



Australian Government

ruralR&D
CORPORATIONS

Cotton Research and
Development Corporation

Grains Research and
Development Corporation

Fisheries Research and
Development Corporation

Land & Water Australia

Rural Industries Research and
Development Corporation

Sugar Research and
Development Corporation

Grape and Wine Research and
Development Corporation

Level 1
33 Ainslie Avenue
Canberra City ACT 2600
Australia

GPO Box 1322
Canberra ACT 2601

Phone: 02 6103 8200
Fax: 02 6103 8233
Email: Secretariat@ruralrdc.com.au



Measuring economic, environmental and social returns from Rural Research and Development Corporations' investment

December 2008

Acknowledgement

The Council of Rural Research and Development Corporations' Chairs would like to acknowledge the 15 Rural Research and Development Corporations for their involvement in this project and the seven economic consultancies whose work was fundamental to the preparation of this report.

Disclaimer

While every care has been taken to ensure accuracy, the Council accepts no responsibility for any action undertaken as result of reliance on this report.

Contents

Summary	5
Main report	10
About the RDCs.....	10
Background.....	10
Purpose of evaluation.....	11
Public benefits.....	12
Methodology.....	12
The counterfactual.....	13
Results.....	13
Highly successful projects.....	14
Randomly selected projects.....	17
Value of RDC R&D collaboration as demonstrated by biosecurity and food safety... ..	19
Collaboration.....	20
National Rural Research Priorities.....	21
Public benefits.....	23
Valuing public benefits.....	25
Consumer and industry benefits of the selected successful projects.....	26
Lessons from year one of the evaluation program.....	26
Assessment of work in progress.....	26
Responding to changing priorities.....	27
Path forward.....	27
Appendix 1 – Glossary of terms	28
Appendix 2 – Methodology	30
Methodology.....	30
Project selection.....	30
Project outputs.....	30
Appendix 3 – Tables	31

List of acronyms and abbreviations

AAHL	Australian Animal Health Laboratory
AARES	Australian Agricultural and Resource Economic Society
ACRCP	Australian Cereal Rust Control Program
AECL	Australian Egg Corporation Limited
APL	Australian Pork Limited
AWI	Australian Wool Innovation
CIMMYT	International Maize and Wheat Improvement Center
CRC	Cooperative Research Centre
CRDC	Cotton Research and Development Corporation
CRRDCC	Council of Rural Research and Development Corporations' Chairs
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DA	Dairy Australia
FRDC	Fisheries Research and Development Corporation
FWPA	Forests and Wood Products Australia
GM	genetically modified
GRDC	Grains Research and Development Corporation
GWRDC	Grape and Wine Research and Development Corporation
HAL	Horticulture Australia Limited
LWA	Land and Water Australia
MLA	Meat and Livestock Australia
MPA	Marine Protected Area
OH&S	occupational health and safety
OJD	Ovine Johnes disease
PV	present values
R&D	research and development
RDC	Research and Development Corporation
RIRDC	Rural Industries Research and Development Corporation
RRP	Rural Research Priorities
SARDI	South Australian Research and Development Institute
SRDC	Sugar Research and Development Corporation
TBL	triple bottom line
TVC	total viable count

Note: All dollar amounts in this report relate to 2007 values.

Summary

Introduction

Australia's productivity growth, which is driven by innovation from investment in research, development and extension, puts the nation in a pre-eminent position to meet the growing global demand for primary industry products.

In part, this growth is generated by the rural Research and Development Corporations (RDCs). There are 15 RDCs,¹ which form a partnership between industry and government. Their role is to prioritise, coordinate and integrate the demands of industry and government with the capabilities of research providers.

The RDCs currently invest around \$540 million per year in R&D (including marketing) to improve the profitability and sustainability of rural industries and communities.

For every \$1.00 contributed by the Australian Government, industry levies and contributions add a further \$1.50, on average. This serves to leverage the total investment and create far greater benefits for Australia than would otherwise be the case.

The structure of the RDCs and the extensive collaboration between the organisations involved promotes effective research, development, innovation and extension of research findings in priority areas such as climate change and natural resource management. The ability to tackle projects² jointly increases efficiency and can result in more effective communication and uptake of the outcomes of R&D. This contributes directly to the growth in productivity in Australian agriculture.

The RDCs embrace the Australian Government's National Research Priorities and Rural Research and Development Priorities in their investment, evaluation and reporting frameworks. Alignment with these priorities is a key consideration when setting strategic directions and making key investment decisions.

This report provides the results of the first year of an ongoing collective evaluation of the impact, effectiveness and return on investment from the RDCs. Further work by the RDCs over the next two years will build on these results. The evaluation was undertaken to provide robust and objective information on the overall economic, social and environmental returns produced by the RDC portfolio. This is the largest evaluation of rural R&D undertaken so far in Australia.

Context and purpose

Individually, RDCs use a range of evaluation approaches to report value to stakeholders and to provide recommendations and guidelines for ongoing and future investment. In 2007 the RDCs agreed to work together to measure and report on the overall return on R&D investment. The methodology and approach developed by the RDCs in this process will be of use to a wide range of R&D investors. This is particularly important in the areas of social and environmental benefits where common tools and frameworks are still evolving.

The projects assessed for this report include projects in the priority areas of improving productivity, developing supply chains and markets, and natural resource management. Climate change also featured in a number of projects. The evaluations were completed prior to the recent *National Climate Change Research Strategy for Primary Industries* which is one of the RDCs' major emerging areas of collaboration.

It is anticipated that this study will make an important contribution to the Government's contemplation of the *National Innovation System Review*.

¹ There are 15 members of the Council of Rural Research and Development Corporations' Chairs.

² 'Projects' mean a group of investments made to produce a particular R&D outcome. This can apply to an individual project or a group of projects with clearly defined innovation outcomes.

Evaluation framework

This evaluation focused on a sample of projects managed by the RDCs. It included projects that achieved significant milestones or had been completed between two and five years prior to 2006–07. This first stage evaluation report has three key components:

1. Examine the returns from 36 **highly successful projects** selected by the RDCs to demonstrate positive returns.
2. Examine the returns from 32 **randomly selected projects** (from a pool of over 600 projects relevant to the sampling period). The 32 projects, while not statistically representative of the pool, provide general insights into the performance of the RDC portfolio. This **randomly selected** group will be increased in number in subsequent evaluations to allow statistically significant conclusions to be made.
3. Examine and evaluate a sample of current RDC programs that involve **collaboration** and have a high level of national importance. The area of biosecurity and food safety R&D was the first to be selected for review and several different biosecurity projects were evaluated.

The Council of Rural Research and Development Corporations' Chairs (CRRDCC) prepared the common evaluation guidelines for this work. These guidelines were reviewed by key economic agencies of the Australian Government including the:

- Treasury
- Department of Finance and Deregulation
- Department of Agriculture, Fisheries and Forestry
- Productivity Commission
- Australian Bureau of Agricultural and Resource Economics.

RDCs engaged economic consultants to undertake the evaluations. In total, a pool of seven consultancies prepared the cost-benefit studies used as the basis of this evaluation report.

Results

The results from the first year of analysis show significant benefits from the investment by the RDCs:

- A sample of 36 **highly successful** projects will return \$10.5 billion in quantified benefits.
- Of the \$10.5 billion in quantified benefits, \$5.5 billion will be private benefits (that is, benefits accruing to rural industries). The remaining \$5.0 billion will be benefits captured by consumers, other participants in the supply chain and the wider public.
- A sample of 32 **randomly selected** projects from the RDC portfolio will deliver an average return of \$11 for each dollar invested (in 2007 dollars).
- A range of significant social and environmental benefits were identified which are distributed broadly to the Australian community.

Background to results

The 36 **highly successful** projects will generate the \$10.5 billion return from a \$265 million investment by the RDCs and a \$200 million contribution from other funding partners. RDCs initiated and managed all 36 projects.

The returns attributable to the RDCs' \$265 million investment – \$5.9 billion – will more than pay for the entire \$4.5 billion invested by RDCs across 600 projects over the past 10 years.

The purpose of examining the cost-benefit analyses from 36 **highly successful** projects was to establish that RDC investment was delivering positive returns.

While choosing highly successful projects proved the capacity of RDC investments to generate compelling returns, analysis of the 32 **randomly selected** projects from a pool of 600 relevant to the sampling period gives a clearer indication of average returns across the portfolio.

While the focus of the current study was to evaluate the return on RDC investments, the evaluation also:

- demonstrates the strong collaboration between RDCs, rural industry, government and research partners
- shows that significant benefits are generated in areas targeted by the National Research Priorities and Rural Research and Development Priorities
- provides a sound basis for further combined evaluation work to:
 - measure the value of RDC investments
 - provide insights to individual RDCs about managing investments
 - provide leadership in approaches to evaluation of innovation in Australia.

Public benefits

This evaluation process has identified many public benefits and quantified them where possible. Where it has not been possible to quantify the benefits, the evaluation process uses a robust 'weight of evidence' case – involving the accumulation of *prima facie* evidence of improvements in environmental and social values for Australian society stemming from the RDC investments.

Taking both the **highly successful** and the **randomly selected project** groups into account, examples of public benefits include:

- improved biodiversity and increased carbon sequestration
- reduced soil erosion and improved water quality
- a reduction in food-borne infectious diseases
- increased efficiency in water use, together with improved water quality for many rural industries
- improved biosecurity
- more sustainable use of natural resources
- increased adaptability of rural industries to climate change.

