
Rural Research and Development Corporations

Natural Resource Management Research & Development Report

2005

Prepared by the:

Joint RDCs NRM Working Group

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Abbreviations:

APL	Australian Pork Ltd
AWI	Australian Wool Innovation Pty Ltd
Cotton RDC	Cotton R&D Corporation
Dairy Australia	the former Dairy R&D Corporation
Fisheries RDC	Fisheries R&D Corporation
Forest & Wood RDC	Forest & Wood Products R&D Corporation
Grains RDC	Grains R&D Corporation
Grape & Wine RDC	Grape & Wine R&D Corporation
HAL	Horticulture Australia Ltd
LWA	Land & Water Australia
MLA	Meat & Livestock Australia
Rural Industries RDC	Rural Industries R&D Corporation (RIRDC)
Sugar RDC	Sugar R&D Corporation

Disclaimer: The data reported herein has been collated from information provided by individual RDCs, generated as they tested and jointly designed a common reporting framework. It is 'work-in-progress' to the extent that not all RDCs have reported from their total portfolio. A number have reported only from projects in designated 'environment' programs and have not yet included environmental contributions from projects in 'production' programs. More work is required before we can be confident that all RDCs are interpreting various definitions within the reporting framework in exactly the same manner.

This report is published with due care and attention to accuracy with regard to the information provided by the RDCs. While each RDC has been diligent, within its resources, to provide accurate and robust data, no responsibility can be accepted for the accuracy and comprehensiveness of the data presented in this report.

Executive Summary

Research and development is instrumental in addressing Australia's natural resource management (NRM) priorities as part of developing globally competitive, environmentally sustainable industries.

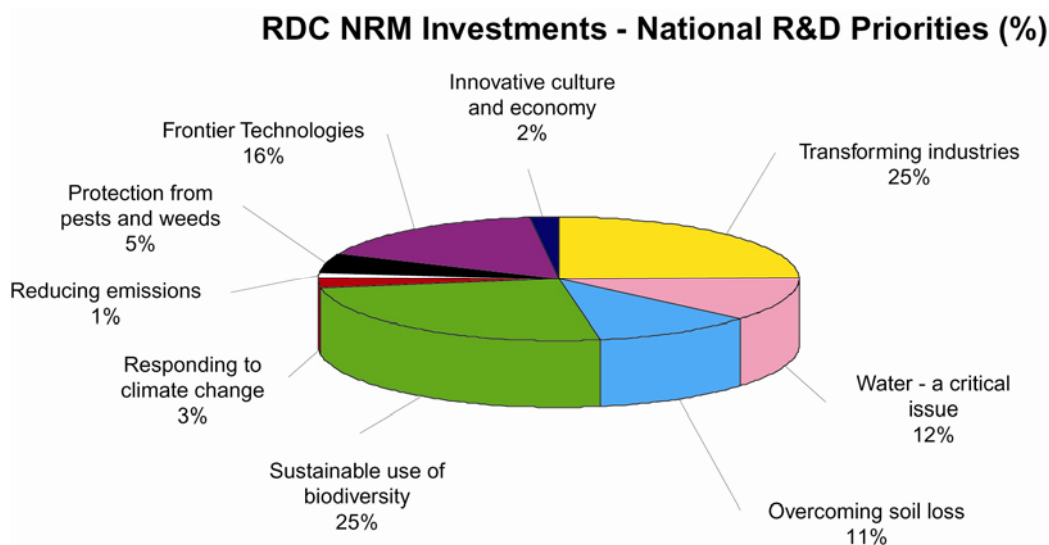
Natural Resource Management priorities

The Rural Research and Development Corporations (RDCs) recognise the importance of NRM issues. They collectively invested \$78.5 million during 2004/05 to tackle those issues. This \$78.5 million is a significant proportion of Australia's total NRM research and represents more than 20% of the RDCs' research investment.

The RDCs understand the importance of NRM to primary industries and their sustainable operations. They have well-developed mechanisms to identify research priorities and to align them with national research priorities and stakeholder needs. This ensures that their investment targets the areas of most importance. They are experienced research managers and use sound techniques in selecting projects and managing their portfolios.

Analysis of the NRM expenditure by the Rural RDCs shows that they are using frontier technologies and innovation (18%), investigating environmental priorities such as water, soils, biodiversity and climate (57%), and transforming Australian industries (25%).

Chart 1. Graph of NRM Expenditure Reflecting National R&D Priorities



Efficient and effective R&D

The Rural RDC model encourages NRM issues to be incorporated with production issues and with other elements of value chain management (e.g. marketing). This, coupled with considerable attention to building the capacity of producers (15% is directed to improving understanding, knowledge and skills), results in the rapid adoption of management practices that are both profitable and environmentally sustainable.

Partnerships and collaboration are features of how the RDCs operate. Their investment has a significant influence on where other research and extension organisations (including CSIRO, universities and State Departments) invest. The RDCs are also investing in R&D in partnership with the Australian Government through the National Landcare Program and Natural Heritage Trust.

Industry-based RDCs collaborate strongly on numerous production and resource management issues such as pastures, soil biology and fertilisers. Land & Water Australia (LWA) and the Rural Industries Research and Development Corporation (Rural Industries RDC) foster cross-commodity collaboration on matters such as climate variability, dryland salinity, irrigation, agro-forestry and capacity building. The RDCs have considerable experience in determining when collaboration will yield rewards and in managing collaborative programs. Nearly \$9.5 million (12%) of the total NRM investment in 2004/05 was invested through collaborative R&D partnerships between the RDCs. This figure is likely to increase in 2005/06.

The RDCs also have advanced methods of managing their research portfolios and programs to maximise the impact of their investments, especially in terms of stimulating the adoption of profitable, environmentally sustainable management practices.

NRM R&D Reporting Framework

This report presents, for the first time, a standard classification system against which the RDCs have reported their environmental investments (be they dryland or irrigated farming, fisheries or forestry based). The development of the Natural Resource Management Research and Development Reporting Framework has been an iterative exercise of 'action learning'. It has laid a foundation on which further reporting may be based and its development has strengthened the networks between the managers of the RDCs' NRM research programs.

In Summary

The Rural RDC model promotes environmentally sustainable production and industries in a cost-effective manner. RDCs invest significant sums in tackling the NRM priorities of industries and the nation. Incorporating NRM issues in their industry context, and using the expertise of bodies such as LWA and the Rural Industries RDC, provides gains for the environment and production.

The RDCs have a long track record of working in collaboration with each other and have been quick to adopt mutually beneficial partnership approaches with the Australian Government. Many RDCs are starting to develop similar relationships with regional natural resource management bodies and to share the findings from their research with them.

The RDCs' industry-driven/market-responsive *modus operandi*, coupled with their willingness to collaborate, ensures that priority matters are dealt with effectively and efficiently for all concerned.

Introduction

The Rural Research and Development Corporations (RDCs) have a strong commitment to improving the environmental sustainability of Australia's primary industries and their management of natural resources such as soil, water and biodiversity. They do this through strategic investments in priority natural resource management (NRM) issues for their particular commodity and through collaborative efforts when issues are of generic importance.

The RDCs' research priorities are shaped by the Australian Government's National Research Priorities, Rural Research and Development Priorities, and the needs of their key stakeholders (i.e. levy payers). They have legislated reporting requirements to Government and are also acutely aware of the need to report to, and be responsive to, the investment priorities of their primary stakeholders (e.g. levy payers).

This report presents, for the first time, a consistent view across the RDCs of investment in natural resource management. It does this through a Natural Resource Management Research and Development Reporting Framework, which has established a standard classification system against which each RDC has reported. The work was done through a collaborative effort under the auspices of the RDCs Natural Resource Management Working Group.

