Australian Government
Department of Agriculture, Fisheries and Forestry

Submission to the Productivity Commission Study into Public Support for Science and Innovation

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1. Executive summary

Australia's agriculture (including fibre, fishing and forestry) and food industries are important and diverse components of the national economy — particularly in terms of regional contributions and employment.

The agricultural sector contributes about 4 per cent of Australia's annual gross domestic product (GDP). Food processing and services industries are a major market for agricultural output, representing about 20 per cent of GDP. Two-thirds of Australian agricultural production is exported, representing about 22 per cent of total export earnings. Food exports comprise about 30 per cent of total manufactured product exports.

Agricultural productivity has shown strong growth over the long term despite volatility imposed by seasonal variation and international competition and has averaged approximately 3 per cent per year over the last 30 years.

The high level of Australian agricultural productivity growth is largely attributable to the sector's strong link to science and innovation. This has led to continued improvements in the performance of farm inputs (eg crops, stock, fertilisers), farm machinery, sustainable farm management practices, and improved use of farm, climate and market information.

Government investment (both federal and state/territory) in agrifood science and innovation recognises that the large number of small producers could not profitably invest as individuals in research and development (R&D) and that farm products are largely uniform and non-rival in nature.

Public support also recognises the significant intra- and inter-industry spillovers, and regional and rural benefits that accrue from publicly supported R&D. It also addresses important national development and sustainability objectives that are the responsibility of government, such as biosecurity and natural resource management.

Australian agrifood science and innovation has evolved over the last two decades from a largely government-driven model to now include an array of government and private investors and providers. This includes Australian Government initiatives such as the rural research and development corporations and companies (RDCs), the Cooperative Research Centres (CRCs), and the National Food Industry Strategy (NFIS).

These initiatives are based on an industry–government partnership approach that leverages significant private funds into agrifood R&D. These initiatives are better equipped than government at servicing a broadening R&D agenda and value chain ('paddock to plate'). Their close link with end users also better facilitates the adoption of R&D outputs, ensuring greater effectiveness and efficiency of government investment.

Total investment in agricultural R&D to 2002–03 was approximately $1.2 billion, having increased by approximately 20 per cent in real terms since 1996–97. States and territories provide the greatest proportion of funds (43 per cent in 2002–03) but this has proportionally declined since 1996–97 (53 per cent). Commonwealth contributions (including higher education) have remained relatively constant (approximately 40 per cent) and business investment has increased in this period (from 8 per cent to 17 per cent).

Support for industry agrifood science and innovation delivered by the Department of Agriculture, Fisheries and Forestry (DAFF) is primarily through the RDCs and the NFIS. DAFF also supports industry-focused competitiveness and capacity-building funding programmes, including through the New Industries Development Programme and Industry Partnerships Programme.

DAFF also invests in science and innovation programmes and agencies to support and protect agrifood industries and the environment (biosecurity and natural resource management), including through the Bureau of Rural Sciences and the Australian Bureau of Agricultural and Resource

Economics, who undertake economic and scientific analyses that underpin government decision-making.

Accurately measuring the impacts of agrifood science and innovation is difficult due to long timescales, unpredictable externalities, and problems apportioning benefits and costs (in economic, environmental and social terms).

Reviews of benefit–cost analyses (used due to their applicability on a project basis) show that returns on public investment in agrifood R&D are real and sizeable, ranging form 5:1 to 10:1 across all providers. Internal rates[1] of return varied between 20 per cent and 200 per cent; the biggest impacts being in large uniform industries (eg grains) wherein one innovation can result in huge improvements. Recent modelling showed that public support for agricultural R&D resulted in an approximately 4 per cent annual net production increase. This compares with an approximately 1 per cent increase in real GDP for public R&D expenditure as a whole.

The impact of the RDCs indicates an average internal rate of return of 20–30 per cent, and social economic benefits[2] of 50–80 per cent. RDC R&D investment also produces a range of intangible benefits including increased stock of knowledge, new companies, enhanced producer skills and natural resource conservation. Specific case studies of RDC impacts are given in Attachment C.

Estimates of the impact of science and innovation aspects of the NFIS (the Food Innovation Grants and Centres of Excellence programmes) are continuing and to date are largely qualitative and measured by development and commercialisation of new products. Productivity improvements among grant recipients are as high as 66 per cent.

Impediments to agrifood science and innovation arise, as in other portfolio industries, from financial, institutional and producer skills constraints at different points in the science and innovation pathway.

Financial impediments include the need to service an ever-broadening agrifood R&D agenda, (with an increasing reliance on private companies to facilitate adoption), and limited funds available to end users to implement R&D outputs due to significant income variability caused by climate and market unpredictability. The increasing costs of R&D inputs (eg intellectual property, data) also impede the rate of progress in R&D and the ultimate cost to end users.

Institutionally, difficulties in prioritising, coordinating and collaborating on R&D between different actors in the agrifood innovation system have previously led to duplication in some research areas and gaps in others. There are also concerns about the potential for a decline in research provider skills and capacity.

Producer skill limitations can also impede the adoption of sophisticated R&D outputs. This is principally a communication and knowledge transfer problem which is an area of focus for the delivery of future programmes. There are also concerns with the willingness of industry to innovate in respect to government non-business priorities for agrifood industries.

The federal government has initiatives in train, in collaboration with state and territory governments, research stakeholders and industry, to address a number of these impediments and improve the effectiveness and efficiency of public investment in the agrifood R&D including:

[1] Internal rates of return reflect the return on investments in R&D and innovation which flow from an individual research project to the organisation or specific industry involved.

[2] Social rate of return on investments in R&D and innovation reflects the dollar value of the benefits that accrue to society at large. It is the private rate of return plus the net effect of the activity upon everyone else in society.

- a review of rural research and development priorities to better direct and account for research and development efforts
- implementing an agreed framework for research, development and extension (RD&E) to improve national collaboration
- improving producer innovation skills through the FarmBis programme
- developing a range of responses to the Corish Report (on future directions of agriculture and food policy commissioned by DAFF) to improve R&D collaboration and better guide public investment in agrifood science and innovation.

2. Introduction

Governments (both federal and state/territory) generally support agrifood science and innovation to ensure that the agriculture and food (agrifood) industries — and the consumers and communities they benefit — remain viable, profitable, competitive and sustainable in economic, environmental and social terms.

This support recognises that agricultural products are usually uniform and non-rival in nature, and produced by a large number of small businesses that could not profitably invest as individuals in research and development (R&D). This support also recognises the significant intra- and inter-industry spillovers, and regional and rural benefits that accrue from publicly supported agrifood R&D. These justifications were noted by the Industry Commission's review of R&D in 1995 and still apply today.

Government support for agrifood R&D also recognises the need to support national development and sustainability objectives that are the responsibility of government, such as biosecurity and natural resource management.

Australia's agriculture (including fisheries and forestry) and food sectors are important and diverse components of the national economy. Although the contribution of agriculture to Australia's gross domestic product (GDP) has remained at 4–6 per cent over the last two decades, this understates the sectors' importance to rural and regional economies, and to the broader food processing and services sector, which in itself represents approximately 16 per cent of GDP. Agrifood produce is also a significant contributor to Australia's terms of trade, accounting for approximately 20 per cent of Australian merchandise exports.

A profile of Australia's agriculture and food industries is provided as Attachment A.

Agricultural productivity has shown strong growth over the long term despite the volatility imposed by seasonal variation, international competition, and declining terms of trade, and has averaged approximately 3 per cent per annum over the last three decades on a multifactor basis (PC, 2005). This performance is considerably stronger than that achieved in Australia's market sector (1 per cent per year in trend terms).

Scientific research, adoption and utilisation of new products and practices ('science and innovation' in broad terms) play a key role in driving the long-term productivity and sustainability of agrifood industries both in Australia and overseas (DAFF, 2005a).

Innovation derives from both traditional R&D focused on incremental improvements in existing farm inputs or processes (eg better performing crops and animal stock, herbicides and additives, improved farm/processing machinery), and from new science, technologies and processes that can lead to significant improvements in some sectors (eg introduction of genetically modified varieties of cotton).

Improved access to information (especially through the internet), enhanced on-farm management practices — including greater attention to use of environmentally sustainable land practices, and changes in institutional and regulatory practices — have also contributed to this improved performance.

The deployment of new technologies and better management practices on farms has also gained from the improvement of farm skills. Education and training have important influences on the ability of farmers to use existing and new technologies and management practices. Structural changes — such as shifts in enterprise mix, the exit of poor-performing farmers and the increase in average farm size — have also contributed incidentally to farm productivity growth (PC, 2005).

The breadth of the agrifood value chain — from 'paddock to plate' — and the maturity of individual sectors within it also influence the nature of the research and innovation undertaken. For example, food processing has existed as a mature market for decades with the fundamental

processes well established. However, the application of new technologies in packaging and functional (health-promoting) ingredients has created more effective and efficient processes in the food industry as well as new products and associated markets.

Less obvious to farm productivity growth is the application of science and innovation efforts focused on ensuring agricultural production remains environmental and socially sustainable. Such efforts are largely (but not exclusively) delivered through the public sector and include programmes focused on natural resource management (eg land degradation, water management, biodiversity management), and protection from plant and animal diseases (biosecurity).

This submission by the Department of Agriculture, Fisheries and Forestry (DAFF) to the Productivity Commission Study of the *Economic, social and environmental returns on public support for science and innovation in Australia* describes the various elements of the agrifood science and innovation system and explains the rationale for government intervention, the policies and programmes delivered by DAFF that support this system, including their impact.

The terms of reference of the Productivity Commission Study are outlined below against the pertinent sections of this submission.

Productivity Commission Term of Reference	*DAFF Submission Section*
1 Economic impact of public support for science and innovation, particularly with respect to productivity performance and adequacy of benchmarks (taking into account key elements and industrial structure)	4. Impacts of publicly supported agrifood science and innovation (Also, Attachment A: Australian agrifood industries — a profile)
2. Impediments to the effective functioning of the science and innovation system (including knowledge transfer, skills, and R&D commercialisation), identifying scope for improvements	5. Impediments to functioning of the agrifood science and innovation system 6. Improving support for agrifood science and innovation
3. Evaluate decision-making principles and programme design that influence the effectiveness and efficiency, and guide funding allocation, within different components of the science and innovation system (including identifying scope for improvements)	3. Science and innovation in Australian agrifood industries (Also, 6. Improving support for agrifood science and innovation)
4. Report on broader social and environmental impacts of public support for science and innovation	4. Impacts of publicly supported agrifood science and innovation

3. Science and innovation in Australian agrifood industries

Key Points

- Public science and innovation in Australian agrifood industries has evolved from a model driven largely by combined research investor/provider agencies (CSIRO and state and territory agriculture departments), to now include a diversity of individual investors and providers — most significantly the rural research and development corporations (RDCs), Cooperative Research Centres (CRCs), and the National Food Industry Strategy (NFIS).
- This complex system has been driven by the need to address a much broader R&D agenda and to service the full value chain — from farm to end consumer. It also recognises the need to engage end users in the development of research and for good priority setting, monitoring and evaluation frameworks.
- Total investment in agrifood R&D to 2002–03 was approximately $1.2 billion, having increased by approximately 20 per cent in real terms since 1996–97. States and territories provide the greatest proportion of funds (43 per cent in 2002–03) but this has proportionally declined since 1996–97 (53 per cent). Commonwealth contributions (including higher education) have remained relatively constant (approximately 40 per cent) and business investment has increased in this period (from 8 per cent to 17 per cent).
- Annual public investment in agrifood R&D equates to approximately 4.5 per cent of gross value of the sectors' production. This compares to 4 per cent for health and 3 per cent for manufacturing.
- DAFF supports a range of programmes that address government agrifood R&D priorities. This submission focuses on the impact of DAFF programmes supporting industry R&D — namely the RDCs and the NFIS.
- DAFF science and innovation programmes designed to meet its organisational responsibilities in biosecurity and natural resource management, projects aimed at improving producers capacity to innovate, and the economic and scientific analyses conducted by its agencies (the Bureau of Rural Sciences (BRS) and the Australian Bureau of Agricultural and Resource Economics (ABARE) are discussed in Attachment B.

3.1 Science and innovation in Australian agriculture

The Australian agricultural R&D system has grown from a model in which publicly funded investor/provider bodies, especially universities and CSIRO, undertook basic research according to self-determined priorities, and state and territory departments of agriculture adapted and applied research outputs to local needs and extended them to industry.

Extension and adoption of agricultural R&D operated (and largely still operates) on a non-rival basis given the sizeable public investment and the nature of information sharing (collaborative rather than competitive) between farmers.

This approach to agricultural R&D worked effectively when research addressed single limiting production factors (such as new plant varieties, mineral deficiencies or irrigation) and has been the basic agricultural R&D model around the world. When substituting one factor in a production system, the benefits could be clearly shown and little, if any, additional management complexity was introduced.

The limitations of this model have become apparent over time as production problems and the nature of the operating environment (including the operation of international markets, greater vertical integration of industries, and interplay of climate and environment on production sustainability) have become more complex and information easier to access. Government

intervention and management of the agricultural R&D system has become more complex as a consequence.

Over the last two decades, the innovation system has been influenced by new agricultural R&D investors and the establishment and implementation of national agricultural and environmental priorities. Hence, the roles of actors and the resources applied to the system have changed significantly.

Investors and providers now vary across a wide range of Commonwealth and state/territory agencies and include various special initiatives such as:

- 15 rural research and development corporations and companies (RDCs)
- the National Food Industry Strategy (NFIS)
- the Cooperative Research Centre (CRC) scheme — in 2005–06, there were 72 CRCs, including 16 operating in the agricultural sector and 17 in the environmental sector
- funding available to universities through the Australian Research Council (ARC)
- programmes delivered under the Commonwealth Backing Australia's Ability (BAA) strategy — including the DAFF-delivered New Industries Development Programme (NIDP)
- funding available to promote sustainable and productive natural resource management and use under the Natural Heritage Trust (NHT) and the National Action Plan for Salinity and Water Quality.

The increasing number of investors and providers has resulted in a complex matrix of actors in the agrifood science and innovation system, including the concept of the R&D 'user' extending from the farmer to now include the full value chain to end consumer (Figure 1).