Many of these benefits have been achieved through the RDC's coordination of projects that specifically address both industry and government Rural Research Priorities.

A small sample of the public benefits that could be quantified includes:

- \$503 million in social and related industry benefits in food safety from a Meat and Livestock Australia (MLA) investment of \$2 million in food safety research
- \$10 million that did not have to be spent on social adjustment for fishing industry-dependent communities had the proposed Marine Protected Areas (MPAs) been implemented in the proposed areas, rather than being relocated.
- \$48 million of total quantifiable environmental benefits as a result of investment by Australian Wool Innovation (AWI), with contributions from Land and Water Australia (LWA) and MLA in the Land, Water and Wool project.
- \$162 million in public benefits from improved water-use efficiency in rice production resulting from expenditure of \$2 million.

The CRRDCC will invest in improving the methodology to quantify the assessment of social and environmental benefits for future evaluations.

While most of the evaluation process has focused on RDC impacts, there is also considerable value in maintaining R&D capacity so that RDCs can absorb international innovations and respond to particular emergency needs as they arise. The maintenance of the RDC investment capacity gives Australian agriculture, fisheries and forestry a 'seat at the international' rural R&D table. Prominent examples of this are:

- the transfer of genetically modified cotton technology through the Cotton Research and Development Corporation (CRDC)
- Australia's participation in international cereal breeding programs through Grains Research and Development Corporation (GRDC) investments in the International Maize and Wheat Improvement Center (CIMMYT).

The evaluation of the RDCs has included an analysis of the insurance value of RDC biosecurity investments.

The RDCs have directly invested around \$35 million per year on biosecurity projects in collaboration with a number of organisations including the CRCs for Australian Biosecurity and National Plant Biosecurity, CSIRO, the Australian Animal Health Laboratory, Animal Health Australia and Plant Health Australia. An assessment of three biosecurity projects indicated returns of \$135.15 million over 10 years' direct investment of \$1 million from several RDCs. The bulk of these benefits arose from reduced costs arising out of earlier diagnosis of horse flu from technology developed originally to detect avian influenza.

Collaboration

Analysis shows 32 of the 36 **highly successful projects** (89 per cent) and 22 of the 32 **randomly selected projects** (69 per cent) involved collaborative funding.

RDCs have a unique perspective that is provided by their close engagement with industry and their intimate knowledge of market conditions that is not easily and regularly assessable either by government or the research community.

Additionally many of the RDCs have ensured collaboration by involving industry (from all parts of the value chain) in boards, panels, reference groups, and specialised regional development groups. This has enhanced capability, engagement and diffusion of knowledge.

Conclusions

It is clear from the results that the RDCs generate significant economic, social and environmental benefits for Australia in key areas that have been determined as priorities by rural industries and the Australian Government. Returns from a small number of **highly successful projects** are greater than the cost of the total investment in R&D. Further, a **randomly selected** set of projects shows a strong average return on investment across the portfolio.

Lessons have been learned from this initial year of evaluation that will be used to strengthen the ongoing evaluation. Social and environmental outcomes are difficult to quantify, leading to a likely understatement of their value. Improved tools and techniques are needed in these areas to be able to capture and value social and environmental outcomes. This is particularly important in areas of priority to government policy makers.

Evaluation methodologies must be developed in conjunction with other non-RDC parties, to ensure that the measures deliver maximum utility to key stakeholders. Ultimately, the results and methods will have value well beyond the RDCs themselves.

Main report

About the RDCs

There are 15 rural research and development corporations. Seven of the RDCs are statutory bodies and are administered according to the *Primary Industries and Energy Research and Development Act (1989)* and eight are industry-owned companies (see Table 1 below). The industry-owned companies enter into a contract with the Australian Government enabling them to receive levies collected and matching funding.

The CRRDCC undertook this evaluation as part of their leadership role to ensure returns from industry and government investment are maximised.

Table 1 **Statutory and industry-owned RDCs**

Statutory bodies	
Cotton Research and Development Corporation	CRDC
Fisheries Research and Development Corporation	FRDC
Grains Research and Development Corporation	GRDC
Grape and Wine Research and Development Corporation	GWRDC
Land & Water Australia	LWA
Rural Industries Research and Development Corporation	RIRDC
Sugar Research and Development Corporation	SRDC
Industry-owned companies	
Australian Egg Corporation Limited	AECL
Australian Pork Limited	APL
Australian Wool Innovation	AWI
Dairy Australia	DA
Forests and Wood Products Australia	FWPA
Horticulture Australia Limited	HAL
LiveCorp	LiveCorp
Meat and Livestock Australia	MLA

Background

Agriculture feeds the world. The secure supply of food and natural fibre in the face of climate change and increasing global population is one of the major challenges facing agriculture globally. The issues of agricultural and food security and climate change mitigation and adaptation have been identified as key priorities for government in the *Review of the National Innovation System*.

Australia is in a pre-eminent position to meet this growing demand for agricultural products through productivity growth, which is driven by innovation from investment in research, development and extension of research findings.

In part, this growth is generated by the rural RDCs, which currently invest about \$540 million per year (including marketing). RDC contributions comprise \$325 million of industry levies³ and \$216 million of Australian Government funds per year. Over the past 17 years, for every \$1.00 that the Australian Government has contributed, industry has contributed \$1.50 on average. This substantial investment accounts for around 50 per cent of the R&D in the agricultural, fisheries and forestry industries undertaken in Australia.

The structure of the RDCs and the extensive collaboration between the organisations involved promotes effective research, development, innovation and extension of research findings in priority areas such as climate change and natural resource management. The ability to tackle projects jointly increases efficiency and can result in more effective communication and uptake of the outcomes of R&D.

Collaboration is critical to the success of the RDCs. Their role is to prioritise, coordinate, and integrate the demands of industry and government with the capabilities of research providers.

Part of the Government's rationale for the RDC model at the time it was set up (*Hansard: 4/10/1989*) was to provide the Australian Government's matching of up to 0.5 per cent of gross value of produce (GVP) as incentive or 'seed money' **to encourage industries to invest more in R&D**. The RDC model, based on industry and government collaboration, is an effective working alliance between government, industry and research partners. It is a unique example of government–industry partnership benefitting both the industry and the wider community. The Australian RDC model is envied by our competitors in North America. Given the enormous and multidimensional current and future challenges in rural industries, this model forms an important part of the innovation process in Australian agriculture, fisheries and forestry industries.

Purpose of evaluation

The RDCs communicate the value and returns of this investment to their industry and government stakeholders both individually and as a group through the CRRDCC.

In 2007 the CRRDCC initiated an ongoing aggregate evaluation reporting program to determine the impact and effectiveness of this major investment in innovation by the RDCs. The purpose of this aggregate reporting is to provide the government and industry with a robust demonstration of the value that the RDCs deliver to their industries and to the broader community through the investment of industry and public funds. This is the largest evaluation of rural R&D undertaken so far in Australia.

Well-established methods exist for measuring economic benefits, and more recently evaluation has expanded to include social and environmental benefits through the use of 'triple bottom line' (TBL) reporting. Triple bottom line reporting captures a range of social and environmental impacts that include significant public good components whose benefits accrue to the wider community.⁴

The TBL approach brings challenges to measuring broader public benefits. In most cases social and environmental goods are unpriced – that is, they have no monetary equivalent – and it is difficult to assign a value to them. Methods for measuring environmental and social impacts are not yet established, yet these indicators are of increasing importance for government policy.

The CRRDCC will take the outputs from this inaugural stage of the evaluation process to continue to build a framework for evaluation and reporting that is at the forefront of this field in Australia.

³ Most of these levies are compulsory, although some are voluntary. The majority of these contributions are based on the value of production.

⁴ For a definition of 'public good' and 'public benefit' see Appendix 1.

This will be the largest and most comprehensive evaluation program undertaken in Australian rural R&D. It will provide the member corporations and government with robust and objective information on the overall economic, social and environmental returns produced by the RDC portfolio. The lessons learned, particularly in the areas of public benefit measurement and reporting across economic, environmental and social benefits, also have implications and uses beyond the RDC arena as many industries seek better ways to report holistically on investment value.

This current report captures the results of the first year of the ongoing evaluation program. It demonstrates a high return on investment to the agriculture sector and to the wider community. The report is mindful of the current interest in public support of rural R&D. Future decision making regarding the funding of rural R&D will rely on an understanding of the full range of benefits delivered through rural R&D. The outcomes of this first comprehensive review of RDCs investment will be an important step in helping to inform such deliberations.

Public benefits

Of the wide range of environmental and social benefits identified in the evaluation process, many accrue to the wider public, and in the absence of the RDCs investments would not be produced. 'Public benefits' are those benefits that accrue to a wide cross section of the community, and that many members of the community would value highly and wish to ensure that they continued to be produced.

This evaluation process has identified many of these public benefits and quantified them where possible. Where it has not been possible to quantify the benefits, the evaluation process uses a robust 'weight of evidence' case – involving the accumulation of *prima facie* evidence of improvements in environmental and social values for Australian society stemming from the RDC investments.

Methodology

The evaluation process included three elements.

