National Beef Production RD&E Strategy

January 2010

Acknowledgments

The National Beef Production Research, Development and Extension Strategy was developed under the auspices of the Primary Industries Standing Committee, Research and Development Subcommittee on behalf of the Primary Industries Ministerial Council.

Development of the Strategy has been led by staff from Department of Employment, Economic Development and Innovation (Qld) together with Meat & Livestock Australia, working with members of the Red Meat Co-investment Committee.

Content has been developed with contributions from:

- Australian Government Department of Agriculture, Fisheries and Forestry
- Charles Sturt University
- Commonwealth Scientific and Industrial Research Organisation
- Cooperative Research Centre for Beef Genetic Technologies
- Department of Agriculture and Food Western Australia
- Department of Employment, Economic Development and Innovation
- Department of Primary Industries Victoria
- Griffith University
- Industry & Investment NSW
- James Cook University
- La Trobe University
- Meat & Livestock Australia Limited
- Murdoch University
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- University of Southern Queensland
- University of Sydney
- University of Western Australia
- University of Tasmania
- producers contributing to the RD&E prioritisation forums.

The assistance and guidance provided by the North Australia Beef Research Council, Southern Australia Beef Research Council and Cattle Council of Australia in developing industry priorities for research, development and extension is acknowledged.

The Red Meat Co-investment Committee

The Red Meat Co-investment Committee (RMCIC) had its origins in the combined Meat & Livestock Australia (MLA)–Departments of Primary Industries (DPIs) Co-investment Committee. The RMCIC was formed in 2005 to improve strategic alignment of production research, development and extension (RD&E) investments in the red meat industries.

In the same year, state ministers for primary industries and the Australian Government endorsed a National Primary Industries Research, Development and Extension Framework (National RD&E Framework) that sought to engender national collaboration across a range of agricultural industries by publicly funded RD&E agencies. MLA and the other rural Research and Development Corporations (RDCs) were asked to join this initiative in 2007.

These parallel processes resulted in the MLA–DPIs Co-investment Committee gaining responsibility for developing and implementing the strategies for both beef and sheepmeat production RD&E under the National RD&E Framework, with the committee subsequently augmented to include representation from the:

- Commonwealth Scientific and Industrial Research Organisation
- Cooperative Research Centre for Beef Genetic Technologies
- Cooperative Research Centre for Sheep Industry Innovation
- Australian Government Department of Agriculture, Fisheries and Forestry
- member faculties of the Australian Council of Deans of Agriculture.

The MLA–DPIs Co-investment Committee was subsequently renamed the Red Meat Co-investment Committee in 2008 to reflect its expanded membership and responsibilities.

The broad national membership of the RMCIC ensures that the National Beef Production Research, Development and Extension Strategy (the Strategy) has strong links to Australia's major publicly funded RD&E providers and, through MLA, to key industry decision makers with interests in RD&E.

The RMCIC will have an ongoing role in facilitating implementation of the Strategy and the operational interactions between its members. Its ultimate aim is to achieve better outcomes for industry from the available RD&E resources.

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Abbreviations and acronyms

ABARE	Australian Bureau of Agricultural and Resource Economics
ASRC	Australian Standard Research Classification
Beef CRC	Cooperative Research Centre for Beef Genetic Technologies
CCA	Cattle Council Australia
CD&E	communication, development and extension
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSU	Charles Sturt University
DAFWA	Department of Agriculture and Food Western Australia
DEEDI	Department of Employment, Economic Development & Innovation (Qld)
DPIs	departments of primary industries
DPIV	Department of Primary Industries Victoria
DREAM model	Dynamic Research Evaluation for Management model
FTE	full-time equivalent
I&I NSW	Industry and Investment NSW
JCU	James Cook University
MLA	Meat & Livestock Australia Limited
MISP	Meat Industry Strategic Plan
MSA	Meat Standards Australia
MWG	Modelling Working Group
NABRC	North Australia Beef Research Council
NFI	net feed intake
NSW	New South Wales
NT	Northern Territory
NTDR	Northern Territory Department of Resources
PIMC	Primary Industries Ministerial Council
PIRSA	Department of Primary Industries and Resources of South Australia
PISC	Primary Industries Standing Committee
Qld	Queensland
RD&E	research, development and extension
RDC	Research and Development Corporation
RMAC	Red Meat Advisory Council Ltd
RMCIC	Red Meat Co-investment Committee
SA	South Australia
SABRC	Southern Australia Beef Research Council
Sheep CRC	Cooperative Research Centre for Sheep Industry Innovation
Tas	Tasmania
The Strategy	The Beef Production Research Development and Extension Strategy
TIAR	Tasmanian Institute of Agricultural Research
UQ	University of Queensland;
UNE	University of New England
USQ	University of Southern Queensland
UTAS	University of Tasmania
UWA	University of Western Australia
UWS	University of Western Sydney
vet	veterinary science
Vic	Victoria
WA	Western Australia

Executive summary

The National Beef Production Research, Development and Extension (RD&E) Strategy, (the Strategy) has been developed at the request of the Primary Industries Ministerial Council (PIMC), and follows the submission of a first draft strategy to the Primary Industries Standing Committee (PISC) R&D Subcommittee in March 2009.

The lead agencies for developing the Strategy are the Queensland Department of Employment, Economic Development and Innovation (DEEDI) and Meat and Livestock Australia (MLA). The leadership roles of both organisations were determined on the basis of the significant interests they oversee in beef production on a national scale.

In developing the Strategy, MLA and DEEDI have worked with all the other organisations represented on the Red Meat Co-investment Committee (RMCIC) to develop and collate information on the relative (industry) demand for, and (agency) supply of, beef RD&E resources (including personnel and infrastructure) across Australia. The RMCIC has overseen the development of the principles and processes for identifying and reallocating RD&E resources in line with future investment priorities.

These priorities have been identified and developed in consultation with beef producers, industry RD&E consultative entities (the North and Southern Australia Beef Research Councils) and the Cattle Council of Australia (CCA). Collectively, the consultation processes and entities have been used to develop:

- ten Priority Industry Outcomes, incorporating the regional and national needs of industry
- seven strategic imperatives that align with Australian Government, state and territory governments RD&E priorities and those prescribed within the Meat Industry Strategic Plan (MISP) 2010–2105
- proposed RD&E programs and deliverables for further assessment and consideration by the RMCIC.

The Strategy has the formal support of all the government agencies and CSIRO represented at RMCIC, and describes the implementation of new processes that will guide investment in the beef RD&E sector in the future. These processes provide for collaborative approaches to:

- stakeholder assessment of investment priorities
- ex-ante investment analysis and ex-post evaluation
- program development, initiation and management
- maintaining critical infrastructure and IP
- maintenance and development of human capacity.

The outcomes from implementing these new approaches to RD&E will be:

- better coordinated RD&E investment that aligns with industry and government priorities
- increased efficiency in resource use and retention of key resources and infrastructure

- development of, and succession planning for retaining key human resources to address current and future priorities
- identification, retention and national coordination of critical intellectual property in terms of research herds, animal samples and databases.

The processes described in this strategy provide new mechanisms for government, MLA, universities, CSIRO and the Cooperative Research Centre for Beef Genetic Technologies (Beef CRC) to share information and make collaborative investments on behalf of industry, government and other RD&E providers. The linkage to sheepmeat RD&E investment through the RMCIC will also ensure that appropriate resource and information sharing and co-investment occurs between the two red meat industries. Linkages with other sectoral and cross-sectoral plans have also been identified.

These investment processes are not directly relevant to all the RD&E investment processes currently used in the beef processing, feedlot and live export sectors. Nevertheless, the intention is to further develop this strategy to encompass RD&E relevant to the whole beef supply chain in the near future.

1 Introduction

In 2005, the National Primary Industries Research, Development and Extension Framework (National RD&E Framework) was endorsed by the Australian Government, and all states and territories, supporting a model of national research, regional development and local extension for a range of industries and cross-sectoral themes. The National RD&E Framework recognised that basic and strategic research can be provided from a distance, along with regional adaptive development and local extension, to improve the rate of innovation by industry.

PIMC called for the National Beef Production Research, Development and Extension Strategy (the Strategy) to be developed for consideration in April 2010. DEEDI (Qld), has been allocated the lead role in this process. MLA is the supporting Research and Development Corporation. The development of the Strategy has been facilitated through the RMCIC whose membership includes MLA, state agencies, CSIRO, the Beef CRC, the Cooperative Research Centre for Sheep Industry Innovation (Sheep CRC) and representatives of the university sector. The Cattle Council of Australia (CCA) has also been closely involved with the development of the Strategy.

The aims of the Strategy are to:

- improve the focus, efficiency and effectiveness of beef production RD&E across Australia, and reduce fragmentation and duplication of effort
- create a system of beef production RD&E that better integrates the priorities of industry and industry organisations, investors, federal, state and territory governments, CSIRO, the Beef CRC, universities, and private providers for industry, stakeholder and community benefit
- enhance beef production RD&E capability through increased collaboration, specialisation and critical mass as appropriate, and generate greater national benefits from large infrastructure investments
- provide a beef production RD&E system that is supportive of, and responsive and accountable to, industry needs and which delivers integrated and accelerated industry development.

This document provides a strategic framework and process plan for national collaboration by state, territory and Australian government departments, MLA, universities, CSIRO and the Beef CRC in beef production RD&E. It sets out the process by which agencies and institutions with an interest in beef production RD&E will invest and work collaboratively in the future. This process will provide greater efficiency of resource use by:

- avoiding duplication of effort
- identifying and prioritising critical infrastructure required for beef production RD&E
- maintaining and nurturing human resource capability.

The Strategy further develops the principles for developing a National RD&E Framework set out in the Statement of Intent signed by all PIMC members and the Rural Research and Development Corporations (RDCs), namely:

a) The Parties will cooperate to encourage the establishment of a more efficient and effective RD&E system nationally.

b) Recognising that the Parties will be subject to budget fluctuations, the Parties will endeavour to at least maintain RD&E funding levels for primary industries; and investments, including from savings, should be re-directed to improve the capability of primary industries RD&E in priority areas.

c) The Parties will share information, plans and priorities for investment in RD&E to facilitate development and implementation of the Framework.

d) The Parties will facilitate access to national research capability (people, infrastructure and information) by industry and R&D partners across Australia, including the private sector.

e) The Parties will support processes to refresh the rural R&D priorities and to encourage more consistent and rigorous monitoring of performance of R&D targeting and delivery.

f) The Parties recognise the importance of investing in extension of R&D to facilitate rapid uptake of research and innovation, and the increasing role of the private sector.

g) The Parties agree to work cooperatively to improve the administrative processes and effectiveness of information sharing and management.

h) The Parties agree to freely share the knowledge generated through the primary industries National RD&E Framework, including minimising barriers to RD&E created by intellectual property protection.

i) The Parties will monitor, evaluate and report on the performance of the National RD&E Framework and the sector and cross-sector strategies developed and implemented under the Framework.

The Strategy has also been aligned with the relevant components of the Meat Industry Strategic Plan 2010–2015, released in October 2009, which contains the following strategic themes:

1. Environment and ethics
   Promote ethical and responsible custodianship of the environment, animal welfare and resources used in the production of red meat.

2. Market access
   Maximise, in partnership with government, effective trade facilitation.

3. Our industry
   Promote a single coordinated voice for our industry to reshape and reinvigorate relationships within industry and with government.

4. Our people
   Develop and retain motivated and appropriately skilled people for our industry.

5. Innovation
   Increase competitiveness and profitability through innovation.

6. Marketing and promotion
   Focus on the consumer to continue to achieve profitable growth in demand for Australian red meat and livestock products.

7. Economics and infrastructure
   Foster economic reform and infrastructure investment to enhance the capabilities of our industry.

Some work has been done to align this production sector plan with the processing, feedlot and live-export sectors, but further efforts are required to complete this.

The Strategy will provide a mechanism for the beef industry to retain an effective and efficient RD&E capability. This will support the production sector to innovate and respond to the growing demand for beef, despite pressures on government budgets and human resources.

Meat Industry Strategic Plan 2010–2015

The Meat Industry Strategic Plan (MISP) 2010–2015 represents a single view of the Australian red meat and livestock industry and provides a high-level roadmap for RD&E, marketing and policy investments across the whole red meat supply chain for the period 2010–2015.

The plan was developed by the Red Meat Advisory Council Limited (RMAC), which has custodianship of the MISP planning and implementation process. RMAC comprises five of the six peak industry councils of the red meat and livestock industry:

- Australian Livestock Exporters Council
- Australian Lot Feeders' Association
- Australian Meat Industry Council
- Cattle Council of Australia
- Sheepmeat Council of Australia.