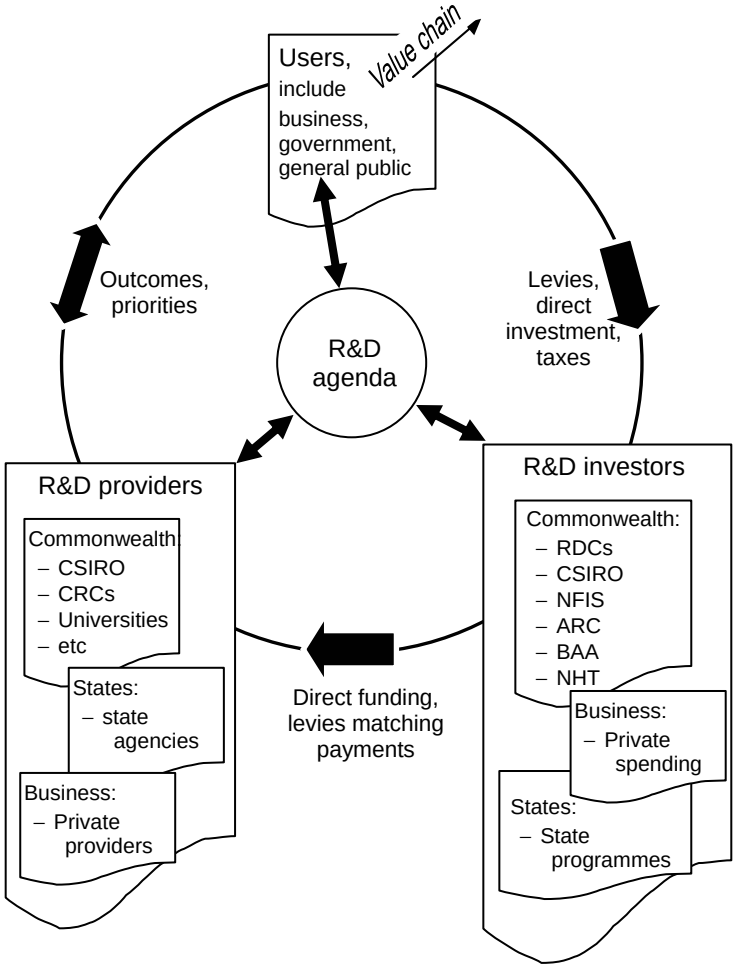
In this complex R&D environment, planning and performance of R&D need to be optimised to meet the diverse adoption pathways and operating environment of different agrifood sectors. Importantly, the agrifood science and innovation system also now needs to address a much broader agenda with far-reaching economic and community benefits. This includes:

- food, fibre and industrial processes
- value chains from producer to consumer — agrifood rather than primary commodity industries — including whole-of-system approaches
- food safety and integrity
- biosecurity (for access to offshore markets, and for protection of our disease-free status)
- natural resource management (water, salinity, biodiversity, etc)
- regional community building.

This expansion means that the mission for agricultural R&D has also expanded, placing more demand on resources — be they financial, institutional or farm skills based.

One of the keys to effective resource use is to actively engage potential users throughout the research programme, and communication with stakeholders is now part of the design of research. This applies whether the nature of the R&D is to provide information for government policy purposes, or for product development and management in the private sector.

Figure 1: The Australian agrifood research and development (R&D) science and innovation pathway



The investor has a central role in information flows in the innovation system. For example, the RDCs have taken on this role and established loosely coordinated, but comprehensive, economic evaluation systems to inform the commissioning and direction of research projects and, in some instances, also collecting market knowledge to provide marketing direction for R&D products.

To optimise R&D resources and outcomes, it is important in this complex investor/provider environment to have good monitoring and evaluation frameworks. Evaluation of agricultural R&D outcomes has moved from purely addressing accountability to taxpayers and stakeholders, to now being integral to planning and management of R&D. Evaluating research programme outcomes over time provides impetus to direction of outcomes and the effectiveness of the agrifood innovation system overall.

3.2 Sources of investment in the Australian agrifood science and innovation system

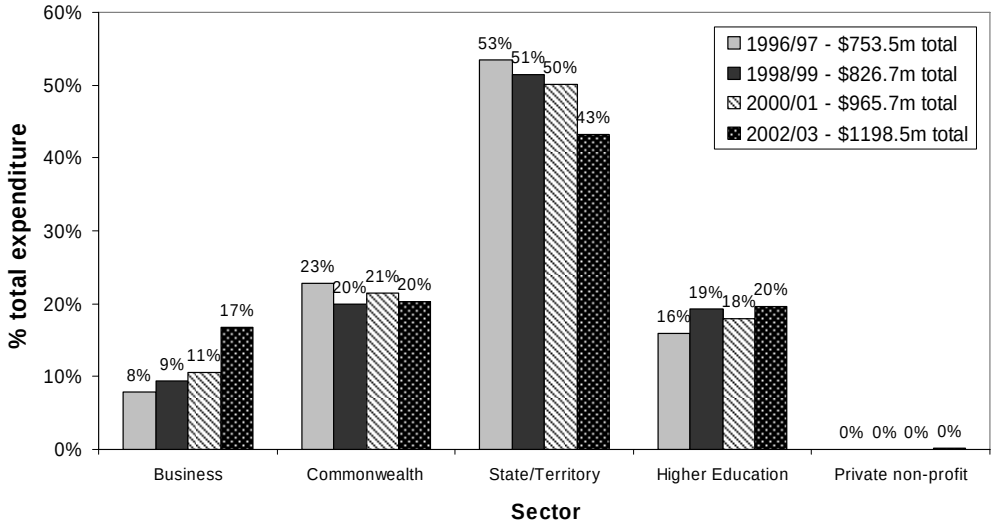
As noted above, government (both Commonwealth and state/territory) investment in agrifood innovation is driven by multiple considerations. A key characteristic of agrifood innovation is that its products and modes of delivery do not deliver profits that can easily be captured by individual/industry investors.

Public funding of agricultural science and innovation also serves national research and economic priorities that are either entirely or partly the responsibility of government, such as biosecurity and natural resource management.

The most recent statistics for R&D investment show that in 2002–03 total investment directed towards agricultural science and innovation was $1.202 billion (ABS, 2004). In real terms, this

expenditure has increased by 20 per cent since 1996–97 (adjusted to 1989/90 price indices; ABS 6401.0). While the total R&D investment has increased by all key providers, contributions by the states/territories — while still predominant over other sources — have declined proportionally over the period of the ABS survey on research and experimental development (from 1996–97). A breakdown of this expenditure by source as a proportion of the total since 1996 is shown in Figure 2.

Figure 2: Share of agricultural, veterinary and environmental science R&D by sector (ABS, 2004)



Commonwealth expenditure on agricultural, veterinary and environmental sciences R&D accounted for 15.9 per cent of total Commonwealth R&D expenditure (all sectors) in 2002–03 (down from around 20 per cent in 1983). This compares with Commonwealth expenditure contributions to engineering and technology R&D of 25.7 per cent, earth sciences R&D of 13.3 per cent, and information and computing R&D of 10.8 per cent.

To place the public agricultural R&D investment into economic perspective, spending on agricultural R&D equated to 4.5 per cent of the gross value added by the industry compared to 3 per cent for manufacturing and 4 per cent for health and community.

Australian public investment in agricultural R&D contrasts with other developed countries where government and private investment is approximately equal (Mullen and Crean, 2006). However, Australia has one of the lowest overall direct subsidy levels for agricultural industries, averaging approximately 4 per cent of gross farm income compared with 18 per cent for the United States of America, 37 per cent for the European Union and nearly 60 per cent for Japan and Korea (OECD, 2005). Such subsidies enable greater private investment in science and innovation in these countries, obviating the need for a large direct public investment.

Distinguishing the impact of public and business investment in agricultural R&D is difficult given the spillovers, especially from public investment into the private sector. For example, public funds that support frontier technologies (eg biotechnology) can drive development of pre-commercial products that are subsequently developed and marketed commercially. Thus, while the outputs of publicly funded projects can be recognised predominantly as public goods, outputs can also contribute to the downstream private benefit of specific industries.

Another example is in the food sector where high-technology outputs developed through publicly funded science and innovation (eg functional foods) can be more easily captured for exclusive profit by individual companies.

The food processing and beverages industry increased its R&D expenditure from $253 million in 2002–03 to $320 million in 2004–05, or from 3.6 per cent to 3.8 per cent of total expenditure by the industry. Research expenditure was dominated by large companies, with 85 per cent of food R&D

expenditure by companies with more than 200 employees. Funds for food R&D were sourced overwhelmingly from businesses' own funds (94 per cent of the total spend), with the Commonwealth contributing 2 per cent. The significantly higher proportion of private investment in food R&D reflects the capacity of companies to exclusively capture R&D benefits, and the relatively large and rapid turnover of new products in the sector. Government investment in food sector science and innovation recognises this linkage and aims to facilitate, in partnership with industry, development and commercialisation of new products that would not attract private venture capital investment.

3.3 The Australian Government and DAFF's role in agrifood science and innovation

The Australian Government invests in agrifood science and innovation, either directly or through its agents, on the basis of a number of considerations including the:

- importance of science and innovation as drivers of productivity and thus economic growth
- economic, development and sustainability goals articulated by the Government
- general inability of individual producers to fully appropriate the benefits of research they may individually fund
- lack of incentives and difficulty in organising the many rural producers to fund and pursue science and innovation activities.

Significant industry under-investment in science and innovation (market failure) is highly likely to occur in the absence of Government support to address these issues.

Another major consideration for Government is the need to fund science and innovation that addresses national needs and priorities — for example, those related to the sustainable management of natural resources and the safety and security of the nation's agricultural systems (biosecurity). Public support for agrifood science and innovation also provides indirect social benefits by supporting a healthy rural sector through the maintenance of profitable, competitive and sustainable industries. Industry profitability has clear spillovers to the maintenance of effective and integrated rural and regional communities.

In late 2002, the Prime Minister announced the Government's National Research Priorities to identify areas of strength, opportunity and needs where increased research effort would make a significant contribution to national wealth, and to determine how targeting and shift of research effort could best be achieved. Four broad themes were identified (see Table 1) and all Government-funded research and funding agencies are now required to develop and implement strategies to address these priorities and how they link with industry initiatives.

In 2003, DAFF developed Rural Research Priorities to guide its own support of public science and innovation activities in order to ensure these activities accord with the National Research Priorities (Table 1).

Table 1: National and Rural Research Priorities

National Research Priority	*Rural Research Priority*
An environmentally sustainable Australia	Sustainable resource management
Frontier technologies for building and transforming Australian industries	Using frontier technologies Creating an innovative culture
Promoting and maintaining good health (strengthening Australia's social and economic fabric)	Improving competitiveness through a whole-of-industry approach Maintaining and improving confidence in the integrity of agricultural, food, fish and forestry products Improving trade and market access
Safeguarding Australia	Protecting from invasive diseases and pests

The Government's support for science and innovation, within both agriculture and food sectors, is delivered largely through DAFF. DAFF's objective is to:

increase the profitability, competitiveness and sustainability of Australian agrifood industries and to enhance the natural resource base to achieve greater national wealth and stronger rural and regional communities.

DAFF has a range of policies developed jointly with state and territory governments to reflect respective Constitutional responsibilities. DAFF's actions to support these policy objectives include a range of science and innovation activities delivered either by the department itself (eg programmes supporting quarantine and biosecurity, natural resource management, crop/stock management) or aimed at supporting agrifood industry science and innovation capacity (Table 2).

Core components of DAFF's industry science and innovation responsibilities are delivered for the agriculture, fishing and forestry sectors through the R&D corporations (RDCs). Science and innovation support for the food sector is delivered through the National Food Industry Strategy (NFIS). Both these components, and related industry development activities delivered by DAFF, are based largely on a co-investment partnership approach with industry.

The strong 'demand-driven' focus on outputs provided through both the RDCs and NFIS has resulted in a highly effective linkage between the science and innovation system to industry priorities, and the development and adoption of many products and processes that have underpinned the productivity increases in the agrifood sector.

Table 2: Representation of Australian Government agrifood portfolio objectives (DAFF 2005a)

Competitive, profitable and sustainable agricultural and food industries					
Responsive and efficient industry	Improved market access and performance	Skilled, financially self-relilant producers	Sustainable use and management of the natural resource base	Benefiting from new technology and practice	Protecting the health and safety of our plant and animal industries
– Dairy Industry Adjustment Package – Sugar Industry Reform Package – National Food Industry Strategy – Women In Rural Industries Programme – Young People in Rural Industries Programme – Industry levies to facilitate marketing and promotion	– Multilateral trade negotiations – Bilateral trade negotiations – Market maintenance activities – Agricultural Cooperation and Development Programme – National Food Industry Strategy	– Agriculture — Advancing Australia (AAA): • FarmBis • Farm Management Deposits • Farm Help • Rural Financial Counselling • Exceptional Circumstances	– Natural Heritage Trust: • Envirofund • Environmental Management Systems – National Action Plan for Salinity and Water Quality – Market Based Instruments – Landcare – National Water Initiative – Murray–Darling Basin Commission – Living Murray Initiative – Great Artesian Basin Sustainability Initiative	– Research and Development Corporations – New Industries Development Programme – National Food Industry Strategy	– Australian Quarantine and Inspection Service – Import Risk Analysis – Australian Animal Welfare Strategy – Managing Pest and Disease Incursions – National Livestock Identification System

3.4 DAFF's science and innovation programmes

The focus of this submission is on activities delivered by DAFF through the RDCs and the NFIS to support science and innovation within agrifood industries. Attachment B describes other DAFF-delivered science and innovation activities that underpin the capacity of industries to remain innovative, competitive and sustainable. These include:

- natural resource management programmes
- biosecurity programmes
- economic and science agencies — the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Rural Sciences (BRS)
- farm skills programmes
- ancillary industry development programmes (eg the New Industries Development and the Industry Partnerships programmes).

3.4.1 The rural research and development corporations and companies (RDCs)

The R&D corporations and companies (RDCs) are a partnership between the Australian Government and industry. The objective of this partnership is to:

- expand Australia's agricultural R&D effort
- improve industry efficiency and effectiveness by investing in high priority R&D areas
- enhance industry's international competitiveness through more effective uptake of research results.

