Email: RDEPlan@DAFF.qld.gov.au

Post: Agri-Science Queensland
Department of Agriculture, Fisheries and Forestry
GPO Box 46, Brisbane Q 4001

Phone: for further information, contact us on 13 25 23

The consultation period will close 5pm, **Friday 9 August 2013**.

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Minsters foreword

Feeding a growing and increasingly hungry world is a considerable and significant challenge. Increased food production is vital for our future. In recognition of the importance of agriculture to Queensland, the Queensland Government has established agriculture as one of its four economic pillars.

Queensland's agriculture, fisheries and forestry industries are estimated to have a production value of \$14.7 billion (2011-2012), employ approximately 320,100 people across the food chain, and generate export earnings of over \$6.3 billion.

Going forward, Queensland's agriculture, fisheries and forestry industries are confronted with significant challenges such as global economic uncertainties, a high Australian dollar, increasing production costs, pest and disease risks and climatic variability. I am confident, however, there is still significant capacity to grow Queensland's agricultural sector.

The world's population is predicted to increase to 9.2 billion by 2050, requiring an increase in global food production of 70 per cent¹, Meeting this demand presents a unique scientific, economic and political challenge. Queensland is strategically placed to supply growing demand from our neighbouring countries, and contribute to global food security. In response to increasing demand for food, the Queensland Government has set an ambitious target to double Queensland's agricultural production by 2040.

Research, development and extension (RD&E) is well known for contributing to a range of technological advances and expertise that leads to productivity growth. Funding in RD&E for the development of new technologies and knowledge is a fundamental component of the innovation process. Extension is of critical importance in facilitating the adoption of new innovations at the grass roots level.

Queensland is one of the few developed regions in the world with unique tropical bio-diverse ecosystems. Queensland's proximity to future tropical markets in Asia and the fact it has a strong RD&E base in sub-tropical and tropical agriculture makes it well placed to capitalise on the potential increases in demand for tropical agricultural products.

I believe that effective and targeted RD&E will steer the next wave of productivity growth in Queensland agriculture in partnership with industry, universities and other research providers.

RD&E conducted by the Queensland Government will therefore be directed towards strategic areas where market failure from business and industry is evident. In a modern economy, the private sector should take up the innovation challenge wherever possible.

The Honourable Dr John McVeigh MP
Minister for Agriculture, Fisheries and Forestry

¹ Croplife, 2012. Submission in Response to National Food Plan Green Paper. Introduction, paragraph

Queensland agricultural research, development and extension plan

Purpose

The Queensland Government has set a clear, ambitious target to double Queensland's agricultural production by 2040.

The purpose of this plan is to describe how the Queensland Department of Agriculture, Fisheries and Forestry's (DAFF) agricultural research, development and extension (RD&E) will contribute to achieving this target.

This plan addresses the recommendations of the Queensland Chief Scientist's Audit of DAFF Science, and is informed by the National Primary Industries Research Development and Extension (RD&E) Framework where Queensland has a strategic advantage from an industry and science capability perspective.

Queensland has a major role for establishing national priorities for RD&E in beef, sugar, summer cereals, tropical forests, tropical and subtropical horticulture, tropical and subtropical fisheries and aquaculture. It has a support role in cotton, dairy, winter cereals, temperate horticulture, pulse grains, pork, poultry and new and emerging industries, and a link role in temperate forests, horticulture and fisheries and aquaculture, sheep-meat, wine and wool. We are the lead proponents for the beef and sugar industries and the development of strategies for these industries.

Introduction

Queensland's agricultural production has grown steadily over the past 30 years and Queensland continues to be a significant net exporter of agricultural products. Queensland's primary producers have a strong tradition of being innovative and adopting new farming practices and technologies. This has been central to the development of the competitive Queensland agricultural sector with a solid reputation as an efficient supplier in the competitive international market.

RD&E leads to improvements in productivity through lowering the costs of production, increasing yields, improving sustainability, encouraging efficient resource allocation and providing opportunities to new markets. RD&E is critical in preventing and responding to emergent pest and disease incursions that have the potential to harm agricultural production in Queensland. It is also crucial that innovation occurs along supply chains as a key enabler of productivity growth.

R&D is an evolving process increasingly drawing upon knowledge acquired through science and innovation both in Australia and overseas. This joined with an effective extension (E) network to facilitate the dissemination of that knowledge, encourage change and innovation for end users of that knowledge, aims to improve the productivity, sustainability and competitiveness of the rural sector².

For rural R&D to achieve the best results, research outcomes must be extended to and adopted by farmers and other end users. Traditionally, state and territory governments

² http://www.npirdef.org/files/resourceLibrary/resource/25_ExtensionPrinciples.pdf

provided extension services. In recent years, extension services have broadened to include providers such as private consultants, agribusiness and input suppliers, local grower groups and public information. The result is a set of complex communication and delivery channels through which information, knowledge and ideas flow.³ This makes for an increasingly complex RD&E system where effective communication and coordination is crucial.

The Queensland Government in collaboration with a range of RD&E partners will facilitate a funding environment and provide a concerted effort to encourage innovation in the agricultural sector. Queensland has the capability to be at the forefront of cutting edge tropical and sub-tropical agricultural RD&E.

This plan describes how agricultural RD&E will contribute to the Government's vision of *an efficient, innovative, resilient and profitable sector that thrives for the long term*. It seeks to provide clarity for stakeholders, researchers' investors, and partners on how DAFF funded RD&E will contribute to each of the *four pathways to growth* described in Queensland's agriculture strategy.

It identifies the Queensland Government's commitment to the National Primary Industries RD&E Framework and how the government works effectively with collaborators. The outcomes of the Productivity Commission Review into the Rural Research and Development Corporations (2010) along with a review by the Queensland Chief Scientist (2012) have been incorporated into this plan.

³ Australian Government Rural Research and Development Policy Statement Department of Agriculture, Fisheries and Forestry 2013 p 8

Agriculture RD&E funding trends

Global

In 2008, global public spending on agricultural RD&E totaled approximately \$31.7 billion with an average increase of 2.4% per year since 2000. Almost half of this growth can be attributed to accelerated RD&E spending by China and India. Other middle income countries (particularly Argentina, Brazil, Iran, Nigeria, and Russia) also significantly increased their spending on public agricultural R&D during this period. However, agricultural RD&E funding by high income countries, including Australia, continued to decline during this period, a trend that has been observed over the previous decade⁴.

Australia

Australia has a long history of investing in agricultural RD&E to improve productivity in rural industries. However, this investment has declined in the last 20 years. The funding profile in RD&E across Australia is also complex. There are multiple investors and research providers, reflecting the diversity of Australia's agricultural industries, as well as the breadth of the RD&E conducted, spanning on-farm and off farm RD&E and commercialisation of research outcomes.

Private sector and public sector funding of agricultural research is driven by different goals, with private funding more likely in areas where there is clear direct commercial benefit to a particular enterprise and opportunities for quick returns. Meanwhile, traditional on-farm RD&E has been funded predominantly through public sector funding. However, there is an increasing trend over the last two decades towards industry, private and public sector co-funding.