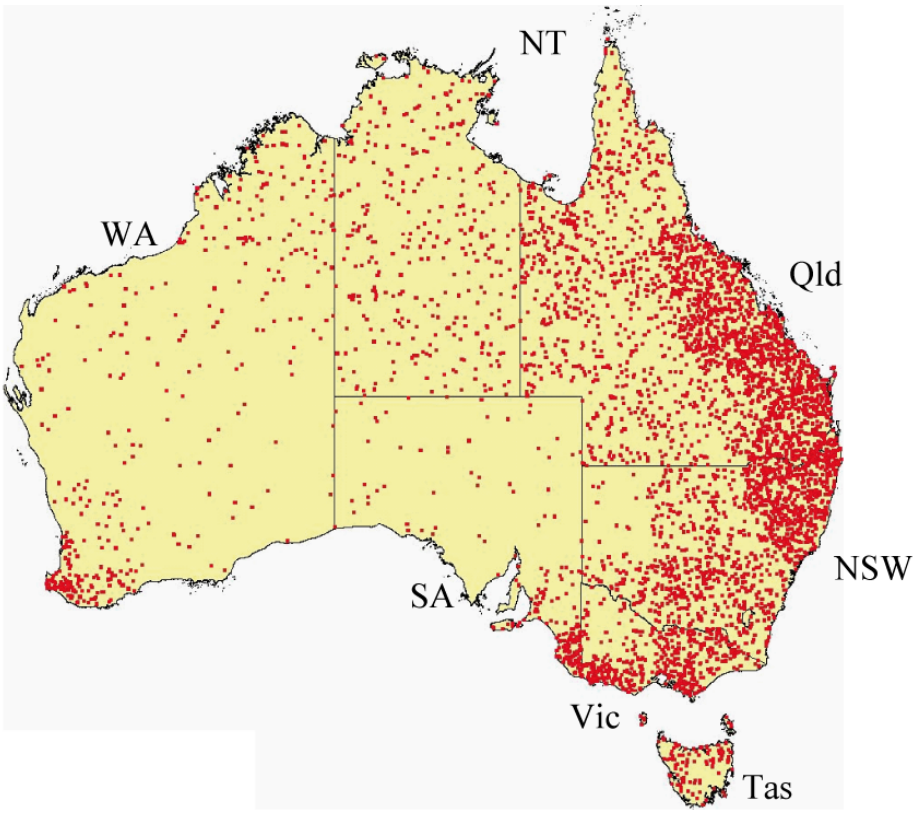
The Goat Industry Council of Australia, although involved in the red meat industry, is not a member of RMAC. The MISP is now into its third major iteration — the foundation plan (MISP 1) was developed by industry in 1996.

2 Situation analysis

This section provides an overview of the beef industry in Australia, including the industry size and value, structure and production systems, productivity and industry prospects.

2.1 Industry size and value

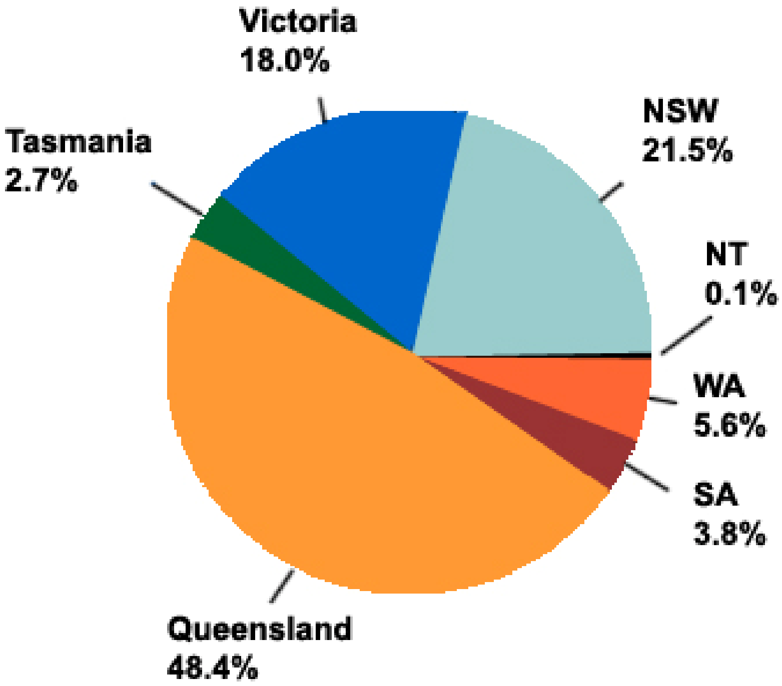
The Australian beef industry has the largest geographical footprint of all broadacre industries, occupying 332 million hectares (43 per cent) of the country's land mass and having a strong presence in all states and territories (Figure 2.1). In June 2008, there were 27.3 million cattle in Australia, 44 per cent of which were in Queensland.



Source: Australian Bureau of Statistics

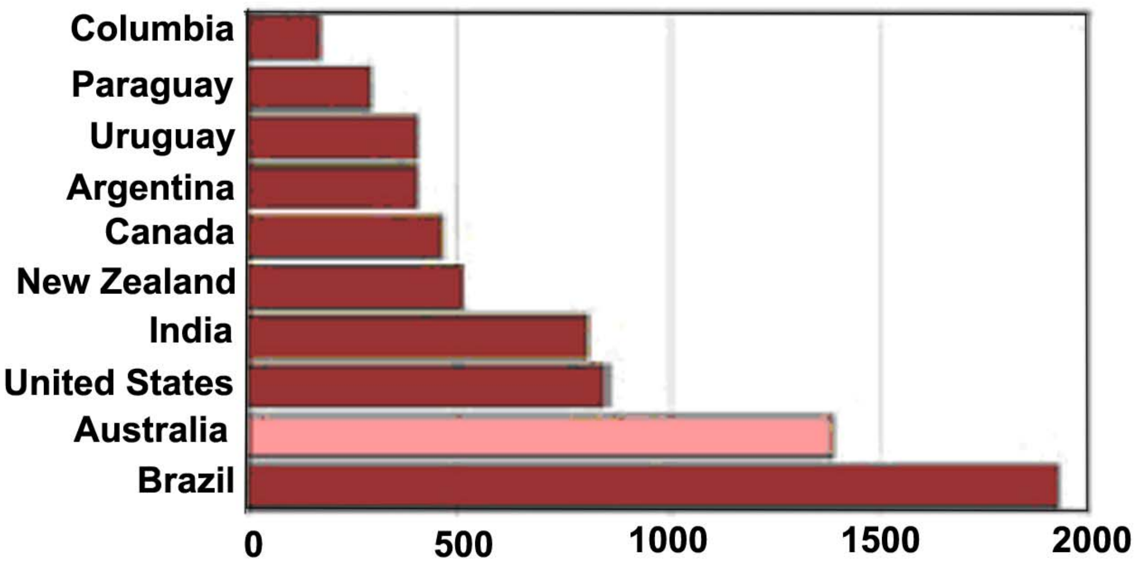
Figure 2.1 Distribution of beef cattle by state and territory (million head) (2008)

Total beef and veal production was 2.2 million tonnes in 2008–09 (Figure 2.2) with a farm-gate value of $8 billion. Beef exports in that year were distributed to more than 100 countries and totalled 968,000 tonnes (A$5052 million free-on-board [FOB] value), making Australia the second largest beef exporter in the world (Figure 2.3). With live cattle exports reaching 891,000 head, valued at A$646 million, beef and beef cattle are Australia's most valuable agricultural export commodity.[1]



Source: Australian Bureau of Statistics

Figure 2.2 Australian beef and veal production, 2.2 million tonnes cwt (2007–08)



cwt = carcase weight
a Includes processed meat
Source: United States Department of Agriculture (2008)

Figure 2.3 Top ten beef-exporting countries[a], '000 tonnes cwt (2008)

[1] MLA (Meat & Livestock Australia) (2009). *Cattle industry projections — mid year update*, MLA, Canberra.

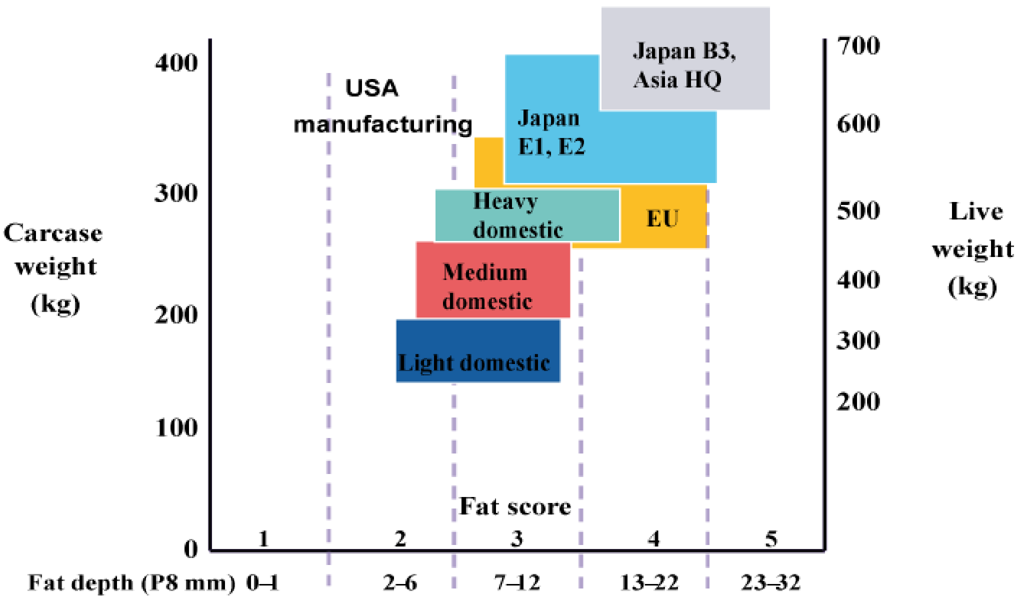
2.2 Structure and production systems

The beef industry employs more than 220,000 people at the farm, processing and retail levels. There are nearly 43,000 commercial beef properties in Australia (>100 head), with the largest 27 per cent of those carrying 79 per cent of the total beef herd. The scale of production is a particular feature in northern Australia, where the largest 17 per cent of properties carry 71 per cent of the region's beef herd.[2]

The industry is characterised by a wide range of farm sizes and production systems. In the extensive rangelands of Australia, producers generally have large properties and production is based mainly on the grazing of native pastures. In intensive production regions, properties are generally smaller in area and the grazing of cattle is usually part of a mixed enterprise (crops and other livestock) with a greater reliance on introduced pastures and forage crops.

In area terms, grazing is the most widespread form of land use in all Australian states and territories. In the extensive rangelands of central and northern Australia, where few alternative income-generating forms of land use exist, grazing systems provide a particularly important source of income, as well as environmental stewardship over vast tracts of sparsely populated land.

The beef industry can and does target a wide range of products and market outlets, which is testament to the diverse range of climates within which Australian beef is produced and the different requirements of destination markets. These range from light carcases of less than 200 kilograms for the domestic market to the long-fed carcases demanded by Japanese markets of more than double that weight (Figure 2.4).



kg = kilogram; mm = millimetre

Figure 2.4 Beef market specifications for slaughter cattle

[2] ABARE (Australian Bureau of Agricultural and Resource Economics) (2009). *Australian beef 09.1:financial performance of beef farms, 2006–07 to 2008–09*, ABARE, Canberra.

2.3 Productivity

Total factor productivity (TFP) measures outputs relative to the total inputs used to produce the output. Between 1977–78 and 2005–06, TFP of the Australian beef industry grew by an average of 1.5 per cent per annum.[3] This is on par with productivity growth in mixed crop–livestock systems and average overall TFP for all broadacre industries (Table 2.1).