A full profile of RDCs including their financial, governance and collaborative arrangements is provided in Attachment C.

Under this model, the Government has sought to address the potential for significant under-investment in R&D through market failure and recognise the substantial spillover benefits to others in the industry and the wider community.

Responding to concerns over 'free riders' and the public benefits that arise from rural R&D, the Government collects compulsory industry levies for R&D and matches industry R&D expenditure up to a limit of 0.5 per cent of an industry's gross value of production (GVP).

In 2004–05, this partnership delivered R&D expenditure of over $510 million, with industry contributing some $233 million and the Government about $204 million. Draw down on reserves, commercial returns and voluntary contributions provided additional revenue to invest in R&D.

Most of the rural RDCs were established in 1990–91 as statutory, single-focus, R&D corporations with the intention of improving the performance of the national R&D effort for rural industries. There have been adaptations of this model, in particular where industry stakeholders have identified a need for an industry-led marketing role. As such marketing activities are outside the scope of the *Primary Industries and Energy Research and Development Act 1989* (PIERD Act), these RDCs have been transformed into industry-owned multi-purpose companies responsible for managing R&D and/or combinations involving marketing/promotion, regulation and industry representation. R&D responsibilities continue to be funded by industry levies and matching Government funding up to the limit of 0.5 per cent of the industry's GVP and managed through statutory funding agreements between the Government and the individual companies.

There are currently eight statutory R&D corporations and seven industry-owned companies (Table 3).

Table 3: Research and development corporations and companies (RDCs)

Statutory R&D corporations	*Industry-owned R&D companies*
Cotton (CRDC) Fisheries (FRDC) Forest and Wood Products (FWPRDC) Grains (GRDC) Grape and Wine (GWRDC) Land & Water Australia (LWA) Rural Industries (RIRDC) Sugar (SRDC)	Australian Egg Corporation Ltd Australian Pork Ltd Australian Wool Innovation Ltd Dairy Australia Ltd Horticulture Australia Ltd Livecorp Ltd (from 1 January 2005) Meat and Livestock Australia Ltd

Recognising their broader public interest research roles, Land & Water Australia, the Fisheries Research and Development Corporation, and the Rural Industries Research and Development Corporation receive limited unmatched government funding. In some sectors, downstream suppliers and other stakeholders provide additional funds through voluntary levies and contributions to fund research to meet particular needs.

The RDCs have three key roles in supporting the competitiveness and sustainability of Australia's primary industries:

- setting priorities for primary industry R&D, reflecting industry-identified needs and Government priorities
- investing in R&D services, purchasing from research providers such as CSIRO, universities, state and territory agriculture departments and the private sector; also undertaking strategic R&D investment through joint venture companies and holding intellectual property (IP)

- facilitating communication and adoption of research outputs by industry .

The RDCs commission and manage targeted investment in research, innovation, and knowledge creation and transfer on behalf of their major stakeholders; their industries and the Government.

To guide the RDCs' investment strategies, industry and stakeholders are consulted and their input helps to develop three to five year corporate plans to determine R&D priorities. Complementing the industry priorities are those the Government sets out under its National Research Priorities and Rural Research Priorities for publicly funded research in Australia (Section 3.3).

3.4.2 The National Food Industry Strategy (NFIS)

The NFIS is a five-year Australian Government – food industry action agenda, through which the Government is providing $114.4 million to assist the Australian food industry to improve its international competitiveness. The NFIS is scheduled to end on 30 June 2007. Strategic oversight of the NFIS is provided by the National Food Industry Council.

Under the NFIS there are two programmes specifically designed to encourage food industry innovation and increase investment in R&D. These are the Food Innovation Grants programme and the Centres of Excellence programme. The Government is providing $50 million for the Food Innovation Grants programme and $12 million for the Centres of Excellence programme over the five years. Both programmes are delivered by a private company, National Food Industry Strategy Ltd (NFIS), under an outsourced service provision agreement with DAFF.

Food Innovation Grants

As part of the NFIS, the Food Innovation Grants programme is designed to foster innovation in the Australian food industry by providing competitive, merit-based grants on a matching dollar-for-dollar funding basis for up to half the eligible project costs to food businesses. To be eligible, food businesses must be registered for tax purposes and operating in Australia. Projects funded under the programme involve R&D to resolve a scientific or technical challenge for the Australian food industry. Project outputs must have strong prospects for commercialisation within the business and uptake by other food businesses.

The majority of Food Innovation Grants programme proposals involve service links or collaboration between Australian-based food businesses and research organisations, including Food Science Australia, CSIRO, universities and a range of technical consultants. The projects must involve R&D that includes systematic experimentation, investigation and analysis in any field of science and technology. The project must resolve a scientific or technical challenge and involve technical risk.

Under the Food Innovation Grants programme, 73 Australian food manufacturers have received grants totalling $45 million, leveraging a total of $103 million in new food industry R&D. The results of one further granting round will be announced in the near future.

Food Centres of Excellence

The Centres of Excellence programme is designed to provide grants to Australian food R&D providers to attract and develop world-class capability, particularly in human capital, and contribute to better coordinating Australia's R&D efforts. Under the Centres of Excellence programme, two centres have been established, with grants totalling $10 million. These are the Centre for Functional Foods (based at the University of Wollongong) and the Centre for Food Safety (based at the University of Tasmania). Both centres have leveraged substantial matching research-body and industry contributions which have exceeded the grants provided.

Expected outcomes of the programme include (by focusing on agreed key technologies):

- commercialisation of R&D and achieve follow-through food industry investment and employment

- access to world-class R&D expertise for Australian-based food processors
- enhanced food industry R&D capability in areas of national priority
- further rationalisation of Australia's food R&D infrastructure and lead the collocation or integration of company R&D with centres of excellence, in order to achieve the critical mass necessary to attract and support world-class food science and technology capability
- increased awareness of food science and technology as a career of choice by development of a high-profile career path through links between centres of excellence and education organisations that deliver programmes in food science and technology.

4. Impacts of public support for Australian agrifood science and innovation

Key Points

- Measuring the impacts of publicly supported agrifood science and innovation is difficult due to the long timescales, unpredictable externalities, (especially climate), and the complexity of apportioning benefits and costs within an intricate system of investors and providers.
- Different science and innovation programmes have different approaches to monitoring and evaluating the impacts of their outputs that reflect the differences within and between industries and the priorities targeted.
- Benefit–cost analyses are most often used to assess agrifood R&D impacts due to their applicability on a project basis. Qualitative assessments complement benefit–cost analyses to evaluate adoption and social impacts. Commercialisation impacts are used less often due to the open-source nature of agrifood R&D dissemination and adoption. The most effective assessments are usually done on a case-by-case basis rather than for whole-of-industry sectors.
- Integrated analyses of agrifood undertaken through reviews of benefit–cost analyses show that the returns to public support for agrifood science and innovation are both real and sizeable, ranging from 5:1 to 10:1 across all providers. Internal rates of return vary between 20 per cent and 200 per cent with biggest impacts being on large industries with uniform products (eg grains). General modelling of impacts estimates that annual productivity improvements of approximately 4 per cent accrue from agricultural R&D.
- The impact of RDCs is estimated on an annual return on investment basis to be approximately 30 per cent for private/industry benefits and approximately 65 per cent for social economic benefits. A range of intangible benefits (eg skills enhancement, new company creation, and increased scientific and technological knowledge) also accrue from this investment. Most of these assessments are likely to be conservative. Individual RDC impact case studies are provided in Attachment C.
- Estimates of the impact of science and innovation aspects of the NFIS (Food Innovation Grants programme and Centres of Excellence) are continuing and to date are largely qualitative and measured by development and commercialisation of new products — over half of the recipients of Food Innovation Grants have been successful, with productivity improvements as high as 66 per cent.

4.1 Measuring the success of the agrifood science and innovation system

As noted previously, measuring the impact of publicly supported agrifood science and innovation has moved on from a process undertaken primarily for accountability purposes, to embrace monitoring and evaluation as a requirement to determine a realistic assessment of R&D outcomes and to inform the allocation of resources.

However, quantifying the benefits from R&D is difficult, even for private corporations where sales earned from individual products can be monitored (Kandibyn and Kihn, 2004). For agricultural industries, those difficulties are multiplied by externalities such as international markets, exchange rates, and climatic and regional variation.

Agricultural research is characterised by long-run experiments that may take years to deliver results and work that often remains relevant for extended periods once it has been completed. Results from individual research projects may also add to a continuum of knowledge and be incorporated into other technologies once the project terminates, making it difficult to assess the contribution of individual projects, even through measures as simple as adoption. Research completed for specific

application for a limited number of producers may be found to have a wider application, the benefits or costs of which are not easily allocated to the original research project.

Accurately evaluating the benefits from long-lived research imposes a range of problems and questions including — What is the effective life of the outcomes of the research? Over what period should the return on investment be calculated? Perceptions of costs, benefits and externalities may also change over time.

Diversity within a sector, common across the range of agricultural industries, also creates problems for assessing the impact of R&D. While the impact of high-technology R&D products (eg biotechnology products, new food products) can be quantified as they are usually commercial in nature, many measures of success for public support for science and innovation in agrifood industries are qualitative and rely on an intuitive assessment of achievement. These difficulties have previously been recognised by the Productivity Commission (Shanks and Zheng, 2006).

A further complication is the need to report against multiple measures of impact, so called 'triple bottom line' measures. These measures aim to draw together impacts at the social, environmental and economic level; a complex task given the number and difficulty of assumptions to be made. While quantitative measures can be used, the balance of such assessments is more qualitative.

4.2 Impact assessment methodologies

Both quantitative and qualitative methods have been used to evaluate the impact of agricultural R&D. Differences between industry sectors and in the nature of the desired outcomes (eg crop enhancement versus soil conservation) mean there is a diversity of approaches to impact assessment to cater for the nature of the industry and the manner in which funding or other resources are provided, making cross-sectoral analysis difficult. Most assessments have been attempted on a project-by-project basis in an attempt to limit the complexity of analysis.

Benefit–cost analysis (BCA)

Benefit–cost analyses (either *ex ante* or *ex post*) offer a familiar framework to assist in assessments of research projects and their expected products. However, for use in agricultural research where the life of the outcomes for an experiment may be extremely long term, selection of payback periods and discount rates becomes somewhat arbitrary. While BCA offers methods to consider externalities, using monetary values to provide a universal measure for environmental and social effects remains perplexing. Despite these problems, several groups have applied BCA to their research and innovation projects.

Econometric analysis

Econometric analysis may offer some potential to assess the impacts of research and innovation in different sectors of the economy. However, to date the use of econometric analysis has proved difficult, because of the lack of long-run data on research and innovation. Further to this, the within- and cross-sectorial diversity within agriculture makes any assumptions hard to apply with any great degree of certainty (Shanks and Zheng, 2006).

Qualitative impact assessments

Most quantitative impact assessments are complemented by qualitative assessments in some form. This may be through the use of specialist advisory groups, workshops to assess project impact or through evidence provided by case studies.

Such analyses may be semi-quantitative in nature, typically by measuring attendances at field days or through farmer surveys, but cost and response bias restricts the use of these assessment techniques largely to the adoption of highly specific technologies.

Qualitative measurement of impact may only come together after a number of years, by which time the research project is completed, funding exhausted and researchers moved on to new projects.

Consequently, snap-shot measures such as surveys may underestimate the adoption of research outputs. For much of the research that is a public good, there is no simple way of identifying the parentage of a technique applied in the paddock, as a user who has learnt it from friends or neighbours is unlikely to have defined origins. In contrast, private goods purchased through a supplier are much more likely to have an identifiable point of origin. Hence, the purchaser is more likely to know the origins of the technology they are applying and benefits easier to attribute.

Commercialisation assessments

Commercialisation of research impacts is generally pursued where it has been assessed as the most beneficial way to make new technologies and processes available to producers.

Most RDCs now explicitly include the management of intellectual property (IP) as part of the annual strategic plan, including managing research on the basis that it may generate valuable IP. Most plan to own 100 per cent of any IP generated through their own R&D where they are the only investor, or the relevant proportion of IP in situations where they have collaborated on projects.

The RDCs themselves do not typically commercialise new technologies or processes, but seek to license out the commercialisation phase in return for royalties that are reinvested in R&D.

While valuable, IP rights do not operate easily in agriculture, given the nature of the innovation pathway; especially the relatively open-source nature of innovation sharing. It is thus difficult to get a return on IP through licensing, and leverage investment is usually required to enhance adoption.

The current emphasis on commercialisation as a key mode of innovation delivery can also reduce the freedom to operate of R&D providers through their need to seek formal IP rights such as patents, copyright and plant breeders' rights. This can ultimately reduce the rate of adoption of IP-dependent R&D products.

4.3 Integrated analyses of agrifood R&D impact

The effectiveness of impact assessment is dependent on the validity of assumptions used (such as overhead allocation, adoption and discount rates) and care is required in integrating such assessments to provide a profile of agrifood R&D impact. Nevertheless, several studies have attempted to integrate such analyses.

A survey of Commonwealth and state/territory R&D providers, undertaken for the Primary Industry Standing Committee, found that benefit–cost analyses across all providers ranged between 5:1 and 10:1. Internal rates of return across a range of projects varied between 20 per cent and 200 per cent. The biggest impacts occur in large industries (eg grains) where one innovation, widely adopted, provides huge potential improvement. A sample of the range of returns achieved across different industries is shown in Attachment D.

Recent modelling completed by Econtech Consulting for the Department of Education, Science and Training's submission to the Productivity Commission Study found that significant productivity impacts and economic benefits flow from public investment in R&D, with impacts for agriculture exceeding those for other industry sectors.

Econtech used a general equilibrium model of the Australian economy fed with information on rates of return on public R&D expenditure from the domestic and international literature. Results reported productivity gains achieved through public R&D led to a long-term increase in real GDP of 1.02 per cent per annum, equivalent to a $9.1 billion GDP increase in 2004–05. As a measure of consumer welfare, Econtech modelled a net increase of $3.6 billion in annual real consumption as a result of public R&D activity.

For the agricultural sector specifically, Econtech demonstrated an average annual net production increase of 4.36 per cent as a result of public R&D spending. The Econtech study attributes the production increase to a significant boost in productivity due to the relatively high rates of return to

agricultural research (30 per cent per annum) and to the relative proportion of public funds spent on research benefiting the agricultural sector.