The amount of funds invested each year in rural RD&E in Australia has been estimated to be \$2.9 billion. This has been estimated by the Rural Research and Development Council, defining the rural sector broadly to include rural industries along the supply chain and other rural related R&D. This included areas of environmental sciences such as, ecosystem management of land and marine resources and control of pests and diseases⁵.

Primary producers provide significant funds for RD&E through national levies that are managed by the commodity based Research and Development Corporations (RDCs). These levies attract matching funding from the Australian Government. In 2008-09 the total expenditure by the RDCs on R&D was around \$470 million⁶. The RDCs are an integral component of the rural RD&E structure, alongside the Australian, state and territory governments, CSIRO and universities.

Evaluations of rural R&D have shown that \$1 invested in rural R&D returned \$10.51 over the course of 25 years⁷.

Investment in Agricultural R&D reached a peak of five per cent in the late 1970s, as a proportion of agricultural gross value of production, but this has steadily declined to just over

⁴ <http://www.ifpri.org/sites/default/files/publications/astiglobalassessment.pdf>

⁵ http://www.daff.gov.au/__data/assets/pdf_file/0004/2176222/research-and-development-policy-statement.pdf

⁶ <http://www.daff.gov.au/agriculture-food/innovation>

⁷ PMSEIC, 2010. Australia and Food Security in A Changing World. Canberra, Australia. p.16

three per cent in 2007⁸. The slowing in real investment of Agricultural R&D has been linked to a slowing of growth in agricultural productivity.⁹ This might be due to the significant lag between R&D investment being made and a productivity gain (or benefit) being seen. The investment in Agricultural R&D and how the investment is focused will be critical in achieving necessary productivity gains.

The decline in Australian agricultural RD&E funding and the need to maintain critical agricultural RD&E capability and infrastructure led to the development of the National Primary Industries RD&E Framework ('the National Framework'). The National Framework seeks to improve collaboration between jurisdictions and concentrate RD&E effort nationally to avoid duplication and maximise the return on investment. Queensland is committed to being an active partner in this framework.

Agricultural science is the only area that Australia has a research organisation ranking in the top 10 of the world (CSIRO) and in plant and animal sciences we have six organisations ranked in the world's top 10%.¹⁰

In 2010 Australia produced 743 graduates in Agricultural science and in the same year approximately 4500 agricultural science jobs were advertised.¹¹ China produces more than 100,000 agricultural graduates a year. This coupled with declining student participation in Agricultural Science subjects (down 31% between 2002 and 2010) presents a challenge to ensure we have the ongoing Agricultural science capability to support producers and the economy.

RD&E funding in Queensland is provided through public organisations, such as government, RDCs, universities, and CSIRO and directed by priorities of industries. The overall investment in Queensland for RD&E in the agriculture sector has also declined significantly in the last 20 years.

⁸ Nossal, K and Sheng, Y. 2010. Productivity growth: Trends, drivers and opportunities for broadacre and dairy industries. *Australian Commodities*, vol. 17, no 1. ABARE, Canberra.

⁹ Sheng, Y., Mullen, J.D. and Zhao, S. 2010. Has Growth in productivity in Australian broadacre agriculture slowed? Paper presented to the Australian Agriculture and Resource Economics Society Conference, Adelaide, 10-12 February.

¹⁰ PMSEIC, 2010. *Australia and Food Security in A Changing World*. Canberra, Australia, p.52 (based on Thompson Reuters Web of Knowledge, 2010)

¹¹ Office of the Chief Scientist, 2012. Senate Enquiry into Agriculture. Available: <http://www.chiefscientist.gov.au/2012/02/senate-enquiry-submission-agriculture/>

The way forward

RD&E is one of the key interventions underpinning the implementation of Queensland's agriculture strategy. The Queensland Government's investment in RD&E will be focused in the areas where Queensland has a competitive advantage, particularly in the areas of beef production, sugarcane, tropical forest plantations, summer cereal grains, tropical and subtropical horticulture.

Funding in Queensland agricultural RD&E will continue to target clear benefits to these industries to stimulate economic growth. Leveraging capability and capacity through effective partnerships, collaborations and out-sourcing will provide flexibility in approaches to accessing cost-effective and targeted RD&E.

Four pathways to growth

Queensland's agriculture strategy identifies four key production pathways to grow Queensland's agricultural sector. The key RD&E strategies underpinning the four pathways are:

(1) Resource availability - securing and increasing resource availability:

- develop new whole-farm production systems for new agricultural areas;
- develop cost-effective ways to build resilience to seasonal changes and foster adaptation opportunities;
- develop and promote best management practices such as soil conservation, water, nutrient and energy use efficiency, integrated pest and disease management; and
- minimise nutrient and sediment transfer into waterways and reef systems.

(2) Productivity - driving productivity growth across the supply chain

- increase the uptake of best practice including measures such as conservation cropping techniques, irrigation efficiency, machinery adaption and sustainable grazing land use;
- increase the value of harvested product, either through improved varietal attributes and/or post-harvest processing and packaging;
- developing integrated pest management systems to improve plant health, animal health, welfare and productivity; and
- enhance science and technology capability, including partnerships with universities, to provide practical research which boosts productivity.

(3) Markets - focusing on securing and increasing market access

- identify new market opportunities and the processes to refine raw produce to a stage suitable for new and established uses and markets;
- support exotic pest and disease preparedness;
- improve food quality; delivering fresh, safe products with minimal pesticide residues through efficient supply chains to consumers; and
- Disinfestation of fruit fly and other pests to gain market access both domestic and international.

(4) Production costs - minimising the costs of production.

- genetic improvement resulting in, new varieties, new breeds, with increased yield and resilience to biotic and abiotic stresses;
- develop enhanced capabilities, diagnostics and tools for surveillance, detection and control of pests and diseases of plants, animals and the environment; and
- improve systems for integrating new technologies focusing on people, enterprises and business management to support adoption and uptake of new innovations.

Principles for investment

The Queensland Government is committed to working with agribusiness and industry to create the conditions to build a resilient, innovative, efficient, profitable and productive agricultural sector.

The following principles outline how the Queensland Government will fund and collaborate in RD&E projects and programs with industry, private enterprise, universities and other research funders and providers:

Public benefits

The Queensland Government will invest in agricultural RD&E where there are clear benefits, including economic, environmental and social, to Queensland. This includes the provision of higher quality and lower cost food and fibre products to consumers.

Consistency with Queensland Government policy platforms

The Queensland Government is committed to the delivery of agricultural RD&E and values its role as an enabler of sustainable economic growth. Queensland's agriculture strategy (as well as an internal review undertaken in 2012) highlights the importance of science and extension to increasing the productivity and resilience of the agribusiness sector.

Building skills and capacity

The availability and continuity of skilled scientific expertise will be crucial to meeting the challenge of doubling agricultural, fisheries and forestry production in a sustained and efficient way into the long term. Therefore, training and skilling in agricultural science, and promoting agriculture as a desirable career is imperative to achieve this critical capability.