The development and first application of the Framework has been an iterative exercise of 'action learning' – which is still under way. Not all organisations have had the opportunity as yet to apply the framework to their entire research portfolio. The data presented is based on mid-2004/05 investments, so there will be an element of under-reporting in this exercise. Furthermore, there is scope for more dialogue between organisations on how the classifications in the framework are best applied to their situation. Comparing examples and perspectives will, over time, lead to greater uniformity in the application of the standard Framework to diverse situations.

This report also presents an overview of the RDCs' investment planning and prioritisation processes, along with a report on collaboration across the RDCs. The section outlines the decision-making process applied by RDCs to determine when collaboration is the most effective investment approach, along with a summary of current NRM collaborations involving Land & Water Australia, as an example.

The manner in which RDCs conduct their operations and deal with natural resource challenges has proved to be very effective. Several "mini case studies" are reported to demonstrate the impact that Australia's RDCs are having.

If there is positive stakeholder response to this initial report, the Rural RDCs will continue to improve the NRM R&D Reporting Framework permitting its incorporation in their individual, as well as collaborative, reporting. Subject to stakeholder interest, further elements (e.g. geographic analysis) may be added to future reports.

Addressing Priorities

National Research Priorities

The Australian Government has established National Research Priorities, supported and defined by further 'priority goals':

An environmentally sustainable Australia – Transforming the way we utilise our land, water, mineral and energy resources through a better understanding of human and environmental systems and the use of new technologies:

- Water - a critical resource
- Transforming existing industries
- Overcoming soil loss, salinity and acidity
- Reducing and capturing emissions in transport and energy generation
- Sustainable use of Australia's biodiversity
- Developing deep earth resources
- Responding to climate change and variability

Promoting and maintaining good health – Promoting good health and well being for all Australians

- A healthy start to life
- Ageing well, ageing productively
- Preventive healthcare
- Strengthening Australia's social and economic fabric

Frontier Technologies – Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting-edge research

- Breakthrough science
- Frontier technologies
- Advanced materials
- Smart information use
- Promoting an innovation culture and economy

Safeguarding Australia – Safeguarding Australia from terrorism, crime, invasive diseases and pests, strengthening our understanding of Australia's place in the region and the world, and securing our infrastructure, particularly with respect to our digital systems.

- Critical infrastructure
- Understanding our region and the world
- Protecting Australia from invasive diseases and pests
- Protecting Australia from terrorism and crime
- Transformational defence technologies

Rural research priorities

The National Research Priorities are supported by priorities for rural research and development. These are:

- sustainable natural resource management;
- improved trade and market access;
- use of frontier technologies;
- improving competitiveness through a whole-of-industry approach;
- maintaining and improving confidence in the integrity of Australian agricultural, food, fish and forestry products;
- protecting Australia from invasive disease and pests; and
- creating an innovative culture.

Aligning investment priorities

A major strength of the Rural RDCs is their ability to address National Research Priorities in a manner aligned to the needs of industries. All the RDCs develop a Strategic Plan which reports the key industry issues, checks and maps their alignment with the research priorities established by the Chief Scientist and the Australian Government (Rural Research & Development Priorities), and presents the programs they develop to address those joint needs.

The close alignment of most RDCs with industry permits a ready dialogue, which is supported by structures and processes aimed directly at ensuring stakeholders have access to relevant information (e.g. national R&D priorities and industry trends, etc) in order to make informed recommendations to the RDCs. In many industries, the marketing and processing sectors have powerful commercial knowledge (of both domestic and global relevance) that is also contributed through that consultation.

To ensure the RDCs are at the global forefront of research, a range of measures is used to inject thinking from internationally respected scientists. Many RDCs also consult with community and broader stakeholder interests. Some place considerable emphasis on scanning international literature for emerging issues.

Formation and support of regional and/or national industry consultative bodies

Examples of regional and industry stakeholder consultation mechanisms include:

- MLA works with Southern and Northern Beef Research Advisory Councils, the Feedlot R&D Advisory Committee, the Australian Meat Processing Committee and sheepmeat advisory groups to identify priorities and help foster sound research approaches and infrastructure (including States, CRCs, Universities and CSIRO).
- The Grains RDC has three Regional Panels (involving producers and scientists) in a similar process.
- Forests and Wood Products RDC convenes four Industry Advisory Groups.
- Grape and Wine RDC engaged an independent consultant to lead industry consultation, including a survey of industry. A Priorities Reference Group (involving growers and winemakers) is also used for ongoing advice.
- The Sugar RDC annually presents a 'report card' to regional workshops of growers and researchers, as well as meeting three times annually with representative bodies.
- Dairy Australia supports eight Regional Development Programs that advise on industry priorities, develop and manage projects of local relevance, and network with States and catchment bodies.

- The Cotton RDC meets at least twice annually with the industry body to which it reports, the Australian Cotton Growers Research Association – in March to review research priorities and proposals and in July to present the Annual Operating Plan.
- HAL works in partnership with an extensive number of industries through their peak bodies; 33 of which are HAL members.

Access to corporate industry intelligence

Many businesses involved in Australian industries are vertically integrated and global in their operation and outlook. They have rare commercial knowledge which, while not necessarily reported itself, is applied to advise on industry research needs in order to remain internationally competitive. All RDC Boards include specialist industry knowledge.

- The self-funded Australian Cotton Growers Research Association works with the Cotton RDC to convene a biennial Australian Cotton Conference to review and showcase research (including processing).
- Dairy Australia involves producers and processors in advisory groups, such as its Farmgate Reference Group and Dairying for Tomorrow Steering Committee.
- MLA has staff in several international offices with considerable trade and marketing experience, and also involves end users in the development and implementation of projects.
- The Grape and Wine RDC has close links with bodies like the Australian Wine Research Institute and the Winemakers Federation of Australia (WFA), and conducts a biennial Technical Conference involving growers and wineries. In addition, a Strategic Directions Group (involving WFA) is guiding the development of a Prospectus for future research.
- The Grains RDC's panel members include skills in grain handling, milling and marketing.

Scanning, scoping and forecasting the future

Many natural resource management issues become apparent in looking at future production issues, considerations of likely policy and regulatory measures (e.g. access to resources or environmental protection measures) and from evaluation of market demands.

- MLA, Grains RDC, AWI, HAL, Sugar RDC, Cotton RDC and Dairy Australia have all undertaken specific projects scanning the environmental issues faced by their commodity.
- LWA monitors international literature for emerging NRM issues, scoping potential research for consideration by the Board, and has devoted resources to incorporate 'futures thinking' in its activities.
- The Cotton RDC and MLA review a major program of work each year and often engage internationally respected scientists in the reviews.
- The Grains RDC's strategic plan notes environment (along with markets and infrastructure) as a key driver of future industry success.
- Dairy Australia has worked with the National Dairy Alliance (State, university and CSIRO researchers) to assess research capacity and future needs, and regularly engages external reviewers (including experts from NZ) in mid-term program reviews.

Selecting sound investments

Besides mounting a concerted effort to target research to critical national and industry topics, the RDCs also apply sophisticated techniques to the selection of individual research projects. This ensures each project has the best prospect of success and that their total portfolio is well balanced and distributed.

Many RDCs are progressively increasing the proportion of their investment that is commissioned, i.e. where they work with potential providers (and often a network of co-funders) to design collaborative research and extension programs. Several RDCs prepare a 'prospectus'-style document to signal key research areas and invite proposals and partnerships to address them. Formal cross-commodity discussions about programs are also common, e.g. AWI and MLA meet quarterly, MLA and Dairy Australia meet periodically, and AWI, MLA and Grains RDC program managers meet regularly – often with input from LWA.

Examples of project assessment and portfolio management approaches include:

Project assessment

- Measures such as peer review of methodologies, benefit:cost analysis, and alignment with priorities are widely used. The prospects for adoption are a key element, as is the degree of 'market failure' – assessing whether other bodies would be likely to fund equivalent research;
- The Rural Industries RDC scores projects for 'fit' (relevance, leverage, etc), potential gain (production, markets, environmental or social), likelihood of success (researcher capability, methodology, project risk etc) and rate of adoption (extent and rate);
- The Grape & Wine RDC assesses projects for their impact on grape and wine quality and production efficiency or sustainability; and from domestic and export market perspectives.
- The Grains RDC adopts a value-chain assessment to determine not only what benefits accrue from research but also where they will be enjoyed along the value-chain;
- MLA uses IMAP – a computer-based system for rigorous qualitative and quantitative (net present value) project assessment.