1. Examination of the return of 36 specifically-selected **highly successful** projects. These **highly successful** projects can be defined as having reached a stage where significant evidence of delivery was available.
2. Examination of the returns of 32 **randomly selected** projects from a pool of 600. These projects were chosen at random from the entire range of projects in order to provide an indication of the average return to Australia from the RDC investment. Note that at this stage the results are considered indicative only, as it will take several years of such sampling to reach a level that would be considered statistically significant.
3. Examination and evaluation of a sample of current RDC programs that involve **collaboration** and have a high level of public interest. Biosecurity was the first area to be selected for review and several biosecurity projects were evaluated.

Project evaluations were undertaken by seven independent economic consultants commissioned by individual RDCs. This has ensured that the evaluations are robust and independent. The process was coordinated and the results have been compiled by the CRRDCC.

The consultants engaged to undertake the evaluations were required to use cost-benefit analysis methods to derive estimates of the value of investments made by RDCs in specific projects.

Evaluation guidelines were prepared by the CRRDCC. These guidelines were reviewed by the economic agencies of the Australian Government including the:

- Treasury
- Department of Finance and Deregulation
- Department of Agriculture Fisheries and Forestry

- Productivity Commission
- Australian Bureau of Agricultural and Resource Economics.

All of these agencies have supported the approach and methodology used, and have provided comments. A summary of the terminology and methodology is presented in Appendices 1 and 2. The full methodology can be found at www.ruralrdc.com.au.

The counterfactual

A component of the evaluation was the derivation of the counterfactual – that is, what would have otherwise happened in the absence of funding support by the RDC for a specific investment.

By considering what might otherwise have eventuated, the estimated returns provide an indication of the incremental value to Australia of the RDC investment. However, in addition to the counterfactual for individual projects, the RDCs are also investigating the counterfactual of the RDC model as a whole – that is, the amount of net benefits that would have been produced had the RDC model not been established.

The proposition is that a reduction in the pool of knowledge available to farmers – of which the RDC portfolio is a major component – reduces the rate of agricultural productivity growth over time. This proposition, to be further tested by the RDCs as part of this evaluation process, is supported by the research findings of John Mullen,⁵ president of the Australian Agricultural and Resource Economic Society (AARES).

For each evaluation, consultants considered all benefits to Australia, in terms of economic, environmental and social impacts. Where possible such impacts were quantified. Impacts that could not be quantified were identified and evaluated from a qualitative perspective. In future evaluations, consideration will be given to developing methods to either quantify such impacts in monetary terms or to use other metrics to express their significance.

This report does not provide details of each evaluation undertaken. Individual evaluations can be found at www.ruralrdc.com.au.

The purpose here is to provide a summary of evaluation results and to discuss the range of public benefits and triple bottom line (TBL) impacts that can be generated from investments made by Australian RDCs.

Results

This section contains the results of the three evaluation approaches:

1. **Highly successful projects** – which showcase a selection of successful RDC projects and demonstrate a positive return on RDC investment
2. **Randomly selected sample projects** – which give an indication of the average return on RDC investment
3. The value of RDC R&D **collaboration** in addressing key government priorities, specifically biosecurity.

The results demonstrate the important and significant economic, social and environmental benefits delivered by the RDCs. The quantified benefits alone show a return well in excess of the total level of investment by the RDCs.

⁵ Mullen, J, (2007) *Productivity growth and the returns from public investment in R&D in Australian agriculture*. Presidential address to the 51st Annual Conference of AARES, 13–16 February 2007, Queenstown, New Zealand.

Significant non-quantified benefits have been reported, particularly in the social and environmental impact areas that address the Australian government’s rural research and development priorities. Understanding these impacts is of increasing importance to government and RDC levy payers.⁶

Highly successful projects

The 36 **highly successful** projects will generate the \$10.5 billion return from a \$265 million investment by the RDCs and a \$200 million contribution from other funding partners. RDCs initiated and managed all 36 projects.

The returns attributable to the RDCs’ \$265 million investment – \$5.9 billion – will more than pay for the entire \$4.5 billion invested by RDCs across 600 projects over the past 10 years.

Of the \$10.5 billion in quantified benefits, \$5.5 billion will be private benefits (that is, benefits accruing to rural industries). The remaining \$5.0 billion will be benefits captured by consumers, other participants in the supply chain and the wider public.

The purpose of examining the cost-benefit analyses from 36 **highly successful** projects was to establish that RDC investment was delivering positive returns.

In several cases environmental benefits have been captured and quantified as economic benefits because they have identifiable market values. Water and waste management, for example, represent input costs for agricultural producers.

Further, the environmental and social impacts are underestimated because there are significant challenges in quantifying the environmental and social benefits and outcomes of the R&D driven by the RDCs. These challenges include that:

- the tools, frameworks and standards are not fully developed – there need to be accepted standards for quantifying and reporting
- in some cases the market values available from robust analysis are clearly lower than the commonly held societal value.

The RDCs are leading the way on this front and will work together with government and research partners to address these challenges as part of this ongoing evaluation program.

The following sections provide a discussion of the economic, environmental and social benefits identified (see Table A3:3 and Table A3:4 in Appendix 3).

Economic benefits

Economic benefits accrue to agricultural and other enterprises in Australia. These benefits include:

- reduced production costs
- improved supply chain and markets
- increased royalties
- increased demand for primary products
- increased yield
- improved efficiency
- increased industry value add.

⁶ RDC levy payers are producers from whom a compulsory levy is collected to fund the activities of the RDC. For most RDCs, the amount of the compulsory levy is voted on regularly by the growers.

Non-measured economic benefits include:

- labour savings
- increased investment
- capital savings
- market development.

Analysis of the results reveals a wide range of economic benefits. Around \$946 million were attributable to reducing costs from 10 projects and \$189 million from increasing yield from two projects. In general terms three projects delivered in total \$285 million from increasing prices for primary products and two projects delivered \$1.5 billion in total from increasing value add to primary commodities.

Specific examples of the types of economic benefits resulting from RDC investments are:

- The Australian Cereal Rust Control Program (ACRCP), which aimed to reduce the frequency and severity of cereal rust outbreaks in grains, delivered benefits of \$2144 million in total, while the GRDC component of the benefits was estimated to be \$632 million.
- The Eating Quality for Beef and Sheep Meat program, which is aimed at improving the eating quality of red-meat, will deliver substantial economic benefits, including:
 - \$1.1 billion in additional industry value
 - \$3.5 billion in additional consumer welfare.⁷
- The MLA Market Access Program was targeted at reducing and eliminating trade barriers and has improved access to markets that will deliver \$415 million in additional industry value.
- Dairy Australia's Countdown Down Under program has delivered a significant reduction in the incidence of mastitis across the dairy herd. The total productivity gains and control cost savings from this program were evaluated at \$225 million.

The projects also identified a range of non-quantified economic benefits including reduced costs, labour savings, capital savings, improved markets and market development, increased yields and improved productivity.

Environmental benefits

Not all **highly successful projects** had quantified environmental benefits. Those which could be quantified demonstrated substantial returns. Three of the 36 projects produced \$179 million in quantified benefits to water quality and biodiversity. The areas where benefits were identified include:

- increased water use efficiency – 16 per cent of projects
- improved water quality and biodiversity outcomes – 16 per cent of projects
- reduced chemical usage – 6 per cent of projects
- reduced waste – 3 per cent of projects
- reduced emissions of greenhouse gases or carbon sequestration – 5.5 per cent of projects
- improved land use and soils management – 16 per cent of projects
- reduced salinity – 6 per cent of projects.

⁷ These benefits are not included in the \$10.5b of total benefits.

Social benefits

Social benefits that were quantified in 23 projects included:

- improved food safety and security – 8 per cent of projects
- increased profits for suppliers – 28 per cent of projects
- increased consumer welfare – 25 per cent of projects
- strengthening rural communities – 6 per cent of projects
- improved human health – 3 per cent of projects.

Additional social benefits that were *not* quantified included:

- improved human health – 14 per cent of projects
- improved occupational health and safety – 14 per cent of projects
- enhanced R&D research capability – 8 per cent of projects
- increased consumer welfare – 3 per cent of projects
- improved training – 8 per cent of projects
- animal welfare – 3 per cent of projects.

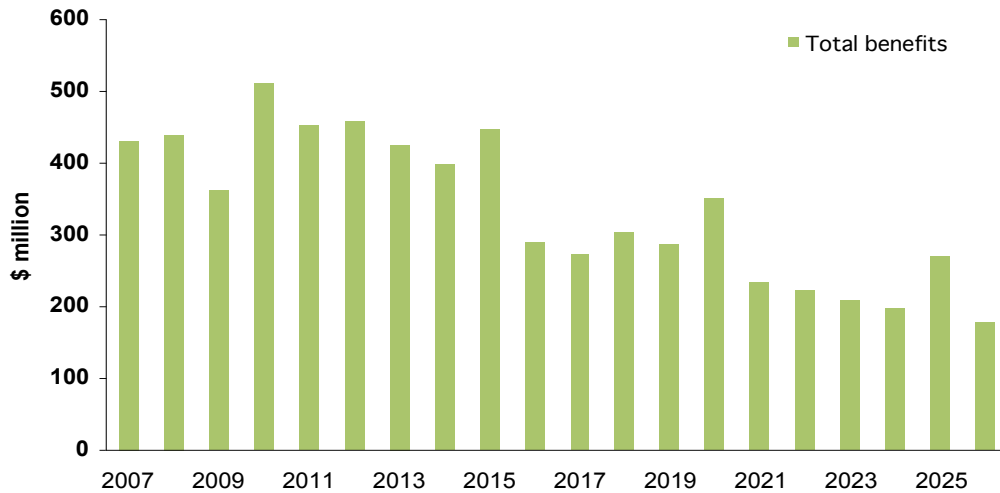
Examples of the types of social benefits resulting from RDC investments follow.