The Queensland Government aims to improve agricultural skills and career pathways by working with industry, government agencies and educational institutions to increase the uptake of relevant skills and professional qualifications. This includes building a critical mass of experienced agriculture scientists, extension specialists and business improvement specialists where appropriate to increase the productivity of producers and their supply chain.

Market failure

Market failure in rural RD&E is generally more prevalent when compared to other industries based on the large numbers of small producers with limited capacity to undertake RD&E.

The Queensland Government encourages the development of private sector agricultural RD&E services and will assist where there are gaps in the RD&E continuum. The Government will consider its role in extension where there is a market failure i.e. the market does not deliver the optimal amount of RD&E to address industry-wide or cross-sectoral issues.

Co-funding and strategic leveraging

Significant RD&E capability exists across numerous public and private organisations. DAFF's research and extension capability is trending towards the development of collaborative partnership models resulting in more integrated, interdependent and specialised capacities. This has resulted in larger critical mass with less fragmentation, greater efficiencies and reduced duplication. Additionally, partnering creates attractive new opportunities for scientists and extension specialists and provides rewarding career pathways.

The Queensland Government has had a long beneficial collaborative relationship with the university sector and other research providers. One major alliance is with the University of Queensland, as the *Queensland Alliance for Agriculture and Food Innovation (QAAFI)* where under a 5-year agreement research is provided to DAFF from a university grant.

To maximize returns on funding and expenditure, the Queensland Government will increasingly encourage partnerships and collaborative opportunities with other research, investment, and extension providers (including other universities) to leverage co-investment and capabilities from local, national and international sources.

Domestic and export opportunities

Expanding the penetration of Queensland production into new markets is a critical component of the Queensland Government's goal to double agricultural production by 2040. It is one of the key determinants of future growth. Securing current markets and accessing new export markets such as India and China, and other near neighbour markets in Asia, will be vital to the sector's ongoing performance.

This will be done by working with enterprises to extend scientific and technical expertise and knowledge to producers who are keen and able to enter or expand into new markets. In many instances this involves working along the whole value chain to improve production and management practices, post-harvest handling techniques, enhanced product shelf life innovations, provide timely market intelligence and in-market assistance (including the purchasing habits and decisions of consumers).

RD&E investment profile

To achieve optimal returns on investment, the Queensland Government will target a funding and expenditure profile (as outlined in the National Strategic Rural R&D Investment Plan¹²), covering the areas of transformational RD&E, Industry Development, Sustainable Production, Capacity, and International Linkages. While these areas are not necessarily mutually exclusive, the Queensland Government proposes to align expenditure in the following proportions:

- | | |
|---|--------|
| - Transformational RD&E | 10-20% |
| - Industry development and sustainable production | 60-80% |
| - Capacity | 10-20% |
| - International linkages | <10% |

National RD&E framework

The Queensland Government is a supporter of the National Primary Industries RD&E Framework¹³. The National Framework aims to improve the co-ordination of RD&E nationally, maximising the impact of the nation's resource investments and ensuring that fragmentation and duplication of these resources throughout Australia is minimised.

The premise of the National Framework recognises that basic and strategic research can be provided from a distance, with regional adaptive development and local extension then required to assist the uptake of innovation by industry.

Queensland is committed to supporting the National Primary Industries RD&E Framework and a nationally co-ordinated RD&E system particularly in areas of greatest interest to the state's agriculture sector.

DAFF Queensland values the intent of the Commonwealth to provide guidelines and direction to facilitate and strengthen a national rural RD&E system with increased efficiencies and positive returns on investment

¹² Rural Research and Development Council (2011), National Strategic Rural Research and Development Investment Plan, Department of Agriculture, Fisheries and Forestry, Canberra.

¹³ www.npirdef.org

The way forward for key industries

The following section outlines the way forward for key Queensland Agricultural industries. Detailed operational RD&E plans and funding will be guided by *Industry Action Plans* to be developed by the Queensland Government in collaboration with industry. (Figures used for gross value in key industries include figures for farm gate and first stage processing.¹⁴)

Beef

The beef industry is Queensland's largest agricultural industry with the gross value of cattle sales and meat processing worth \$4.8 billion in 2011-12. Beef production occurs across 85% of Queensland and the industry employs approximately 52,000 Queenslanders. The majority of beef produced by the state is exported (60%). This totals 1 million tonnes and is destined mainly for Japan, Korea and the United States.

Through the North Australian Ministerial Forum (NAMF), Queensland leads the implementation of the North Australian Beef Industry Action Agenda, and collaborates with the Governments of the Northern Territory, Western Australia, Commonwealth and key industry stakeholders to promote industry development. In particular, the Action Agenda highlighted the need for Research and Development that supports industry growth, and has recently completed research (in partnership with CSIRO) to evaluate transport and logistical impediments to beef supply chains and where investment could improve the transport of cattle from property to export.

Under the National Framework, Queensland plays a Major role in implementation of the National Beef Production RD&E Strategy in partnership with Meat and Livestock Australia.

Science capability within DAFF and its main collaborators (The University of Queensland and CSIRO) is able to deliver against most of the on-farm RD&E needs of the beef industry.

Major focal points include:

Improving cattle, productivity and welfare to increase profitability and market access while minimising environmental impacts.

Within the Queensland Agricultural Strategy's four key production pathways, this includes:

1. Resource availability

- Minimising nutrient and sediment transfer from grazing lands into waterways and reef systems, reduce the impact of environmental and greenhouse gas issues and derive carbon offsets from use of waste materials as high value fertilizers to decrease greenhouse gas emissions.

2. Productivity

- Improving the reproductive performance of cattle through improved genetics, genetic tools, nutrition, and management of reproductive diseases;
- Improving sustainable growth pathways through optimised nutritional inputs;

¹⁴ Queensland AgTrends 2012-13, Forecasts and Trends in Queensland Agricultural, Fisheries and Forestry Production – September Quarter 2012-13 - Department of Agriculture, Fisheries and Forestry

- Reducing the impact of pest and disease through epidemiology and the development of diagnostic and integrated systems for the control of endemic and exotic diseases and pests in intensive and extensive beef production systems; and,
- Improving the feedbase through new and improving forages and forage systems and improving grazing land management.

3. Markets

- Supporting exotic pest and disease preparedness;
- Developing applications to detect and manage zoonotic diseases and toxins in livestock populations and products for improved food safety; and
- Developing technologies to support improved welfare and husbandry practices.

4. Production costs

- Improving systems for integrating new technologies focusing on people, enterprises and business management.

Challenges

Despite the strong economic position of Queensland's beef industry it faces a number of challenges to on-farm productivity growth and on-farm profitability in the face of the high value of the Australian dollar. The northern production cycle is constrained by poor forage quality with seasonally low levels of protein and dry matter digestibility. This leads to weight loss during the dry season and low conception and weaning rates.

Other challenges include high land values, rising energy costs, changing consumer demand and consumer expectations around animal welfare, pests and diseases, converting low-value waste-streams to higher value fertilizer products and minimising off-site impacts from extensive and intensive beef production systems (sediments, nutrients, noise, dust, odours and pathogens).