Portfolio management

- Many commodities adopt variations of the approach developed by CSIRO of assessing 'attractiveness versus feasibility' ensuring their portfolio is balanced in terms of risk, and time until benefits are delivered, etc.
- HAL uses a team of 15 Portfolio Managers, each with specialist industry knowledge and experience in a facet of research or marketing, to develop synergies between the programs of its numerous constituent industries.

Maximising returns on investment

The close alignment of research with industry provides a good alignment with industry needs and also significantly narrows the gap between research and application; thus maximising the return on investment. Much commodity-based research combines environmental investigations with those relating to production and some goes the next step to address producer needs in a farming systems context. The RDCs also invest in the social science of 'extension' or 'capacity building' to develop methods to promote interaction between scientists and producers and the consequent adoption of new knowledge.

The management, review and evaluation of projects is a priority for the RDCs to ensure their investments perform to expectation and to continuously improve their knowledge of research management. Methods such as 'participatory action research' and direct producer involvement in managing projects (not just advising) are employed. Some examples of industry engagement and evaluation are:

- The Grains RDC adopts a theme of 'better practices, faster' to target research to application.
- MLA's Sustainable Grazing Systems program and its collaboration with Grains RDC, AWI and LWA in Grain & Graze – a farming systems program. Both have high stakeholder involvement and, with Grain & Graze in particular, a means for ready evaluation of program success and outcomes.
- The Cotton RDC supports an Extension Team and structured Best Management Practices approach.
- Many RDCs engage external reviewers in the evaluation of large projects and, each year, also select at random a number of smaller projects to assess their performance and benefit:cost.

Natural Resource Management Investments

Context

The national and Ministerial priorities for research and development make it clear that Rural RDCs have a critical role in natural resources research and ecologically sustainable development. In the interests of sustainable production, the priorities of rural R&D corporations include issues associated with **water** quality and availability, **soils, biodiversity** (including fisheries and native forests), and the **atmosphere** (in terms of greenhouse emissions, climate change and climate variability).

The R&D bodies are encouraged to adopt **frontier technologies** and develop **innovative cultures** as part of improving the quality of their research. They are also committed to maximising opportunities for collaboration in their efforts.

The ultimate aim of these initiatives is to have new knowledge incorporated in programs that **transform industries** and the landscapes they inhabit; and to promote good health and **safeguard Australia**. Considerable investment is committed to build the understanding and capacity of producers and to ensure the outputs of component research are incorporated into management practice, to give the ultimate return on research investments.

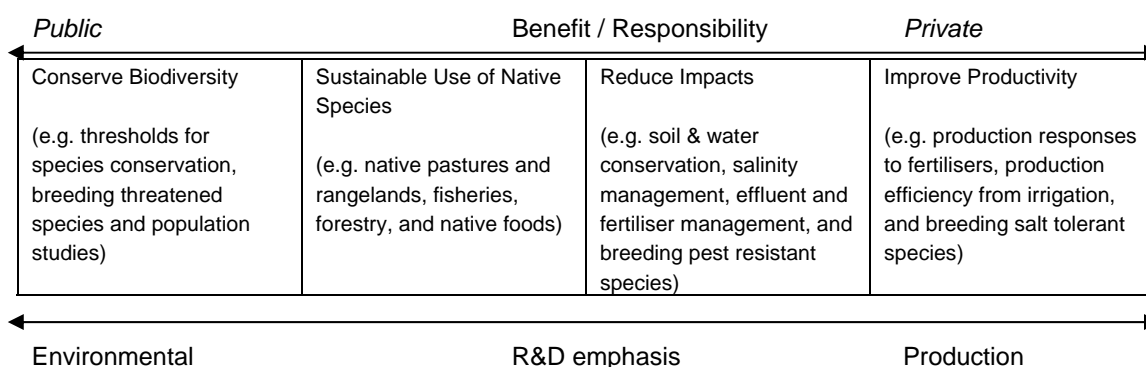
Defining Natural Resource Management

When defining and categorising R&D investments, it is not easy to neatly apportion them with natural resource management (NRM) outcomes. For some, the term NRM may be restricted to projects with a strong environmental conservation focus; others may consider all elements of primary production to be NRM. In practical terms, it is necessary to appreciate that R&D investments deliver a mix of NRM outcomes that have various environmental/production outcomes and public/private benefits.

The Department of Agriculture, Fisheries and Forestry (DAFF) is the Australian Government’s lead agency in production and resource management. Its aim is to promote the sustainable use and management of the natural resources which underpin production and to secure access to them. Emphasis is placed on improving productivity and profitability; building the health of natural resources; and improving environmental outcomes by preventing long-term degradation, minimising side effects and providing ecosystems services.

DAFF appreciates that the economic environment in which Australian primary industries operate stimulates a constant need for increased productivity, competitiveness and profitability. In that context, it has suggested that NRM be considered as a spectrum, rather than something with a precise definition.

Spectrum of NRM outcomes prepared by DAFF:



As a guide, DAFF recommends that the definition (or classification) of NRM should focus on the *intended* effects of a R&D project as it applies to the management of the natural resources in question – e.g. water, soil, vegetation and biodiversity – and encompass activities which have, as one of their stated objectives or intended outcomes, a feature such as:

Salinity:

- prevent, stabilise and reverse trends in dryland salinity; and
- minimise, avoid or reduce the impact of salinity on land and water resources.

Water:

- improve water use efficiency;
- maintain or improve surface and groundwater quality, including off-site; and
- secure reliable supplies of water.

Soils:

- maintain productive and resilient soils – to deal more effectively with sodicity, acidity, salinity and decline in soil carbon; and
- reduce erosion and on-farm management practices which cause off-farm environmental effects, e.g. in rivers, estuaries and inner coastal areas.

Biodiversity and natural systems:

- protect or conserve native biodiversity;
- maintain, enhance or rehabilitate biodiversity and ecosystem services; and
- improve native vegetation and wildlife habitat management outcomes.

Capacity building:

- capacity and institutional building activities which support achievement of the above, including provision and extension of scientific information and communication.