- ACRCP has enhanced food security through its involvement in an international collaboration for the screening of varieties for the UG99 wheat stem rust strain. This fungal disease of wheat has been identified as a potentially significant threat to food supplies.
- The MLA Food Safety: Predictive Microbiology Project. MLA, in collaboration with regulatory authorities at both federal and state levels, has achieved the inclusion of R&D outcomes into new regulations which will yield additional social benefits, including reduced illness and death resulting from listeriosis plus spillover benefit to the pork industry. This benefit to society and related industry totals \$503 million, including an estimate of consumer welfare benefit.
- Dairy Australia's Dairy Food of Life program has led to an increase in the consumption of dairy products in Australia, delivering improved health outcomes as well as quantified consumer welfare benefits of \$209 million.

Time profile for delivering benefits

The time profile of delivery of the estimated private and public benefits from the **successful projects** is shown in Figure 1. Note that the present value of benefits accruing in each year increases to a maximum over the period up to 2010. After this the value of benefits are relatively level until around 2015 when they decline slowly. This suggests that the significant component of the present value of benefits is realised in the first 15 years following the last year of funding of the project.

Figure 1 Total quantified benefits from *highly successful projects*



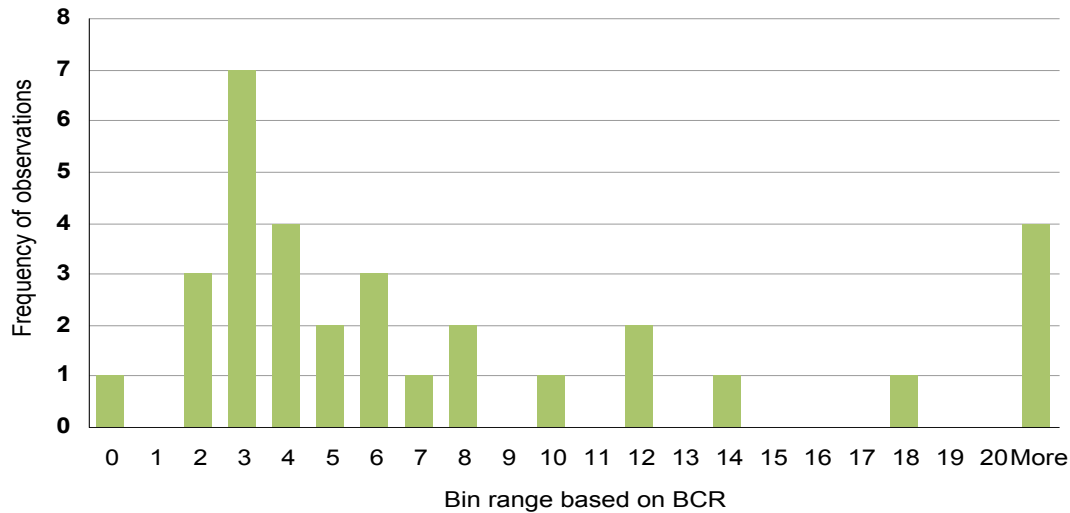
Randomly selected projects

The random sample of 32 RDC projects shows a snapshot of the range and breadth of projects undertaken by RDCs, and provides an indication of the average quantifiable returns. It should be emphasised that this group is a relatively small sample out of some 600 programs.

The sampling process will be repeated on a yearly basis, building up from an indicative to a statistically significant sample over time. By year three it is expected that over 10 per cent of projects will have been included in the random pool.

The distribution of the benefit to cost ratios for the **randomly selected projects** is shown in Figure 2. The distribution from this first round of results of **randomly selected projects** shows that all of the projects delivered a benefit to cost ratio greater than one – in other words, all delivered benefits greater than the costs involved.

Figure 2 **Distribution of randomly selected projects**



Note: 'Bin range based on BCR' (x axis) refers to the range of benefit to cost ratios divided into BCRs bins or ranges e.g. how many BCRs have been reported between 1–2, 2–3, 3–4, etc.
Source: CRRDCC analysis

The first round of results from these projects shows that these project clusters will produce a simple average benefit to cost ratio of \$11 of benefits after 25 years for every \$1 invested.

Table A3:5 and Table A3:6 in Appendix 3 show the breadth of both quantified benefits and those benefits that were identified but not quantified for the 32 **randomly selected projects**.

Economic benefits

Looking across the 32 projects, the quantified benefits reported range from increasing productivity and yields, reducing costs, increasing market demand and exports to increasing industry profits. Non-quantified benefits included labour and capital savings.

Increasing productivity and yields delivered benefits in excess of \$380 million in present value terms. Achieving higher prices for commodities, market development and generating higher profits for producers generated an additional \$90 million.

Environmental benefits

Environmental benefits included increasing water use efficiency, improving biodiversity outcomes, reducing greenhouse gas emissions, reducing chemical use and waste, improving land use and reducing erosion. Benefits in water quality and biodiversity and reduced greenhouse gas emissions were estimated to deliver \$1.7 million.

Social benefits

Social benefits included improving human health, increasing consumer welfare, improving animal health, improving occupational health and safety for employees, increasing building research and development capacity, strengthening rural communities and education, and training.

Quantified improvements in human health, and increases in consumer welfare and animal health were valued at around \$14 million. In addition, increased profits for related and supporting industries were estimated at \$29 million. Projects enhancing consumer 'happiness' produced benefits of \$115 million.

Value of RDC R&D collaboration as demonstrated by biosecurity and food safety

An important area of investment by the RDCs has been in improving the prevention, preparedness and responses to biosecurity and food safety threats in Australia. The RDCs have directly invested around \$35 million per year on biosecurity projects in collaboration with a number of organisations including the CRCs for Australian Biosecurity and National Plant Biosecurity, CSIRO, the Australian Animal Health Laboratory, Animal Health Australia and Plant Health Australia. This current report has evaluated a series of investments by the RDCs in biosecurity research. These investments are in:

- tests for detection of poultry disease and the transfer of avian influenza tests to laboratories in Australia
- the development of predictive microbiology in red meat
- research on procedures for Ovine Johnes disease (OJD), which is a wasting disease of sheep.

The returns attributable to the RDC investment and the nature of the benefits are summarised in Table 2. This table shows total returns in excess of \$135.15 million against expenditure of about \$1 million by the RDCs. The bulk of these benefits arise from the impacts of the reduced cost (due to earlier diagnosis of the disease) of responding to avian influenza and horse flu virus. The equine influenza project illustrates the options value in research and development where research carried out to develop better tests for avian influenza was found to also benefit the management of horse flu. The RDCs contributed to the transfer of the testing methods to other laboratories, which has led to the extension of the testing to areas outside the immediate concern of avian influenza testing.

Table 2 Returns and benefits from selected biosecurity and food safety projects

Project	Period of investment	RDCs involved	RDC costs	Benefits attributable to RDCs	Nature of benefits
Avian influenza test development, transfer and spillover. The three stages were: 1. Rapid test for avian diseases 2. H5N1 testing using rapid test platform 3. Transfer of test to state laboratories	2002–03	RIRDC, AECL. RDCs involved in stage 1 and 3 of the programs.	\$289,235	\$126,309,296	Benefits realised through the ability to relax movement controls 2–3 months earlier than would have been the case without the assay. Includes avoidance of lost incomes and implementation and management of controls.
Predictive microbiology in red meat	2006–07	MLA	\$184,881	\$5,376,470*	Costs saved from lower incidence of listeriosis (a food borne bacteria)
Ovine Johnes disease procedures	1998–99 to 2003–04	MLA	\$536,815	\$3,465,947	Social benefits from lower incidence of depression in farming communities affected by the threat of OJD.

Note: All benefits are present values at 5 per cent discount rate real.

* This is included in the \$503 million reported benefit reported on pages 8 and 16.

Data source: ACIL Tasman and Agrans

In many important ways, research into biosecurity provides insurance against more catastrophic consequences of disease and pest incursion. In other words, this provides the rural industries with a range of options to manage the risks associated with biosecurity incursions in future. The evaluation has not attempted to value these options.

This group of projects is an example of collaborative investment by RDCs and others in biosecurity affecting animal industries. Each year, as part of the ongoing R&D evaluation process, further large-scale collaborative projects will be included in this group and will undergo further analysis.

Collaboration

Collaboration is a key strategy of the RDCs. Their role is to prioritise, coordinate, and integrate the demands of industry and government with the capabilities of research providers. Although the RDCs invest around \$500 million per year in agricultural innovation, research organisations and industry partners also make significant cash and in-kind contributions. This leverages the total investment and creates far greater benefits for Australia than would otherwise be the case.

Co-investment provides one example of how RDCs join with industry and other partners in R&D projects. This involves jointly funding a program or project, with the outcomes being shared between the participating stakeholders.