4.4 Impact of RDCs

The submission to the Productivity Commission Study made by the Council of RDC Chairs (2006) makes a distinction between economic returns on science and innovation investment for the industry involved, and the total net benefit returned to society at large.

Using reviews of the economic literature for both categories of return (private/industry and social returns), RDCs calculate private returns of between 20 per cent and 30 per cent for their investment. They also estimate a return of 30–40 per cent on business investment taking into account the existence of measured spillover benefits for non-funding industry participants and other industries. This range is likely to be an underestimate, given studies' inability to measure returns to all areas of the economy.

Also using reviews of relevant literature, the RDCs' submission notes net social benefits from R&D investment of between 50 per cent and 80 per cent, again pointing to significant underestimation of spillover benefits not captured by industries in which the R&D investment was made.

Using averages of rates of return reported in relevant studies of 34.4 per cent for private/industry benefits and 64.7 per cent for economic benefits to society, the RDC Chairs estimated private and social returns to Australia expected from RDC investments in 2004–05. These estimates imply an expected social return on the total $511.3 million of RDC investment (both government and industry contributions) of $331 million. This means that the estimated net benefit captured by society, outside of the benefits captured by industries represented by the rural RDCs, of $180 million or 30 per cent per annum.

The RDC submission also describes the following intangible benefits, and makes the point that estimates of the return from R&D based solely on quantifiable productivity improvements, whether private or publicly funded, are likely to be conservative as they do not account for:

- increasing the stock of useful knowledge and the capacity for scientific and technological problem solving
- training skilled graduates
- conserving natural heritage for its existence, use and options values
- creating new scientific instrumentation and methodologies
- forming networks and stimulating social interaction
- creating new firms.

Attachment C profiles the RDCs' financial, governance, evaluation and collaborative structures and includes impact assessments of individual RDC projects. It also provides case studies across a range of industry-specific and cross-sectoral R&D impact.

4.5 Impact of the National Food Industry Strategy

Both the National Food Industry Strategy (NFIS) Food Innovation Grants and Centres of Excellence programmes are delivered by a private company, National Food Industry Strategy Ltd (NFIS Ltd) under an outsourced service-provision agreement. Under this agreement, NFIS Ltd is required to undertake an annual survey of successful and unsuccessful Food Innovation Grants applicants to measure attitudes towards innovation as well as the company's performance as the administrator of the programme. The company is also required to undertake two surveys during the life of the programme to measure industry attitudes towards innovation and whether attitudes change over the life of the NFIS.

NFIS Ltd is advised by an Innovation Committee, which has a Grants Assessment Group that deals with allocation of grants under the Food Innovation Grants programme. The Innovation Committee monitors the company's management of both the Food Innovation Grants and Centres of Excellence programmes and provides advice to the company Board.

NFIS Ltd provides an annual business plan and budget to the Minister for Agriculture, Fisheries and Forestry for approval. It provides quarterly and annual performance reports to DAFF which report on performance against the business plan and budget and (for the annual report) against programme performance indicators.

A mid-term evaluation of the Food Innovation Grants programme was undertaken in 2004 by Allen Consulting Group. A mid-term evaluation of the NFIS, which took into account the Allen report, was undertaken by Ridge Partners in 2005. A final evaluation of the NFIS (including the Food Innovation Grants and Centres of Excellence programmes) is currently being undertaken by independent consultants KPMG and a final report is expected early in October 2006.

Food Innovation Grants

The purpose of the the Allen Consulting Group commission was to provide an assessment of the appropriateness, effectiveness and efficiency of the Food Innovation Grants programme. The report was published in November 2004 and full details, including a copy of the report, are available on the NFIS Ltd website.[3]

The review of the programme found that it 'occupies a unique position' in government programmes supporting business innovation and that:

- 68 per cent of firms who have received a Food Innovation Grants said that their project would not have proceeded without it, with a further 20 per cent saying they are 'unsure' if the project would have proceeded without Food Innovation Grants support
- 58 per cent of grant recipients have successfully commercialised new technology
- 58 per cent have developed a new product
- 53 per cent have increased their market share
- 79 per cent have increased their expertise or knowledge
- productivity improvements amongst grant recipients were as high as 66 per cent
- 90 per cent of recipients believe their grant project will lead to increased sales
- Food Innovation Grants funding has had a significant impact on exports, including a 21 per cent increase in the second year for one firm.

The Allen Consulting Group also found Australia's food industry has relatively low levels of business expenditure on R&D compared with other manufacturing industries and this has declined as a proportion of industry value added to 2001. This trend reflects the large number of small-to-medium enterprises (SMEs) in the industry, large firms in the sector being small by international standards and the significant role in the sector played by multinational companies, which tend not to direct their innovation expenditure to their Australian subsidiaries. The report also found that there are achievable benefits for firms through greater uptake of innovation and R&D. There are also spillover benefits beyond the individual company through productivity gains, increased knowledge and skills and potential environmental and social benefits, which justify government intervention.

[3] http://www.nfis.com.au/dmdocuments/figreview.pdf

This view was supported by the subsequent Ridge Partners report.[4]

The two reports and separate surveys of Food Innovation Grants applicants have found that the programme is being managed effectively and efficiently. Some improvements to key performance indicators (KPIs) were suggested in both reviews. These changes were agreed by the National Food Industry Council in August 2005. The current programme KPIs are:

- introduction to the market of food products and adoption of production processes that incorporate scientific discoveries and technological applications supported by the programme
- the extent to which the programme generates processed food and enabling technology activities that are innovative (proportion of grants funded) reflected in
    - number of new products, improved processes and new enabling technologies developed
    - demonstrated returns on investment in Food Innovation Grants projects, as measured by sales and new product development
    - industry participation (location, SMEs, range of sectors) with measurement of the size of firms to be based on employment numbers
- an increased number of processed food firms with improved knowledge, understanding and uptake of innovation through grants and projects funded by the Food Innovation Grants programme
- increased levels of strategic investment in firm-based R&D, including flow-on benefits outside Food Innovation Grants-funded activities, and increased linkages between business and public R&D activities.

Food Centres of Excellence

Each Centre of Excellence has a business plan with specific KPIs against which it reports as well as providing quarterly reports to NFIS Ltd. Each centre has a management structure consisting of a Management Team and an Industry Advisory Board that meet each quarter.

Impact is measured both through the underpinning science as well as the commercial engagement of those centres. NFIS Ltd reports on the performance of the centres in its reports to DAFF.

The effectiveness and efficiency of the Centres of Excellence was evaluated in the Ridge Partners report. As a result, programme KPIs were modified and these changes were agreed by the National Food Industry Council in August 2005. The current programme KPIs are:

- increase in the number of global food corporations that conduct R&D activities in Australia
- increase in the number of collaborative partnerships between Australian R&D organisations and Australian-based food-processing companies
- extent to which the centres have
    - increased commercial application of R&D by Australian-based food-processing firms
    - increased investment by Australian-based food-processing firms in pre-competitive projects
    - made significant contribution to generation of knowledge in key technology areas

[4] http://www.nfis.com.au/dmdocuments/NFIS%20mid-term%20review%20by%20Ridge%20Partners%20-%20final%20report%20101.5.05.pdf

    - improved access to world-class R&D expertise for Australian-based firms, as measured by evidence of the centres' involvement in international networks

- customer satisfaction with the services provide by the centres and their partners. Self sustainability of the centres, as measured by the percentage of incomes derived from commercial project service.

5. Impediments to the functioning of the agrifood science and innovation system

Key Points

- Impediments to agrifood science and innovation arise from financial, institutional and producer skills constraints at different points in the science and innovation pathway.
- Financial impediments derive at the R&D provider end from the need to service an increasing agrifood R&D agenda, declines in the financial resources available to implement agrifood R&D (with an increasing reliance on private companies to facilitate adoption), and limited funds available to R&D end users, compounded by significant seasonal income variability. The increasing cost of R&D inputs (eg intellectual property, data) also impedes the rate of development of R&D and the ultimate cost to end users.
- Institutionally, difficulties prioritising, coordinating and collaborating on R&D between different actors in the agrifood innovation system leads to duplication in some research areas and gaps in others. There are also concerns with the potential for declining research provider skills and capacity.
- Producer skill limitations also impede the adoption of, at times, sophisticated R&D outputs. This is principally a communication and knowledge transfer problem. There are also concerns with the willingness of industry to innovate in respect to Government non-business priorities for agrifood industries.

Considering the complex nature of the investor/provider agrifood science and innovation pathway, and the need to service both industry and national priorities, impediments to the effective and efficient functioning of the pathway arise from a number of sources (some of which have already been touched on). To simplify discussion, impediments are categorised below into financial, institutional and skill-based.

5.1 Financial impediments

Financial impediments to the efficient and effective functioning of the agrifood science and innovation system exist both at the R&D, and implementation and extension ends of the continuum.

The increasing competitiveness in agricultural markets, and declining terms of trade, have pushed agricultural industries towards greater levels of specialisation. Similarly, new fields of research (especially on cross-sectoral issues, such as climate change and sustainability), new issues, and the development of new industries have resulted in greater demand on financial R&D resources. While public funding for agrifood R&D has steadily increased over the years, stronger competition for funds, and an increasingly competitive market environment have led to constraints on the capacity to make progressive innovations for all agrifood industry sectors.

As noted previously, the adoption of agrifood R&D outputs (especially commodity outputs) is largely achieved through an open-source non-competitive extension approach which has largely been delivered through state/territory-based services. A decline in the proportion of funds provided by the states and territories for such services has been evident over the last 10 years. While to some extent this gap has been filled by industry advisors, it has only been partial. A continued decline in R&D extension services has the capacity to compromise the impact of agrifood R&D outputs. This will place greater financial strain on R&D investors in having to direct funds to extension services.

For primary producers, the principal financial problem is in having capital available to implement innovations. Often producers are asset rich but cash poor and have difficulty finding funds for change management practices or to make capital purchases. For industry participants further along

the value chain, investing in innovation may make less financial sense than investing in other parts of the business.

At the end of the food production chain, intellectual property (IP) issues cause difficulties for producers, including food companies. Food producers need to achieve a competitive advantage in the market place, often through exclusive access to IP or the ability to exploit some particular knowledge. An innovation system focusing on collective funding approaches can not easily deal with stakeholders requiring IP sharing or managed access.

The 2002 National Food Industry Strategy noted that 'the Government recognises that sound intellectual property (IP) protection is critical for a successful innovation system. The Government has made fundamental changes to the patents system, to provide better protection and better meet the needs of users of the IP regulatory regime. *Backing Australia's Ability* builds on these changes by strengthening firms' ability to protect ideas and better capture the returns from commercialisation.

Major Commonwealth R&D programmes (such as the R&D tax concession and R&D Start) already consider the management and exploitation of IP through application and compliance frameworks. The Government will have agencies that fund R&D examine the issue of ownership of IP and reflect this through their individual contracting arrangements, noting that major Commonwealth R&D programmes already consider the management and exploitation of IP.

NFIS Ltd has considered ownership of IP for both the Food Innovation Grants and Centres of Excellence programmes and has reflected this in the documentation. Grantees retain IP rights as long as these are commercialised within a specified time frame.

The 'Corish Report' (AFPRG, 2006) made a number of recommendations regarding improvements to the food regulation framework to reduce regulatory impediments to food industry innovation. Food regulation system arrangements are currently being reviewed through a number of processes including the Food Regulation Agreement (FRA) Review and the Review of the Joint Food Standards Treaty between Australia and New Zealand. The findings of FRA Review will be presented to the Council of Australian Governments (COAG) for consideration by December 2006.

A review of the food regulation governance arrangements has also been raised as part of the report of the Taskforce on Reducing Regulatory Burdens on Business — 'Rethinking Regulation' (the Banks' Report), which was released on 7 April 2006. The report contains a specific recommendation (No. 4.49) relating to the potential reduction in red tape in food regulation. Recommendation 4.49 states that the Australian Government should commission an independent public review to examine:

- implementing outstanding recommendations from the Blair Review on the consistent application of food laws
- aligning levels of enforcement (including penalties) across jurisdictions
- the role of the Australian Government in the food regulatory system, including whether it could play a greater role in enforcing standards.

The Government has recently announced its response to the Banks' Report to fully or partially implement 158 of the 178 recommendations of the report, includes recommendation 4.49. The findings of this review could be reported to the Council of Australian Governments at its next meeting, alongside the findings of the FRA Review. The reviews are strongly linked and it is intended that they be progressed together to ensure a strategic outcome. These reviews will address Corish Report recommendations.

5.2 Institutional impediments

Difficulties with institutional coordination and cooperation between agricultural R&D participants were key impediments highlighted by the Corish Report.

The industry-focused RDCs model has great benefits for meeting the needs of individual industries, and has great flexibility in responding to new and emerging issues and in pursuing new and productive avenues for research that emerge over time. This is a critical feature of the rural R&D model. However, this model also can have problems in relation to managing duplication of, and gaps in, research areas across more than one industry. Overlaps may be reduced to a considerable extent through improved R&D coordination across and between agencies.

In addition, innovation that requires a regional rather than an industry or nation-wide perspective, or which applies to a mixed-enterprise farm business that operates in more than one industry sector and therefore cuts across the boundaries of more than one industry RDC, is not easily accommodated under the existing R&D model. This creates difficulties with providing efficient and effective links between R&D providers and landholders and community groups, in particular those operating under the umbrella of important DAFF programmes which support catchment, regional and community activities, including under the Natural Heritage Trust.

To help address this problem, Land & Water Australia plays a key role in developing and managing collaborative R&D projects that cut across the boundaries of commodity, industry, region, production and natural resource management. These projects have delivered long-term returns to industry and government, providing significant improvements in areas such as sustainable irrigation, climate variability, farm systems, salinity management and riparian management. Major collaborative R&D projects that demonstrate this approach are the Grain & Graze project, the Land, Water & Wool project, the Managing Climate Variability project, the National Programme for Sustainable Irrigation, and the Healthy Soils for Sustainable Farms project. These projects provide effective models that could be applied more widely to the rural R&D effort, for example by involving R&D providers such as CSIRO and CRCs that operate outside the DAFF portfolio.