Reporting Framework

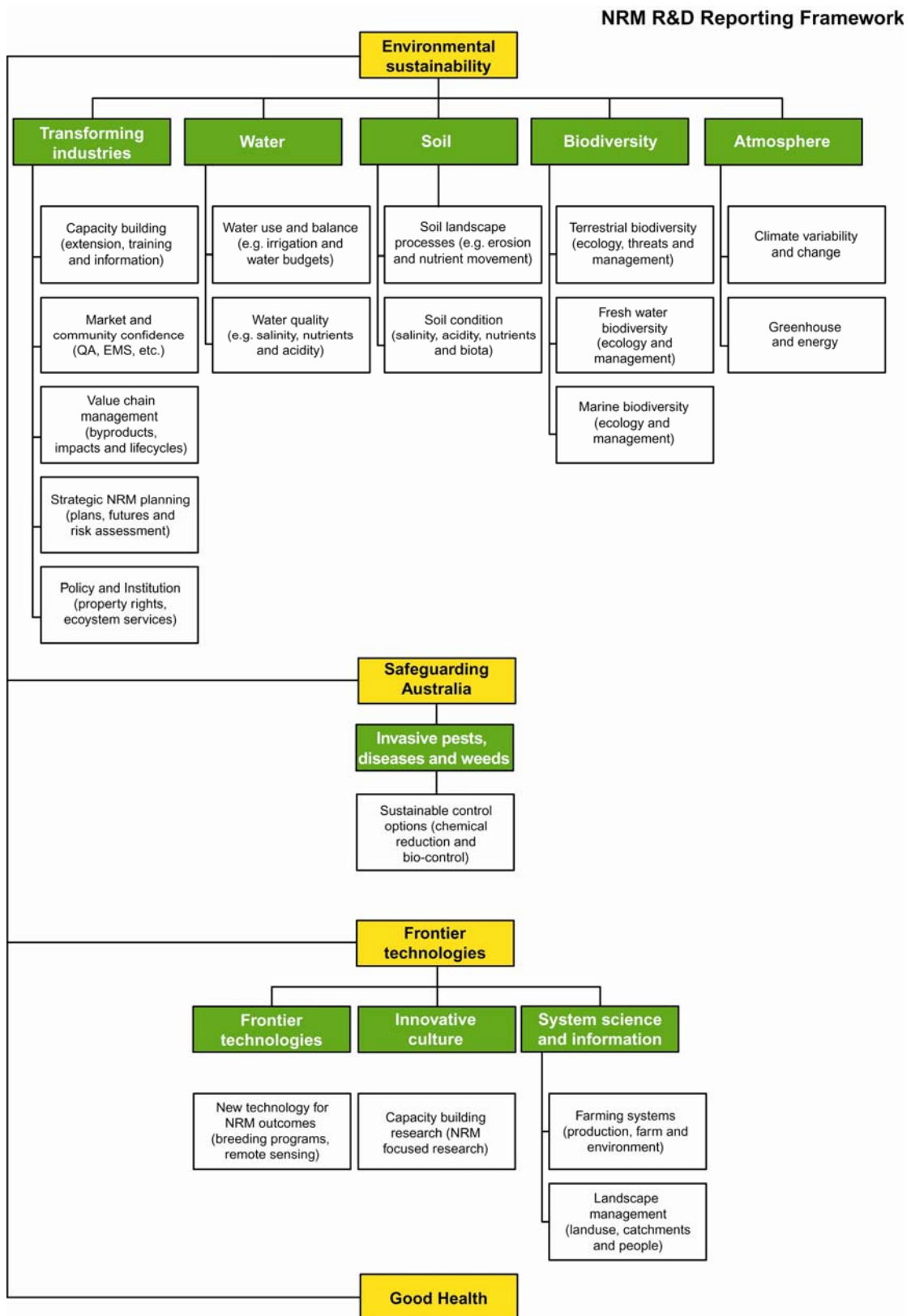
The National and Rural R&D priorities provide a broad framework for the classification and reporting of rural research and development investments. Thinking such as that outlined above generates an appreciation that, for these purposes, any definition of NRM needs to be based on outcomes. Considering those aspects together (and the emerging framework being proposed by the Signposts for Agriculture project to record the contribution of rural industries to sustainable development) led to the development of a single classification system for adoption by all RDCs: the NRM R&D Reporting Framework.

The framework (see below) marks the first time that all commodities have been able to adopt a uniform structure for the analysis of their NRM R&D investments.

The components of the NRM R&D classification are defined in Appendix 1, with data from its application by the RDCs presented below.

When considering the framework, the emphasis is on the desired outcome, rather than any individual action. For example, breeding a plant that can lower saline water tables may be considered an environmental project, but breeding a plant that has better quality fruit would not. Investments with a high private/production outcome have not been considered in this exercise.

NRM R&D Reporting Framework



Reporting RDC NRM Investments

To support this discussion, the Rural RDCs have listed their contracted projects for 2004/05 and then:

- determined the amount of the investment that could be termed NRM. In terms of the spectrum of NRM outcomes (above) they have concentrated on projects with outcomes that have a higher public and environmental benefit – as opposed to a private, production gain (ie projects in the first three quadrats of the DAFF spectrum); and
- classified the investment in terms of the NRM Reporting Framework.

As an example, a \$100,000 project may be deemed to be 40% about production and 60% toward an environmental outcome, i.e. \$60,000 for NRM. The project may be 80% about water quality (nutrients) and 20% about freshwater aquatic biodiversity. Through the framework, the \$100,000 project would be reported as:

Water Quality – \$48,000 (80% of \$60,000)

Freshwater Biodiversity – \$12,000 (20% of \$60,000).

For the purposes of this report, any contracted projects that are, in turn, managed by another RDC have been deleted from the list of projects submitted by each RDC. The investments are only recorded by the final funds manager, ensuring there is no risk of cross-investments being recorded twice.

The RDCs believe the financial data generated to be a conservative indication of their investment in environmental outcomes.

The development of the reporting framework has not been simple. It has involved considerable testing, evaluation and learning. Now that a functioning framework has been developed and proven effective, its future application will be more straightforward. However, there is still progress required to develop an easier data entry and analysis process, to better integrate that into other RDC methods, and to promote further consistency in the interpretation of the framework.

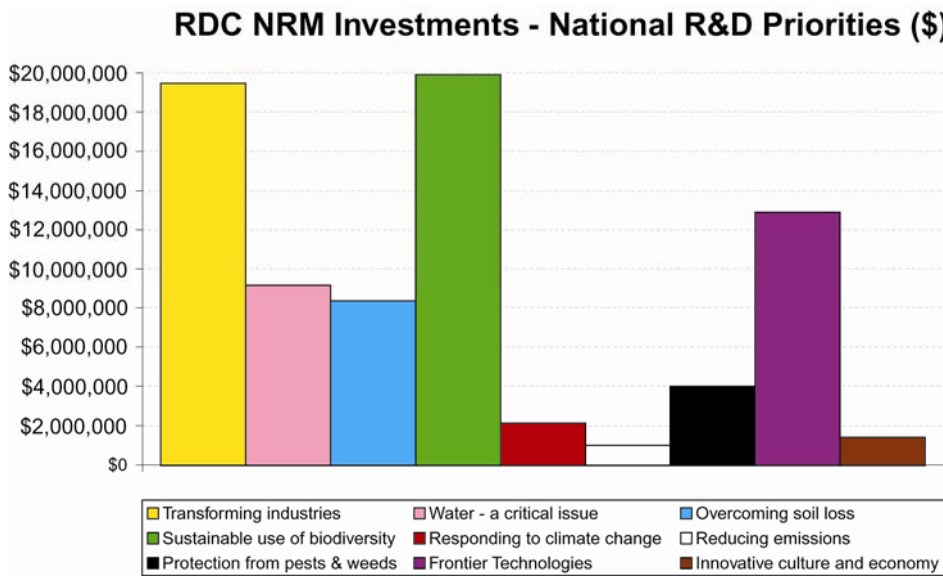
RDC investments in NRM

In 2004/05, the Rural RDCs collectively invested \$78.5 million in natural resource issues. This equates to 17% of their total (\$450 million) investment and at least 20% of their total investment in research.

Of this NRM investment, \$60.1 million (77%) addresses the national research priority of sustainable development; \$4 million (5%) safeguarding Australia; and \$14.4 million (18%) in frontier technologies.

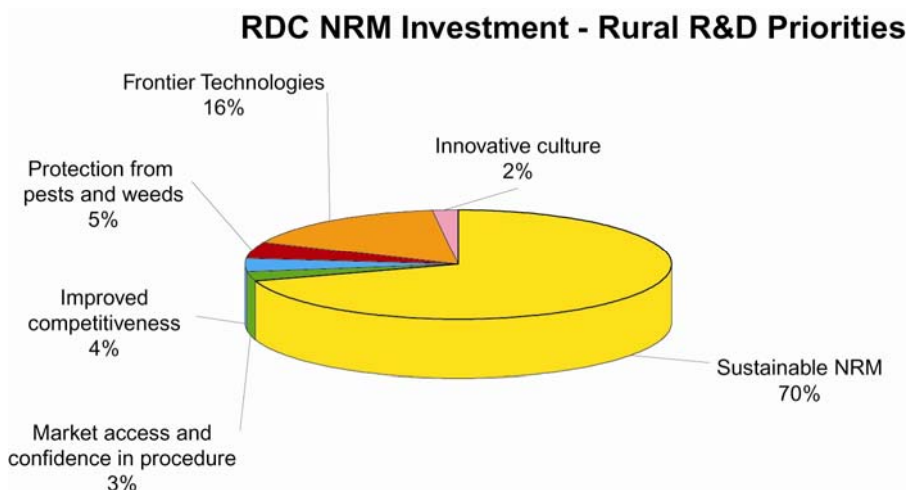
As the following diagram shows, Rural RDCs are investing in frontier technologies and innovation, investigating environmental issues such as water, soils, biodiversity and climate, and transforming Australian industries.