Many of the projects included in the selection of **random and successful projects** have been collaborative ventures. The RDCs have collaborated financially with a wide variety of industry, research, university and government stakeholders to conduct research. Table A3:1 in Appendix 3 shows funding partners for the 36 **highly successful projects** and Table A3:2 shows funding partners for the 32 **randomly selected projects**. The tables indicate that 32 of the sample of 36 **highly successful projects** (89 per cent) and 22 of the 32 **randomly selected projects** (69 per cent) involved collaborative funding respectively.

Collaboration is not only financial. Projects included in the **highly successful and randomly selected projects** identified other partners, including research partners and organisations, as providing in-kind support.

RDCs have a unique perspective that is provided by their close engagement with industry and their intimate knowledge of market conditions that is not easily and regularly assessable either by government or the research community.

Additionally many of the RDCs have ensured collaboration by involving industry (from all parts of the value chain) in boards, panels, reference groups, and specialised regional development groups. This has enhanced capability, engagement and diffusion of knowledge.

The measure of success in collaboration is not through the value or number of collaborative investments conducted, but rather whether increasing the level of collaboration increases the R&D investment's efficiency and effectiveness. While determining the extent to which co-investment increases the investment's efficiency and effectiveness was not included in this evaluation phase, it would be reasonable to assume that if the co-investment had not taken place, the effectiveness of the R&D would be lower due to reduced resources.

National Rural Research Priorities

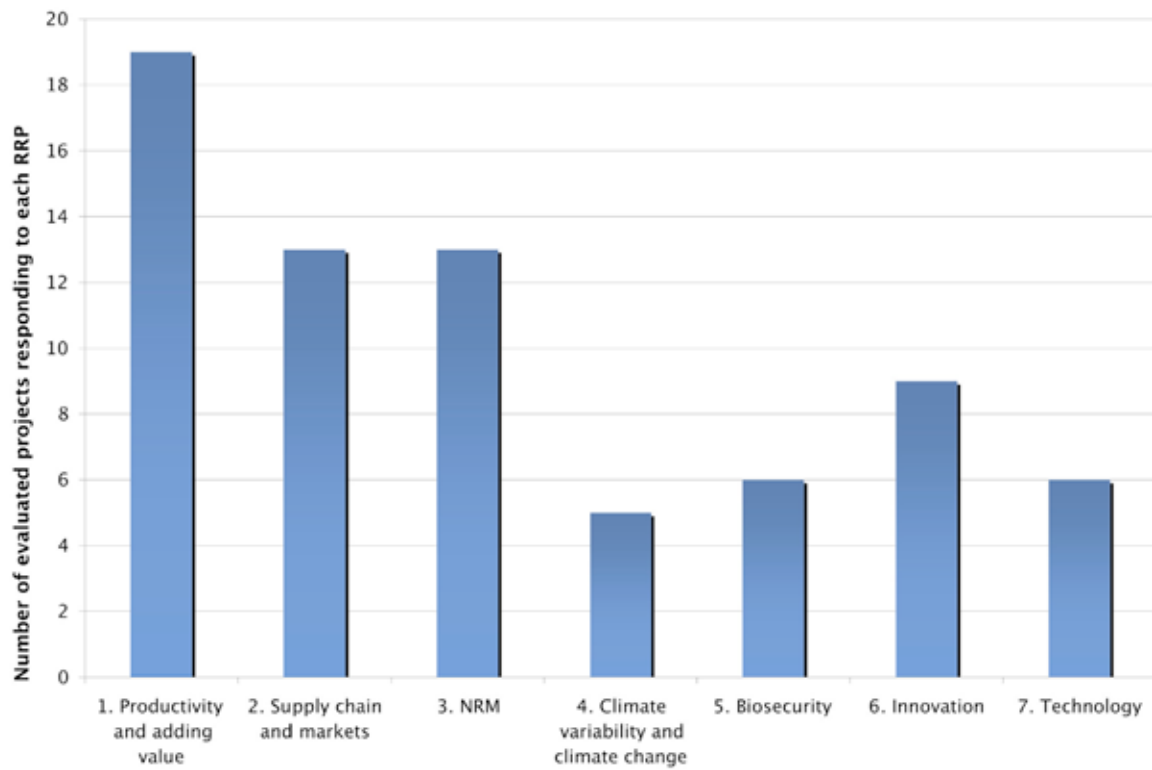
The Australian Government's National Rural Research Priorities (RRP) provides one of the frameworks that contribute to the R&D strategies of the RDCs.

Figure 3 suggests that the majority of the **successful projects** focused on RRP 1 — **Productivity and adding value**. RRP 3 — **Natural resource management** and RRP 2 — **Supply chain and markets** were equally cited.

It is not surprising that productivity increments have been the focus of the majority of these projects as this was the primary aim in most cases. Indeed, the majority of results indicate that the projects served to increase productivity by showing producers how to use the resources available to them more efficiently.

Natural resource management has also been identified as a key research priority addressed by the RDCs. This is important in light of growing awareness by the wider Australian community of environmental sustainability in recent years.

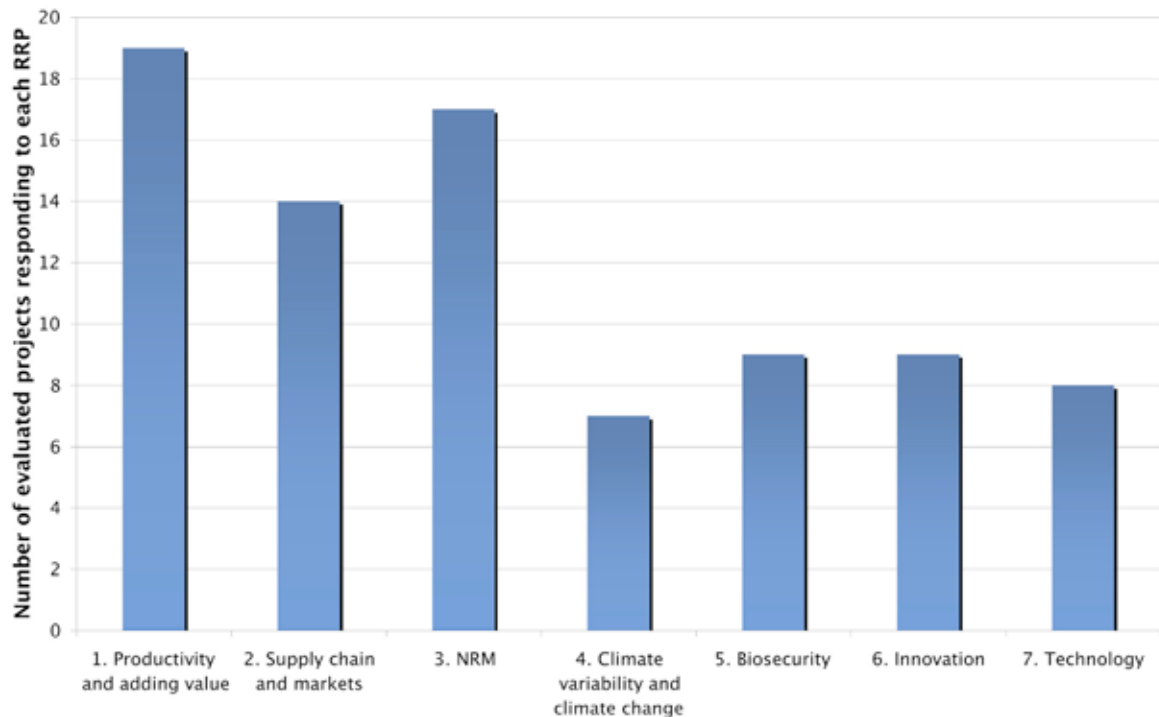
Figure 3 Concentration of RRP in *highly successful projects*



Data source: Rural RDCs various sources

The **randomly selected projects** follow a very similar pattern to the **highly successful** projects as indicated by Figure 4. The figure indicates that Rural Research Priorities 1, 3, and 2, respectively were most represented in the **random selection**.

Figure 4 **Concentration of RRP in randomly selected projects**



Data source: Rural RDCs various sources

Public benefits

All the projects evaluated reported a wide range of public benefits. Public benefits are those benefits that accrue to a wide cross section of the community that would not be produced if public contributions to the RDCs were reduced. That is, they are benefits that many members of the community would value highly and wish to ensure that they continued to be produced.

A major challenge for this process is to isolate the many and varied social and environmental benefits that are largely embedded across the RDC portfolio. While identification of the public (social and environmental) benefits presents some challenges, quantification is even more difficult as measurement of the outcomes is problematic. For example, many RDCs invest in improvements in water quality by reducing run-off from farms. While the reduced run-off per farm can be measured, measuring these improvements downstream is almost impossible as there are a number of other factors contributing to water quality well beyond the influence of the RDC investment. This does not mean that the farm-level effects are not real or have no value.

The public benefits are also generated in conjunction with improved industry performance. Using the example of improved water quality, these improvements have been made by improvements to enterprise efficiency such as an increased use of perennial pastures, or more efficient fertiliser use. Combining the investments in environmental outcomes with industry priorities ensures a much higher level of adoption than if they were undertaken in isolation. This is a fundamental strength of the RDC model. Good environmental outcomes are integral to good business for rural enterprises.