Table 2.1 Broadacre agricultural total factor productivity, input and output growth (1977–78 to 2005–06)

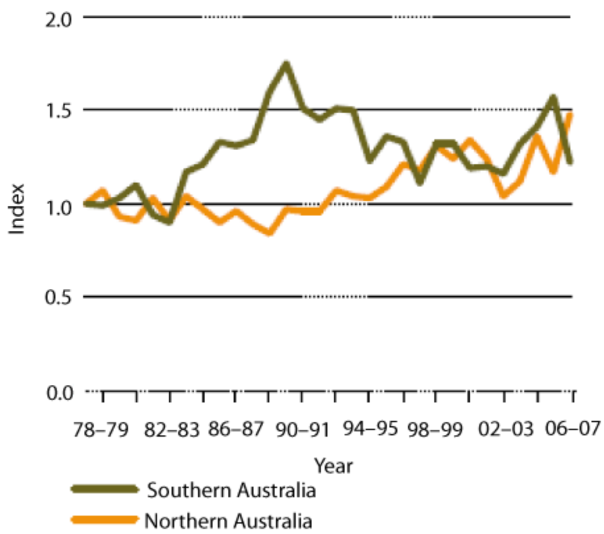
	TFP growth (%)	Output growth (%)	Input growth (%)
Total broadacre	1.5	0.8	–0.6
Cropping	2.1	3.1	1.0
Mixed crop–livestock	1.5	0.1	–1.5
Beef[a]	1.5	1.7	0.1
Sheep	0.3	–1.4	–1.8
Dairy[b]	1.2	5.1	3.9

TFP = total factor productivity
a Includes farms mainly engaged in beef cattle and beef–sheep production
b Dairy industry estimates are for the period 1988–89 to 2006–07
Source: ABARE (2009)[3]

Over the past decade, northern Australia has attained higher levels of overall productivity growth than southern Australia (Figure 2.5), due mainly to the significant expansion of beef and live cattle output in northern Australia over this period.

Total factor productivity is highly variable in all of Australia's broadacre and dairy industries, with shorter-term (year-on-year) variability in productivity being a feature of both the northern and southern beef industries (Figure 2.5 on the following page). In the north, this is often a function of scale, whereby higher efficiencies, including in production, are often achieved on larger properties. In southern Australia, variability is also a function of the smaller and more diverse nature of the agricultural enterprises in that region.

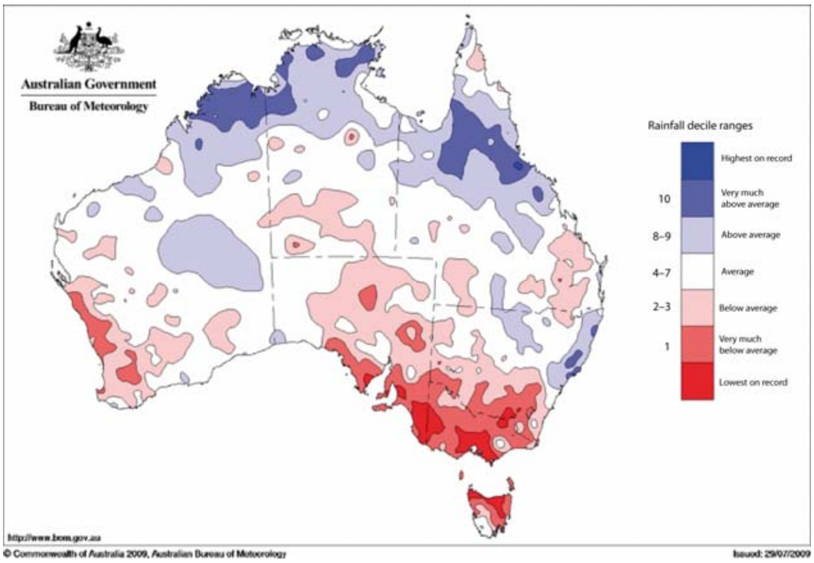
[3] ABARE (Australian Bureau of Agricultural and Resource Economics) (2009). *Australian beef 09.1:financial performance of beef farms, 2006–07 to 2008–09*, ABARE, Canberra.



Note: 1977–78 = 1.0
Source: ABARE (2009)[4]

Figure 2.5 Total factor productivity growth in specialist beef producers (2009)

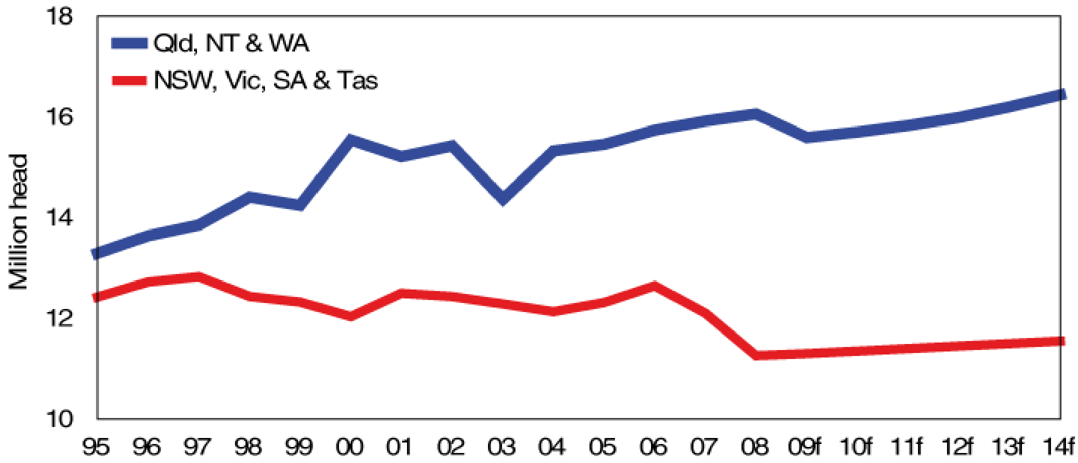
More recently, the high severity and frequency of drought conditions (Figure 2.6) have impacted significantly on agricultural productivity in southern Australia. This, and ever-increasing competition for land use in many southern agricultural regions, has contributed to a reduction in beef production in southern Australia. Conversely, better seasonal conditions, lower costs of land resources, the uptake of improved management practices and technologies, and the decline of the sheep industry have seen beef production in the north expand (Figure 2.7) on the following page.



Note: Distribution based on gridded data
Source: National Climate Centre, Bureau of Meteorology (2009)[5]

Figure 2.6 Australian rainfall deciles, July 2006 to June 2009

[4] ABARE (Australian Bureau of Agricultural and Resource Economics) (2009). *Australian beef 09.1:financial performance of beef farms, 2006–07 to 2008–09*, ABARE, Canberra.
[5] www.bom.gov.au



f = forecasts
Note: As at 31 March 1995 to 1999; as at 30 June 2000 to 2014
Source: Australian Bureau of Statistics; MLA forecast (2009)[6]

Figure 2.7 Geographical distribution of beef cattle, 1995–2014

Continued productivity growth is required in the beef industry to offset declining terms of trade and to maintain and improve profitability. RD&E to support such growth is critical.

2.4 Industry prospects

The medium to long-term prospects for the Australian beef industry are undoubtedly strong. The domestic market is highly valuable, and is growing and reliable. Over the past decade, and especially in recent years, the Meat Standards Australia (MSA) grading scheme has successfully underpinned a positive shift in beef-eating quality in Australia, and a strengthening of domestic demand and expenditure. In 2008–09, domestic expenditure on beef approximated A$6.4 billion, up from A$5 billion in 2002–03. Per capita beef consumption now stands at around 32.5 kilograms per year in Australia.

Export demand for Australian beef is also forecast to grow, particularly with the growth in disposable incomes in Asian markets, for which Australia is well placed to take advantage. Fall-out from the global financial crisis continues to affect exports, but recovery is already occurring in some outlets. Recent and unprecedented volatility in the Australian dollar, and its present high value, are major factors mitigating against rapid recovery in export markets.

Ultimately, the prosperity of the industry depends upon continuity of supply and consistency of product. In the short term, supply will be tight. Poor brandings in 2007–08 (due mostly to prolonged and widespread drought) contributed to one million fewer breeding cattle in 2009. This is approximately an 8 per cent decrease from the previous year. It is expected that supply of slaughter cattle will be down by 300,000 early in 2010, with total slaughter in 2010 predicted to be 7.5 million head. A relatively slow rate of herd expansion is expected in 2010, before herd growth resumes in 2011, especially in northern Australia. Localised drought conditions will continue to affect the recovery of the cattle herd overall.

[6] MLA (Meat & Livestock Australia) (2009). *Cattle industry projections — mid year update*, MLA, Canberra.

3 Industry research, development and extension investment priorities

This section discusses the vision, industry and state agency priorities, and linkages to other agencies that are associated with the beef industry in Australia.

3.1 Vision

Following industry and government agency consultation, the following vision has been developed for the beef production RD&E strategy:

> A competitive and sustainable beef industry, responsive and adaptable to a changing operating environment.

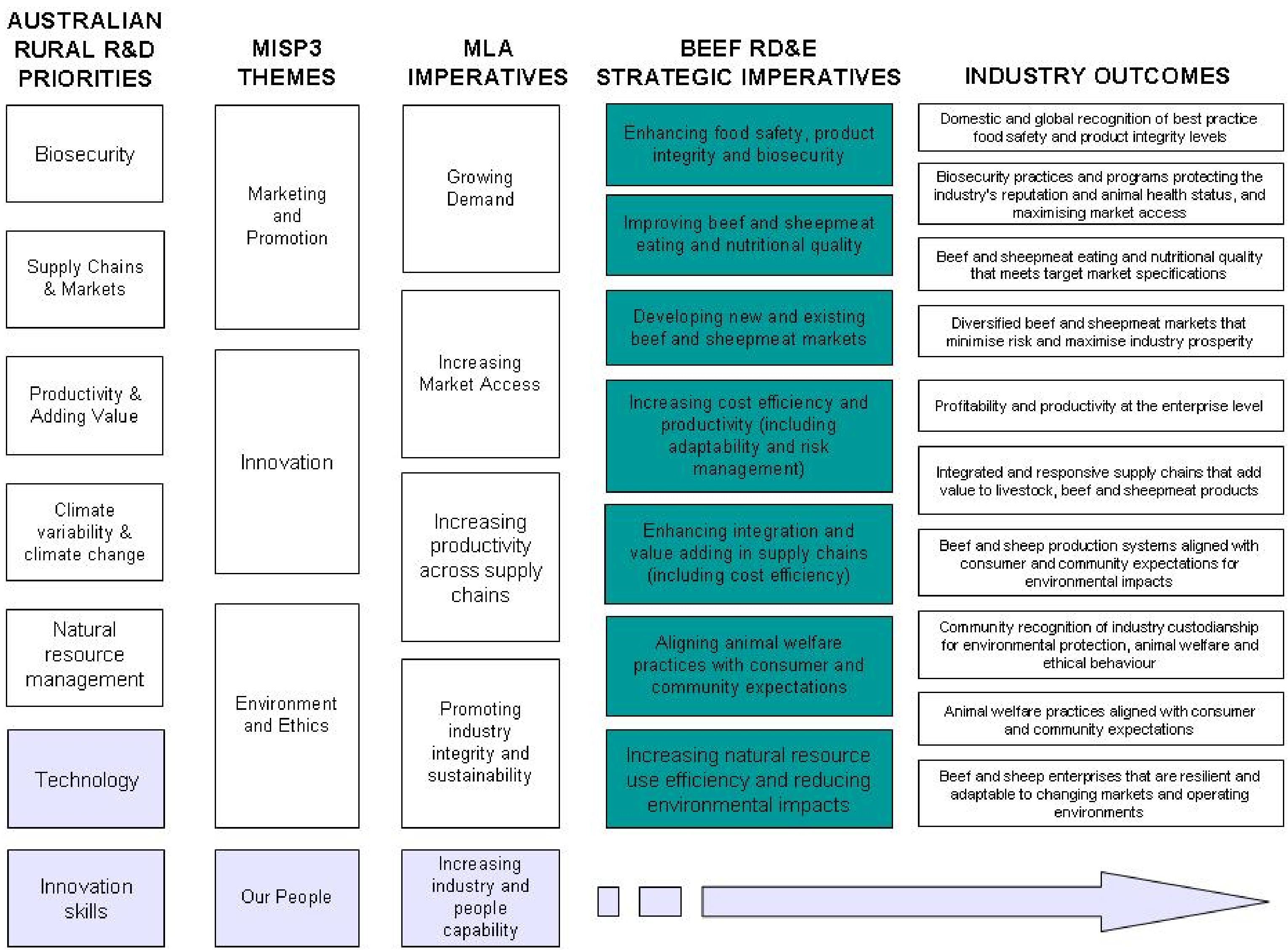
3.2 Identifying industry priorities

Development of an industry plan and the setting of investment priorities require input from producers and processors, in consultation with RD&E organisations that have the capacity to execute the plan. With this as the focus, the Southern Australia Beef Research Council (SABRC), North Australia Beef Research Council (NABRC) and MLA ran four regional consultation forums (Brisbane, Tamworth, Adelaide & Bendigo) during October–November 2008. These forums gathered information on industry priorities for future RD&E. The participants were a mixture of producers, peak body representatives, state and other RD&E agencies and MLA representatives.