Identifying specific priorities that can focus the whole R&D effort is also difficult due to the wide range of issues that impact on rural Australia and the uncertain nature of much of the available body of knowledge. While national priorities exist for rural R&D, these are defined in fairly broad and general terms and disparate CRCs, universities, RDCs and government institutions find it difficult to coordinate specific, well-defined research output against these priorities.

Monitoring and evaluation of the effectiveness of R&D is an important issue, especially in areas such as sustainable natural resource management, where the factors that affect resource condition may not be well understood and it can take long periods of time for impacts and changes to be recognised and measured.

The Corish Report highlights the rising importance of cross-industry issues such as biotechnology, climate change, trade and natural resource management issues, further necessitating increased focus on collaboration in R&D between different RDCs and with other R&D bodies like CSIRO and relevant CRCs. The cost and management effort of implementing collaborative approaches can be a significant impediment to better coordinating R&D. R&D providers operate under widely diverse conditions and in very different sectors and the reporting, evaluation and project management systems they have developed for their own purposes and to provide accountability to their stakeholders can impede efforts to develop more common systems and approaches.

Impediments to science and innovation also accrue from the declining institutional research capacity — primarily the loss of human capital to undertake research. In 2005, the *Audit of Science, Engineering and Technology Skills* (DEST, 2006) examined trends in demand and supply of science and technology skills in Australia and factors affecting the balance. The audit report found that while skills were currently generally satisfactory, recruitment difficulties are being experienced within areas underpinning agricultural and food science needs (eg chemistry and entomology; the latter having particular significance to supporting future biosecurity requirements). It also found that skills capacity will be impacted by retirements within the science workforce, a decline in the number of school leavers interested in science careers from 2010 onwards, and a potential inadequacy of places and teaching infrastructure.

Reports by the Australian Academy of Science (2005) and the Government's *Mapping Australia's Science and Innovation* (Australian Government 2003) report also highlighted a looming shortage of scientists to meet future R&D needs.

5.3 Producer skills and willingness to innovate

At the production end of the agrifood value chain, producers' ability to participate in the innovation system is also impacted by their education, skill and knowledge profiles. Increasingly sophisticated farm and food businesses require a highly educated and skilled workforce. The Corish Report (AFPRG 2006) highlights the need for producers to have knowledge across a wide range of disciplines in addition to traditional farming skills: 'Managerial capability is a major determinant of farm performance, and skills in information technology, natural resource management, financial management, marketing and risk management and in the use of increasingly sophisticated machinery, are growing in importance.'

Factors that assist successful adoption of agricultural innovation include:

- extensive knowledge of the problem or issue
- working in the field alongside producers to overcome the barriers to adoption
- involvement of a credible researcher, specialist or extension practitioner
- experience in communication methods to raise awareness about successes
- support and extension activities.

While formal qualifications have traditionally been considered less important than practical experience in agrifood industries, it is known that farmers who participate in training and education activities are more likely to be profitable and to change their practices to improve performance. Education and training engenders an increased capacity, confidence and willingness to change, to seek and adopt innovative technologies and best-practice management techniques, and to manage risk.

Almost half of people in management positions (46 per cent) on farms have only completed year 10 or below at school, while only 18 per cent of people currently in management positions on farms have any tertiary qualifications, in comparison to 57 per cent in the general labour force. The strong growth trend in tertiary education involvement has slowed in recent years, with interest in agriculture at tertiary institutions declining 6 per cent in the four years to 2004. University qualifications account for less than 20 per cent of post-school qualifications in agriculture and related industries, compared to around 33 per cent for the rest of the workforce (PC, 2005).

A further factor limiting the efficiency of the agrifood science and innovation system is the potential lack of willingness of primary producers to implement R&D outputs specific to government-determined priorities. This is especially the case in some areas of natural resource management which may require producers to expend financial resources, and potentially remove land for production, thereby applying a cost penalty on production. Government-led innovation initiatives include projects aimed at enhancing natural resource sustainability and biodiversity which may require long time frames to provide returns to producers.

6. Improving support for agrifood science and innovation

Key Points

- The Australian Government is undertaking a number of initiatives, in collaboration with states/territories, research stakeholders and industry, to improve the effectiveness and efficiency of public investment in the agrifood sector including:
  - a review of rural R&D priorities to better direct and account for R&D efforts
  - work towards implementing an agreed framework for research, development and extension (RD&E) to improve national collaboration
  - improving producer innovation skills through the FarmBis programme
  - investing in the Cooperative Venture for Capacity Building to strengthen the provision of agricultural extension and advisory services
  - developing a range of responses to the Corish Report to improve R&D collaboration and better guide public investment in agrifood science and innovation.

This submission has highlighted a number of financial, institutional and skill-related impediments to the efficient and effective functioning of the Australian agrifood innovation system. A number of initiatives being undertaken by DAFF to improve the performance of the agrifood innovation system are described below.

6.1 Refreshing rural research priorities

In early 2003, a revised list of the rural R&D priorities was developed by DAFF to reflect consistency with the National Research Priorities (Section 3.3).

The rural priorities set parameters that help guide the work of the RDCs to ensure publicly supported agrifood R&D is in the interest of both industry and government stakeholders. It is important that the RDCs have a balanced R&D portfolio with an appropriate mix of longer-term strategic research programmes and shorter-term demand-driven research.

The April 2006 meeting of the Primary Industries Ministerial Council (PIMC) noted there was a need to review and update the rural R&D priorities. DAFF is now considering a process to refresh the priorities.

As part of DAFF's response to the Uhrig Review of the Corporate Governance of Statutory Authorities, DAFF will issue regular Statements of Expectations for each RDC, outlining the Government's requirements against the research priorities. The RDCs will be required to respond with a Statement of Intent. This approach reflects the Uhrig Review's aim of improving the governance of Commonwealth agencies through establishment of greater clarity regarding purpose, direction and objective, and expectations on operations.

6.2 National framework for primary industry research, development and extension

In 2006 PIMC agreed to principles (for application by Commonwealth, state and territory agencies) to enhance collaboration and consolidation of research, development and extension (RD&E) efforts, including: an RD&E system led by industry initiatives and government cross-sectoral frameworks; shared priorities and plans to facilitate collaboration; allowing shared access to national research capability by industry and R&D partners; and more consistent and rigorous monitoring of R&D performance and better targeted delivery. The principles include a commitment by PIMC agencies

to maintain existing funding levels for RD&E, redirected as necessary to priority areas, and to report regularly on progress in the development of the national RD&E system and priorities for action.

The aim of this initiative is to ensure Australia's RD&E capacities are aligned with industry needs, to initiate collaboration that strengthens Australia's position in international markets, and to ensure that RD&E delivery is more efficient and effective.

While the national framework is under development, along with an action plan, the increased focus on coordination and collaboration between stakeholders for RD&E is already bearing fruit through a greater culture of cooperation. This has recently been demonstrated by the rationalisation of Grains Research and Development Corporation's grains research centres of excellence, in cooperation with the states and territories, to focus the research of individual centres on specific physical environments while improving communication between different centres. This has reduced duplication of research outcomes common between centres, but improved the ability of centres to respond to the demands of particular regional stakeholders.

6.3 FarmBis programme

The key tool used by DAFF to train primary producers in developing and adopting innovation in their business is the FarmBis programme. FarmBis also works to encourage an innovation mindset in producers, addressing the often neutral to negative views some place on innovating in their farm business.

The flexibility and demand-driven nature of FarmBis has proven very popular with primary producers, with more than 160,000 producers across Australia having participated in FarmBis-assisted learning activities.

In addition to providing support for primary producers to attend courses, the programme also funds FarmBis State Coordinators and Networkers, who work with key stakeholders at a strategic level. Their aim is to encourage uptake of education and training by producers and collaboration in the delivery of learning activities. Stakeholders include industry, government, communities and training providers.

Developing the commitment of industry participation is seen as an important tool in helping to ensure primary producers are able to maintain and develop their skills as required in an increasingly competitive agricultural market.

There is a solid link between FarmBis and the RDCs, with the FarmBis programme an integral partner in education, training and adoption of on-farm initiatives and activities. Many courses developed by these organisations are eligible for support under the FarmBis programme.

6.4 Cooperative Venture for Capacity Building (CVCB)

DAFF is a partner in the cooperative venture 'Capacity Building for Innovation in Rural Industries'. Other partners include the RDCs and the Murray–Darling Basin Commission. The CVCB's mission is to ensure an effective system for continuous capacity building in primary industries in Australia by coordinating and funding a targeted R&D programme to enhance the capacity of cooperative venture participants, their stakeholders and other organisations to effect change by:

- facilitating R&D in key areas identified by the cooperative venture
- delivering learning methods and processes to cooperative venture partners and other stakeholders
- providing a forum for members and stakeholders to learn from and help each other
- promoting the benefits of capacity building in managing change.

The CVCB has commissioned projects to investigate ways to strengthen the provision of agricultural extension and advisory services in four key areas:

- *what works and why* — identify current 'best practices' in rural extension/education and training to assist in the design and delivery of learning
- *fostering involvement* — improve understanding of non-participation in learning activities and what is needed to involve current non-participants; to increase accessibility of learning activities and involvement of the farming community
- *optimising institutional arrangements* — promote and rethink rural extension/education through government, industry and community groups so they respond to new and changing environments and enhance rural learning and practice
- *professional support for rural educators* — enhance the capacity of rural service providers to deliver and enable effective learning activities.

Many of the projects have been completed and the CVCB is currently focusing on rolling out the findings with the venture members and a major project to integrate the findings of all projects and to communicate the findings to those involved in policy decisions.

An evaluation is due to be completed by June 2007.

6.5 Agriculture and Food Policy Reference Group Report (the Corish Report)

This submission has previously mentioned the report of the Agriculture and Food Policy Reference Group (AFPRG, 2006), led by Peter Corish (and hence known as the Corish Report). The Corish Report considered research, development and innovation as factors crucial to improving industry competitiveness and made a number of recommendations (see below) regarding R&D and innovation that are crucial to continued productivity growth and the future competitiveness of farmers and food businesses:

- *the successful partnership funding structures involving (a) farmers (through industry levies), government and rural R&D corporations and companies, and (b) the National Food Industry Strategy must be maintained*
- *state governments and CSIRO, as major providers of agricultural research and extension services, must continue to contribute constructively to the efforts of the agriculture and food sector to be more innovative and globally competitive*
- *the Australian Government should establish a process for major agriculture and food research participants (including Australian, state and territory agriculture portfolios, RDCs, CSIRO, CRCs and NFIS Ltd) to collaborate in regularly identifying emerging research priorities for the sector*
- *the research effort, while broadening to reflect new areas of importance, must continue to generate the all-important incremental increases in on-farm productivity that offset the long-term decline in farmers' terms of trade*
- *the Council of Research and Development Corporation Chairs should take a stronger leadership role, to promote*
  - *high-priority collaborative initiatives by RDCs on strategic and cross-industry activities*
  - *more systematic and consistent data collection and financial reporting, and methods of determining research priorities, allocating funds, evaluating results of R&D expenditure and disseminating the findings.*

The Corish Report has highlighted several developments to strengthen RDC coordination and collaboration, including: increased communication; greater exploration of opportunities for cost-effective collaboration in cross-industry research projects; and improved transparency and capacity

for performance comparison between RDCs and between projects in individual RDC research portfolios. Improved collaboration and coordination between RDCs is being led by the Council of RDC Chairs.

The Government's response to the Corish Report was released on 3 October 2006[5] and agreed with the majority of the Report's recommendations. DAFF is working to implement a number of activities to address these recommendations that will guide future policy for the portfolio, and DAFF's future efforts on science and innovation. As part of the Government's response, a comprehensive policy statement – the 2007 Agricultural Statement – will be announced that will cover a range of themes including the importance of R&D collaboration, and maximising the effectiveness and efficiency of public R&D investment for agrifood industries.

It is hoped that the Productivity Commission Study report will also provide guidance on the difficult task of evaluating the impacts of publicly supported science and innovation for agrifood industries, to better direct public expenditure to agreed research priorities and where public expenditure can do the most good.

[5] http://www.daffa.gov.au/about/publications/corish_report_response

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Australia's agricultural, fisheries, forestry and food industries — a profile

A.1 Agricultural industries

Agricultural industries (including fisheries and forestry) are important elements of the Australian economy. They underpin both human health and regional welfare and make a significant contribution to world agricultural trade for several commodities.

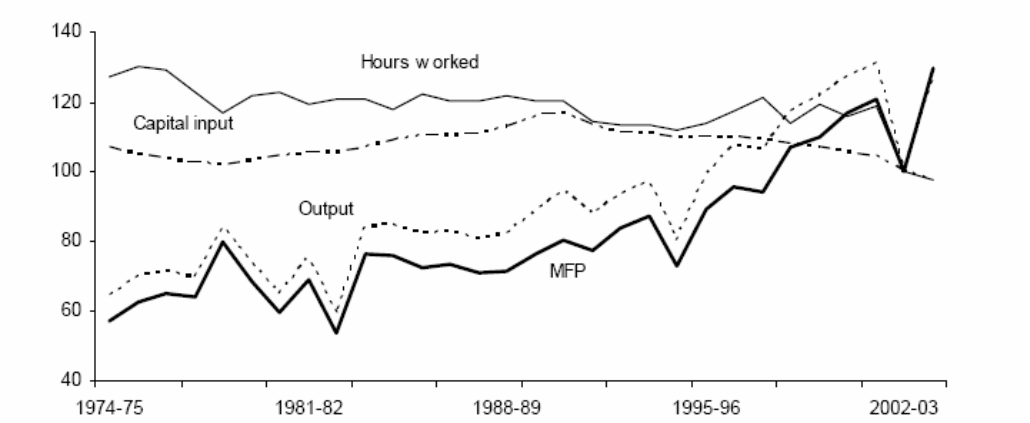
Agriculture is generally considered to include cultivation of animals or plants for food use but for statistical purposes also includes the outputs of forestry and fisheries and also incorporates the services that underpin the production of these commodities (eg spraying, milling, ginning).

In economic terms, the importance of agricultural industries peaked in the first half of the twentieth century and has subsequently declined, with its value in gross domestic product (GDP) terms falling from about 25 per cent after Federation to approximately 4–6 per cent over the last two decades.