Chart 2. Graph of RDC NRM Investments Reflecting National R&D Priorities.



Sustainable natural resource management (one of the priorities set for Rural RDCs) is a major investment for the RDCs (see Chart 3). A significant portion of their environmental investment involves the development or application of frontier technologies and an innovative culture (16% and 2% respectively). Reflecting the degree to which environmental issues are incorporated in mainstream industry activities, improved competitiveness, market access and consumer confidence are also strengthened by NRM projects – as are efforts to contain threats from pests in an environmentally sensitive manner. NRM R&D is used to address Australia’s key environmental issues and develop globally competitive, environmentally sustainable primary industries.

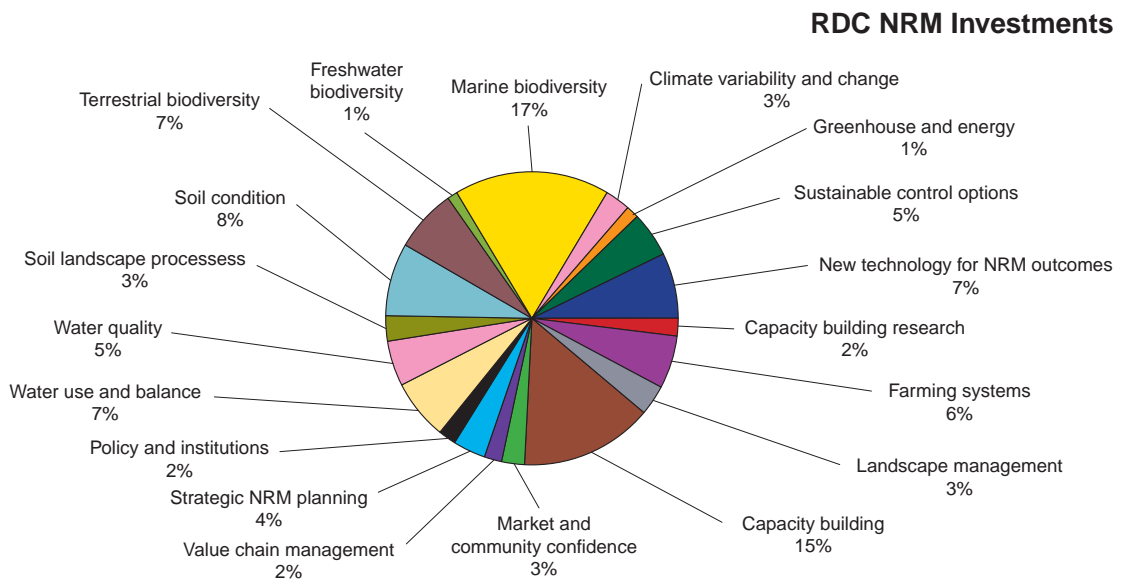
Chart 3. Graph of RDC NRM Investments reflecting Rural R&D Priorities



At a finer level of detail, it can be seen in Chart 4 that the Rural RDCs have a well-balanced portfolio of research that comprehensively addresses the most important issues concerning the ecologically sustainable development of primary industries in Australia.

The RDCs also invest heavily in developing the capacity of producers and researchers. Of their NRM investments, 15% is on developing aware, informed and knowledgeable producers, capable of assessing their particular situations and applying the latest technology to meet the circumstances of their businesses.

Chart 4. Graph of RDC NRM Investments reflecting the NRM R&D Reporting Framework



Collaboration

Managing Collaboration

Collaboration in research and development is generally considered to provide numerous advantages, including:

- increased efficiency and generation of a critical mass for quality research;
- support for the multi-disciplinary teams required to tackle complex problems; and
- improved quality of research (through peer-exchanges) and adoption (by collaboration between researchers, end-users and any intermediaries).

Many producers manage mixed enterprise businesses and contribute levies to more than one RDC. For them, collaboration gives more opportunity for the efficient delivery of solutions, with fewer gaps or duplication.

However, collaboration comes at a cost, as it:

- requires more time in planning and negotiation before research commences;
- generates numerous transaction costs (that escalate with the number of partners involved);
- can diminish the control and recognition of individual organisations; and
- introduces new risks to the management and performance of a project.

It is important to appreciate that collaboration is a means to an end, not an end in itself. RDCs have placed considerable importance on determining when to use collaboration as a tool and how to best manage collaborative investments. Appendix 2 provides further discussion of the pros and cons of collaboration. Appendix 3 presents a 'Collaboration Checklist' to help RDCs determine when to collaborate and highlight critical elements to be managed for optimal outcomes.

From their experience in establishing collaborative research programs the RDCs have identified subtle differences in some legal aspects of their contracts and inter-RDC agreements as a potential hurdle and delaying factor. Meat and Livestock Australia convened a working group to develop a common contract (i.e. standardised clauses) for use across the RDCs when undertaking collaborative investments. That work has concluded with several standard contracts now available for application in different circumstances, depending on the nature of the collaboration and the partners in that collaboration.

How much collaboration occurs?

Of the \$78.5 million the RDCs invested for natural resource management outcomes in 2004/05, \$9.5 million (12%) was spent in collaboration with each other. This does not include sums invested in collaboration with CRCs, CSIRO and universities, various Australian Government programs (e.g. NHT or NLP), or with State agencies.

The majority of multi-RDC collaborative investment is in a relatively small number of large and significant programs. The cost does not warrant the extensive management infrastructure required for successful collaboration, unless the venture is a significant one. These large programs may be quite sophisticated and take considerable effort to initiate as investors negotiate for outcomes that will meet their specific needs. Once well-established they are durable investment vehicles – often surviving several phases of investment, through evolutionary changes.

Case studies in collaboration

A multi-RDC Program

The Managing Climate Variability Program serves as a useful case study of multi-RDC collaboration. The five-year program follows a predecessor, the Climate Variability in Agriculture Program. Dealing with the consequences of Australia's variable climate (drought, floods and bushfires) challenges the ability of producers and industries to sustain production and profit, while containing the environmental degradation often associated with episodic weather events. Climate variability is complex, it is a significant issue, and it has broad interest. It is an issue that invites collaboration.

A number of RDCs (e.g. GRDC, RIRDC, SRDC, Dairy Australia, MLA and AWI) work with DAFF in the LWA-managed program. Their objectives are the same: to better understand the nature of climate variability and to develop applications for use by land managers to minimise the impact of variability. Individually, they would struggle to commit sufficient resources to address the issue – collectively they can. Partnerships are sensible and sustainable.

The program has its own Management Committee, which has delegated authority to make investment decisions with pooled funds. This management model overcomes many of the questions that can otherwise jeopardise collaboration. It provides individual investors with significant (and sufficient) influence, but not control at the expense of others.

The collaborative investment is easy for the investors to justify to their stakeholders. It addresses a priority concern, shares what can be a risky investment, and is an efficient means to establish a 'critical mass' of research; sufficient to attract the rare expertise required for the work.

Climate Variability fits the problem definition, partnership, management and justification criteria of a program well suited to collaboration. Similar comments can be made about other major collaborations such as the National Program for Sustainable Irrigation, Cooperative Venture for Capacity Building, Joint Venture Agroforestry Program and the National Dryland Salinity Program (which achieved its initial objectives and spawned other research programs – notably the CRC for Plant Based Management of Dryland Salinity).