These forums provided the RMCIC with information to develop 10 national industry priority outcomes (Appendix A). From these, seven strategic imperatives that would form the basis for this strategy were formed:

1. Enhancing food safety, product integrity and biosecurity.
2. Increasing natural resource use efficiency and reducing environmental impacts.
3. Increasing cost efficiency and productivity (including adaptability and risk management).
4. Enhancing integration and value adding in supply chains (including cost efficiency).
5. Improving beef eating and nutritional quality.
6. Developing new and existing beef markets.
7. Aligning animal welfare practices with consumer and community expectations.

These strategic imperatives, on which this Strategy is based, and their relationship to the Meat Industry Strategic Plan (MISP) and Australian Government priorities is illustrated in Figure 3.1



MISP = Meat Industry Strategic Plan; MLA = Meat & Livestock Australia; RD&E = research, development and extension

Figure 3.1 National beef production research, development and extension strategic imperatives and their relationship to other national plans

3.3 State agency priorities

As part of the development of the RD&E Strategies, the PISC R&D Subcommittee have requested that each agency identify whether their organisation will take a 'major', 'support' or 'link' role in beef production RD&E in the future.

The definitions of major, support and link for the purposes of the Strategy are:

- major — the agency will take a national lead role by providing significant RD&E effort
- support — the agency will undertake RD&E, but other agencies will provide the major effort
- link — the agency will undertake little or no RD&E: instead it will access information and resources from other agencies.

Table 3.1 indicates the priority that each state agency involved in development of the plan places on beef production RD&E. The states intending to take a major role in beef RD&E in the future (Queensland, Northern Territory and New South Wales) also have the largest capability in terms of full-time equivalent (FTE) staff. Agencies indicating a support role also have significant capability currently allocated to the beef production sector.

Table 3.1 Beef production research, development and extension priority in state agencies[a]

State agency	Intended role in beef RD&E	FTE capacity in beef — 2009
Primary Industries and Resources South Australia	Support	12.9
Department of Food and Agriculture Western Australia	Support	21.4
Victorian Department of Primary Industries	Support	23.6
Tasmanian Institute of Agricultural Research	Link	4.1
Department of Employment, Economic Development and Innovation Queensland	Major	119.5
Industry & Investment New South Wales	Major	78.5
Northern Territory Department of Resources	Major	28.8
Total		288.8

a The total capacity in beef RD&E across state agencies, CSIRO and the university sector is 458.8 FTE (Section 4.1).

In developing this plan, each agency has also indicated the relative future priority (high, medium or low) that it places on each of the strategic imperatives within the Strategy.

In Table 3.2, the current FTE capacities for beef production RD&E within each state agency are compared with priorities for investment at the strategic imperative level.

Table 3.2 Strategic imperatives mapped by agency priority and the current full-time equivalent staff capability (2009)

Strategic imperatives	Agency FTE							
	PIRSA	DAFWA	DPIV	TIAR	DEEDI (Qld)	I&I NSW	NTDR	Total
1. Enhancing food safety, product integrity and biosecurity	0.0	0.0	3.4	0.0	8.6	15.9	2.0	29.9
2. Increasing natural resource use efficiency and reducing environmental impacts	0.0	3.7	6.6	1.3	25.6	16.8	11.6	65.6
3. Increasing cost efficiency and productivity (including adaptability and risk management)	11.8	14.1	7.8	2.1	55.0	28.3	13.5	132.6
4. Enhancing integration and value adding in supply chains (including cost efficiency)	0.0	0.0	1.4	0.0	8.1	1.5	0.0	11.0
5. Improving beef eating and nutritional quality	0.3	0.0	0.5	0.1	12.7	5.3	0.0	18.9
6. Developing new and existing beef markets	0.0	0.0	0.5	0.0	4.4	0.3	1.2	6.4
7. Aligning animal welfare practices with consumer and community expectations	0.0	1.4	0.1	0.1	5.1	2.0	0.5	9.2
Other	0.8	2.3	3.3	0.6	0.0	8.4	0.0	15.4
Total	12.9	21.4	23.6	4.1	119.5	78.5	28.8	288.8

FTE = full-time equivalent; RD&E = research, development and extension

High priority Medium priority Low priority

Notes: The total capacity in beef production RD&E across state agencies, CSIRO and the university sectors is 458.8 FTE (Section 4.1)

'Other' means that the organisation has the FTE capacity that is engaged in work not covered or described by items 1–7

No shading indicates that the organisation has not placed any priority on that particular strategic imperative

Table 3.2 indicates that, currently, most capability in the state public sector agencies exists within strategic imperatives 2 and 3, which are associated with the efficient use of natural resources and productivity on-farm. This is not surprising, given the importance of sustainable use of resources and productivity in driving the performance of a land-based industry, and the role of government investment in on-farm RD&E and public good outcomes.

Historically, governments have not invested in RD&E further down the supply chain. The table indicates that these two strategic imperatives are considered to be a high priority for the future by these agencies.

3.4 Linkage to other strategies

This Strategy identifies all RD&E activity considered by industry to be a priority for the beef production sector. Many of the programs and deliverables that have been identified for consideration by the RMCIC require investment activities that are the same as or have some relevance to, other sectoral and cross-sectoral plans, such as sheepmeat, wool, animal welfare and climate change.

The Strategy has been developed to provide a complete picture of the requirements of the pre-farm-gate sector. Many of the priorities and programs will be implemented as part of cross-sector and cross-industry investments. These linkages will reduce duplication and increase the efficiency of investment in the future.

Care should be taken not to 'double count' capacity and investment intentions between sectoral and cross-sectoral plans.

The cross-sectoral strategies will summarise what is happening across all industry sectors relevant to that topic, identify gaps in investment and ensure collaboration across sectors, where it is appropriate.

North Australia Beef Research Council and Southern Australia Beef Research Council

NABRC and SABRC are the key industry–agency forums with the responsibility for determining and advising on strategic requirements for RD&E activities (including education and training) in the Australian beef industry.

NABRC and SABRC act as the central consultative councils comprising all major northern and southern beef RD&E agencies and educational institutions (departments of primary industries, CSIRO, CRCs and universities) and producer representatives from applicable states and territories. NABRC and SABRC will contribute to overseeing and implementing the processes and policies developed by RMCIC in relation to collaboration, program coordination and monitoring and evaluation for implementation of this Strategy.

NABRC and SABRC have formal linkages to other industry organisations, including CCA and state farm organisations, and provide information and advice to support RD&E policy development by these prescribed bodies. Oversight of the activities of levy-funded service companies, including MLA's involvement in delivering the objectives of the Meat Industry Strategic Plan (MISP3), is the express responsibility of peak industry councils (including CCA). Therefore, CCA has the overarching authority over MLA's strategic direction within the Strategy.

4 Capability, infrastructure and intellectual property

This section presents current beef industry capability, infrastructure and intellectual property available to the Strategy.

4.1 Capability

In the preparation of this Strategy, significant effort has been allocated to collecting data that describe the current status of human capacity, infrastructure and beef research herds that exist across the broad spectrum of organisations contributing to the national RD&E effort.

Detailed summaries on an organisational basis are provided in Appendix B for full-time equivalent (FTE) capacity in relation to the Australian Standard Research Classification, employment classification, strategic imperatives and age classification. A snapshot of the national data is provided in figures 4.1–4.3. This information will be used by each RMCIC member organisation to inform their decisions about research capability and its application to investment priorities at the strategic imperative and program levels.

These data represent a new opportunity to integrate reallocation and succession planning activities where appropriate. RD&E resourcing will be an ongoing area of RMCIC consideration under the Strategy, with the aim of increasing efficiency of resource use and ensuring that skills that are scarce are applied to the highest priority RD&E activities. In particular the RMCIC will use this data set in 2010 to consider the effect of short-term and project-based funding on the future supply and development of important research and technical skills. This information will have an influence on actions taken.

The current snapshot of capability prepared for the Strategy indicates that a total of 459 FTEs were engaged in beef production RD&E across the government agencies, CSIRO and universities in 2009. Figure 4.1 on the following page indicates that the bulk of this capacity is in the field of animal production and extension (other) is the second-most prevalent. Smaller capacities exist in the fields of veterinary science, and crop and pasture science. Within the organisations, there is substantial capacity within other scientific disciplines (eg soil and water, biometrics, economics and business) that is not currently allocated directly to beef production RD&E, but could be called upon to address specific issues as required. This capacity is not recorded here.

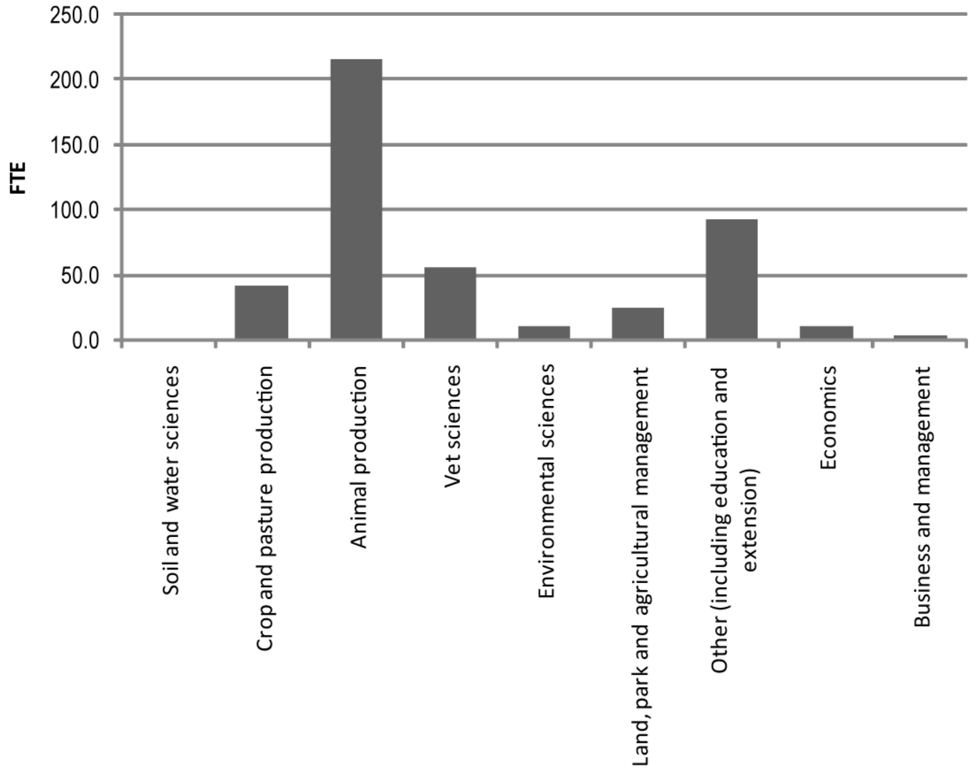


Figure 4.1 Full-time equivalent (FTE) staff in beef production research, development and extension by Australian Standard Research Classification series (2009)

Figure 4.2 provides a snapshot of capability defined by employment classification. Across all the research provider agencies, there are approximately 162 FTEs classified as research staff, 101 in technical roles and 111 classified as working in extension. When a 2.5 multiplier is applied to base salaries to account for internal organisation costs,[7] the total investment in human capability is valued at $79.8 million per year.

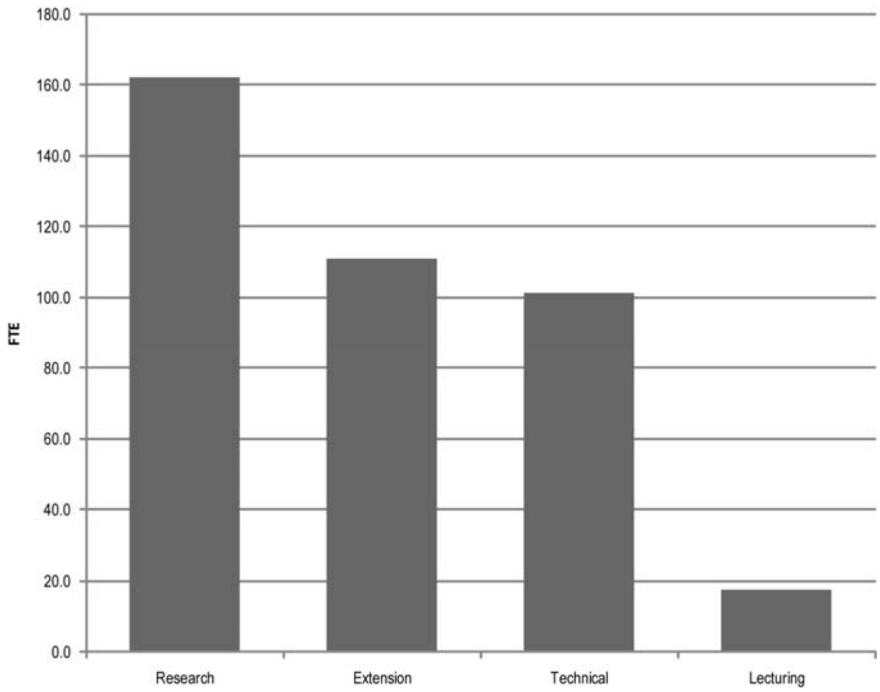


Figure 4.2 Full-time equivalent (FTE) staff in beef production research, development and extension by employment classification (2009)

[7] McCausland I (2006). *Report on MLA–DPI audit relating to livestock production research, development and extension*. Meat & Livestock Australia Ltd, Canberra.