Opportunities

Opportunities exist to increase the rate of productivity growth, profitability, sustainability and social resilience of the beef sector through increased uptake of known and new technologies. Segments of the industry have shown productivity growth and favourable rates of return despite variable climatic conditions and a high Australian dollar. Significant opportunities exist to work in new ways with the next generation of beef industry managers.

Intensive livestock

Intensive animal industries (dairy cattle, pigs, poultry and aquaculture) in Queensland account for more than \$1 billion in gross value of production. Fisheries and aquaculture are addressed separately below.

Under the National Framework, Queensland plays a support role in implementation of the National Pork, Poultry and Dairy RD&E.

Science capability within DAFF is primarily focused on the management of pests and diseases, improving productivity and profitability and the management of environmental impacts in intensive livestock production systems.

Major focal points include:

Improving tropical livestock health, productivity and welfare to increase profitability, and market access while minimising environmental impacts.

Within the Queensland agricultural strategy's four key production pathways, this includes:

1. Resource availability

- Developing technologies and systems to enable the dairy, poultry and pork industries to reduce the impact on the environmental and minimise nutrient and sediment transfer into waterways and reef systems.

2. Productivity

- Undertaking epidemiology and development of diagnostic and vaccine applications for control of endemic and exotic diseases and pests in poultry and pork production systems.

3. Markets

- Monitoring and assessment of key fishery resources to maintain market access.

4. Production costs

- Optimising tropical and sub-tropical feeding systems to enable dairy businesses to compete competitively to meet the fresh milk market demand.

Challenges

Intensive livestock industries face a number of changes and challenges to which they need to respond, including competition (domestic and international), declining terms-of-trade, rising energy costs, changing consumer demand and consumer expectations around animal welfare, water restrictions, pests and diseases and minimising off-site impacts from livestock production systems (noise, dust, odours and pathogens).

Opportunities

Opportunities exist to meet the rapidly increasing consumer demand for poultry products and also increase the rate of productivity growth, profitability, sustainability and social resilience of the intensive livestock sector through increased uptake of known and new technologies. Significant opportunities exist to work in new ways with the next generation of managers. The industries are significant employers and major contributors to the economy and viability of a number of rural and regional areas throughout Queensland and are reliant on sustainable environmentally friendly production systems to increase the footprint of these industries (especially the poultry industry) in these regions.

Sugarcane

The Queensland sugarcane industry is anticipated to represent \$1.2 billion GVP for Queensland in 2012-13 and \$0.68 billion for first-stage processing¹⁵. Over 80% of the sugar is exported.

In 2013-14 the Queensland Government, through the Department of Agriculture, Fisheries and Forestry, will invest \$3.95 million in Sugar Research Australia, the principal provider of research, development and extension to the Australian sugarcane industry.

The Queensland Government is keeping its 2012 promise to the sugarcane industry to increase its R&D funding to \$16 million over four years. This funding will complement the industry's annual investment and will deliver valuable growth for the sugar industry through a variety of projects.

The funded program of projects aims to increase yield and achieve improvements in productivity and profitability, improve efficiency along the supply chain, maintain environmental sustainability, and investigate diversification opportunities. In addition, the DAFF investment considers the agricultural science skilling needs and capabilities of the industry.

DAFF funded R&D projects focus around three of the four key production pathways of the Queensland Agricultural Strategy:

1. Resource availability

- Profitable and sustainable farming systems – developing nutrient, pest, disease and weed management technologies that can be integrated into farming systems to deliver productivity, profitability, and sustainable agribusiness; and
- accelerating growth and resilience in field crop productivity via the design, development and delivery of effective and better integrated whole-farm production systems that remain productive, profitable, and sustainable in a environment with plant pest and disease and soil-health pressures.

2. Productivity

- Genetic improvement - developing systems to ensure the best parents are selected to improve sugarcane breeding;
- developing and delivering enhanced genetics for sugarcane in Queensland to ensure a reliable and increasing supply of market-focused food despite seasonal variability, scarce resources, high input costs and biological and environmental threats;
- Investigation of in-field sucrose losses and determining possible systems to minimise harvesting loss for increased profitability to the sugar industry; and
- Exploring impacts of nutrient and farm management systems on biomass production.

3. Markets

- Crop protection - developing system protection technologies to protect crops from insects and diseases and ensure sustainable, productive and safe field crop industries in Queensland.

¹⁵ Queensland AgTrends 2012–13, Forecasts and trends in Queensland agricultural, fisheries and forestry production

DAFF Sugar RD&E investments in Queensland are strongly aligned to the National Sugarcane Industry RD&E strategy. RD&E funding is based upon ongoing industry collaboration, as well as vital partnerships with organisations such as BSES Limited, Sugar Research and Development Corporation (SRDC), CSIRO and universities.

Challenges

The Sugarcane industries face several challenges including stagnating productivity growth, environmental impacts including water use and quality, continued investment in the development of genetically modified (GM) sugarcane varieties, preparedness for disease outbreaks, seasonal variability, declining numbers of researchers committed to sugar industry R&D, socio-economic factors such as grower age, succession planning and small farm size and market competition from industries with lower production costs.

Opportunities

Opportunities for R&D in the sugarcane industry include the development of second-generation biofuels and other products from sugarcane that do not compete with sugar production. Diversification brings options for exploring new markets and products. The R&D to underpin these opportunities are likely to take many years to develop and implement.

Broad acre cropping

Broad acre cropping in Queensland is valued at \$2.2 billion and includes production of feed grains and fodder, cereals, pulses, and cotton in a sustainable manner. The major production areas are the Darling Downs and Central Queensland. The high value of the Australian dollar directly affects the competitiveness of exports from this sector.

DAFF coordinated RD&E projects focus around the four key production pathways of the Queensland agriculture strategy:

1. Resource availability

- Developing technologies and systems that support profitable broad-acre cropping by addressing issues of soil nutrient decline, pasture run-down, irrigation water use efficiency, and soil health.
- The development of a BMP framework to boost profitability while improving water quality in the reef catchments. The sector needs to ensure its farming practices meet community expectations of sustainability and not impact on the natural environment such the Great Barrier Reef.

2. Productivity

- Developing and delivering enhanced genetics for field crops in Queensland to provide a reliable and increased supply of market-focused food, feedgrains and fodder despite seasonal variability, scarce resources, high input costs and agronomic threats; and
- Development and delivery of improved integrated farm production systems including best management packages that address issues such as crop rotations to increase soil health and nutrition and reduce disease and insect pressures, herbicide resistant weeds, and reduce the biosecurity risk.

3. Markets

- Developing cropping and harvested product management systems and technologies and genetic solutions to protect crops from pests and diseases to ensure sustainable, productive and safe field crop industries in Queensland; and
- Developing market access protocols to gain access to a broader range of markets for Queensland's broad-acre crops and search out new crop options that fulfill consumer needs and lead to new market segments.

4. Production costs

- Developing and delivering more efficient production systems that have reduced input costs or greater harvested value to enhance enterprise profitability; and
- Developing the skills and human capacity in Queensland's broad-acre cropping sector to drive enterprise production efficiencies and capture costs savings through the supply chain.