An RDC Example

The RDCs co-invest when circumstances suggest it is the best option. Examples include Better Fertiliser Decisions (managed by Dairy Australia, with investment from MLA and LWA), the soil biology program of MLA, AWI and Grains RDC and the National Cadmium Minimisation Strategy involving HAL and Grains RDC.

Table 1 records significant collaborations in which a single RDC (LWA) is involved. It is acknowledged that the table is not exhaustive for LWA, and that most RDCs are involved in a wide range of different collaborative efforts not involving LWA programs (e.g. via CRCs or multi-commodity projects). It is, however, presented as one example of the extent and nature of collaboration going on.

Table 1. Summary of significant collaborations involving LWA.

RDC	Recent Collaboration	Current Collaboration
Australian Pork Ltd	MEDLI	
Australian Wool Innovation	SGS*	Land, Water & Wool National Annual Pasture Legume Improvement Program (NAPLIP)* Managing Climate Variability Cooperative Venture for Building Capacity* Grain & Graze
Cotton RDC	Pesticide BMPs Water use efficiency NPIRD	National Program for Sustainable Irrigation Riparian Guidelines Evaluation Case studies
Dairy Australia	National Land & Water Resources Audit Climate Variability in Agriculture Oral history Effluent management through the general call Gippsland Riparian project NPIRD (nutrients)	Riparian Guidelines Managing Climate Variability Cooperative Venture for Building Capacity* Better Fertiliser Decisions* CMA Knowledge Management project Dairy catchment Dairy Australia workshop
Fisheries RDC	Drainage techniques for sugar lands on coastal floodplains Project re: Impact of catchments on estuaries Ord-Bonaparte Program Scoping Study	
Forests & Wood Products RDC	Joint Venture Agroforestry Program	Joint Venture Agroforestry Program
Grains RDC	Climate Variability in Agriculture Program Native vegetation project Adoption Program	National Dryland Salinity Program Managing Climate Variability National Annual Pasture Legume Improvement Program (NAPLIP)* Cooperative Venture for Building Capacity* Grain & Graze
Grape & Wine RDC	National Program for Irrigation R&D (partial root zone drying (PRD))	Acidity Audit Cooperative Venture for Building Capacity*
Horticulture Australia	National Land & Water Resources Audit Pesticide risk assessment NPIRD (PRD, soil /organic matter)	National Program for Sustainable Irrigation Building Capacity for Innovation*
Meat & Livestock Australia	North Australia Program* Sustainable Grazing Systems* Adoption Program	Grain & Graze Land, Water & Wool (SGSL) Cooperative Venture for Building Capacity* Better Fertiliser Decisions* Managing Climate Variability (Northern Program) National Dryland Salinity Program
Rural Industries RDC	Climate Variability in Agriculture Program Adoption Program Pesticides project (rice)	Joint Venture Agroforestry Program* Managing Climate Variability National Dryland Salinity Program NLWRA outputs Managing Riparian Lands guidelines Cooperative Venture for Building Capacity*
Sugar RDC	Climate Variability in Agriculture Program Drainage techniques for sugar lands on coastal floodplains Riparian Guidelines Acid sulphates project work Trash blanketing project NPIRD (water use efficiency) Nitrogen work at project level	Managing Climate Variability Cooperative Venture for Building Capacity*

* Investments by LWA into programs managed by other RDCs (the program is highlighted in **bold** in the quadrant associated with the managing body)

'Key learnings'

There is substantial collaborative investment occurring between the RDCs, through their experienced research investors and managers. They understand the need for good outcomes and are very aware of the management issues associated with achieving them.

Collaboration is a very effective approach in the right circumstances. However, collaboration is not a universal solution to every situation. Even when commodities share an issue as a priority, there may be factors that mitigate against collaboration.

The RDCs have numerous interactions and share information and ideas. Their major collaborative investments tend to be in a relatively small number of large programs. These programs may be quite sophisticated and may take considerable effort to initiate as investors negotiate for outcomes that will meet their specific needs. Once well established they are durable investment vehicles – often surviving several phases of investment, through evolutionary changes.

The long life and size of these collaborative investments justify the endeavour behind their development. They permit research to be undertaken that would otherwise not be contemplated. The fact that a number of significant bodies are involved means the application and extension of research findings is rapid and widespread.

Delivering Outcomes

The Rural RDC model is respected for its ability to generate outcomes for government, community and industry interests. The industry networks nurtured by the commodity RDCs and their value chain approach ensure research and development is industry driven, credible and responsive to market requirements. This leads to the prompt adoption and commercialisation of findings. The RDCs' innovative culture sees them developing and employing frontier technologies, which further reduces the interval between research and application, providing a better return on investment.

There are numerous examples of RDCs developing sophisticated research programs involving producers in participative, systems-based research. Producers who contribute to the research have greater opportunity to understand and appreciate knowledge generated in the context of their businesses. They inject practical expertise into the research process so that results are often already being applied on farm well before the researchers publish the results.

Resource management and production

The RDC model also permits natural resource management (NRM) issues to be incorporated into production themes. This approach delivers management changes that maintain or improve production while promoting environmental outcomes.

Examples of effectively incorporating NRM and production themes include:

- Sustainable Grazing Systems – The MLA program, with support from LWA, was developed by producers, was governed by a producer and researcher steering committee and was delivered through regional producer committees working with researchers. It directly influenced grazing practices on 8,000 properties with 81% of those properties anticipating sustainability benefits and 78% anticipating financial benefits.
- Grains RDC Farming Systems and the promotion of minimum tillage – Up to 70% of grain growers in various agro-ecological zones now adopt minimum tillage practices that maintain or increase production while improving soil health and reducing soil erosion.
- Green Cane Harvesting by Sugar RDC and LWA – More than 95% of sugarcane is now harvested while it is green. This significantly reduces the loss of nutrients from farms, can improve the harvest experience and maintain, if not improve, yields and returns. Green cane trash blanketing (which reduces soil loss) has also been adopted by 75% of growers.
- Sustainable Grazing of Saline Lands by AWI and involving MLA and LWA. A part of the Land Water and Wool program is developing methods to increase production while rehabilitating saline lands. It has an extensive network of grower groups participating in, and contributing to, the research with more than 1,200 wool growers involved.
- Better Fertiliser Decisions, initiated by Dairy Australia with the support of MLA and LWA, plus the fertiliser industry. This program is developing standard approaches to the recommendation of fertiliser needs that incorporate current soil status, production requirements and risks to the environment. The aim is to maximise production and profit – and minimise environmental losses.
- National Program for Sustainable Irrigation, a major collaboration that has involved numerous commodities over various phases (e.g. HAL, and the Cotton and Grape & Wine RDCs). The LWA-managed program has been a leader in better understanding water use efficiency and sustainable irrigation options.

Adding value to Government programs

The Rural RDCs have been quick to adopt the 'partnerships' style of program now being offered by the Australian Government. The Sustainable Industries Initiative (National Landcare Program) and the Pathways to Industry EMS Program (Natural Heritage Trust) are two examples where industry (through the RDCs) programs have been well aligned with those of the government, enabling mutually beneficial partnerships to be established.