Figure 4.3 illustrates the heavy focus on productivity and cost-efficiency RD&E for the beef production sector — 200 FTEs allocated to strategic imperative 3. This is not surprising, given the focus that industry and government has applied to profitability and productivity in the past.

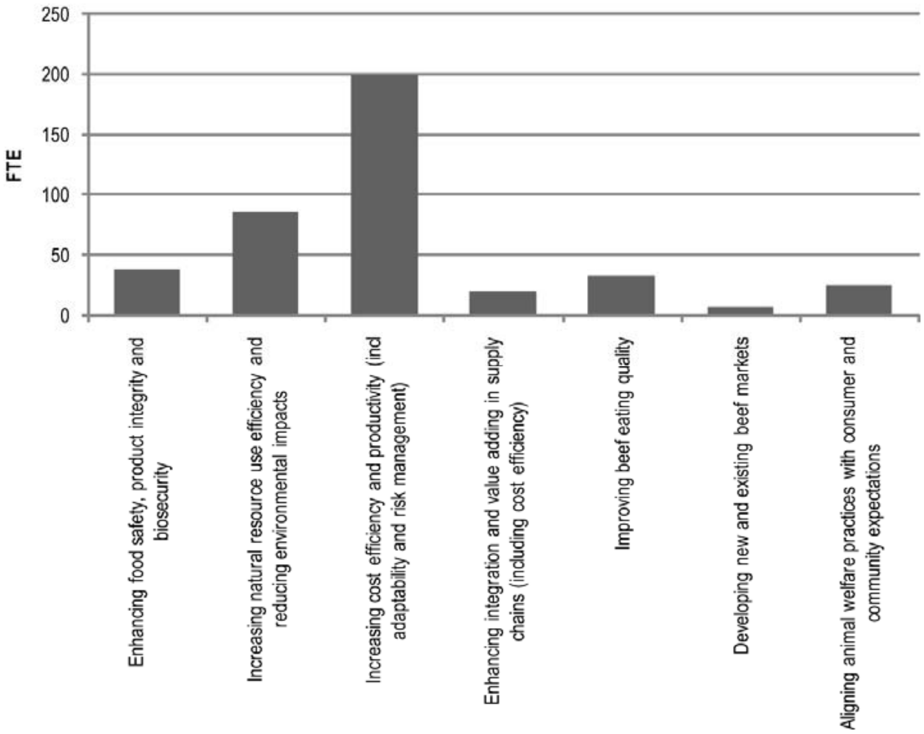


Figure 4.3 Full-time equivalent (FTE) staff in beef production research, development and extension by strategic imperative (2009)

The prioritisation of strategic imperatives and programs for future investment is underway within the RMCIC. Once this prioritisation is finalised, the RMCIC will consider emerging gaps in capability, and how capability could be moved into new investment areas through training, succession planning and interagency agreements. This process could include actions to address any problems identified relating to researchers supported by short-term or project-based funding.

In 2009, there were at least 125 postgraduate students undertaking studies relevant to the livestock industries (sheepmeat, beef, wool and dairy) and approximately 950 students due to graduate from tertiary courses relevant to the rural sector this year (Appendix C).

4.2 Infrastructure and intellectual property

Across the organisations contributing data to the Strategy there are 64 research stations located in agri-ecological zones suitable for cattle production. In total, 30 beef research herds are located across these research stations (Appendix D). Section 5.4 identifies the process that will be applied by the RMCIC to prioritise this infrastructure for retention and future investment.

4.2.1 Livestock and pasture resources and databases

Databases and sample collections have been created over many years of research across Australia. These are essential research tools. Often, historical data can be re-analysed to answer current questions and emerging issues that were not a priority in the original projects. These data can also provide important information in the design and implementation of new RD&E.

The member organisations of RMCIC own many databases and generally seek to ensure that data and intellectual property are available for future public good. Thus, these databases have been available for research and development, with access to data and outcomes licensed through appropriate contracts. It is likely that the future development of RD&E programs will require access to historical datasets and intellectual property — this should be a formal consideration of program development and implementation.

Government agencies have previously transferred relevant genetic and phenotypic resources from completed programs to new programs. For example, the transfer of New South Wales Net Feed Intake (NFI) cattle to South Australia and Western Australia allowed the continual recording of difficult and expensive-to-measure traits. It also enabled effective linkage between the projects that builds on the capacity to inform industry of genetic and genomic outcomes.

The maintenance and security of historical data bases has been an issue, particularly if computer software and hardware is changed or updated, or key staff retire or change roles. The development of centralised databases with common structures within each organisation is recommended. This will provide easier access to data resources in the future. Financial support may be required to ensure development of appropriately maintained databases.

Significant beef databases include:

- Beef CRC 1 & 2 — this is a large database of genetic, growth and carcase information for *Bos taurus* and *Bos indicus* (including eating quality assessment)
- Beef CRC 3 — genetic resource (DNA bank) and female productivity data
- Industry and Investment NSW (I&I NSW) cattle database, which includes
  - Trangie growth-selection lines — growth, female performance, body composition, carcase information, genetic correlations and heritable traits (20-years of data)
  - Trangie NFI-selection lines — growth, female performance, feed intake, carcase information, genetic correlations and heritable traits (20-years of data)
  - data from the Grafton crossbreeding experiment — this included *Bos taurus* and *Bos indicus* crosses (20-years of first-cross, backcross and terminal cross data, growth, maternal performance, substantial carcase, eating-quality information and heterosis effects)
  - muscling selection lines (15-years of growth, performance, female performance, carcase, scans and body dimensional data)
- South Australia — The University of Adelaide and Primary Industries and Resources South Australia (PIRSA), which includes
  - data from the southern crossbreeding experiment (4 years of *Bos taurus* data, including first-cross data, growth, progeny performance and carcase data)
  - Jersey × Limousine crossbreeding data
- CSIRO — DNA database
- BREEDPLAN database — an Australia-wide genetic evaluation (commercial database).

Livestock resources include the NFI cattle lines and muscle-selection lines within I&I NSW, and new cattle lines developed for methane divergence.

Existing databases for beef are being shared through the Beef CRC. However, these arrangements have been facilitated and funded by Beef CRC. In the future, in the absence of a CRC or its equivalent, the function of coordinating access and sharing of livestock resources and databases will be assumed by the RMCIC. An audit of beef industry databases will be undertaken by the RMCIC in 2010.

4.2.2 Pastures and plant genetic resources

The current Australian network of plant genetic resources encompasses three pasture collections:

- Australian Trifolium Genetic Resource Centre (Western Australia)
- Australian Medicago Genetic Resource Centre (South Australia)
- Tropical Crops and Forages Genetic Resource Centre (Queensland).

Other pasture gene banks of value also exist within Australia:

- temperate forages (grass, legumes and herbs) (Tasmania)
- temperate forages (mostly grasses) (Victoria)
- collections of white clover (*Trifolium repens*) and trefoil (*Lotus* spp) (New South Wales and Victoria).

Industry and government are currently unable to sustain these pasture plant gene banks and databases. The collections are at risk and their maintenance requires the attention of government and industry. The Australian Government has an obligation to support conservation and international distribution of seed since its signing of the International Treaty on Plant Genetic Resources for Food and Agriculture in 2002. The future of these genetic resources and databases needs to be considered and included in the development of a cross-sectoral RD&E strategy for pastures when it is developed.

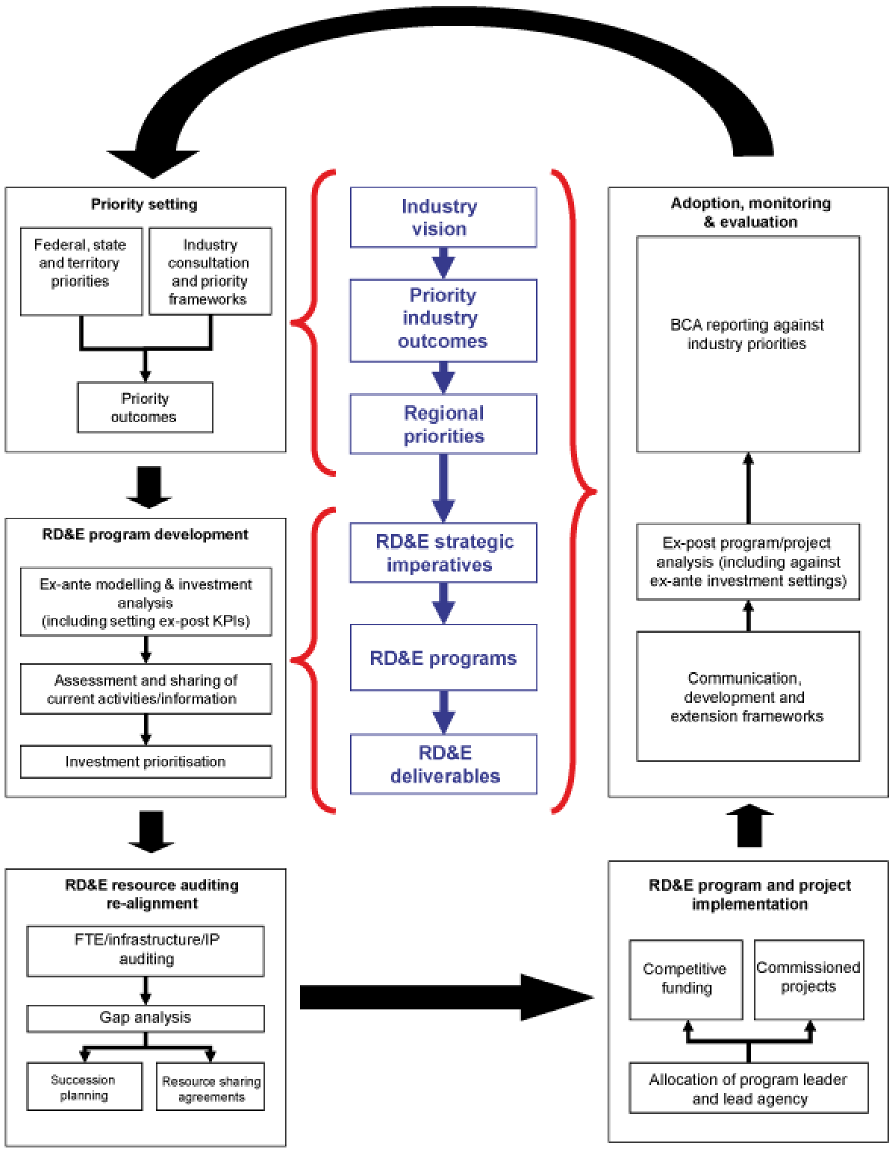
4.2.3 Other forms of intellectual property

The agencies contributing to beef production RD&E in Australia own other forms of intellectual property not listed above, possibly including: copyrights, patents and inventions, trademarks (including brands), industrial design rights, circuit layouts, trade secrets and confidential information, know-how, plant breeders and variety rights, and moral rights. Also relevant are: digital, broadcast and URL rights, indigenous intellectual property, and rights relating to the use of indigenous flora and fauna. Patents and confidential information in particular are owned individually, jointly and collectively by the agencies themselves, as well as the joint ventures they have been involved in (eg CRCs). In many cases, packages of intellectual property are licensed to private entities for the purpose of commercialisation, and those agreements are enforceable.

It is impractical to list and define all the packages of intellectual property that will be relevant and valuable for current and future beef production RD&E, or indeed the commercial arrangements that have been put in place for each. The PISC R&D Subcommittee will be discussing this broad issue for all of the sectoral and cross-sectoral RD&E plans in early 2010 to be consistent with the principle '…to freely share the knowledge generated through the primary industries National RD&E Framework, including minimising barriers to RD&E created by intellectual property protection'. The parties to the Strategy and the RMCIC will pay particular attention to any new knowledge or intellectual property generated by parties working under the new arrangements. The guiding intent in the first instance will be to improve the flow of information for the benefit of Australian industry and the community. A realistic initial goal is to increase the access of all parties to know-how and confidential information, while at the same time endeavouring not to compromise commercial opportunities or the moral rights of the discoverers.