DAFF grains and cotton RD&E investments in Queensland are strongly aligned to the National RD&E Strategies for those industries. Activity is centred on the priorities for Queensland industries. RD&E investment is based upon ongoing industry collaboration as well as vital partnerships with organisations such as the Grains Research and Development Corporation (GRDC), Cotton Research and Development Corporation (CRDC), Universities (including QAAFI), other state-based research agencies, the CSIRO, private enterprise and CRC's.

Under the Grains Industry National RD&E Strategy, Queensland has major focus in summer crop genetic improvement, winter cereal pre-breeding for biotic stress resistance, tropical pulses, crop protection (weeds, pathology and entomology), agronomy and farming systems including bio-economic modeling, soil biology and nutrition, grain quality assurance, functionality and product development and biometry and bioinformatics.

Under the Cotton Industry National RD&E Strategy, Queensland has a major focus on improving farming systems including water use efficiency, crop production stewardship, sustainable natural resource management and system integration.

Challenges

The broad-acre cropping industries face several challenges including stagnating productivity growth, seasonal variability, increasing risks to production, skills and labour shortages, food security and safety and declining availability of inputs such as land and water.

Opportunities

Broad-acre cropping industries have opportunities to raise productivity and profitability through the adoption of innovative biotechnology and farming systems technologies, genetic solutions, expanded market access and innovative pest and disease management systems.

Case Study 1: Barley Pre-Breeding

Premier Campbell Newman and Agriculture Minister John McVeigh joined with the Grains Research and Development Corporation to announce on the 5 September 2012 that the Government will maintain a barley breeding capability in Queensland and enhance the program through a focus on genetics and pre-breeding.

They also recognised that greater private sector investment in barley breeding for the northern region was vital for the future delivery of improved varieties to growers and industry. DAFF will concentrate on the early stages of breeding, and InterGrain Pty Ltd would breed finished varieties for growers. (InterGrain was described as one of the largest barley breeding companies in Australia.)

DAFF will develop capacity in other key RD&E areas such as regional agronomy, entomology and plant pathology.

Case Study 2: Robotics

This project will develop small cooperative agricultural robots to increase broad-acre crop production and reduce environmental impact. The growth in size of agricultural equipment has increased soil compaction damage as well as disruptions due to single machine failures. This project will create a new class of machines to perform weeding which is the key element of zero-tillage agriculture.

These robots will have advanced navigation capability using low-cost sensors, unlike current agricultural precision guidance, while also supporting local navigation with respect to weeds and other robots. They will cause less soil damage, apply herbicide more intelligently, and operate as a system that is more robust to individual machine failures.

Fisheries and aquaculture

The Queensland Government's aim is to not only protect the fisheries and aquaculture resource but balance its use to ensure fair and managed access for Queenslanders wishing to utilise these resources. Further, the Government's aim is to sustainably manage the resource utilising the best available science, while minimising regulatory burden and intrusion in daily activities. The Queensland Government's approach to fisheries management will be based on the best available science, taking into account environmental, economic, social and cultural impacts.

By its very nature, in comparison to terrestrial activities, knowledge of the marine ecosystem, fisheries and the impacts of the industry on the resource is relatively limited. Continuing research and monitoring is a vital part of improving this knowledge leading to better decision making.

The Government supports the need for some public funding of fisheries research. This research must be targeted to priority issues which deliver optimum outcomes for the community's investment. Priorities need to be determined in conjunction with stakeholders. Where the Queensland government contributes to bodies such as the Fisheries Research and Development Corporation (FRDC) it expects its priorities to be addressed in subsequent project approvals."

Fisheries and aquaculture make a modest contribution to the gross value of production in Queensland. Commonwealth and state-managed commercial fisheries account for \$260 million, the recreational fishing sector \$73 million and aquaculture \$103 million. However, aquaculture is one of the fastest growing agricultural sectors with a doubling of production in the past 10 years, to meet a growing demand for seafood.

Under the National Framework, Queensland plays a Major role in implementation of the tropical component of the National Fisheries and Aquaculture RD&E Strategy, in partnership with Western Australia and the Northern Territory in a northern tropical alliance.

Science capability within the Department and its main collaborators (CSIRO, The University of Queensland, James Cook University and the University of the Sunshine Coast) is able to deliver against most of the RD&E needs of the fisheries and aquaculture industries.

The major focal point of fisheries RD&E is to sustain production through preventing a decline in fishery health as opposed to increasing productivity.

Within the Queensland's agriculture strategy's four key production pathways fisheries RD&E will focus on:

1. Resource availability

- Stock assessments and management strategy evaluation of the major fisheries;
- Fishery-independent surveys and the evaluation of the effects of fishing; and
- Impacts of seasonal variability and adaptation needs for east coast fisheries.

2. Productivity

- Enhancing freshwater fishery production through riverine habitat rehabilitation; and
- Determining optimal harvest rates to maximise economic yields.

The major focal point of aquaculture RD&E is to increase productivity through genetic improvement, nutrition, broodstock husbandry, and to minimise off-site impacts through effluent reduction.

Within the Queensland agriculture strategy's four key production pathways aquaculture RD&E will focus on:

1. Resource availability

- Uptake and extension of effluent-reduction technology.

2. Productivity

- Extending the breeding season of farmed fin fish species by photothermal control;
- Nutritional improvements to growth and survival during the fingerling stage; and
- Prawn broodstock infertility.

4. Production costs

- Technical solutions to reduce the cost of prawn farming.

Challenges

Fisheries

A Federal government commitment to expanding the footprint of marine reserves will diminish the area available to fishing. This will lead to either a concentration of fishing effort, and consequent increased risk of overfishing in the reduced area, or a reduction of fishing effort or catches to prevent this happening. Like other industries, wild-capture fisheries are exposed to increasing costs, particularly fuel and price competition with cheaper imports. Unlike other agricultural sectors, the purpose of most fisheries RD&E is to maintain fishery production at or near maximum sustainable levels. There is lesser capacity for increasing harvests, except through habitat amelioration (especially freshwater systems), which leads to increased fish production. Fisheries RD&E therefore contributes to fishery production by preventing its decline rather than increasing it.

Aquaculture

A major and unique challenge to aquaculture expansion in Queensland is the requirement for zero-net-discharge of nutrients to the environment for new farms. Zero net discharge is technically feasible from pond-based aquaculture (prawns, barramundi) but generally not economically feasible. An additional challenge is the ability to attract commercial investment into a relatively new industry in Queensland where competition from imports is strong.

Opportunities

Fisheries

Strengthening of science partnerships to deliver fishery forecasts from large national initiatives such as QIMOS (Integrated Marine Observation System – Queensland node) and strengthened fishery assessment capability through strong alliance between DAFF and the Centre for Applications in natural Resource Mathematics (CARM at UQ).