More specifically the most common environmental impacts were:

- reduced chemical usage and impact on the environment. The Timerite project submitted by AWI resulted in more effective control of the pasture and crop pest the red legged earth mite using less chemicals, and the adoption of GM cotton dramatically reducing pesticide use in cotton crops.
- reduced water and nutrient run-off and improvements in water quality. Many of the RDC projects submitted in this process – Land, Water and Wool (AWI), Rivers and Water Quality (LWA), and eco efficiency in milk production (DA) – developed ways to increase water-use efficiency such as through the increased use of perennial pastures.
- improved biodiversity. The benefits of improved biodiversity are included in many projects submitted for this process. Almost every RDC has invested with LWA on projects to manage the ecology of farms while maintaining or improving productivity.

A small sample of some of the projects that have identified public benefits are summarised below. They have been chosen as representing a particular aspect of the public benefits produced by the RDC portfolio on an ongoing basis.

FRDC Marine Protected Areas research

In 2006, a series of Marine Protected Areas (MPAs) were being considered by the Australian Government that would have excluded fishing from a number of ecologically important areas of the Southern Ocean. The FRDC, in collaboration with representatives from the fishing industry and management agencies from three states, commissioned a report on the impacts of the MPAs on the fishing industry and the communities dependent on them. The costs to the fishing industry and dependent regional communities was going to be substantial had they been implemented as the Government proposed.

This report led to a relocation of the MPAs resulting in a 30 per cent increase in the area and conservation values of the MPA and a significant reduction in impacts on fisheries in the proposed areas. The net social benefits are valued at \$10 million, based on avoided social-adjustment costs that the Government would have provided the fishing industry-dependent communities had the proposed MPAs been implemented.

Food safety: predictive microbiology

This MLA-funded research into predictive microbiology provides a scientific basis for assessing pathogen growth at each point in the processing chain and has been adopted by every sector of the meat-processing industry. On the whole, the report suggests that as a result of this practice the quality of red meat has improved four-fold since 1993.

The spill-over effect of this is related to increased health benefits for consumers. It is estimated that the food safety program is expected to generate \$503 million in social and related industry benefits over the next 30 years by reducing food-borne infectious diseases, such as listeriosis.

Moreover, the program has led to significant reductions in total viable count (TVC) and *E. coli*. TVC gives a quantitative idea about the presence of microorganisms in a sample. Estimates provided indicate that both TVC and *E. coli* in beef, for example, decreased by 35 per cent. The study also found a 50 per cent reduction in TVC and a 75 per cent reduction in *E.coli* for boneless beef and sheep meat from 1994–2004.

AWI Land, Water and Wool Project

Land, Water and Wool was a national research and development program providing woolgrowers with practical tools to help manage natural resources sustainably and profitably.

The \$40 million five-year program, a partnership between Australian Wool Innovation, Land & Water Australia and Meat and Livestock Australia, researched major issues facing the wool industry.

Land, Water and Wool conducted a best practice survey and found that Australian woolgrowers had adopted a range of natural resource practices including planting salt tolerant species on salt affected lands, replanting or retaining vegetation along waterways and limiting stock access, fencing of native bush and native grasses and adjusting farming practices to seasonal forecasts. Environmental service benefits included improved water quality in creeks and rivers, biodiversity conservation and reduced erosion.

A case study of a 2630 ha mixed enterprise property in Western Australia valued the public benefits of native vegetation planting and riparian zone protection at \$4.9 million.

The total benefits of the Land, Water and Wool program were estimated at \$120 million. Approximately \$48 million of these benefits are environmental and attributable to AWI's investment. These included rehabilitation of degraded land, water quality improvements, biodiversity enhancement, and increased greenhouse gas sequestration.

Valuing public benefits

This evaluation methodology has sought to quantify the public benefits identified in the evaluation to the extent that is practical and commensurate with the value of doing so.

The CRRDCC recognises that there are considerable constraints on the measurements, empirical valuation and attribution of the public benefits produced by the RDC investments. To this end the CRRDCC evaluation methodology instructs those conducting the evaluations to quantify public benefits where a robust and credible case can be established. Where this was not possible, reasons were provided together with a description of the benefits.

The results of the first year of evaluation have identified a broad range of both quantified and unquantified social and environmental benefits that fall more broadly into the category of 'public benefits spillover' to the community. This establishes a robust 'weight of evidence' case – involving the accumulation of *prima facie* evidence of improvements in environmental and social values for Australian society stemming from the RDC investments.

Care is needed to ensure that this limited tangibility does not become a reason to ignore these potentially high-value outcomes from RDC investments. To do so is likely to undervalue the work of the RDCs and to risk moving forward with an incomplete picture of where the public value lies – and this would risk biasing subsequent activities in favour of the tangible outcomes. This would be at the expense of potentially high value if less-tangible outcomes.

If public contributions were solely based on the quantified public benefits, the RDCs would be subject to a perverse incentive to invest only in those areas where public benefits could be reasonably quantified, thus diverting resources from the projects that have a wide range of social and environmental values.

It is also important to be realistic about the level of precision and comprehensiveness, at reasonable cost, that can and should be achieved in relation to some of these less tangible impacts. Quantification can only be undertaken to the point that it remains cost-effective to push this work – before information limitations and the effects of legitimate variation in the way that different stakeholders would value different outcomes prevent useful further progress.

Information limitations, such as measuring biodiversity, water quality and reduced salinity, have been identified as a major constraint on the valuation of public benefits. In response to this the RDCs are investing in developing robust metrics for presenting significant social and environmental outcomes.

Consumer and industry (non-producer) benefits of the selected *highly successful projects*

Consumer benefits are generally measured in terms of positive changes in consumer surplus. Consumer surplus is the difference between the price consumers are willing to pay (or reservation price) and the actual price. If someone is willing to pay more than the actual price, their benefit in a transaction is how much they saved.

Where quantified changes in consumer surplus can be proved, these can be considered as part of the benefits delivered. Changes in consumer surplus can be difficult to measure. In the case where a change in supply does not lead to a change in price (as is the case of many exported agricultural products) there is no change in consumer surplus. Factoring in changes in consumer surplus therefore needs to be treated with care in a benefit to cost analysis.

Changes in consumer surplus that were identified are wide and could include any innovation produced by the RDCs that resulted in an improvement in quality in the final product such: as meat-eating quality (MLA); lighter weight, easier-care wool garments (AWI); and awareness of the range and versatility of dairy products (DA). All of the efficiency gains derived from the innovations produced by the RDCs are passed on to Australian consumers in the form of either lower prices and/or higher-value products.

Lessons from year one of the evaluation program

This report describes the initial outcomes of the first round of the combined RDC evaluation program. This is an ongoing program that will evolve over time, providing continually higher quality information and insights both for the RDCs and other parties taking similar routes.

The major lesson learned is that there are significant environmental and social benefits that are undervalued because of challenges faced in their measurement and monetisation. These are especially relevant when estimating the benefits associated with the delivery of public goods arising from the investment.

There may ultimately be a role for government in assisting this shortcoming through developing credible and agreed values. This can be achieved either through creating markets, ascribing values (carbon being a notable example) or other mechanisms.

The ability to quantify a number of areas of benefits, especially in social and environmental categories, is limited by the lack of a market where the benefits can be valued. Such benefits are therefore potentially undervalued in the quantification.

In many areas of benefits, the tools and frameworks are not available to enable consistent and credible representation of value in a quantified sense. For example, MLA and DA had projects delivering significant health benefits to the wider community, including reduced hypertension and obesity. However, a dollar value of 'no value' was ascribed to these benefits. This is an area that will need to be addressed in future work – but in many cases will require a sustained program of research in its own right to develop standards and credible endorsement.

Assessment of work in progress

This current evaluation was based on projects that had been completed or had reached a major milestone. This *ex poste* approach ignores the substantial value in research and development projects that are under way but have not reached a major milestone. The examination of the biosecurity projects demonstrated that considerable value is embedded in 'work-in-progress'. Future evaluation may explore this further.

Responding to changing priorities

The Rural Research Priorities provide the RDCs with a strategic framework to address issues of priority to governments. However, the rapid changes in global markets, the need for continued productivity improvement in the agriculture, fisheries and forestry industries and the challenges of climate change and the management of water mean relative priorities are changing rapidly.

Maintenance of research capacity and the ability of the research community and industry to absorb and adopt innovation will also be critical issues in the future.

The RDCs in collaboration with the Primary Industries Standing Committee have taken a leadership role in developing national Research and Development Strategic Plans. These are to be considered at the meeting of the Primary Industries Ministerial Council in November 2008.

These new initiatives were not in place when the first round of evaluations was started. Future evaluation will need to consider the impact of these strategies and their subsequent investments in terms of the effectiveness of meeting these national priorities.

Path forward

This report describes the results of the first round of what will be an ongoing annual program of evaluation. Representatives of the RDCs will meet in February 2009 to further review the results and decide the next steps.

Furthermore, the RDCs are looking to develop frameworks for measuring social and environmental benefits. This work will focus on areas where the current gaps in ability to measure results and ideally quantify in dollar terms are most significant.

Appendix 1 – Glossary of terms

Benefit to cost ratio (BCR) – the ratio of the quantified benefits to the cost of investing in the R&D project.