5 New processes for collaborative investment

The collaboration by government agencies through the RMCIC is a significant change to the way that decisions about beef production RD&E investment have been made in the past. The following section provides details of the processes that will be implemented by the RMCIC to ensure effective collaboration and integration of investment activities in the future. Figure 5.1 is a diagrammatic representation of the implementation processes that will be managed by the RMCIC and described in sections 5.1–5.10.



BCA = Benefit Cost Analysis; FTE = full-time equivalent; IP = intellectual property; KPI = key performance indicator; RD&E = research, development and extension

Figure 5.1 Red Meat Co-investment Committee processes for implementation of the beef production research, development and extension strategy

5.1 Evaluation and prioritising of investment

The industry consultation process detailed in Section 3.2 identified a range of priorities for beef production RD&E investment. These priorities have been organised into programs under seven strategic imperatives (see Figure 3.1), and will be used by the RMCIC to plan future investment in RD&E for beef production.

The Modelling Working Group (MWG) has been established as a subcommittee of the RMCIC to undertake economic evaluation of programs and provide advice on priorities for investment based on likely economic, environmental and social benefits. Members of the MWG are drawn from the government agencies and the private sector, and have economics and evaluation expertise.

The funds required to invest in all programs, and the programs themselves, are beyond the capacity of the RMCIC agencies to address with new initiatives in the short term. However, it is likely that many of the deliverables requested by industry already receive RD&E investment to varying degrees. The RMCIC will collate all current RD&E into ‘virtual programs’ during 2010. This will improve information exchange, encourage collaboration and connect project outputs to higher order outcomes.

The MWG has developed a rapid evaluation technique to provide a first-pass evaluation of potential programs and identify the most important programs for detailed investment analysis. The results of the first-pass evaluation and detailed investment analysis, including cost–benefit ratios and net present values, will be reported to the RMCIC and will inform the ranking of programs for future investment. The RMCIC will also consider the need to take a portfolio approach to investment across the spectrum of ‘blue sky’ and incremental RD&E opportunities, and to consider the risk associated with the various project types.

The intended first-pass evaluation and investment analysis process is detailed in Appendix E.

5.2 National program coordination and development

The Strategy will be implemented through multi-agency RD&E processes and programs overseen by RMCIC, with agency and industry direction through SABRC and NABRC and additional consultation and policy oversight through CCA.

Coordination of agency investment in programs (or subprograms if more appropriate) will occur through the process described here, subject to review after two years.

The priority ranking for initial national RD&E programs will be determined by the RMCIC from the programs derived from the industry consultation process. This ranking will be informed by the broad investment analysis process described in Section 5.1. Any new programs will be prioritised using the same process. Programs are not a funding mechanism; their purpose is to coordinate individual agency investments for better industry and agency outcomes.

Individual agencies will take on program leadership roles, based on:

- relevance of the topic to their state and agency investment priorities
- their existing human and infrastructure resource capacity relevant to the topic
- their ability to commit resources to the program over its likely duration

Some of the coordinating roles may be taken on by MLA, and the organisation may also provide funding to support agencies to take leadership roles. Processes to encourage competition (Section 5.6) will be incorporated at the project level.

For areas of large investment (eg strategic imperative 3 'increasing cost efficiency and productivity'), there are likely to be multiple programs per imperative. In areas of smaller investment (eg strategic imperative 7 'aligning animal welfare practices with consumer and community expectations'), one program is likely.

Program management will entail three key functions:

- gather information on current RD&E investment and collate this activity into 'virtual programs' as per the program structure agreed by the RMCIC
- monitor the degree to which current activity meets the identified priorities in the Strategy and initiate new projects to fill gaps
- facilitate the implementation of new programs to address any industry priorities that are not currently addressed through existing investment.

An annual program development cycle will allow structured development of new programs as follows:

1. The RMCIC will meet in August each year to:
   - review progress in national programs, reported by each program's lead agency
   - agree in principle on new (or significant changes to existing) priority programs or subprograms to commence in the following financial year, taking into account feedback on priorities from CCA, NABRC and SABRC; the Meat Industry and MLA Strategic Plans; other relevant strategies of the National Primary Industries RD&E Framework; priorities of the various state and territory governments; the Australian Government's National Rural R&D Priorities; and research undertaken in existing projects to identify industry RD&E needs.
2. The agency proposing to develop and lead a new or changed program will present a detailed 'value proposition' to the RMCIC (based on analysis provided through the MWG) and nominate a program leader to develop program targets.
3. Lead agencies will work with contributing agencies to develop program targets and concepts, and identify resource needs. Lead agencies will also propose solutions to resource gaps and draft requirements for new interagency arrangements.
4. Each program concept will include a logical framework to describe the monitoring and evaluation mechanisms and systems (on a national, regional and local basis), the industry targets against which success will be measured and the key performance indicators that will be reported to RMCIC, industry and other stakeholder groups.

5. If the project teams have been decided collaboratively, the lead agency will be responsible for negotiating cash and in-kind contributions, as well as the work plan for each project. Where a preferred team has not been chosen (eg because the project requires development of new capability, new technologies or knowledge), then a competitive process will be used to select the most appropriate agency (see Section 5.6).

5.3 Mechanisms to monitor and address gaps in capability and infrastructure

Each August, RMCIC members will report and review recent and forecast changes in their human resource and infrastructure capability.

A simplified spreadsheet with automated analysis will be developed for updating the database, and a full audit will be conducted every three years to coincide with the planned external review requested by the PIMC (Section 5.9).

Members will discuss options to address actual and forecast changes, and emerging requirements in capability and infrastructure on a national basis.

5.4 Prioritising infrastructure for future investment

Relevant infrastructure, beef herds and significant intellectual property available to the Strategy have been documented by the RMCIC (Section 4). Much of the infrastructure can be used for RD&E in other species (particularly other ruminant species) and for other commodities (to varying degrees), and this remains an important consideration in prioritising for retention.

The RMCIC will review the total list and agree on facilities, herds and intellectual property critical for retention to support the Strategy, taking into account the following considerations:

- the needs of the priority RD&E programs identified via the MWG
- the recent history of use for RD&E for the relevant commodity.

Criteria that will be considered will include:

- for infrastructure
  - the extent to which it represents a significant and typical farming system in one of the priority agri-ecological zones and is not duplicated elsewhere
  - the extent to which it cannot be readily duplicated on commercial properties
  - where alternative infrastructure exists in other areas or other agencies, the condition and ‘state of the art’ nature of the infrastructure
  - the degree to which it is ‘multipurpose’ or ‘multicommodity’ and can be supported by a range of investors
  - the cost of maintaining it, and the priority and view of the current owner(s)
  - the extent to which revenues generated through its sale can be re-invested in alternative infrastructure to support the national RD&E strategy

- for research herds and intellectual property
  - the extent to which the maintenance of the resource will build on existing data and result in cost savings by not repeating data collection in the future
  - the relevance of the herd to current industry priorities for productivity and product attributes.

It is proposed that SABRC and NABRC will review future regional requirements for infrastructure and make recommendations to industry and the RMCIC.

5.5 Succession planning

Succession planning is a process for identifying and developing internal personnel or recruiting new personnel with the potential to fill key or critical organisational positions. Succession planning ensures the availability of experienced and capable people, who are prepared to assume these roles as they become available.

The Strategy aims to enhance RD&E capability through increased collaboration, specialisation and critical mass, as appropriate. Achieving these aims will depend on having continued access to experienced and capable research, extension, technical and lecturing expertise.

Although succession planning is an organisational responsibility, it will need to occur in the context of the National RD&E Framework. There will be a high cross-organisational and industry dependency on the continued supply of capability, and hence the need to consider succession planning as a key input into the design of the National RD&E Framework.

With the implementation of the National RD&E Framework and the formation of critical mass locations, there will be a reduction in the places from which to recruit capability in Australia. The capability audit provides for future resource planning on a national basis and the capacity to project career opportunities and encourage the retention of talented personnel.

Data supplied via RMCIC on capability by Australian Standard Research Classification and age classification provides some insight into future areas of focus for succession planning. Critical aspects of science discipline and industry leadership will need to be considered by RMCIC in the development of programs.

Although age is not a good indicator of the talent pool in any particular discipline series, it serves as some indication of the need and capacity for succession planning. Age data have been provided based on the groupings of younger than 40 years, 40–55 years and older than 55 years, and currently includes all staff classifications (research, technical, extension and lecturing). Further analysis will be undertaken for the next update of the Strategy. However, the personnel data available to the RMCIC suggest that:

- 45% (207 FTEs) of the capability mapped to beef is under the age of 40
- 17% (79 FTEs) is over 55 years of age.

Data provided on the number of postgraduates indicate that there are currently at least 125 students (84 related to animal production; 30 to vet sciences) that could potentially seek a career in beef and/or sheepmeat RD&E. This suggests that there could be between 30 and 40 new postgraduate-trained scientists in the market each year. However, not all these will choose to be employed in the public research and university market sectors, and a proportion of international students will return to their home countries to work.

The universities that responded to the RMCIC's request for information reported that at least 948 undergraduate students were expected to graduate from rural-sector-related study in 2009 and this is predicted to rise to almost 1,350 students in 2013. Most of these undergraduate students are studying agriculture and rural sciences, animal sciences and vet sciences. There are significantly fewer studying environmental science, economics and agribusiness, and agricultural engineering (Appendix C), although more of these students may be studying at other universities.

From this initial analysis, it would seem potential focus for succession planning would be in the areas of crop and pasture production, environmental science, and economics and management. However, the data reflect the capacity allocated specifically to beef production RD&E in 2009, and a review of other sectoral plans may reveal additional capacity in these disciplines that could potentially be allocated to beef RD&E if required. Development of the Strategy and its implementation through RMCIC using the processes described in this section provide opportunities for an active program for developing skills and maintaining capacity within the sector. Issues for consideration include:

- scholarships for postgraduate study, in disciplines identified as lacking capacity, that are directly sponsored by employers and supported by vocational development activities
- secondment to allow for skills development and to address capacity issues in particular organisations
- the creation of 'virtual' teams to address specific high-priority issues for industry
- the creation of career pathways across the organisations contributing to beef (and related) RD&E
- opportunities for the development of leadership skills through the program leader roles that will emerge from this strategy
- development of leadership capability within industry organisations.

5.6 Maintaining the competitive funding element at the project level

Competitive processes are a key feature of the Australian innovation system for several reasons. First, such processes give all eligible research providers (whether they have a history in production research or not) an equal opportunity to bid for research funds. This means that new ideas and novel approaches are considered periodically, in a system that might otherwise be closed. Second, competitive processes provide a degree of transparency to the process, demanding novelty, science quality, capacity, comparable costings from the research providers, and transparency of decision making and contestability on the part of the funding agency or its delegates.

The requirement for competitive funding is also essential for some research providers, especially the university sector. Funding that qualifies under the Australian Competitive Grants for Research (Category 1) contributes to the level of university research infrastructure block funding under the new Sustainable Research Excellence initiative. Funding success is also an important criterion of excellence in the new Excellence in Research for Australia Initiative.

Notwithstanding these benefits, competitive funding processes can be expensive, time consuming and suffer from the weaknesses common to all peer-review processes. An alternative, non-competitive model would be based on identifying the ‘preferred’ research teams (assessed against defined criteria) and commissioning them to undertake a research project. Commissioned research has constituted a growing proportion of the total red meat sector funding over the last decade, and this is likely to increase due to the contraction in national research capability, the reduction in number of potential providers and the drive for increased cooperation between research providers.

Therefore, the most likely funding model under the Strategy will be a mix of both competitive and non-competitive funding elements. The process for commissioning a preferred team to do research project work has been described in Section 5.2. The competitive process would require the program leader to publicise a call for expressions of interest from the research community to complete defined bodies of research work essential to enable an RD&E program to deliver the agreed deliverables to industry.

The selection criteria for successful project teams would need to be defined and a transparent process run by the program leader with reference to relevant external advice, such as peer review, and with the oversight of the RMCIC. In the long term, the incentive for research organisations to develop and maintain excellent and unique capability in a particular field would be the opportunity to become a preferred supplier of research in that field and for later funding rounds.

The other aspect of competition relates to demonstrated performance. Research groups that have been granted funding and that do not perform (either by not achieving milestones or not producing work of an appropriate quality) will risk losing preferred status. Other research groups will then be given the opportunity to compete for the research funds via the process defined above.