The RDCs are now striving to make a similar connection with the regional NRM bodies. There is great potential for those bodies to be informed by RDC research. There is also scope for industry and regional natural resource management bodies to develop partnerships and mutually beneficial programs – as industry has done with the Australian Government – to help both producers and the wider rural community to better understand, communicate and support sustainable production techniques. Examples are:

- Grain & Graze collaborating with Catchment Management Authorities. The joint MLA, AWI, Grains RDC and LWA program includes nine regional projects; each of which is a co-operative effort between the industries, farming systems groups and the local catchment or regional NRM body.
- Dairy Australia Targets for Change and Catchment Research. Dairy Australia has developed a portfolio of projects examining farm-to-catchment interactions and, in the process, several (e.g. DairyCatch and GipRip) have developed collaborative programs with State agencies and catchment or regional NRM groups.
- Evergraze. A project between MLA, the CRC for Plant Based Management of Dryland Salinity and three catchment groups to develop profitable production systems that will reduce recharge by 50%.
- LWA and the Australian Government's Natural Heritage Trust and National Action Plan for Salinity and Water Quality. As part of the Natural Heritage Trust, LWA has been commissioned to explore better means to broker the exchange of knowledge and information between industries, researchers and catchment management bodies.
- Floodgate management and acid-sulphate soil. This project between the Sugar RDC, Fisheries RDC and LWA developed an understanding of, and management solutions to, the catchment (estuarine) impacts of drainage from acid-sulphate soils.
- Johnstone River. An early example of commodity collaboration (involving HAL, the Sugar RDC, Dairy Australia and LWA) to understand (and minimise) the movement of nutrients from farms to waterways.

Influencing other investors

A primary role for the RDCs is to deliver the best outcome for government and industry by co-ordinating and facilitating research and delivery investment.

The RDC collaborative partnerships provide gains in efficiency and effectiveness and work closely with CRCs, CSIRO, universities, State Departments and private sector organisations. The industry investment brings with it the networks that are vital for extension and adoption and provides other investors with confidence in the strategic importance of the work and in its application.

The RDCs represent an increasing proportion of rural research investment (e.g. the Grains RDC now accounts for half the total grains R&D).

Examples of RDCs influencing other investors include:

- The Cotton RDC has been a leading influence on the new Cotton, Catchments and Communities CRC, the Grape and Wine RDC has been an influential sponsor of the CRC for Viticulture, and MLA has been a major investor in the Tropical Savannas Management CRC.
- The National Program for Sustainable Irrigation includes co-investment from a diverse array of irrigation interests, ranging from commodities, CSIRO, State Departments, Water Authorities and catchment management bodies. Collectively, they have consequently helped to develop and promote the CRC for Irrigation Futures.
- The Grains RDC, MLA and AWI have been significant influencers on the activities of the CRC for Plant Based Management of Dryland Salinity, addressing recharge in the southern high rainfall zone, biodiversity decline and the management of saline lands.
- The LWA Riparian Management program pioneered research into the interaction between riparian management and river health to develop guidelines for riparian management. The program has tailored its knowledge to meet the needs of specific commodities including sugar, cotton, wool and dairy through their respective RDCs. In the process, it has engaged numerous research institutes, catchment management bodies, and State departments.

Delivering high returns on investment

Conducting a standard benefit:cost assessment on NRM projects is often difficult due to the lack of hard data linking a management change with quantifiable, broader environmental changes; and to the unpriced nature of many of the benefits that result. Nonetheless, there are methods available to manage these challenges, providing data that can be a useful adjunct to other evaluation measures. The collection of data and pre-experimental modelling conducted to test hypotheses about environmental outcomes can also help inform benefit:cost assessments.

Examples of investment analysis for some environmental projects are:

- Pesticide Management in Cotton. Cotton RDC, in conjunction with LWA and other bodies, developed best practice guidelines for growers to minimise their use of pesticides. It has enjoyed widespread adoption, with a significant reduction in pesticide use (from up to 11 kg/ha in the late 1990s to less than 2 kg/ha in 2005) and detections in streams (down from 35% of samples to 0% in NSW), generating an estimated net present value for the research of \$131 million.
- Integrated Pest Management to combat Citrus Jassid. The program had 100% uptake, resulting in a 95% reduction in damage to citrus, reduced chemical usage and savings of up to \$38,500 per hectare.
- MEDLI – Model for Effluent Disposal using Land Irrigation and related effluent projects. Australian Pork Ltd and LWA were among the investors in the development of models for the design of systems to store, treat and dispose of effluent in a sustainable manner. The collective work is estimated to have a net present value of \$105.5 million, a benefit:cost ratio of 5.4:1 and an Internal Rate of Return of 23%.
- Biocontrol of Paterson's Curse and thistles. Working with State Departments and other partners, the meat and wool industries have generated outcomes with a net present value of \$287 million and a benefit:cost ratio of 14:1.

- **Water Use Efficiency.** The collaborative National Program for Irrigation Research (NPIRD – a precursor to the current NPSI) invested in several water use efficiency projects that are collectively estimated to have a net present value of \$71 million, a benefit:cost ratio of 6:1 and an IRR of 47%.

For more information on means to apply economic evaluations to natural resources, see Making economic valuation work for biodiversity conservation (LWA, 2005) and Evaluating consequences of changes in farm and riparian management (Malcolm B, Dairy Australia, 2005). In addition, LWA will soon be making available (via its website) a number of evaluation reports that highlight benefit:cost analysis that effectively incorporate environmental aspects.

Appendices

Appendix 1. NRM R&D Framework - Definitions

Transforming Industries

Capacity Building

Building the capacity of individuals and industries can involve researchers, land managers and a range of private and public intermediaries to promote awareness, understanding and knowledge to permit the incorporation of sustainable approaches into farm management systems. It can involve participative research, training and education programs and events, the development of information products and the development and delivery of decision support programs (e.g. drought forecasting).

Market & Community Confidence

Developing and implementing programs to give communities and markets confidence in the environmental integrity of produce and the systems that generate it involves industries working with markets and governments; as well as with producers. It may involve QA, EMS or FMS styled accreditation programs and can help maintain access to inputs (e.g. to water) and markets, as well as freedom from alternative regulations.

Value Chain Management

Producers, processors, markets and communities may be interested in the value chain from farm to market; and optimising its environmental performance. Approaches such as strategic analysis (e.g. Life Cycle Assessments), improving the eco-efficiency of processing, transport or sales components of the value chain, and developing new uses for 'wastes' or byproducts will result in reduced overall environmental impact from the industry and the efficient use of resources.

Strategic NRM Planning

Industries need an appreciation of the longer term, strategic issues likely to affect production, market demand and the environment. It could involve activities such as futures thinking, the development and application of risk assessment protocols, or the development of strategic environmental plans. Outcomes will include increased sustainability and competitiveness.

Policies & Institutions

Investigating means to promote the adoption of 'best practices' may involve exploring and testing new policies, concepts or other instruments; and their application. Matters such as property rights, regulatory approaches, and ecosystem services may be relevant. Such work may also apply at the institutional level to understand how alternative structures and processes may interact.

Water

Water Use & Balance

Irrigation is a major user of water in Australia. Work to research and apply more efficient irrigation practices is important and is often linked to larger scale exercises to understand deep drainage and regional (or catchment) water budgets and water cycles. Research may also be conducted to better understand the environmental parameters to be considered in allocating water.

Water Quality

Nutrients and salinity are major 'contaminants' of surface and groundwaters. Investigating how different management practices impact on water quality (including pH etc) and the consequences of those impacts, helps to develop improved management practices.

Soil

Soil Landscape Processes

Understanding mass balances of nutrients and soil itself (i.e. erosion and deposition) is important to decisions about land use and management. It involves investigating or modelling the processes that shape landscapes in all regions (e.g. from arid landscapes to dryland farming or irrigation).

Soil Condition

The health of soils may be driven by many factors (e.g. salinity, acidity, nutrients, biota and water-repellence). Understanding how they interact, are influenced by management (e.g. the application of fertilisers), and influence production and the broader environment is fundamental to the design of sustainable farming systems.

Biodiversity

Terrestrial Biodiversity

Understanding the ecology of Australia's native species and communities, and threats such as pests and weeds, helps to develop sound management practices. It may include optimising the commercial value of native species (e.g. kangaroos or other 'bush-tucker'), as well as protecting their future. An element of such work may be aimed at a production or profit outcome; and could also include aspects promoting better performance of a 'duty of care'.

Fresh-Water Biodiversity

Generating knowledge of fresh water species and communities will help to maintain inland aquatic environments and to optimise any opportunities for the 'farming' of suitable species.