Collaboration – where two or more RDCs (or external agencies) agree to work together through enhanced communication, coordination or coinvestment to leverage their respective investments.

Counterfactual – what would have otherwise happened in the absence of funding support by the RDC for a specific investment; the baseline scenario.

Discount rate – a discount rate serves the purpose of discounting from the original investment the benefits otherwise obtained if the investment had been placed in the financial system at a market interest rate (5 per cent was used in this report). It can also be interpreted as a foregone income for having undertaken the investment in the RDC project. The discount rate, jointly with inflation rate, is used to determine the real value of investment (cost/benefits) at some point in time, usually present terms.

Economic (or industry) benefits – benefits such as improved productivity, market share or market access.

Environmental benefits – benefits which directly affect the environment, such as water or air quality, salinity, endangered species and biodiversity. These benefits generally represent a ‘public good’ or ‘spillover’ benefit, although some benefits are accrued to levy payers.

Ex-ante – evaluation carried out before an investment has been made.

Ex-post – evaluation occurring after the R&D has been completed.

Highly successful project – a project selected because it demonstrates a positive return to the RDC.

GVP – gross value of produce. This is the farmgate value of commodities produced.

Internal rate of return (IRR) – the discount rate that makes the *net present value* equal zero. Can also be the rate of growth the project is expected to generate.

National Research Priorities (NRPs) – an Australian Government initiative to help focus R&D efforts on issues of national importance. Rural Research Priorities are aligned with National Research Priorities.

Net present value (NPV) – after the stream of nominal benefits of an investment project has been determined, for instance \$100 per year for the next five years, the NPV comprises in one single value, usually the current year, such stream of future benefits. Its calculation implies the use of inflation rate and a discount rate in order to account for the loss of value from future inflation and the opportunity cost of an alternative investment, respectively.

Non-quantified benefits – benefits stemming from an R&D project that cannot be valued in dollar terms.

Primary Industries and Energy Research and Development Act (1989) – enabling legislation for the statutory RDCs.

Public benefit – benefits stemming from the investment that are enjoyed by society as a whole.

Public good – a good that is ‘non-rivalrous’ (that is, where consumption by one party does not prevent another party from also consuming that good) and ‘non-excludable’ (that is, where, once a good is produced, one party cannot stop another from enjoying its benefits).

Quantified benefits – benefits stemming from an R&D project that can be valued in dollar terms.

Randomly selected project – a project selected from a defined set of projects that will contribute to a pool to demonstrate the distribution of returns to the total RDC investment portfolio.

Rural Research and Development Corporations (RDCs) – a unique co-funding partnership between the Australian Government and the agriculture, forestry and fisheries industries which commission and manage targeted research and foster uptake and adoption based on the identified needs and priorities of both industry and the Australian Government.

Rural Research Priorities (RRPs) – an Australian Government initiative to balance new and ongoing R&D investment needs for the primary industries sector, and to ensure that the R&D objectives of the Australian Government are met. RDCs align their R&D investments with the RRP: productivity and value adding; supply chain markets: natural resource management, climate variability and climate change; biosecurity; and supporting priorities.

Social benefits – benefits stemming from a project that directly affects the wider Australian public, such as public health, occupational health and safety, resilient regional communities and animal welfare.

Spillovers – costs and benefits borne by those not party to the transaction are called ‘spillovers’ or ‘externalities’, as they are external to the activity.

Total viable count (TVC) – TVC gives a quantitative idea about the presence of microorganisms in a sample.

Triple bottom line (TBL) – a measurement of the economic, environmental and social performance of a project.

Appendix 2 – Methodology

Methodology

An evaluation framework was prepared to help develop the cost-benefit analyses (CBAs). The framework's key points are outlined below.

Project selection

The methodology required evaluation of 36 **highly successful projects** and 32 **randomly selected projects**. An analysis of the **highly successful projects** would provide at least a minimum positive return on investment on the total portfolio of projects. An analysis of a collection of **random projects** (to be undertaken over time) would be used to calculate an average return and establish a distribution of returns to the total portfolio.

Project outputs

The CBA must report on the net present values (NPV), the internal rate of return (IRR) of the investment, the benefit to cost ratios (BCRs) of the investment. The values were reported in real terms (2006–07 dollars) to ensure consistency.

Values were determined based on a 5 per cent real discount rate. This rate was selected as it is a fairly neutral opportunity cost of the funds. To overcome likely changes in this discount rate, CBAs were invited to undertake a sensitivity analysis of this and other key variables and parameters.

The NPVs, IRR and BCRs were to be reported along a project horizon of 0, 5, 10 and 20 years in the first instance, with additional time points added as necessary. It was decided to incorporate a series of time horizons as part of the generally conservative nature of the evaluation process. It also needed to be recognised that while benefits from research grow over time, they also diminish further into the time horizon. Possible obsolescence of technology is one example of why a range of time horizons was incorporated into the framework. However, it was also recognised that for some fields of research, in particular natural resource management and forestry, it may take considerably longer for the benefits to be generated. Consequently, a longer time horizon may be necessary.

CBAs had to report benefits accruing to industry (that is, the industry sector contributing the levy funds), the environment and society.

CBAs were required to report outputs against the RDC investment and the total investment (that is, including the contribution of other funding partners). This would allow the benefits directly attributed to the RDC investment to be drawn out from the benefits accruing to the total investment.

Examination of the counterfactual scenario was used to consider the situation with and without the project. Benefits to the project could therefore be the net of the benefits with and without the project.

Appendix 3 – Tables

Table A3:1 shows funding partners for a selection of *highly successful projects*. For the first year, RDCs were asked to select a minimum of two highly selected projects. In subsequent evaluation years, it is expected that further projects will be added.

Table A3:1 *Highly successful project funding partners*

Leading RDC	Project name	Other funding partners
AECL	<i>Salmonella</i>	RIRDC (pre AECL establishment), Department of Natural Resources & Environment Victoria and the CRC for International Food Manufacturing and Packaging Science
AECL	Cannibalism	University of New England
APL	Quantitative genetics	Pig breeders, University of New England
APL	Carcase grading	Industry consortium, AusIndustry
AWI	Timerite	CSIRO, Bayer Australia, farmers
AWI	Land, Water Wool	MLA
CRDC	Resistance management for transgenic cotton	CSIRO, NSW Department of Primary Industries
CRDC	Irrimate suite of tools and techniques for management of water resources on-farm	National Centre for Engineering in Agriculture, Aquatech Consulting
DA	Australian dairy herd improvement scheme	Australian Dairy Herd Improvement Scheme
DA	Countdown downunder	Countdown Downunder
DA	Dairy moving forward	Industry partners
DA	Dairying for tomorrow	Department of Agriculture, Fisheries and Forestry, NRM agencies, state governments, dairy farmers
DA	Eco-efficiency	University of Queensland, milk processors
DA	Lactose utilisation	Food Science Australia, University of Western Sydney
FRDC	Marine protected areas	Tasmanian Department of Primary Industries and Water
FWPA	Pine breeding	CSIRO, Southern Tree Breeding Association, universities, state governments
GRDC	Cereal rust control	University of Sydney, NSW Department of Primary Industries

GRDC	Precision agriculture methods	CSIRO, CTF Solutions, NSW Department of Primary Industries, Queensland Department of Primary Industries and Fisheries, SARDI, Victorian Department of Primary Industries, Department of Agriculture and Food, University of Sydney, Silverfox Solutions, Southern Precision Agriculture Association
GWRDC	New processing technologies for protein haze removal	Hardy Wine Company, Australian Wine Research Institute, University of Adelaide
HAL	Biology, ecology and control of citrus jassid	Gayndah and District Fruit Growers Association, Growcom, Mundubberah Fruit Growers Association
HAL	Control of bacterial blight in walnuts	Webster Fresh Pty Ltd
HAL	Insect pest management in sweet corn	Vegetable Industry Levies (Ausveg – Vegetable Industry Body/Assoc.)
LWA	National dryland salinity program	GRDC, the National Land and Water Resources Audit, the Murray-Darling Commission, MLA, the Department of Agriculture, Fisheries and Forestry, the RIRDC, CSIRO and the state governments of Western Australia, South Australia, Victoria, Tasmania, New South Wales and Queensland
LWA	Riparian lands	SRDC, DA, CRDC
MLA	Eating quality	Beef CRC, WA Agriculture, Meat & Wool New Zealand, Real Cold Milmech
MLA	Market access	Department of Foreign Affairs and Trade, Department of Agriculture, Fisheries and Forestry, Australian Quarantine and Inspection Services
MLA	Food safety	Australian Quarantine and Inspection Services, Australian Food Safety Centre of Excellence
RIRDC	Olives	HAL, Charles Sturt University, NSW Department of Primary Industries, University of Adelaide, Kangaringa P/L, Olive South Australia
RIRDC	New oat varieties	SARDI
RIRDC	Electromagnetic induction	NSW Department of Primary Industries
SRDC	Yield decline joint venture	BSES Ltd, CSIRO Land and Water, Queensland Department of Primary Industries and Fisheries, Queensland Department of Natural Resources and Water
SRDC	Travel and learning opportunity projects	A large number of sugar industry stakeholders including research organisations, agribusiness, individual growers and milling companies

* Four projects (AECL: sensory, AECL: ullage audit, DA: novel products to Japan and DA: dairy food of life) did not have external funding partners.