5.7 National communication, development and extension

The effective development and extension of research outputs generated through the Strategy is imperative in ensuring that the value of these investments is realised by industry stakeholders. Such value, at an enterprise and whole-of-industry level, only arises from the timely and effective implementation of new technologies, knowledge and practices. The current time lag in adoption, fragmentation in extension delivery, and a lack of industry skills and capacity to capitalise on the advantages of new knowledge and technology must be addressed. This will improve productivity and industry resilience to respond to the social, physical and financial effects of seasonal adversity, rising input costs, and variability in markets and climate.

A highly collaborative approach is required to ensure efficient and consistent extension processes and better harvesting of new RD&E ideas. This approach relies on integrated mechanisms for communication, development and extension (CD&E) of research outputs, in which all contributing agencies have a defined and integrated role in the funding, coordination, delivery and monitoring of related activities.

CD&E programs will coordinate regional development and local extension of the outputs from national research programs. These programs will:

- identify extension needs and align appropriate CD&E delivery methods in consultation with industry and extension agencies

- develop and promote quality controls and minimum delivery standards, based on accountable and consistent monitoring and evaluation of program outcomes
- broker delivery arrangements in each state through government agencies, Research and Development Corporations, and other organisations and individuals, including efforts to build private capability where appropriate.

The purpose of each CD&E program is to facilitate — at a local, regional and national level — long-term consistency, efficacy and efficiency in the conduct of beef development and extension. Each program will provide a consistent approach for all delivery agencies to interact with entities (including the private sector) who are not formally engaged with the Strategy. The objectives of this approach are to:

- ensure consistency and relevance in the key messages, information and tools extended to industry
- recognise and accommodate regional and local differences in RD&E needs and delivery capability
- enable standardised monitoring and evaluation of the impact of RD&E investments in industry
- improve the cost efficiency and long-term efficacy of extension resources
- foster timely and robust industry and agency engagement in the identification, prioritisation and evaluation of RD&E programs and investments.

CD&E programs will be positioned and directed (at a strategic level) under the existing industry–agency consultative forum provided by SABRC and NABRC.

A regional network of consultative industry–agency committees is planned for implementation in southern Australia under SABRC (such a network already exists in northern Australia under NABRC). These networks will provide for the concurrent exchange of RD&E outputs and ideas of regional, sectoral and national relevance. It will also constitute a checking mechanism by which progress against the RD&E priorities and programs within the Strategy can be reported and evaluated. MLA, as a national industry services provider, will have a lead role in overseeing the coordination and strategic direction of each CD&E program, through SABRC and NABRC.

5.8 Funding models and agreements

During the development of the National Dairy RD&E Strategy, the ‘Dairy Moving Forward’ Steering Committee identified six broad categories or types of investment models:

1. contract research and development
2. collaborative research and development (two-party project)
3. collaborative research and development (multi-party project or program)
4. unincorporated joint venture delivering programs
5. Cooperative Research Centres
6. incorporated joint ventures delivering programs.

Together, they represent a spectrum of models — from short-term contracts for specific outcomes using existing capability, to long-term multiparty joint ventures with management and ownership structures focused on solving underlying needs and often managing or building capability.

Although it was developed from a dairy-industry perspective, understanding this spectrum can inform discussion on which models, structures and combinations of these might be best suited to managing the changing needs of the Australian red meat industry with respect to RD&E and associated capability.

All of these models are valid and there are variations around each model. No model excludes the application of another and multiple models applied concurrently may be required in some situations. However, it will not be possible to achieve effective and efficient collaborative RD&E in the red meat industry without significant use of ‘the partnership models’ (ie models 2, 3 and 4), which would allow more complex issues to be addressed and would better build and maintain capability.

RMCIC has collected and collated information on the diversity of existing arrangements that exist between government agencies, CSIRO and universities. This information, together with an assessment of the strengths and weaknesses of alternative models, will be used by the RMCIC and its member organisations to determine the most appropriate forms of agreement for new collaborative RD&E programs.

5.9 Monitoring and evaluation

Each program investment plan will include a logical framework describing the monitoring and evaluation mechanisms and systems (on a national, regional and local basis), the industry targets against which success will be measured, and the key performance indicators that will be reported to RMCIC, SABRC, NABRC, CCA and other stakeholder groups.

Program leaders will submit a brief report each year summarising relevant joint initiatives, highlights and progress against specific key performance indicators for consideration by RMCIC in August and review by SABRC at their next meetings. These reports, together with any significant changes in capacity and infrastructure, will be submitted to the Ministers at the final PIMC meeting each calendar year.

RMCIC members will actively participate in each external 3-year review as foreshadowed in the Statement of Intent. At these review points, the human capacity and infrastructure audit will be updated. Ex poste (after the fact) analyses of return on investment will be undertaken by the MWG for each 3-year review.

5.10 Next steps

This document describes the processes that will be used by the RMCIC to implement a national strategy for beef production RD&E. In documenting the Strategy and its associated processes, the member organisations have identified the potential for increased resource use efficiency, succession planning and collaboration in the future.

This document represents a substantial step forward in implementing a new and increasingly collaborative approach for the beef production RD&E sector to deliver against identified industry and government priorities. Future updates will expand the scope to include RD&E for the post-farm-gate and live-export and feedlot sectors.

The Strategy and its implementation plan will evolve over time and PISC and PIMC will be updated on progress.

The work plan for the RMCIC beginning in 2010 includes:

- refining the programs and deliverables for the Strategy
- incorporating input and priorities from the broader beef supply chain (including live export, feedlot, processing, wholesaling and retail sectors
- analysing current and modelling proposed program investments
- developing guidelines and templates for program management, and a position description for the program leader roles
- mapping current investment across the identified priorities and collating into 'virtual' programs
- drafting cooperating principles for the development of CD&E programs
- completing data collection and analysing capability and infrastructure
- simplifying data collection and analysing mechanisms for future use
- analysing the employment basis for current capability (permanent versus temporary industry funding)
- collecting regional estimates of private-sector capability
- mapping current capability against imperatives and programs
- prioritising infrastructure against imperatives and programs
- undertaking an audit of beef production RD&E databases

Appendix A Regional industry priorities and derived national priority industry outcomes

Table A.1 Regional beef industry priorities from southern and northern Australia, and derived national priority industry outcomes (2009)

Southern and northern industry priorities[a]			
Theme	Rank	Southern forums	Northern forum
Production/on-farm	1	• enterprise sustainability, adaptability and risk management (including climate change, etc)	• beef production within healthy ecosystems
	2	• on-farm cost efficiency and productivity	• efficient use of resources and inputs
	3	• integration and value adding in supply chains	• integration of innovative science into production systems
	4	• efficient use of natural resources in beef production	• world leader in animal welfare standards and practices
Consumers/markets	1	• level and reputation of food safety, integrity and biosecurity	• red meat eating, nutritional,health, quality, consistency[c]
			• lead world in agricultural biosecurity[c]
			• unrestricted access to existing and new markets[c]
	2	• access to new and existing beef markets	
	3	• red meat eating and nutritional quality	
Community	1	• level and reputation of beef industry integrity and food security (and stewardship)	• level and reputation of beef production 'footprint'
	2	• level and reputation of beef production 'footprint'	• community awareness of industry leadership in animal welfare innovation
	3	• level and reputation of the objective demonstration of animal welfare	• level of the Australian beef industry's role in addressing global food security

National priority industry outcomes[b]
• profitability and productivity at the enterprise and industry level • integrated and responsive supply chains that add value to livestock and beef products • beef enterprises that are resilient and adaptable to changing markets and operating environments • animal-welfare standards and practices aligned with consumer and community expectations • beef-production systems aligned with consumer and community expectations for environmental impacts • domestic and global recognition of best-practice food safety and product integrity levels • biosecurity practices and programs that protect the industry's reputation and herd health status and maximise market access • beef eating and nutritional quality that meets target market specifications • diversified beef markets that minimise risk and maximise industry prosperity • community recognition of industry custodianship for environmental protection, animal welfare and ethical behaviour

a Derived and ranked through regional industry consultation forums
b Derived by the Red Meat Co-investment Committee to capture the spectrum of regional priorities identified in southern and northern Australia
c these three priorities obtained equal prioritisation scores

Appendix B Beef production research, development and extension capacity

Table B.1 Beef production research, development and extension capacity (full-time equivalent) — categorised by Australian Standard Research Classification and age (2009)

ASRC		300100	300200	300400	300500	300800	300900	309900	340200	350200	
Organisation	Age[a]	Soil and water sciences	Crop and pasture production	Animal production	Vet sciences	Environ-mental sciences	Land, park and agricultural management	Other (including education and extension)	Economics	Business and manage-ment	Total
DEEDI (Qld)	1	0.0	5.2	10.5	1.8	1.3	4.8	13.9	3.0	0.0	40.5
	2	0.0	1.9	17.2	8.6	2.2	11.7	9.8	6.0	1.8	59.1
	3	0.0	1.8	5.9	0.6	0.4	0.6	10.0	0.0	0.5	19.8
I&I NSW	1	0.0	0.2	12.0	0.8	0.0	0.0	11.2	0.6	0.0	24.8
	2	0.0	0.6	16.9	1.5	0.0	0.1	10.6	1.0	0.0	30.7
	3	0.0	0.7	9.9	1.1	0.0	0.1	10.3	0.9	0.0	23.0
DPIV	1	0.2	0.8	4.4	1.8	0.0	0.0	8.3	0.0	0.0	15.5
	2	0.2	0.5	1.5	0.7	0.0	0.0	2.1	0.0	0.0	5.0
	3	0.0	0.0	0.5	0.0	0.0	0.0	2.6	0.0	0.0	3.1
PIRSA	1	0.0	1.9	1.8	0.0	0.0	0.0	1.4	0.0	0.0	5.1
	2	0.0	4.8	0.4	0.0	0.3	0.0	0.1	0.0	0.0	5.6
	3	0.0	0.3	1.3	0.0	0.1	0.0	0.5	0.0	0.0	2.2
DAFWA	1	0.0	0.9	5.8	0.0	1.1	0.2	2.4	0.0	0.0	10.4
	2	0.0	2.0	1.7	0.0	0.2	0.6	2.7	0.0	0.2	7.4
	3	0.0	0.3	2.5	0.4	0.3	0.0	0.1	0.0	0.0	3.6
NTDR	1	0.0	0.0	12.0	0.0	2.8	0.0	1.0	0.0	1.0	16.8
	2	0.0	0.0	2.0	2.5	1.0	0.0	1.0	0.0	0.0	6.5
	3	0.0	2.0	2.0	0.5	1.0	0.0	0.0	0.0	0.0	5.5
TIAR	1	0.0	0.3	0.7	0.0	0.0	1.0	0.0	0.0	0.0	2.0
	2	0.0	0.4	0.0	0.0	0.0	0.1	0.7	0.0	0.0	1.2
	3	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
CSIRO	1	0.0	0.0	21.5	6.5	0.0	1.3	0.0	0.0	0.0	29.3
	2	0.0	0.0	22.4	3.6	0.0	3.7	0.0	0.0	0.0	29.7
	3	0.0	0.0	7.2	0.5	0.0	0.6	0.0	0.0	0.0	8.3
UNE	1	0.0	0.8	5.6	0.0	0.0	0.0	0.0	0.0	0.0	6.4
	2	0.0	0.2	4.2	0.0	0.0	0.0	0.0	0.0	0.0	4.4
	3	0.0	0.2	2.5	0.0	0.0	0.0	0.0	0.0	0.0	2.7
University of	1	0.0	0.0	0.0	6.1	0.0	0.0	0.8	0.0	0.0	6.9
Melbourne	2	0.4	0.1	0.4	1.6	0.0	0.1	1.7	0.0	0.0	4.3
	3	0.0	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.0	0.5
University of	1	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.5	9.6
Adelaide	2	0.2	0.1	2.6	0.4	0.0	0.0	0.0	0.0	0.0	3.2
	3	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Murdoch	1	0.0	0.0	2.3	1.1	0.0	0.0	0.0	0.0	0.0	3.4
University	2	0.0	0.3	1.3	2.7	0.0	0.2	1.0	0.0	0.0	5.4
	3	0.0	0.0	1.3	1.7	0.0	0.0	0.0	0.0	0.4	3.4
USQ	1	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3
UQ	1	0.0	4.2	12.1	0.4	0.0	0.0	0.0	0.0	0.0	16.7
	2	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6
	3	0.0	0.5	0.9	0.1	0.0	0.0	0.0	0.0	0.0	1.5
LaTrobe	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
University	2	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2
	3	0.1	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5
University of	1	0.0	8.0	0.7	7.5	0.0	0.0	0.0	0.0	0.0	16.1
Sydney	2	0.0	0.0	1.6	1.1	0.0	0.0	0.0	0.0	0.0	2.7
	3	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1
CSU (vet)	1	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.6
	2	0.0	0.0	0.3	0.6	0.0	0.0	0.0	0.0	0.0	0.9
	3	0.0	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.4
UWA	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JCU	1	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	0.0	2.4
	2	0.0	1.0	4.1	0.2	0.0	0.0	0.0	0.0	0.0	5.3
	3	0.0	0.5	1.1	0.3	0.0	0.0	0.0	0.0	0.0	1.9
Total		1.2	41.5	216.3	55.6	10.6	25.1	92.5	11.5	4.4	458.6