Aquaculture

Commercial partnerships in fin fish aquaculture in Queensland using recirculation technology could lead to a major expansion of this industry over the next few years, particularly as it addresses the requirement for zero net discharge from new farms. Global demand for fish is driving strong growth of the aquaculture sector (a doubling of production in the past 10 years). There is strong potential in Queensland and south-east Asia for application of effluent reduction RD&E (notably polychaete-assisted sand filters, or worm beds) to substantially reduce the nutrient content of waste streams. The application of novel breeding designs to fin fish aquaculture could greatly accelerate genetic improvements in growth or other desired traits.

Horticulture

Queensland is a major production state for Australian horticulture. DAFF looks to opportunities in North Queensland for industry expansion. Total value of horticultural crop production in Queensland, including first stage processing is \$3.8 billion.

Under the National Framework, Queensland holds *Major Agency* responsibilities for the tropical and subtropical horticulture crops: avocado, banana, capsicum, macadamia (shared with NSW), pineapple, strawberry, sweet corn, sweet potato, tomato and 'other' tropical

fruits. This imposes an obligation on Queensland to co-ordinate national RD&E on these crops between the state agencies, universities and industry. In addition, Queensland has *Support Agency* status for certain aspects of the national RD&E effort for apple, bean, brassica, citrus, cucurbit, leafy greens, pea, persimmon, pome fruit, stone fruit and table grape, but lead responsibility for these crops is vested in Agencies in other states.

Queensland is able to deliver against most of the RD&E needs of these industries. Specialist scientists from a range of relevant disciplines (entomology, microbiology, nematology, physiology, chemistry, and genetics) work with applied scientists in crop protection, agronomic systems, supply chain and market access improvement. Some more specialist skills are accessed through university collaborations, including strategic arrangements and alliances. These include five horticulture-related researches aligned to the University of Queensland through QAAFI, and a professorial position part-funded by DAFF at Central Queensland University (Bundaberg), establishing a vegetable research focus and valuable expertise to the rapidly growing horticulture industries of that region.

Major research focal points mainly align to two of the key production pathways:

1. Productivity

- Productivity improvement and growth of horticultural sectors of significant economic importance and growth potential for Queensland, where RD&E is demonstrably making a difference. These include each of the crops for which Queensland has *Major Agency* status under the Framework, and also mango, apple and (low chill) stone fruit; and
- Active breeding programs and development of more productive varieties for a range of crops including capsicum, citrus (mandarin only), macadamia, mango, pineapple, stone fruit (low chill), strawberry, sweet corn and tomato. Other varietal improvement underway without full ongoing breeding programs includes apple (commercialising from an earlier breeding program), banana (on imported germplasm), custard apple and papaya.

2. Markets

- Market access (disinfestation research, mainly focused on fruit fly);
- Supply chain optimisation (product quality maintenance, increasingly supporting export growth into overseas markets); and
- There is also a market growth component to the breeding programs mentioned above, modifying products to better suit market and consumer preferences.

Challenges

The horticultural industries face a number of changes and challenges, including competition (domestic and international), changing consumer demand, preferences and expectations, seasonal variability, pests & diseases, maintaining product quality along the supply chain, access to interstate and international markets.

Opportunities

While import/export data are scarce for individual states, Australia exports 13% of fruit and 9% of vegetables produced but imports 34% of fruit and 19% of vegetables consumed – probably mainly processed. With increasing affluence in Asia, and particularly if world population grows as predicted, the opportunity for increased Australian horticultural exports may be greater than the opportunity/need for import substitution.

Case Study: Small Tree High Productivity Initiative

Over the last 35 years there has been a dramatic improvement in our understanding of 'old world' horticultural tree crops such as apple, with research and development spectacularly improving their productivity.

A new 'Small Tree- High Productivity' initiative aims to do for sub-tropical and tropical Queensland fruit and nut tree crops what has already been done for apples. Work will be undertaken on many aspects of the orchard system that are known to influence yields and the ability to automate tending and harvesting. These include development of dwarfing rootstocks, optimizing flowering, fruit set, light interception and tree architecture. The initiative will reduce production costs and increase yields and quality, profitability and ability of Queensland growers to export and compete internationally.

Forest and timber

Total value of the forestry and timber industries in Queensland, including first stage processing, is \$536 million.

Under the Queensland Forest and Timber Industry Plan (2013), an industry-led panel is being established to advise on R&D investment priorities. While capacity to meet most expected industry needs already exists within Agri-science Queensland, a small but growing partnership with the University of the Sunshine Coast will also play a key future role. Of particular significance is the DAFF forest products research capacity and equipment located at Salisbury in Brisbane, Australia's only remaining site dedicated to timber processing and product development, and increasingly viewed and used as a strategic national resource.

Under the National Framework, Queensland holds *Major Agency* responsibilities for tropical and subtropical production forestry and timber R&D, obligating Agri-Science Queensland to co-ordinate national RD&E in these fields between the state agencies, universities and industry.

Major recent research focal points are aligned to all key production pathways, but priorities are expected to be adjusted after the advisory panel is established:

1. Resource availability

- After decades of genetic improvement to the subtropical exotic pines that are now the state's primary timber resource, recent focus has been on expansion of resources with hardwood plantations. As with the former softwood breeding work, this takes a long term view, producing reliable germplasm and deployment knowledge in readiness for future rounds of plantation investment and expansion.

2. Productivity

- Increasing wood yield and quality by developing elite germplasm for deployment in new or 2nd/3rd rotation plantations;
- Quantifying carbon sequestration rates for future potential carbon market trading;
- Developing systems to reduce losses and risks from pests, diseases and fire, with particular current attention being paid to the recently introduced myrtle rust; and
- Increasing value of harvested wood through improved post-harvest processing.

3. Markets

- Identifying new market opportunities for timber based products and building systems, development of these products and processing technologies, reclaiming market segments previously lost to alternative building materials.

4. Production costs

- Development of cost-effective pest and disease strategies using semiochemistry-based science; and
- Development of less energy-intensive processing technologies.

Challenges

Low housing starts and sales volumes, profitability and return on investment across the industry are constraining new investment particularly in the forest-growing (plantation) and primary processing sectors. Substitute non-renewable building products (steel, concrete, aluminum etc) have displaced timber in some traditional market segments. Poor understanding of the industry and the environmental benefits of wood products has reduced community support for the industry.

Opportunities

There is very significant potential for growth of timber-based products and building systems in the commercial and multi-story residential construction, where the adoption in Australia of trends and innovations already firmly-established overseas has been very slow, but is now starting. It is widely expected that this will see timber-based products regain significant market share from concrete in these sectors in Australia, but growth could quite quickly become constrained by domestic log supply. There is export potential into new and existing markets, particularly as the Australian dollar value returns to long-term values.

The way forward for key cross sector RD&E services

Biosecurity

Biosecurity RD&E is essential to the future prosperity of Queensland's agricultural, fisheries and forestry industries, for maintaining its diverse environment and for Queensland's continued social amenity. Exotic pest animals, weeds and diseases, if not prevented or rapidly addressed, can result in large direct and indirect costs to industry profitability. Impacts of a biosecurity event can also go beyond the industry involved with flow-on effects to the rest of the economy. An incursion or outbreak of a pest or disease can have a range of significant direct and indirect costs to the affected producers, the industry, the economy and the community in general.