Rather than reflecting a systemic weakness of the sector, this decline reflects the increased vigour of the Australian economy as a whole — especially the growth of the services sector — over this period. Over the last 30 years, the productivity performance of the agricultural sector has consistently outperformed other areas of the economy with productivity growth accounting for the entire increase in output of this sector — the value of both labour and capital inputs declined over this period (Figure A.1). The *Australian Agriculture and Food Sector Stocktake* (DAFF 2005a) assessed that 85 per cent of the productivity gains for agriculture can be attributed to technology development and adoption.

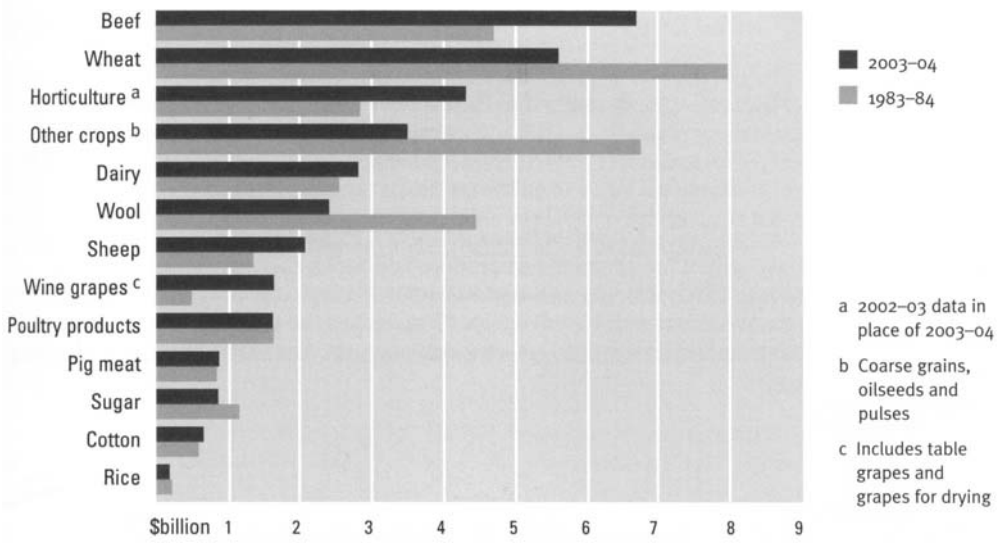
This productivity growth has occurred in the face of a continued decline in the number of farm businesses which, between 1983–84 and 2001–02, fell by about 30 per cent to approximately 131,000 (DAFF, 2005a).

Figure A.1: Growth in inputs, outputs and multifactor productivity (MFP) for agriculture, 1974–75 to 2004–04 (PC, 2005)



While overall productivity growth has been significant, there is a wide diversity of both agricultural industries and their relative size. A ranking of agricultural industries according to gross value of production in real terms indicates between 1983 and 2004 (Figure A.2) sectors with the highest increase in gross farm output included beef/veal, horticultural products, sheep products and wine grapes. In contrast, over the same period, the value of wheat and other crops fell, as did wool. However, despite this drop in value, the top productivity growth sectors on a per annum basis were cropping (3.3 per cent) followed by mixed crops/livestock (2.5 per cent), beef (1.8 per cent) and dairy (1.7 per cent).

Figure A.2: Major Australian farm industries — gross value of production (in 2003–04 dollars) (DAFF 2005a)



A.1.1 Agricultural trade

The agricultural sector produces a surplus which underpins a significant export market in GDP terms. Two-thirds of production is now exported, representing about 22 per cent of Australia's export earnings (PC, 2005) (see Figure A.3). Trade barriers, foreign subsidies, price distortions and declining terms of trade (ABARE, 2004; Mann et al, 2005) all combine to make competing for markets difficult.

Agricultural producers are largely price takers rather than setters as prices are largely determined by global demand and supply in a highly competitive market. Prices and access are also affected by trade arrangements and the influence of national specifications on pest and disease risks and other matters such as food safety and labelling requirements.

The effective rate of public farm assistance in Australia is the second lowest of the Organisation for Economic Co-operation and Development (OECD) member countries at less than 5 per cent of farm receipts (New Zealand has the lowest). The high level of public support in other OECD countries means Australian farmers and exporters must be efficient enough to compete in subsidised markets. The continued profitability of Australian agrifood industries will depend on their ability to compete whilst ensuring sustainability of production — an ability that will largely depend on the continued innovation and production proficiency.

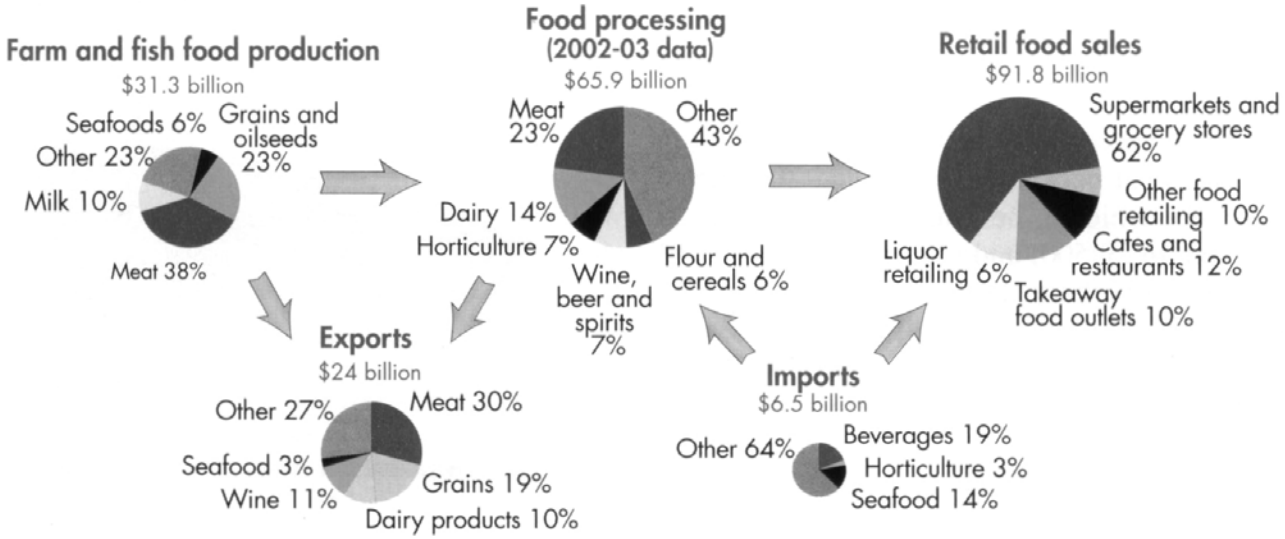
Despite the impressive overall performance of the agrifood industries over the last few decades, benefits have not been evenly distributed across all industries and regions. A key factor in these efficiency gains has been the ability to adopt new technology. Farm size and industry profitability are determining factors in the ongoing ability of farms to continue to adopt technologies and improve their productivity and profitability.

A.2 Food industries

Food is largely distinguished from agricultural produce by the degree of transformation of raw or semi-processed agricultural commodities. This transformation involves manufacturing activities largely post farm gate to convert commodities into readily usable consumer products.

Australian food manufacturing industries include meat, dairy, seafood, confectionery, bakery items, beverages and ingredients, and other processed foods. Together these industries comprise Australia's largest manufacturing industry at $65.9 billion in 2004–05 (Figure A.3).

Figure A.3: Value chain for Australian food 2004–05 (DAFF 2005b)



While the output of the entire manufacturing sector has declined since the late 1970s, the value of the food sector as a proportion of gross national product (GDP) continues to account for about 20 per cent of output and remains one of the largest manufacturing industries in terms of value-added content.

Productivity growth in the food industry has averaged around 2 per cent annually for the past 10 years. Geographically the distribution of food manufacturing in Australia closely mirrors population density, with the bulk of the industry located along the east coast, predominantly in Victoria and New South Wales.

High-labour productivity within the food sector, combined with other factors, has contributed to this growth as full-time employment has remained relatively constant over this period. On a year-to-year basis, however, full-time employment can fluctuate by up to 10 per cent a year as food raw material supplies are affected by major climatic events such as droughts, flooding and severe storms.

Within the food sector, the most solid growth in percentage terms over the past five years has been in wine, beer and malt, and soft drinks, cordial and syrup. These categories, as well as meat products, had large absolute increases in value added, of about $300 million each between 1997–98 and 2003–04. Meat products were also the largest single product category in terms of value added each year during this period.

A.2.1 Food trade

Overall, the performance of the Australian food sector, as viewed through export performance, suggests that the Australian food industry is performing well above what might be expected.

The economic competition for inputs (raw materials, labour and capital investment) mean that countries that have a comparative advantage in producing agricultural goods needed as raw inputs to food manufacturing — such as Australia — are not necessarily advantaged in producing manufactured foods for export. Despite these economic factors, Australian performance in food exports has been significant.

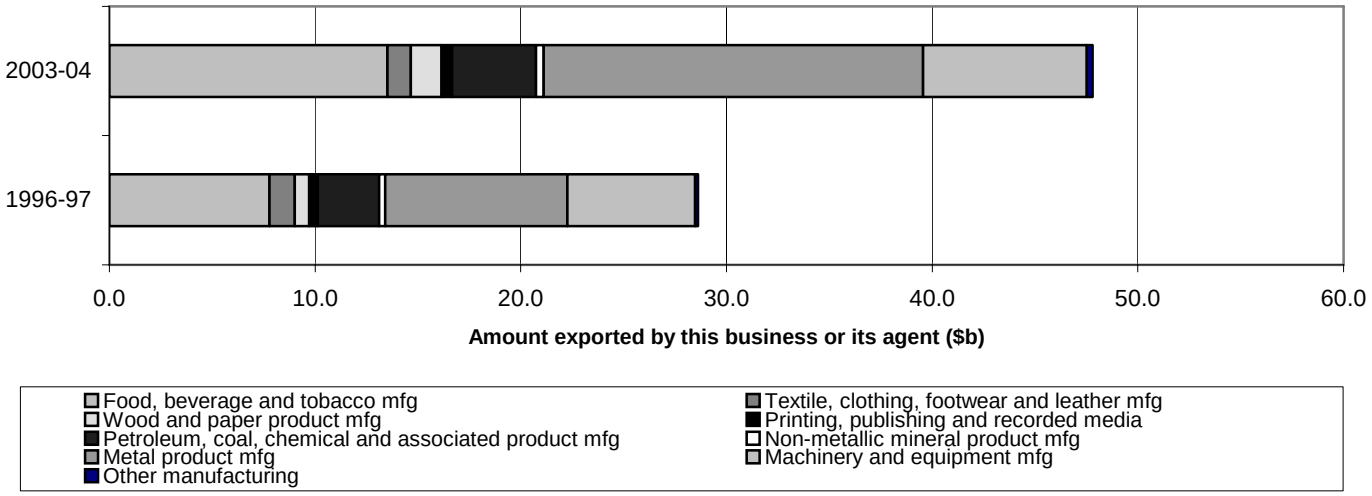
Between 1995–96 and 2004–05, total agrifood exports increased by $4 billion to $24 billion, with an annual growth rate of around 2 per cent. Meat products have been the main export category, although there has also been a large increase in wine and dairy exports.

Over 95 per cent of the value of Australian processed food exports occurs in products for which Australia has a ‘revealed’ comparative advantage. The majority of these exports are in the bulk, and minimally or substantially transformed product categories. Only a small percentage of Australia’s

exports are represented by elaborately transformed products such as confectionary, stuffed pasta, or cakes and pastries.

Exports of manufactured food items have consistently accounted for a large proportion of total exports of manufactured goods (about 30 per cent in 2003–04). Between 1995–96 and 2001–02, food manufacturing exports increased the most ($5.5 billion), followed by machinery and equipment ($4.6 billion) (Figure A.4).

Figure A.4: Manufactured exports by category (ABS 2006)



A.3 Agrifood — Future trends

Over the last 20 years Australian farms have become far more consumer focused, with an increasing proportion of output under pre-arranged contracts to processors and retailers — especially for the fruit, vegetable, wine, poultry and sheep industries (PC, 2005). The removal of statutory marketing arrangements has resulted in a closer integration of farm production and market demand with farmers now much more able, and required, to respond to changing market conditions. The increase in demand-responsive production has resulted in a diversification of the sector with the number and size of new and emerging industries (eg organic foods) on the rise. This trend is set to continue and the demand for new innovations, both on-farm and in the food sector, will place greater demands on the agrifood science and innovation system.

Australian household expenditure on food and non-alcoholic beverages is currently growing and anticipated to continue to increase at an annual rate of 0.2 per cent, reflecting a mature domestic market. Future growth for Australian agrifood industries will continue to reside mainly in the export sector. However, increasing international agrifood productivity will continue to challenge Australian market access and a further decline in the terms of trade for agrifood products can be anticipated in the medium term.

An ongoing challenge for the Australian agrifood industries will be to maintain focus in areas of competitive advantage for high-quality and safe food products to compete more effectively against countries with low costs, and to secure access for food products in overseas markets through the resolution of technical market-access issues.

DAFF-delivered science and innovation activities

B.1 Natural resource management

Land and water degradation in Australia, excluding weeds and pests, is estimated to cost up to $3.5 billion a year. One-third of Australian rivers are degraded as a result of high water extraction rates and high nutrient runoff from surrounding land. At least 2.5 million hectares, or 5 per cent of cultivated land, is affected by salinity.

To address these problems, DAFF is involved in the following major programmes and initiatives: the Natural Heritage Trust, National Action Plan for Salinity and Water Quality, National Landcare Programme, National Water Initiative, Murray–Darling Basin Commission, the Living Murray Initiative, and the Great Artesian Basin Sustainability Initiative.

To achieve natural resource management (NRM) objectives, NRM R&D is conducted at a scale that meets local needs and provides opportunities for local adaptation of low-cost solutions. It is also essential to reduce the uncertainty in planning and management required and identify, model and analyse NRM issues and solutions. Land use change and land management practices are also required to meet both production and sustainability imperatives. NRM R&D supports:

- promotion of productive and profitable agriculture
- enhanced ecosystem services and functions on private land
- enhanced surface and groundwater quality
- promotion of water use efficiency to meet sustainable production requirements
- innovation in sustainable production systems and management practices.