Data source: RDCs

Table A3:2 shows funding partners for a selection of *randomly selected projects*.

Table A3:2 *Randomly selected project funding partners*

Leading RDC	Project name	Other funding partners
APL	Land application of effluent	Queensland Department of Primary Industries and Fisheries
APL	Herd Feed Conversion Efficiency	Queensland Department of Primary Industries and Fisheries
AWI	On line communications	Sheep CRC
AWI	Education and training	Australian Wool Textile Training Centre (funded by AWI), Aust Wool Education Trust, International Fibre Centre (CSIRO)
CRDC	Soils research	CSIRO, NSW Department of Primary Industries
CRDC	Fibre classification	CSIRO
CRDC	Windcott	Monsanto, ANZ, Bayer Crop Science, Telstra, Drummuster, Grant Thornton Sydney
DA	Landscapes ⁸	Dairy farmers, Department of Agriculture, Fisheries and Forestry, NRM agencies, industry advisors, milk processors, state governments
DA	Catchments	Queensland Department of Primary Industries and Fisheries, Deakin University
DA	Regional development projects	Public and private organisations
DA	Health and nutrition	Public research organisations
GRDC	Climate cluster	CSIRO, SARDI, LWA, Department of Agriculture and Food, NSW Department of Primary Industries, Victorian Department of Natural Resources, Consult Ag
GRDC	Functional genomics program	Melbourne University, Adelaide University
GRDC	Breeding of other cereal crops	NSW Department of Primary Industries, Australian Grain Technologies, University of Sydney, Value Added CRC for Wheat, Pork CRC, WA Department of Agriculture and Food, SARDI, UTC, Westons Tech
GWRDC	Improving vineyard productivity through assessment of bud fruitfulness and bud necrosis	SARDI

⁸ This project largely involved investment in the *Dairying for tomorrow* (DFT) project, which is included in the highly successful project group. DFT partners are included in this table.

GWRDC	The use of molybdenum foliar sprays to improve fruit set and bunch yield of Merlot vines in the Adelaide Hills in 2002/2003; and molybdenum foliar sprays and other nutrient strategies to improve fruit set and reduce berry asynchrony ('hen and chickens') in Australia	SARDI
GWRDC	Strategic management of flowering sprays	SARDI
LWA	Contaminants program	Murray Darling Basin Commission
LWA	AusRivAS	Environment Australia; and State/Territory Agencies
MLA	Environment cluster ⁹	Murray Darling Basin Commission, NSW Agriculture, Victorian Department of Natural Resources, Department of Agriculture and Food, NSW Department of Land and Water Conservation, the International Wool Secretariat, University of Melbourne, University of New England, AWI, GRDC, LWA, Queensland Department of Primary Industries and Fisheries, CSIRO Division of Entomology, NSW Department of Agriculture, Victorian Department of Primary Industries, SARDI, Western Australian Department of Agriculture
MLA	Lamb and sheep meat cluster ¹⁰	Animal Health Australia, AWI
MLA	Feedlots cluster ¹¹	Beef CRC
SRDC	Farm management systems for sugar cane	Queensland Canegrowers, BSES Ltd, Isis Central Mill, CSIRO Sustainable Ecosystems, Agrecon, CSR Sugar
SRDC	Non-conventional genetic modification of sugarcane plants for new and improved characteristics	BSES Ltd, Texas A&M University, CRC Sugar Industry Innovation through Biotechnology, University of Queensland

Data source: RDCs

⁹ Environment cluster includes five project groups.

¹⁰ Lamb and sheep meat cluster includes four project groups.

¹¹ Feedlots cluster includes two project groups.

Table A3:3 shows the spread of quantified economic, environmental and social benefits from *highly successful projects*.

Table A3:3 **Measured benefits from *highly successful projects***

Measured benefits					
Economic		Environmental		Social	
Reduced costs		Water quality and biodiversity		Food safety and security	
<i>10 projects</i>	<i>\$946m</i>	<i>3 projects</i>	<i>\$179m</i>	<i>1 project</i>	<i>\$50m</i>
Royalties				Increased profits for suppliers	
<i>1 project</i>	<i>\$4m</i>			<i>10 projects</i>	<i>\$695m</i>
Higher prices for primary products				Consumer welfare	
<i>3 projects</i>	<i>\$285m</i>			<i>9 projects</i>	<i>\$4081m</i>
Increased profits				Strengthening rural communities	
<i>6 projects</i>	<i>\$551m</i>			<i>2 projects</i>	<i>\$46m</i>
Increased yield				Human health	
<i>2 projects</i>	<i>\$188m</i>			<i>1 project</i>	<i>\$49m</i>
Product improvement					
<i>1 project</i>	<i>\$390m</i>				
Increased value add					
<i>2 projects</i>	<i>\$1,516m</i>				
Crop specific disease control					
<ul style="list-style-type: none"> • Reduction in frequency and severity of outbreaks • Yield losses avoided • Less need for seasonal control • Higher gross margins 					
<i>1 project (cereal rust)</i>	<i>\$2.144m</i>				
Total	\$6,024m	Total	\$179m	Total	\$4,921m

Note: Quantified benefits expressed in present value terms as at 2007 using a 5 per cent real discount rate.

Data source: RDCs evaluation reports.

Table A3:4 shows the spread of economic, environmental and social benefits from highly successful projects that were identified but were not quantified.

Table A3:4 Non-measured benefits from *highly successful projects*

Non-measured benefits		
Economic	Environmental	Social
Reduced costs <i>5 projects</i>	Increase water efficiency <i>6 projects</i>	Food safety and security <i>2 projects</i>
Employment and workers <i>2 projects</i>	Water quality and biodiversity <i>6 projects</i>	Human health <i>5 projects</i>
Increased industry investment <i>1 project</i>	Reduced chemical use <i>2 projects</i>	OH&S <i>5 projects</i>
Capital savings <i>2 projects</i>	Reduced waste <i>1 project</i>	R&D capacity building <i>3 projects</i>
Increased profits <i>5 projects</i>	Greenhouse gas emissions <i>2 projects</i>	Consumer welfare <i>1 project</i>
Market development <i>3 projects</i>	Better land use <i>1 project</i>	Strengthening rural communities <i>4 projects</i>
Increased yield <i>7 projects</i>	Soil improvement <i>2 projects</i>	Training <i>3 projects</i>
Improved efficiency <i>3 project</i>	Land rehabilitation <i>3 projects</i>	Amenity and aesthetics <i>2 projects</i>
Pollination <i>1 project</i>	Salinity <i>2 projects</i>	Animal welfare <i>1 project</i>
Product improvement <i>1 project</i>	Erosion <i>2 projects</i>	Other social benefits <i>5 projects</i>
Impact on supplying industries <i>9 projects</i>	Other industry specific benefits <i>6 projects</i>	
Other industry specific benefits <i>9 projects</i>		

Note:

Quantified benefits expressed in present value terms as at 2007 using a 5 per cent real discount rate.

Data source: *RDCs evaluation reports*.

Table A3:5 shows the breadth of quantified benefits for the 32 *randomly selected projects*.

Table A3:5 **Measured benefits from randomly selected projects**

Measured benefits			
Economic	Environmental	Social	
Reduced costs 3 projects \$46m	Water quality and biodiversity 1 project \$0.7m	Human health 1 project \$4m	
Royalties 1 project \$1m	Greenhouse gas emissions 1 project \$1m	Increased profits for suppliers 5 projects \$29m	
Higher prices for primary products 2 projects \$25m		Consumer welfare 4 projects \$13m	
Increased yield 5 projects \$270m		Animal health 1 project \$1m	
Increased profits 1 project \$45m		Consumer happiness 2 projects \$ 115m	
Market development 3 projects \$20m			
Productivity gain 3 projects \$115m			
Total: \$522m		Total: \$1.7m	Total: \$162m

Note: Quantified benefits are expressed in present value terms as at 2007 using a 5 per cent real discount rate.

Data source: RDCs evaluation reports.

Table A3:6 shows the breadth those benefits that were identified but not quantified for the 32 randomly selected projects.

Table A3:6 Non-measured benefits from randomly selected projects

Non-measured benefits		
Economical	Environmental	Social
Labour savings <i>1 project</i>	Increased water efficiency <i>1 project</i>	Knowledge <i>5 projects</i>
Capital savings <i>1 project</i>	Water quality and biodiversity <i>5 projects</i>	Human health <i>4 projects</i>
Increased profits <i>1 project</i>	Reduced chemical use <i>2 projects</i>	OH&S <i>1 project</i>
Market development <i>1 project</i>	Waste <i>1 project</i>	R&D capacity building <i>4 projects</i>
Increased yield <i>1 project</i>	Climate <i>1 project</i>	Animal health <i>1 project</i>
Reduced costs <i>3 projects</i>	Better land use <i>1 project</i>	Strengthening rural communities <i>4 projects</i>
Improved efficiency <i>3 projects</i>	Erosion <i>1 project</i>	Training <i>3 projects</i>
Other economic benefits identified <i>4 projects</i>	Knowledge <i>2 projects</i>	
	Other benefits identified <i>3 projects</i>	

Note: Quantified benefits are expressed in present value terms as at 2007 using a 5 per cent real discount rate.

Data source: RDCs evaluation reports.