An outbreak, or suspected outbreak, of diseases such as foot and mouth, 'mad cow disease' / BSE (Bovine Spongiform Encephalopathy), avian influenza for poultry, classical swine fever for pigs and equine influenza (EI) in horses, all have major impacts on production and trade. For example:

- A 'Foot and Mouth' outbreak alone could cost the Queensland economy \$9B and have an impact for many years as lost market share is regained;
- 'Red Imported Fire Ants' could cost the Australian economy \$8.9B (it currently costs Texas \$1.2B a year to manage) and have major impact on productivity and social amenity;
- Varroa mite, a parasitic mite of European honey bees and other bees, has the potential to kill European honey bee colonies, resulting in reduced productivity of crops that rely on bee pollination and commercial honey production;
- Papaya fruit fly and citrus canker infestations affected both the trade and productive capacity of many fresh fruit and vegetable crops. Although Papaya fruit fly and citrus canker entered Australia a rigorous response has resulted in eradication of both pests; and
- Established weeds and pest animals cost Queensland in excess of \$700M annually. Investment in weed and pest animal research can provide a benefit:cost ratio of 80:1. Notable successes include biological control of some of our worst weeds such as prickly pear, rubber vine, harrisia cactus, parthenium and groundsel bush, by using natural enemies like insects and pathogens from the weeds' native range.

Biosecurity services are heavily reliant on sound, multidisciplinary science and achieves this via collaboration and alliances with DAFF RD&E programs, other research providers including the CSIRO Biosecurity Flagship, Cooperative Research Centres (CRC's), aligned agencies, industry, NRM groups, business sectors and the community. Effective biosecurity systems need scientific information for risk assessment, decision making and to provide the necessary tools and policies for biosecurity responses,

Challenges

Biosecurity operates within an uncertain and unpredictable environment with priorities set using a risk management framework. The ability to predict new and emerging incursions and to target scarce biosecurity resources presents a major challenge.

Biosecurity science is broad in scope, the focus includes pre-border, border and post-border issues as well as a range of environments, including terrestrial, freshwater and marine systems. The extensive science needs of Biosecurity Queensland pose a challenge to ensure the organisation can influence the development of national and state biosecurity RD&E priorities.

Major biosecurity incidents are expected to become more frequent as the movement of products and people around the world increases, climates and environments change, free trade agreements become more common and market requirements intensify. Additionally, the greater focus on decreasing chemical use presents a challenge to develop new approaches and tools to control new and established pests.

Biosecurity incidents occur frequently and often more than once for some pests and diseases. Having information and knowledge management systems in place to draw upon and learn from past events is important to effectively predict and respond to emerging and repeated biosecurity events.

Opportunities

Biosecurity RD&E aims to provide scientific information, tools and solutions to better manage biosecurity risks in Queensland.

In particular, the goals of biosecurity RD&E aligned with Queensland's agriculture strategy's four key production pathways are to:

1. Resource availability

- Understand characteristics and impacts of known damaging weeds, pests and diseases; and
- Develop an ongoing prioritisation process to identify and agree research priorities across the system.

2. Productivity

- Identify innovative approaches to help manage existing biosecurity problems;
- Analyse risk pathways and vectors for entry and dispersal of weeds, pests and diseases;
- Develop methods for managing risks offshore; and
- Develop innovative data mining and intelligence methodologies that aid in the capacity to forecast and respond to emerging biosecurity risks.

3. Markets

- Understand the impact on plant and animal physiology of chemical residues and contaminants;
- Develop an understanding of human behaviour in creating, managing and communicating biosecurity risks; and
- Investigate ways to promote animal welfare including the humane treatment of animals in the control and treatment of pests and diseases.

4. Production costs

- Improve systems and infrastructure for delivery of specialised diagnostic services;
- Develop cost-effective surveillance tools and treatment technologies;
- Develop innovative control mechanisms for weeds and plant diseases including smarter chemical and biological controls; and
- Develop enhanced capabilities, diagnostics and tools for surveillance and detection of pests and diseases including aquatic invasive pests.

Case Study: RD&E applied to Foot and Mouth Disease

To be FMD ready, Queensland requires RD&E designed as part of surveillance, preparedness, prevention and response planning to support actions to be taken in the event of an FMD emergency. Activities would include:

- Risk assessments of potential pathways of FMD introduction, establishment and spread and the likely consequences of an incursion for government, industry and the community
- The identification of preventative measures that minimise the risk of introduction, establishment and spread of FMD in Queensland and Australia
- Extension activities including disease recognition, clinical signs, reporting mechanisms and use of Personal Protective Equipment and personal decontamination

This work will deliver greater veterinary, government and community awareness and ability to detect and respond to an FMD incursion.

Value added foods

Queensland's food value chain in 2010-2011 was worth at least \$18.7 billion to the state's economy and supported 267,000 Queensland jobs¹⁶. \$9.4 billion of the value and 186,000 jobs from the food value chain were and are situated post-farm gate within the food processing, value adding, wholesale/retail and service industry sectors. Production capabilities range from fresh fruit and vegetables, seafood, grains, sugar and meat to value-added foods including fresh ready-to-use horticultural products, processed foods and food ingredients. The industry is spread across 1,030 food processing business in Queensland of which 95% are small (employ <20 staff) or medium (employ <200 staff) sized companies.

Under the draft National Food and Nutrition RD&E Strategy, Queensland has a major focus on providing the linkage between the research and the commercial application of new products and technologies and researching and promoting the human health constituents of foods and their impacts.

The government through its Value-Added Foods RD&E Program invests in developing and delivering products and services that underpin the ability of Queensland primary producers, food processors, retailers and service industries to better meet consumer needs in the areas of food choices, safety, quality, health and convenience.

¹⁶ Estimates based on 2008-09 ABS data and DEEDI *Prospects* publication 2010-2011.

Within Queensland's agriculture strategy's four key production pathways, the Queensland Government in partnership with QAAFI/Centre for Food and Nutrition Sciences (CNAFS) has the RD&E capability to:

1. Resource availability

- Contribute to improving Food Security and minimising Environmental Impact through maximising commodity use, improving processing efficiency and reducing resource wastage.

2. Productivity

- Increase the value of harvested product, either through improved varietal attributes and/or post-harvest processing and packaging.

3. Markets

- Research and define consumer needs/attributes to identify and inform market opportunities;
- Produce new value added products that improve competitive position in target markets, including export markets; and
- Utilise innovative pilot plant manufacturing research to test and refine product concepts.

4. Production costs

- Increase skills and capacity to engage in food product innovation and World's Best Practice; and
- Raise competitiveness to manage import substitutions.

Challenges

The major challenge to undertaking broad impact value added food RD&E is the perceived lack of a peak industry body to provide strategic direction and co-investment to government and other RD&E providers. As a result of this, much of the current RD&E is done for private benefit and application of new knowledge across a broad cross-section of industry is constrained. The Queensland Government has invested heavily in value added food research infrastructure recently in an attempt to facilitate collaborative research efforts in this area.