B1.1 National Landcare Programme — Natural Resource Innovation Grants

Natural Resource Innovation Grants are one-off grants provided to individuals, incorporated communities and other not-for-profit groups with links to natural resource management and portfolio industries who wish to develop and promote innovative practices, production techniques, technologies or products.

Encouraging innovation, the grants facilitate continuous improvement and adoption of best practice. For the purposes of these grants, ‘innovation’ is a practice, production technique, technology or product that has not been developed and/or adopted before or has been adopted only on a limited scale. Innovative land management practices could be developed and/or implemented to address issues such as climate change and sustainable production, water quality, salinity, maintenance or restoration of productive capacity, and nutrient use efficiency.

B1.2 Natural Heritage Trust

In early 2005, the Natural Heritage Ministerial Board agreed to national evaluations of the Natural Heritage Trust and the National Action Plan for Salinity and Water Quality (NAP), including the environmental themes of:

- significant invasive weed species
- biodiversity
- salinity
- sustainable agriculture
- coastal, estuarine and marine environments.

The evaluations were conducted by independent consultants who were selected through a public tender process. Each evaluation was guided by a steering committee with members from the Department of the Environment and Heritage (DEH), DAFF, regional bodies, state and territory government agencies, environmental, Indigenous and industry groups, and academic organisations. The evaluations contain recommendations and actions to improve the programmes they report on.

The general methodology used in the evaluations was to assess the planning and delivery of investments across the programmes, and then to review in detail a number of elements or projects in various jurisdictions on a case study basis.

A key impediment to assessing progress of investments is the long-term nature of natural processes (plant growth, groundwater recharge etc), which mean that outcomes may take 15–20 years to manifest in the environment. There is also a number of variables that are outside the control of programme managers, such as the effect of drought. Therefore, while monitoring and evaluation requirements under the programmes compel regional bodies to collect evidence of programme performance, including measuring of outputs, the evaluation methodology relies largely on interviews and questionnaires of investment managers and other key stakeholders.

B1.3 Fisheries Resources Research Fund

The Fisheries Resources Research Fund was established in 1991 to provide DAFF with the capacity to undertake policy-related research and to provide expert, objective and independent commentary on the status of the Commonwealth-managed fisheries to the Minister (and the Australian community).

The fund provides for:

- an ongoing programme of assessment of the management of Commonwealth fisheries (which is considered necessary for the ongoing stewardship of those fisheries)
- economic, social and biological research that underpins the Australian Government's response to emerging fishery policy and management issues (on both domestic and international bases).

In 2004–05, the Fisheries Resources Research Fund invested approximately $3.89 million in fisheries-related research.

The Australian Fisheries Management Authority, the Fisheries RDC and the Fisheries Resources Research Fund all require potential research projects to include appropriate plans (eg adoption, communication and/or commercialisation plans) to ensure that the full potential of the research is realised through adoption of research outputs by end users.

All three parties prepare annual reports describing the activities undertaken in the previous financial year and the level to which projects contributed to economic, social and environmental impacts.

The Fisheries Resources Research Fund does not have a formal evaluation and monitoring programme in place. In most instances, the research commissioned by the fund is in response to a specific policy need. The nearest the research comes to being evaluated and monitored is the level of uptake in the development of fisheries policy. For example, the fund commissions the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Rural Sciences (BRS) to undertake research on the economic and biological status of Commonwealth fisheries. This is collated in two annual reports, Australian Fish Statistics (ABARE) and the Fishery Status Report (BRS).

B.2 Biosecurity

With the agricultural and food sectors becoming more globalised, there is heightened risk to Australia's favourable pest and disease status arising from the growing volumes of trade, a

significant rise in international travel, demographic and environmental changes, intensification of agricultural production and the threat of bioterrorism.

Australia's biosecurity risk management systems aim to meet various existing and emerging challenges, while at the same time ensuring that the measures employed are proportionate to the risks involved. Import policies and procedures are underpinned by rigorous scientific assessments which form part of a consultative and transparent import risk analysis system. Biosecurity risks will continue to require management based on science and the development of appropriate import protocols.

With its agricultural and food sectors substantially export-oriented, it will remain critical that Australia continues to work to reduce and manage biosecurity risks to human, plant and animal health. DAFF's efforts will stay focused on the management of pests and diseases, on the improvement of international sanitary and phytosanitary (SPS) standards that apply to international trade, and on maintaining intelligence and surveillance to help identify new and emerging diseases. These efforts are delivered through the Australian Quarantine and Inspection Service (AQIS), supported by scientific risk assessments developed by Biosecurity Australia, and the efforts of the Offices of the Chief Veterinary and Plant Protection Officers and related divisions within DAFF.

The Office of the Chief Veterinary Officer (OCVO) facilitates the development of national policies and strategies and the provision of scientific advice to minimise the potential impacts of diseases on Australia's animal health. The Office of the Chief Plant Protection Officer (OCPPO) helps protect Australia's plant industries from the impact of new plant pests, diseases and weeds to ensure the safe interstate and overseas trade of plant products. Both offices coordinate national responses to plant and animal pest and disease incursions and provide policy leadership in plant and animal health at the national level.

Current publicly supported science and innovation activities undertaken by the OCVO and OCPPO include the National Biosecurity Taskforce which funds targeted research into marine pest risk assessments, the disinfection of ballast water and vessel hulls of marine pests, and research relating to the development and implementation of a national system for the prevention and management of marine pest incursions.

B.3 Farm skills

With increasing requirements for business planning, enhanced market awareness, implementation of modern information technologies (such as computers and global positioning systems), and better agronomic management, modern farm managers will need to become increasingly skilled to implement and reap rewards from science and innovation. As business managers, farmers will need appropriate modern business and technical skills. Higher levels of formal education will increasingly be a feature of farm managers, particularly for new entrants, as will increased use of information technology on farms.

Better-performing farmers appear to make greater use of modern communication tools and are more adept at investigating market opportunities; researching customer requirements; business planning, including financial management; and researching the latest farming techniques.

Risk management skills in particular are an important element of modern farm management. Farmers manage a number of different risks such as climatic, financial, price and safety. A number of risk management practices have become popular, including the using climate and farm management software packages, futures trading, using consultants, and enterprise diversification.

Adoption of risk management practices by Australian farmers is highly variable. Although the cost of services may be a factor in restricting the use of consultants and other professional advisers, farmer attitudes to risk-taking activities (including uncertainty about employing innovative practices) will be important.

DAFF supports farm skills development essentially through the FarmBis programme.

FarmBis is a joint initiative between the Australian and state/Northern Territory governments. Since its commencement in 1998, the Australian Government has contributed around $95 million to the FarmBis programme. The funding is matched 50:50 by participating states and the Northern Territory (New South Wales no longer participates).

FarmBis-supported training is delivered in regional areas convenient to participants on management-level issues of their choosing, utilising adult-learning principles. The main assistance FarmBis provides is through financial support to primary producers to attend eligible training activities in business and natural resource management. However, there are also other strategies in the programme, including the communication/provision of information, a coordination network and Targeted Industry Initiatives (collaborative education and training projects).

B.4 Economic and scientific analysis

B.4.1 Bureau of Rural Sciences

The Bureau of Rural Sciences (BRS) is the science bureau associated with the DAFF portfolio that provides scientific advice as a foundation for evidence-based policy development and decision-making by DAFF itself, by other government agencies, and by portfolio stakeholders. Its work contributes to, and aligns with, the priorities of DAFF's outputs. BRS advice also contributes to the national research priorities and broader Australian Government science and innovation objectives.

BRS provides science for policy decision-making, including for:

- climate and risk in agriculture
- competitive and prosperous rural industries
- Australian fisheries and marine policy
- forest industries policy
- natural resource access and management
- trade, infrastructure and other Commonwealth objectives
- implementation of national natural resource management.

The external operating environment for BRS is characterised by its collaboration through project work with other government agencies. In the Australian Government, BRS has partnerships and other working arrangements underpinned by contracts and memoranda of understanding with CSIRO, the Bureau of Meteorology and Geoscience Australia. BRS also has well-established relationships with state/territory government and regional agencies, including RDCs, CRCs and universities to coordinate national data sets and implement national programmes.

B.4.2 Australian Bureau of Agricultural and Resource Economics

The objective of the Australian Bureau of Agricultural and Resource Economics (ABARE) is to contribute to the competitiveness of Australia's agricultural, fishing, forestry, energy and minerals industries and the quality of the Australian environment by providing rigorous and independent economic research analysis and forecasting.

To underpin commodity analyses and research, ABARE maintains a unique suite of comprehensive databases, which contain over 100 000 data time series on domestic and international agricultural, fisheries, forestry, minerals and energy industries and macroeconomic statistics. Data captured by ABARE inform portfolio R&D direction-setting and include valuable information for on-farm performance, production benchmarks, and rural socio-economic indicators.

B.5 Industry development

B.5.1 New Industries Development Programme

The New Industries Development Programme (NIDP) aims to improve Australia's performance in the commercialisation of new technologies, innovative agribusiness products and services and technologies. The programme's major focus is the commercialisation of market-driven solutions based on innovation. It is also about changing the form, presentation and delivery of traditional products, technologies and services to better meet changing consumer requirements.

Through initiatives supported under the programme, Australian agribusiness enterprises will gain the business skills and resources required to successfully commercialise new agribusiness products, services and technologies. The programme's outputs will assist agribusiness to increase its capability to identify and respond to demands from new customers, thereby generating significant and measurable business and job growth over the medium term, particularly in rural and regional Australia.

The Australian Government is providing over $34 million until 2011 for the NIDP, under 'Backing Australia's Ability'. The programme will:

- positively contribute to medium- to long-term Australian income by generating new, high-value products, technologies and services and new market opportunities
- improve the access of small-to-medium enterprises (SMEs[6]) to 'quality' information on new product development opportunities
- promote understanding of the need for, and improve access to, commercial skills, experience and in-market contacts
- help change the culture and structures within agribusiness to promote cooperation across state/territory and regional boundaries and along potential supply chains
- build investor confidence in Australia's ability to develop new high-value products and services and improve the usage of venture finance and risk management strategies by SMEs involved in new ventures.

B.5.2 Industry Partnerships Programme

Apart from traditional research-based innovation activities, DAFF has programmes to assist industries to improve their capacity and capability to manage their affairs and compete in a changing marketplace. The Industry Partnerships Programme works with industry to highlight an industry's successes and build on its strengths; improve the industry's ability to identify and respond appropriately to threats and risks, ensure key stakeholders throughout the supply chain and in supporting services contribute to the industry's vision and directions; and develop skills and structures to improve industry and organisational capacity. There are three components to the programme:

- *taking stock and setting directions* — aims to assist an industry to improve their current situation and performance by helping them to undertake a rigorous self-assessment and develop priority strategies to improve their capability to respond to threats and risks

[6] An SME is defined as an individual rural producer, group of rural producers, business enterprise with fewer than 200 employees, or agribusiness service provider with less than 50 employees; which has a turnover of less than $25 million per annum

- *action partnerships* — provide funding support for industry organisations at the national level to undertake short-term catalytic projects that are imperative to the future performance and positioning of their industries, including
  - implementing strategies that accelerate the adoption of innovations or technology that addresses an industry-wide challenge or opportunity
  - benchmarking studies to investigate areas to improve productivity, profitability and sustainability
  - training, business and marketing activities
- *capacity building* — initiatives are targeted at those involved in primary production, and associated roles, and non-government rural organisations to improve their capacity to participate in, and contribute to, the future direction of rural industries. Initiatives target women, young people and Indigenous people involved in agricultural, fisheries and forestry industries.

Rural research and development corporations and companies (RDCs) — a profile

The research and development corporations were originally established under the *Primary Industries and Energy Research and Development Act 1989* (PIERD Act) as a partnership between industry and the Australian Government to advance research and development (R&D) in Australia's primary industries. The objective was to enable closer involvement of industry in determining the objectives of R&D and improve the organisation and administration of R&D so that research expenditure was conducted in a more autonomous and flexible manner.

Under the PIERD Act, the functions of the R&D corporations are to:

- investigate and evaluate the requirements of R&D in relation to their respective industries
- coordinate or fund R&D activities consistent with their five-year strategic plans and annual operating plans
- facilitate the dissemination, adoption and commercialisation of the results of R&D in relation to their respective industries.

The original model has evolved since 1989 to incorporate eight statutory R&D corporations which still operate under the PIERD Act and seven industry-owned companies. These industry-owned companies undertake R&D and additional activities, such as marketing and industry representation, as required by their industry members. The Government's interest in these industry-owned companies is now managed through individual statutory funding agreements, rather than the PIERD Act. A list of the RDCs is provided at Table C.1.

Table C.1 Research and development corporations and industry-owned companies

Statutory R&D corporations	*Industry-owned R&D companies*
Cotton	Australian Egg Corporation Ltd
Fisheries	Australian Pork Ltd
Forest and Wood Products	Australian Wool Innovation Ltd
Grains	Dairy Australia Ltd
Grape and Wine	Horticulture Australia Ltd
Sugar	Livecorp Ltd
Land & Water Australia	Meat and Livestock Australia Ltd
Rural Industries	

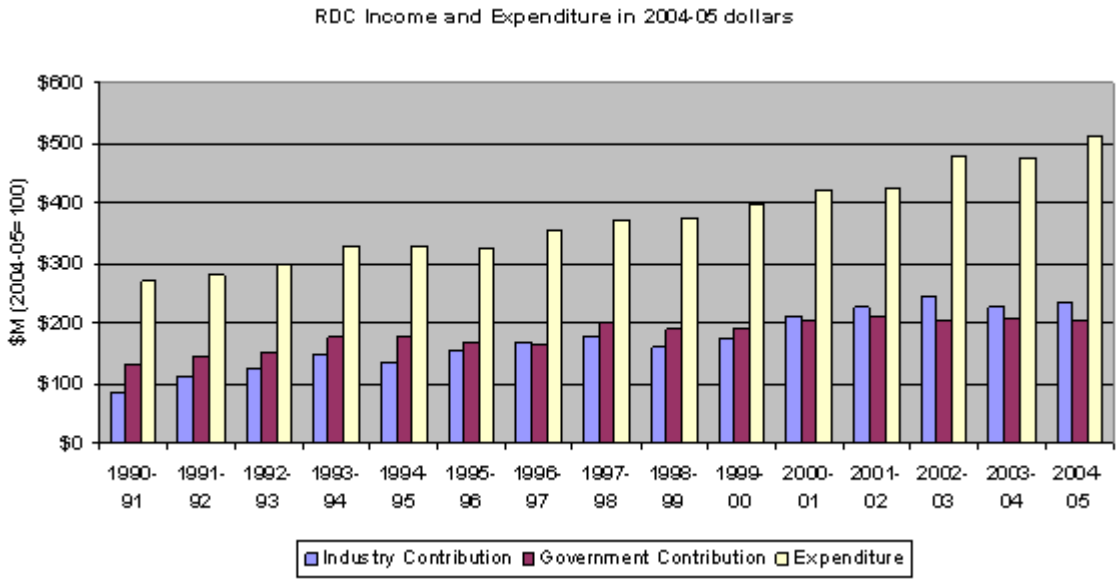
C.1 Funding arrangements

Funding for R&D is provided mainly through compulsory levies on producers for R&D, and Government matching industry R&D expenditure up to a limit of 0.5 per cent of an industry's gross value of production (GVP). In addition, recognising broader public interest and environmental research roles and to support new and emerging rural industries, Land & Water Australia, Fisheries RDC and Rural Industries RDC receive unmatched government funding.