Marine Biodiversity

Research into the taxonomy, ecology and population dynamics of marine species and communities will help to manage their commercial harvesting and develop 'farming' techniques that are environmentally sustainable.

Atmosphere

Climate Variability & Change

Developing dynamic climate models and applied tools to aid decision making and future planning will help industries and individuals to accommodate the vagaries of Australia's climate.

Greenhouse & Energy

Investigating the contribution from different management practices of greenhouse gases, and trade-offs for energy consumption, to assist industries to develop sustainable production systems.

Invasive Pests, Diseases & Weeds

Sustainable Control Options

The sustainable control of pests, diseases and weeds involves measures to reduce the environmental impact of controls. It may include programs to reduce the use of chemicals or to optimise biological controls. Examples include the development of production systems and breeding varieties (either conventionally or via genetic modification) that will reduce the use and impact of chemicals in the environment, as well as exploring biological control options as alternatives to more environmentally harmful techniques.

Frontier Technologies

New Technologies for NRM Outcomes

Various new technologies may be developed to help achieve environmental outcomes. Examples include developing plants and animals to address environmental problems (e.g. new cultivars that are not only productive in saline soil but also help lower water tables or provide other ecosystem services) and the application of remote sensing (e.g. to monitor environmental condition).

Innovative Culture

Capacity Building Research

Designing programs to build the capacity and performance of land managers with regard to the environment may involve special research to understand the drivers of 'best NRM practice' adoption. The outcome from such research will be a better understanding of how land managers make NRM decisions and the consequent design of better capacity building programs.

Systems Science & Information

Farming Systems

Research projects that adopt a systems approach, considering the interplay between different farming practices, production (profit) and the environment. They will generally consider a range of variables and be above 'plot' scale in size; and may often involve modelling. Their aim is to develop new sustainable, farming systems. A percentage of effort may be directed to purely production goals.

Landscape Management

Integrated research projects that include production and environmental outcomes to examine how different land uses or management practices impact on catchment health and environmental processes (or ecosystem services). Social and economic aspects may also be involved. The projects will generally involve work at several scales and will often incorporate modelling. Communities, governments and industries, may be engaged, as well as land managers.

Appendix 2. Collaboration – Pros & Cons

What is collaboration?

Collaboration is not an end in itself. It is an important approach to research in certain circumstances – indeed, it is essential to tackle many complex problems – but it is not a universal solution in all situations.

Collaboration in research occurs at different scales and in various forms. It can range from informal interaction between researchers to large, formal programs of inter-related research. It can vary from getting a group of diverse interests together to scan their thoughts on issues and how they should be addressed; to establishing an interactive partnership between researchers and practitioners (e.g. farmers); to locking up a team of solicitors until they have settled the administrative structure required for a collaborative research program. Dovers & Price (in Hanna & Slocombe *Fostering Integration*) expand on the various forms that collaboration may take.

For the sake of this report, collaboration is taken to mean co-investment in research; either through parties investing via a common body or by aligning individual investments in a synergistic relationship. It is focused on collaboration involving RDC co-investments and other Commonwealth-funded bodies (such as CRCs) and, to a lesser extent, regional catchment or natural resource management bodies.

Why collaborate?

Collaboration can generate significant benefits, such as:

- increased efficiency and critical mass;
- ability to tackle complex problems; and
- improved quality of research and adoption.

Collaboration and co-ordination between RDCs and other stakeholders are seen as the preferred means to these ends, ahead of wholesale restructuring of R&D organisations. However, experience shows that collaboration also brings inherent costs and risks.

The benefits and costs can be summarised as:

Benefits of collaboration

- Ability to tackle complex problems (e.g. multi-disciplinary or multi-scale)
- Ability to access THE best researchers, generate critical mass and build research capacity
- Ability to be involved in programs beyond the capacity of sole investors
- Increased efficiency, less duplication, true synergies and better returns on investment
- Ability to share the risk
- Ability to access new networks and skill sets

Costs of collaboration

- Increased lead time and transaction costs
- Diminution of corporate badging, promotion to investors (e.g. levy payers) and direct control
- Cultural sacrifices, relationship management and internal & external communications
- Loss in focus and the development of complex arrangements that struggle to perform

- Failure due to a 'weak-link' outside of your control
- Risk of accepting the lowest common denominator (rather than 'spiralling to excellence')

As the number of partners increases there is an exponential increase in transaction costs and almost inevitable delays on project design and start-up. Agency self confidence and a need to highlight and attribute returns to levy-paying producers places a high value on direct control.

As commodity RDCs rely on periodic decisions about contributions from producers for their income, they understandably place a high value on their ability to meet (and be recognised as meeting) levy payer needs to maintain their support. Investments that dilute their recognition are less attractive.

RDCs that engage closely with their levy payers (e.g. through regional producer networks) may be limited in the extent they can make unilateral decisions to co-invest without alienating those networks. Similar issues may arise when tailoring general outputs to fit commodity specific extension programs.

Nonetheless, it is clear that in many circumstances those costs are outweighed by the benefits. Complex problems often require complex multi-party research. Collaboration can generate significant benefits and is occurring when organisations think it is the most appropriate response to the issues they face.

The concepts of 'ecologically sustainable development' and 'triple bottom line reporting' are examples of the approaches commonly employed that require collaboration to be effective. Their prominence, and the growth of 'systems' type research, reflects an underlying perception that many of the issues to be addressed for the future require an integrated (collaborative) approach. It is notable that there is concurrently, a trend toward more 'participative' research; engaging both researchers and practitioners. See Brown et al (2003) for more information on 'Practice Research Engagement'.

It has been suggested that collaborative, systems based research is required to tackle many of the complex problems industries now face.

References

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Appendix 3. Collaboration Checklist

How to get the most out of collaboration

To help determine when collaboration will be the most effective course and to plan appropriate responses to associated issues, it is necessary to consider options from several perspectives:

- identify the research questions that ‘demand’, or would benefit from, collaboration;
- build partnerships (relationships) with appropriate potential collaborators;
- ensure proposed management arrangements are adequate; and
- re-affirm the willingness of potential partners to commit to collaboration.

The following checklist (developed by the Joint RDCs NRM Working Group) helps organisations decide when collaboration would be attractive (with the transaction costs outweighed by the benefits) and provides clues on how to manage the challenges of collaboration for optimal outcomes.

Collaboration Checklist

1. Problem definition: Does the issue suit collaboration?

- Complexity – does it require multi-disciplinary, cross-scale or high-risk research; involving various stakeholders (e.g. community)?
- Significance – does the size and duration of the research warrant collaborative infrastructure?
- Broad Interest – does the research have broad (generic) application; is it of interest (and potential advantage) to more than a single entity?

2. Partnership profile: Which other suitable, trusted partners may be interested?

- Objectives – are there clear, understood, valued and compatible expectations and desired outcomes between potential research partners?
- Resources – are there adequate, and complementary (non-competitive) resources and skills available?
- Leadership – does each partner have an effective internal champion; and is there a suitable, agreed program leader?
- Cultures & Processes – are the differing cultures and processes of each partner understood and accepted?

3. Management agreement: Will management be fair and effective?

- Recognition & Reward – will all participants (researchers and organisations) be adequately recognised and effectively rewarded for their input?
- Control & Influence – is there an appropriate balance between input and ability to manage or influence the investment?
- Managing Differences – are there means to raise and address management issues and scientific differences as they arise?
- Program Development – are potential partners willing to invest in (and accommodate an uncertain outcome from) a program scoping / development phase?

4. Justification: Will returns outweigh the transaction costs?

- Priority – does the proposed research address a mutual, high priority issue; and still remain relevant to individual needs?
- Efficiencies – will it generate outcomes or returns that exceed the ability of an individual organisation?
- Resources & Risks – will it attract funds and manage (or share) risks better than an individual organisation could?
- Expertise – will the proposed research attract a mix of researchers, facilities and 'extension' services beyond the capacity of an individual organisation?