ASRC = Australian Standard Research Classification; vet = veterinary science
a Age brackets are 1 = ≤40 years old; 2 = 40–55 years old; 3 = ≥55 years old
Note: Data from UWS, CSU (agriculture) not provided

Table B.2 Beef production research, development and extension capacity (full-time equivalent) — categorised by employment classification and value of salaries (2009)

Organisation	Research	Extension	Technical	Lecturing	Postgraduate students	Total	Salaries[a] ($ million)	Salaries[b] ($ million)
DEEDI (Qld)	46.0	49.8	23.8	0.0	0.0	119.6	11.160	21.460
I&I NSW	27.4	29.0	20.0	0.0	2.0	78.4	8.081	15.541
DPIV	6.9	13.0	3.5	0.0	0.0	23.4	1.939	3.728
PIRSA	7.2	1.9	3.1	0.0	0.0	12.2	1.119	2.306
DAFWA	9.4	6.0	6.1	0.0	0.0	21.5	1.921	3.694
NTDR	15.3	9.1	4.4	0.0	0.0	28.8	2.657	5.109
TIAR	1.3	0.7	1.0	0.3	0.5	3.8	0.356	0.685
CSIRO	24.8	0.0	28.3	0.0	14.2	67.3	6.410	12.340
UNE	5.9	0.8	0.8	1.9	3.6	13.0	1.298	2.497
University of Melbourne	4.2	0.7	1.0	2.4	3.6	11.9	1.090	2.090
Murdoch University	3.8	0.2	1.3	4.9	1.6	11.7	1.760	3.382
University of Adelaide	–	–	–	–	–	13.4	0.783	1.500
USQ	0.9	0.0	0.0	0.2	0.0	1.1	0.105	0.202
UQ	3.0	0.0	0.0	3.4	13.0	19.4	0.719	1.383
CSU (vet)	0.0	0.0	0.2	1.5	0.2	1.9	–	–
La Trobe University	0.4	0.0	0.0	0.4	0.0	0.8	0.096	0.185
University of Sydney	4.3	0.0	3.3	0.3	3.5	11.4	1.013	1.948
UWA	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.000
JCU	1.85	0.0	4.4	2.35	1.0	9.6	0.927	1.782
Total	162.6	111.1	101.3	17.5	43.2	449.1	41.400	79.800

– = missing data; vet = veterinary science

a including 30% oncost

b including a 2.5 multiplier

Note: Data from UWS and CSU (agriculture) not provided

Table B.3 Beef production research, development and extension capacity (full-time equivalent) — categorised by strategic imperatives (2009)

Organisation	Enhancing food safety, product integrity and biosecurity	Increasing natural resource use efficiency and reducing environmental impacts	Increasing cost efficiency and productivity[a]	Enhancing integration and value adding in supply chains[b]	Improving beef eating quality	Developing new and existing beef markets	Aligning animal welfare practices with consumer and community expectations	Other	Total
DEEDI (Qld)	8.6	25.6	55.0	8.1	12.7	4.4	5.1	0.0	119.5
I&I NSW	15.9	16.8	28.3	1.5	5.3	0.3	2.0	8.4	78.5
DPIV	3.4	6.6	7.8	1.4	0.5	0.5	0.1	3.3	23.6
PIRSA	0.0	0.0	11.8	0.0	0.3	0.0	0.0	0.8	12.9
DAFWA	0.0	3.7	14.1	0.0	0.0	0.0	1.4	2.3	21.4
NTDR	2.0	11.6	13.5	0.0	0.0	1.2	0.5	0.0	28.8
TIAR	0.0	1.3	2.1	0.0	0.1	0.0	0.1	0.6	4.1
CSIRO	0.7	12.8	24.1	9.9	5.9	1.0	12.9	0.0	67.3
UNE	0.0	1.2	10.7	0.0	1.5	0.0	0.1	0.0	13.5
University of Melbourne	3.9	0.4	5.9	0.0	0.1	0.0	1.5	0.0	11.7
University of Adelaide	–	–	–	–	–	–	–	13.4	13.4
Murdoch University	2.5	0.0	5.9	0.2	1.6	0.2	0.8	0.9	12.1
USQ	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0
UQ	0.3	5.6	0.9	0.0	3.6	0.0	1.1	7.4	18.8
CSU (vet)	0.3	0.0	1.3	0.0	0.2	0.0	0.0	0.1	1.9
La Trobe University	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.2	0.7
University of Sydney	0.1	0.8	10.5	0.0	0.0	0.0	0.7	7.9	20.0
UWA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JCU	0.2	0.0	7.7	0.0	1.3	0.0	0.1	0.3	9.6
Total	38.5	86.4	199.9	21.1	33.0	7.6	26.3	46.1	458.8

– = missing data
a including adaptability and risk management
b including cost efficiency
Note: Data from UWS and CSU (agriculture) not provided

Appendix C Postgraduate and undergraduate students

Table C.1 Postgraduate students by Australian Standard Research Classification[a] (2009)

ASRC	300100	300200	300400	300500	300800	300900	309900	340200	350200	
Organisation	Soil and water sciences	Crop and pasture production	Animal production[b]	Vet sciences	Environmental sciences	Land, park and agricultural management	Other (including education and extension)	Economics	Business and management[c]	Total
UWA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Murdoch University	0.0	0.0	4.0	0.0	0.0	1.0	0.0	0.0	0.0	5.0
University of Adelaide	0.0	0.0	9.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0
University of Melbourne	0.0	0.0	4.0	14.0	0.0	0.0	0.0	0.0	0.0	18.0
La Trobe University	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CSU (vet only)	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5
University of Sydney	0.0	1.5	7.5	5.0	0.0	0.0	0.0	0.0	0.0	14.0
UNE	1.0	3.0	13.0	2.0	0.0	0.0	0.0	0.0	0.0	19.0
UQ	0.0	3.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0
USQ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CSIRO	0.0	0.0	18.0	8.0	0.0	0.0	0.0	0.0	0.0	26.0
UTAS	0.0	1.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.0
UWA	0.0	0.0	15.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0
JCU	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	00	1.0
UWS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Total	1.0	8.5	84.5	29.5	0.0	2.0	0.0	0.0	0.0	125.5

ASRC = Australian Standard Research Classification

a includes all livestock (beef, sheep, wool and dairy)

b 1 student at University of Adelaide reported by Sheep CRC; 8 students at University of Adelaide reported by Beef CRC; 3 students at UQ reported by Beef CRC; 4 students at University of Melbourne reported by Beef CRC

c 1 student at UWS reported by Beef CRC

Notes: Charles Sturt University (agriculture) not provided

Table C.2 Undergraduate students in the rural sector (2009)

		Numbers estimated to graduate by year				
		2009	2010	2011	2012	2013
Agricultural science/rural science						
Institution	Degree					
UQ	Agricultural Science	7	8	8	12	14
	Applied Science (Plant Studies)	5	5	5	8	10
	Applied Science (Food Science and Nutrition)	20	20	20	20	20
	Applied Science (Plants)	3	5	5	8	10
University of Melbourne	Agriculture/Agricultural Science +/– Management	100	70	70	65	85
University of Sydney	Agricultural Science	18	27	20	17	16
UTAS	Agricultural Science	8	12	12	12	12
	Applied Science (Agriculture)	8	8	8	8	8
University of Adelaide	Agricultural Science	40	40	40	40	40
UNE	Rural Science	10	15	20	20	20
	Agricultural Science	25	25	20	20	20
UWA	Science (Agriculture)	20	15	15	15	15
Subtotal		264	250	243	245	270
Animal science						
Institution	Degree					
UQ	Applied Science (Animal Production)	6	10	12	15	18
	Applied Science (Animal Welfare/Inspection)	7	10	10	12	15
	Applied Science (Production Animal Science)	15	15	17	22	25
University of Sydney	Animal & Vet Bioscience (Production)	27	25	40	46	53
	Animal & Vet Bioscience (Genetics)	12	11	18	20	22
Murdoch University	Animal Science	3	7	10	12	12
University of Adelaide	Animal Science	50	50	50	50	50
CSU	Animal Science	40	50	55	60	65
UNE	Livestock Science	10	10	10	10	10
UWA	Animal Science	15	20	20	20	20
Subtotal		185	208	242	267	290
Veterinary science						
Institution	Degree					
University of Sydney	Veterinary Science	102	120	115	125	110
University of Melbourne	Veterinary Science	108	110	110	110	110
Murdoch University	Veterinary Medicine and Surgery (beef and sheep)	10	10	10	10	10
UQ	Veterinary Science	109	120	100	130	120
CSU	Veterinary Science		30	52	60	60
University of Adelaide	Preveterinary Science		50	50	50	60
	Veterinary Science					50
JCU	Veterinary Science	40	60	60	60	60
Subtotal		369	500	497	545	580

		Numbers estimated to graduate by year				
		2009	2010	2011	2012	2013
Environmental science						
Institution	Degree					
University of Sydney	Land and Water Science	1	2	2	3	0
	Environmental Systems	0	0	0	0	30
Murdoch University	Environmental Science	35	35	35	35	35
UWA	Natural Resource Management	20	20	20	20	20
	Climate Studies			10	10	10
Subtotal		56	57	67	68	95
Economics/agribusiness						
Institution	Degree					
UQ	Agribusiness	18	18	27	27	30
University of Sydney	Agricultural Economics	26	35	45	40	35
	Resource Economics	15	20	10	15	17
UNE	Agriculture/Agribusiness			10	15	20
UWA	Commerce/Agriculture	10	10	10	10	10
Subtotal		69	83	102	107	112
Agricultural engineering						
Institution	Degree					
USQ	Agricultural Engineering	5	6	8	10	10
Subtotal		5	6	8	10	10
Total		948	1104	1159	1242	1357

Note: Numbers for La Trobe University, CSU (agriculture) and UWS not provided

Appendix D Consolidated infrastructure and research herd data

Table D.1 Number of research stations in Australia according to agri-ecological zone and farming system (2009)

State	Agri-ecological zone					Farming system		
	Mediterranean	Mild/warm temperate	Cold/cool temperate	Tropical/ subtropical	Low rainfall/ rangeland	Mixed farming	Intensive grazing	Extensive grazing
New South Wales	10	8	3	4	2	9	6	12
Victoria	2	4	2	0	0	2	4	0
Tasmania	0	0	1	0	0	1	0	0
South Australia	3	0	1	0	0	4	0	0
Western Australia	6	0	0	0	0	4	1	0
Northern Territory	0	0	0	5	1	3	0	3
Queensland	0	0	0	10	2	2	2	7
Total	21	12	7	19	5	25	13	22

Table D.2 Number of research herds in Australia (2009)

State	*Bos indicus*	*Bos taurus*	Dairy	Head (no.)
New South Wales	2	7	2	5,330
Victoria	0	3	2	640
Tasmania	0	0	0	0
South Australia	0	1	2	560
Western Australia	0	2	0	550
Northern Territory	2	0	0	240
Queensland	13	0	2	7,582
Total	17	13	8	14,902

Appendix E First-pass evaluation and investment analysis process

Stage 1 — first-pass evaluation

Rapid evaluation of programs based upon 4 key questions (see next page) and rank programs for Stage 2–6 evaluation

↓

Stage 2 — broadly define the research program with a technology brief

↓

Stage 3 — select appropriate farm level model to evaluate change in profit using price (P), quantity (Q) and costs (C)

↓

Stage 4 — quantify attractiveness of the technology or product in terms of the likely level of adoption using appropriate tools

↓

Stage 5 — identify (and quantify) potential economy-wide spillovers and externalities of the technology or product

↓

Stage 6 — market shift — estimate research induced supply shift Dynamic Research Evaluation for Management model (DREAM model) to derive cost–benefit ratio, net present value and so on

First-pass evaluation questions[8]

1. What is the total farm-gate gross value of production ($) of the industry or industry segment(s) for which the research and development is applicable?
2. How big are the likely enterprise profitability changes following successful implementation of the research and development?
3. What is the probability of success in the required research?
4. What is the maximum rate of adoption by producers within the industry/industry segment impacted by the research (refer to question 1)?

[8] Alston JM, Norton GW, Pardey PG (1995). *Science under scarcity*, Cornell University Press, Ithaca, NY.