Over the life of the RDC model, from 1990–91 to 2004–05, industry contributions have risen from $61 million to $234 million per annum. Australian Government contributions have risen from $95 million to $205 million per annum. Industry confidence in the model is reflected in levy contributions, consistently above matching Government payments since 2000–01. Figure C.1 shows

the growth in industry and Australian Government contributions and RDC expenditure in real dollars.

Figure C.1: Commonwealth and industry contributions and expenditure since 1990–91 (Index: 2004–05 = 100)



Total RDC expenditure in 2004–05 was over $511 million. Draw down on reserves, commercial returns and voluntary contributions provided additional revenue to invest in R&D.

The Government's dollar-for-dollar matching contribution provides an incentive for the primary sector to increase its R&D funding and to become more involved in R&D priority-setting and the adoption of outcomes, whilst recognising that activities funded by the RDC generate a mix of public and private benefits.

C.2 RDC governance and decision-making

Under the RDC model, the Government and industry are the key stakeholders and operate in partnership, providing investment direction as well as financial support.

Each RDC is governed by an independent skills-based board, which is responsible for consulting with its industry representative organisations and stakeholders to make commercial decisions about the investment of R&D funds to achieve tangible outcomes for an industry or sector. Ultimately, each RDC aims to make the outcomes of this well-targeted R&D, such as new technology, information and market opportunities, available to industry as quickly and as cost-effectively as possible.

Each RDC has its own its own style of consultation and strategies for engaging its stakeholders.

Since 1994, it has been the practice of the delegated Minister in the agricultural portfolio to formally communicate national rural R&D priorities to the RDCs. The most recent version of these priorities was released on March 2003, providing specific guidance on issues of strategic significance to rural industries (see Section 3.3 in the body of the report).

Strategic R&D plans are prepared by each RDC, under the PIERD Act and the statutory funding agreements, setting out objectives and priorities for a five-year period, and outlining the strategies which will be adopted in order to meet those objectives (see Table C.2). These plans are prepared through a process of consultation with research providers, industry and Government, and dovetail with the Australian Government National Research Priorities and Rural Research Priorities.

Table C.2: RDC R&D strategic plans

RDC	*Current strategic plan*	*Major strategic elements*
Cotton (CRDC)	2003–08	People and knowledge; integrated natural resource management; crop protection; farming systems; breeding and biotechnology; value chain systems
Forest and Wood Products (FWPRDC)	2003–08	Market knowledge and development; manufacturing and products; resource characterisation and improvement; sustainable forest management; services and capability
Fisheries (FRDC)	2005–10	Natural resources sustainability; resource access and resources allocation; respond to demand; profitability; people development; community and consumer support
Grape and Wine (GWRDC)	2002–07	Extension and training; new production technologies; assessment of social, economic, regulatory and market factors; R&D portfolio providing the best possible return on investment
Land & Water Australia (LWA)	2005–10	Research investment in arenas — industries; landscapes; people and innovation; collaboration and strategic analyses for natural resource management; knowledge into practice
Grains (GRDC)	2002–07	Coordinate a national portfolio approach to grains R&D; deliver against Australian Government priorities; grow and leverage total grains R&D; ensure R&D is market driven
Rural Industries (RIRDC)	2003–08	Develop new opportunities; adopt new technologies and systems for established industries; improve the competitiveness and sustainability of agriculture; underpin innovation and change in agriculture
Sugar (SRDC)	2003–08	Value chain integration; farming systems; processing and distribution systems; industry capacity

C.3 Coordinating RDC R&D activities

The RDCs were designed as industry-driven research brokers to invest in strategic R&D that will benefit the industry and improve its profitability. As a result, opportunities for investment are not confined to the farm but extend to the whole-of-industry from production to consumer. The RDCs therefore form partnerships with a wide range of other funding bodies and research agencies.

This has created a partnership culture between the RDCs, CSIRO, the Cooperative Research Centre (CRC) programme, state and territory agencies, and the Australian Research Council. Such collaboration consolidates research efforts, utilises resources better and provides a critical mass of funding to develop and disseminate R&D.

While the RDCs function as research brokers, the CRC programme enhances cooperative links between public and private sector researchers and research, enabling the transfer of promising technologies to industries. In 2006, the RDCs were core participants in 12 of the 16 agricultural and rural-based manufacturing CRCs and two of the environment CRCs.

The RDCs also collaborate among themselves where their respective industries have a shared interest and complementary needs. For example, farmers in the wheat–sheep belt are able to benefit from the collaboration of the Grains Research and Development Corporation, Meat and Livestock Australia Limited and Australia Wool Innovation Limited in developing new fodder crops that have a minimal impact on summer grain crops.

Collaborative projects depend on R&D needs, research infrastructure, the need for critical mass and geographical factors. One the main topics of collaboration that cuts across the RDCs is natural resource management.

C.4 Facilitating adoption of RDC outputs

A critical element of the RDCs' role is to foster the uptake and adoption of research findings and develop an innovative culture. It is widely recognised that effective adoption of R&D outputs is greatest when parties who will benefit are actively involved in the project as early as possible. The RDCs collaborate with industry and research providers at the project design stage, before finalising the contract and beginning work. Engaging the intended recipients of research outputs is as vital as the knowledge derived from R&D. Simply delivering R&D is not enough to guarantee its adoption (Gordon and Mauldon, 2003).

The flexibility of the RDCs to respond to their own industry ensures they can tailor adoption strategies and measures to better target end users, rather than taking standardised approach.

The results derived from R&D investments, and the resulting adoption and implementation of findings, are wide ranging across the production, value adding and marketing spectrum. A scan of the RDCs reveals extensive involvement in:

- developing new crop varieties and improving yields
- managing disease and pests through prevention and control
- improving the management of natural resources, including water, soils and native vegetation
- improving storage and transport of crops from harvesting to processing
- advancing quality testing and certification for export markets
- finding new markets and product uses and responding to consumer preferences
- improving the skills and qualifications of people in all aspects of the industry
- developing a culture of continual improvement within industries.

In contrast to other sectors, rural R&D commercialisation is only one path to adoption. Rather than focusing on generating royalty streams, the RDCs normally focus on managing intellectual property to develop practical tools to benefit their levy payers and disseminate information as widely and efficiently as possible to those people who have funded the R&D. Royalties and licence fees do not currently represent a substantial portion of RDC income, except for the Cotton RDC (CRDC). Royalties of $1.6 million in 2004–05 represented 13 per cent of the CRDC's income. CRDC's investment in plant breeding with the CSIRO has been notably successful. New improved cotton varieties bred by CSIRO and distributed by Cotton Seed Distributors Ltd have captured around 90 per cent of the Australian market, 25 per cent of the United States market and are also sold in Greece and South Africa. These new varieties have delivered unrivalled productivity gains for the Australian cotton grower with yields increasing by over 20 per cent in the last five years. The return to investment on CRDC's funding of plant breeding has been independently assessed in a 2003 study by the Centre for International Economics to have delivered to the industry over $5 billion since the industry's commencement in the early 1970s.

Other examples of RDC adoption facilitation include the following.

- Rural Industries RDC (RIRDC) has a close relationship with the rice industry, with RIRDC investment oriented to improving commercial returns and the sustainability of the industry. All rice varieties grown in Australia have come from the RIRDC rice programme. These varieties and other technologies have enabled the industry to improve yields per megalitre by 87 per cent while simultaneously reducing water use by 45 per cent. Strong industry interest in the programme ensures a high level of uptake of the research results. The support of the industry for

the RIRDC programme was also evidenced by the fact that rice growers in 2005, through Sunrice (Australia's major processor and marketer of high-quality rice food products and by-products), contributed an extra $540,000 to maintain rice R&D during the drought.

- Grains RDC (GRDC) has facilitated the formation of a national barley-breeding programme in Australia called Barley Breeding Australia. The national barley-breeding programme will be market driven via Barley Australia, which is made up of the Australian Barley Board, GrainCorp and Co-operative Bulk Handling Ltd, a grower consultation and national feed grains consultative group. There will be national intellectual property (IP) sharing with full licence and freedom to operate.

  Barley Breeding Australia will set strategic direction, undertake market research, manage IP, monitor performance, take a whole-of-industry approach, and coordinate the development and release of new varieties. Barley Breeding Australia will have three regional nodes: north, southeast and west. North will have 80 per cent feed and 20 per cent malt, southeast 80 per cent malt, and west 80 per cent malt.

C.5 Specific RDC impact assessments

C.5.1 Land & Water Australia (LWA)

In recent years, Land & Water Australia (LWA) has evolved more accurate measures of the return on investment of public funds in land and water research. This seeks to define the economic returns against the costs of conducting the research, and also to identify wider benefits to the environment and to the community at local, regional and national scales, which have flowed from its adoption. According to LWA, this is the first time that benefit–cost analysis has been applied to such an extensive portfolio of public good research in Australia and represents the current state of the art.

Analysis of 25 separate innovations — which make up about one-quarter of LWA's total portfolio — shows a return of $1.5 billion against a research cost (present value) of $392 million, or almost 4:1. If just the LWA component of the research investment is considered, there is a return of almost $300 million (present value) from a research cost (present value) of $77 million. Among these projects, returns varied from as low as 1.1:1, to as high as 28:1. These estimates are conservative as some environmental and social returns are difficult to quantify and were therefore not counted.

A standardised approach was used in each case study. The result is a 10–20-page qualitative and quantitative analysis of each investment that addresses the rationale, the research undertaken, outputs, outcomes, costs, and benefits accruing to each investment.

Examples of investments which have changed, or are changing, the way Australians look after their land and water, several case studies and a summary of steps used in evaluations are provided in a report by LWA available at http://www.lwrrdc.gov.au/downloads/publications_pdf/PK051013.pdf.

C.5.2 Grains R&D Corporation (GRDC)

As a tool for gauging the uptake and impact of its research, GRDC conducts a formal survey of its growers against its performance objectives and indicators. The 2005 survey engaged 1,165 growers from across Australia and results from the survey include (for the past five-year period):

- 72 per cent of growers indicated they had grown new wheat varieties
- 78 per cent had adopted new farm practices
- 82 per cent believed they had directly benefited from grains R&D.

At the beginning of the 2002–07 planning period, a prospective economic analysis of the GRDC investment portfolio was undertaken. Results indicated that grains R&D would deliver an overall benefit–cost ratio of 6.6:1, based on conservative assumptions. When account was taken of the benefits flowing to off-farm businesses, the benefit–cost ratio increased to 7.8:1. This equates to a net present value of about $3 billion flowing to the wider community through grains R&D.

C.5.3 Australian Pork Limited (APL)

Australian Port Limited (APL) established the Pig Meat Hygiene Programme (PMHP) with the aims of protecting domestic markets through the production and delivery of safe pork to consumers and to meet World Trade Organization food export standards so that access to international markets is enhanced. A key part of the PMHP assesses approaches to meat inspection, particularly to determine lesions of food safety significance in Australia, evaluate appropriate (risk-assessed) inspection procedures, and to recommend a national standard for pig inspection. Since 1995, the APL has invested $927,531 in the PMHP.

Adoption of the PMHP-derived meat quality assurance, risk assessment, and determination of microbe prevalence systems has reduced the potential for food safety issues to affect the demand for pork. The research also led to new meat inspection practices which have reduced processing costs.

The Council of RDC Chairs draft Productivity Commission Study submission (2006) cites an APL *ex post* benefit–cost analysis of selected APL projects. That analysis estimated that the total benefit from changed inspection practices was equivalent to $0.80 per pig slaughtered. Based on this figure, total economic benefits of $2.08 million are attributable to changed inspection. The economic pay-off in terms of net present value and benefit–cost ratio are $33 million and 9:1, when a 6 per cent discount rate is used.

Changes to meat inspection practices as a result of this research programme have delivered considerable economic benefits to industry through labour cost savings in abattoirs and increased meat yields. Additionally, the programme has reduced the probability of food poisoning outbreaks. A break-even probability of the research resulting in a lesser chance of a *Salmonella* outbreak of about 1 per cent would alone be required to justify project expenditure.

Attachment D

Sample of the various return on investment studies undertaken for the Primary Industries Standing Committee[7]

Meat industry return on investment

Project	*Net present value ($ million)*	*Benefit–cost ratio*	*Internal rate of return (per cent)*	*Year conducted*
Beef cattle genetics	863	3.6:1	19	2002
Pasture management	147	15:1	200	2002
Farm management	11	11:1	46	2002
Producer-initiated R&D	11	–	–	1998
Sheep genetics	8.8m	4:1	27	2001

Grains industry return on investment

Project	*Net present value*	*Benefit–cost ratio*	*Internal rate of return (per cent)*
Sample of programmes over last 50 years	N/A	6.5:1	9.8

Sugar industry return on investment

Project	*Net present value*	*Benefit–cost Ratio*	*Internal rate of return (per cent)*	*Year conducted*
Sample of projects between 1998 to 2003	N/A	4:1	14	2004

[7] Primary Industries Standing Committee (PISC) — comprised of Commonwealth, state and territory departments of agriculture.