Opportunities

The major opportunity for value added food products is the ability to improve food quality and functionality as perceived by consumers. This will allow the state's agricultural industries to compete on premium product strengths, rather than a low cost commodity basis. Such an approach is critical to driving increased production (through demand) and increased economic impact (through value-adding and preferential consumer purchasing). The DAFF Food Science & Technology facilities, provides Queensland with an outstanding opportunity to develop and take advantage of strong collaborative research relationships with other leading Food R,D&E Agencies. Collaborative partners include The University of Queensland (QAAFI), CSIRO, James Cook University and Queensland Health.

Environmental sustainability

Long term agricultural productivity is dependent on appropriate conservation and custodianship of the natural resources and protection of the land, resources and environment for the long term. DAFF working together with other Queensland Government departments will promote and encourage best management practices such as soil conservation, water and nutrient use efficiency, integrated pest and disease management and appropriate agronomic practices will assist industry to achieve productivity improvements over the longer term.

DAFF is also currently working with the grazing industry to help producers transition from regulation to an industry-led system underpinned by profitability, productivity and land stewardship. The government is supporting graziers as they develop Best Management Practice (BMP) programs and identify the most profitable and sustainable management practices for their own businesses.

The BMP framework developed through productive negotiations places the grazing industry in a strong position to boost profitability while improving water quality in the reef catchments. The sector needs to ensure its farming practices meet community expectations of sustainability and not impact on the natural environment such the Great Barrier Reef. Queensland agricultural sector's 'clean and green' image is important in export retaining markets.

Extension

Extension is the facilitation of change and innovation aimed at improving the productivity, sustainability and competitiveness of Australia's (and Queensland's) primary industries'.

Public research, development and extension account for two-thirds of Australian agricultural productivity growth (Sheng et al 2011). While R&D contributes to long term productivity gains, extension can generate higher short-run productivity gains, by ensuring a higher proportion of farmers become early adopters of R&D outcomes.¹⁷ The adoption of research outcomes should be treated as an integral part of the R&D planning and delivery process.

The Queensland Government will ensure that extension remains an integrated component of the research, development and extension continuum, in conjunction with its stakeholders. The Queensland Government will further work with all parties to the National Framework to ensure extension priorities are clearly understood and addressed in the implementation of sectoral and cross-sectoral strategies under the framework. The Queensland Government is considering a number of principles to inform its prioritisation of extension delivery:

- DAFF will support the private sector's expansion of extension delivery into areas where there are market opportunities and it will continue to invest in extension where market failure is evident;
- Extension forms a critical component of DAFF's customer-centred service delivery;
- DAFF extension effort will deliver economic development outcomes for Queensland's agriculture, fisheries and forestry industries;

¹⁷ Australian Government Rural Research and Development Policy Statement Department of Agriculture, Fisheries and Forestry 2013 p 22

- Extension will be delivered using different approaches and DAFF will work to optimise the benefits for industry;
- DAFF's efforts should aim to optimise the customer's access to the best available service – which in many cases will be DAFF;
- DAFF will work better with the private sector and our RD&E partners to facilitate and broker information and extension services;
- DAFF will have a resourced and skilled capability to deliver extension services;
- DAFF extension effort will extend from behind the farm gate as well as along the supply chain; and
- DAFF is committed to extension as an important means of contributing to the doubling of Queensland's agricultural production by 2040.

These principles form the basis of a plan to ensure that the Queensland Government is delivering the type of information and advice required by each industry sector in a way that will make enterprises more resilient, innovative, efficient and profitable.

Research facilities

It is DAFF's intention that the efforts made to focus and revitalise the R&D infrastructure of Queensland will lead to their use by all providers of R&D.

The Queensland Government maintains 35 research facilities and associated field sites across Queensland to conduct agricultural RD&E activities.

These facilities cover a range of plant and animal commodities and operations and are both intensive and extensive research sites. Each research facility comprises various unique combinations of built infrastructure such as offices, laboratories, glasshouses and specialist plant & equipment to undertake the required range of RD&E operations specific to each location.

DAFF operates its research facilities to conduct agricultural research on soils, plants and animals under controlled conditions where the nature of the experimental treatments and/or measurements are such that they cannot be conducted on co-operating producer properties or leased land.

The Queensland Government is continuing the process of rationalising and revitalising its Research Facilities. This will change the way that it operates, providing world-class research infrastructure that underpins science delivery. Up to \$40 million in infrastructure re-investment has been spent in the Beef, Dairy, Crop and Food, and Horticulture industries throughout Queensland.

A portfolio management approach ensures consistent methodologies across all research sites. Co-funding of infrastructure and co-location with other (including private) research providers will maximise efficiencies. This will reduce overheads and operating costs and modernise research infrastructure by replacing ageing and/or out-dated facilities. Underpinning the rationalisation of facilities is the recognition that it is financially unsustainable to continue to hold on to properties that are no longer required for research.

There is an unprecedented partnership between industry and government to bring about change. The willingness of industry to work with Government on the challenges being faced by the agriculture sector refocuses the way government works to achieve a vision to double Queensland's agricultural production by 2040.

Capturing and harnessing RD&E resources (skills, infrastructure and finance) across states, industries and research agencies provides the most cost-effective and efficient way to maximise RD&E funding outcomes for primary industries and the food sectors for the long term.

Intellectual property and commercialization

Intellectual Property (IP) and commercialisation is the development of new or original knowledge and applying it to develop a product or service in the market place.

It is essential to enable collaboration with commercial partners in the development and adoption phase of a project. Without protection of IP, commercial partners would not be prepared to make the considerable funding required to deliver improved products to markets. In addition the commercialisation process provides an income stream for future funding in RD&E. Benefits from past funding in R&D accrue to present users of improved technologies and practices.

The protection of IP (where appropriate for commercialisation) provides an avenue for leveraging additional funding and attracting linkages, partnerships and collaborations. Appropriate models are in place to ensure flexibility and enable access to necessary information, goods and services while still ensuring maximum return on funding for individual co-investors.

The Queensland Government will develop IP or undertake commercialisation focused on public benefit and not for the primary purpose of revenue generation. Any IP generated will be effectively managed to enable the maximum uptake of R&D outcomes and maximum benefit to the Queensland economy.

Royalty returns are encouraged where appropriate, to encourage the commercialisation process.

Implementation

Implementation of the Queensland agriculture RD&E plan will:

- Be delivered through existing resources;
- Be undertaken over a five year timeframe;
- Be reviewed after five years or if unforeseen circumstances and or opportunities arise;
- Implement research, development and extension jointly with industry and research providers;
- Be informed by the Industry Development plans developed by DAFF with industry.
- Complement the strategies of the National Primary Industries Research Development and Extension Framework;
- Map and enhance research capabilities of Queensland Universities to enable better fit with the State Government's objectives;
- Improve communication with stakeholders within the rural sector on the requirements of rural RD&E;
- Establish and monitor targets for transformational research etc; and
- Monitor and report on the various components of the RD&E continuum.



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