GRDC Grains Research & Development Corporation

Submission
to the
Productivity Commission
Inquiry into the Australian Government
Research and Development Corporations Model

June 2010

TABLE OF CONTENTS

SUBMISSION SUMMARY

There is a strong economic and policy rationale for Australian Government investment in rural research, development and extension (RD&E). The economic rationale is based on the externalities associated with rural RD&E, in which **benefits are generated beyond the farm gate**. With respect to grains, these include greater certainty of the timing and volume of yields for marketers and traders, reduced soil erosion associated with 'no till' planting, and improved health outcomes associated with reduced spraying and the higher nutritional quality of grains. **Continued public funding support reduces the risk of 'under investment' in the RD&E that generates these external benefits.**

The policy rationale is based on a consideration of the conditions facing Australia's rural industry compared to those in other industries and in other countries. For example, **entities within Australia's agricultural sector are overwhelmingly small partnerships**, rather than large corporations. This means that they are **not eligible for some of the forms of R&D support** that play a much greater role in other industries (such as the R&D Tax Concession). At the same time, Australia's rural industries compete in the global market with the rural industries of other countries — many of which receive direct funding support or subsidies from their governments. While there is no country in the world that does not extend some form of assistance to its farm sector, **the level of direct support in Australia — with the exception of drought relief — is extremely small**. **A significant share of the support that the rural sector receives from the government is through support for RD&E**, which generates benefits on farm, across the industry and to the public as a whole in a way that direct support would not do.

Australia's rural Research and Development Corporations (RDC) model is one of the most effective ways of delivering rural RD&E outcomes, using the combination of industry and Australian Government funding. In this space, **RDCs identify, prioritise and coordinate the RD&E needs of multiple stakeholders across jurisdictions and regions**, and in the case of the GRDC, play a major role in minimising duplication and filling gaps in the rural R&D system. In addition, RDCs have developed close ties with primary producers and with researchers, which means that they are ideally placed to **identify research needs of industry and government and match these with the relative strengths and knowledge bases in the research community** both in Australia and in the rest of the world.

The mix of funding that RDCs draw on, and the relative contributions of industry and government, would ideally be reconciled with the benefits generated by RDC funded research. **It is not easy, however, to identify where the line is drawn between benefits on-farm and to the public** — for example, improved environmental outcomes are a public benefit, but they also prolong the life of growers' land and water assets. In addition, **public funding support generates benefits that go beyond the externalities associated with rural RD&E**. For example, having a single organisation coordinate the research that generates benefits both on-farm and to the public is more efficient than separating these functions. This is particularly so given that **nearly all RD&E investment has some broader community benefits and where often it is efficient for public benefits to be achieved through the industry interfaces of the RDCs** — such as the research implementation and extension work.

Similarly, another indirect and intangible benefit of public funding support is that the **Australian Government obtains a voice in setting RDCs' research priorities**. This is evident in the way in which all RDC funded projects are tied to the National Research Priorities and to the Rural Research and Development Priorities. In addition, the **Australian Government can set out requirements for the administrative and governance arrangements that the RDCs operate under**. As a result, concerns about the

appropriateness of the funding mix — and the way in which it aligns with the **distribution of benefits generated by RDC-funded research — can be directly addressed through government input** into the investment planning and prioritising process, and through clearer administrative and reporting guidelines on research impact analysis and evaluation.

As the Productivity Commission itself has identified in its Issues Paper, **there is strong evidence that the RDC model generates effective outcomes with respect to improved competitiveness and productivity**. In the case of the grains industry, given the small economic size of individual growers, **many of the gains from improvements in competitiveness and productivity are captured by operators further along the supply chain** due to the greater market power that traders, marketers and exporters have compared to growers. Ultimately, these **gains are passed on to consumers in the form of lower prices and greater product diversity**. In light of this and the other externalities associated with rural R&D, the current funding levels and arrangements are considered appropriate, although there is some scope for improvement to the RDC model.

THIS SUBMISSION

The structure of this submission follows the structure of the Productivity Commission's Issues Paper and includes three appendices containing supporting information. The first appendix contains the terms of reference for the Productivity Commission inquiry, and indicates the sections within this submission that provide analysis and support for the conclusions presented in this summary. The second provides evidence from the international organisations that the GRDC has worked or collaborated with that demonstrates their recognition of the strengths of Australia's RDC model. The third appendix is an independently prepared Impact Analysis Framework, commissioned by the GRDC from the Allen Consulting Group, which **analyses the GRDC's research portfolio and assesses the mix of expected beneficiaries from GRDC-funded research against the sources of funding for the GRDC**.

ABOUT THE GRDC

The Grains Research and Development Corporation (GRDC) is one of the world's leaders in grains research activity, and is responsible for planning, investing in and overseeing RD&E, delivering improvements in production, sustainability and profitability across the Australian grains industry. GRDC is a statutory corporation, founded in 1990 under the *Primary Industries and Energy Research and Development Act 1989* (PIERD Act), it is subject to accountability and reporting obligations set out in the Commonwealth Authorities and *Companies Act 1997* (CAC Act). The GRDC's portfolio department is the Australian Government Department of Agriculture, Fisheries and Forestry (DAFF).

The GRDC's mission is to invest in research, development and extension (RD&E) activities for the greatest benefit to its stakeholders — grain growers and the Australian Government. The GRDC links innovative research with stakeholder needs. The GRDC's vision is for a profitable, internationally competitive and ecologically sustainable grains industry.

The GRDC's research portfolio covers 25 leviable crops[1] spanning temperate and tropical cereals, oilseeds and pulses, worth over $7 billion a year in farm production, alone. The GRDC operates as a research investment body in partnership with growers and Government.

[1] Leviable crops consist of coarse grains (barley, oats, sorghum, maize, triticale, millets/panicums, cereal rye, and canary seed), pulses (lupins, field peas, chickpeas, faba beans, vetch, peanuts, mung beans, navy beans, pigeon peas, cowpeas, and lentils) and oilseeds (canola, sunflower, soybean, safflower, and linseed).

Funding is provided in part through a levy on grain growers. The levy rate is recommended to the Minister for Agriculture, Fisheries and Forestry each year by a designated representative organisation, currently the Grains Council of Australia (GCA). The Australian Government matches this funding, up to an agreed ceiling. In practice, approximately two-thirds of the GRDC's funding comes from the grower levy.

The GRDC derives its functions, powers and objects from the PIERD Act. This enabling legislation provides the foundation for the GRDC's accountability to the Australian grains industry and to the Australian Government for securing the greatest possible returns.

1. RATIONALE FOR GOVERNMENT FUNDING SUPPORT FOR RURAL R&D IN AUSTRALIA

1.1. OVERVIEW

There is a strong rationale for government funding support for rural RD&E in Australia. This is because there are characteristics of the rural sector that make market failure more likely than in other sectors of the economy.[2] Some of the reasons for this include the high potential for free-riding among growers given that there are a large number of small enterprises that produce and sell a homogenous product, and that there can be long lead times between when research is conducted and when the benefits are fully realised.

All successful RD&E generates benefits external to those who funded the expenditure. It can be argued that even unsuccessful research generates benefits to others, since it provides an insight into what does not work and which research pathways are unprofitable, which prevents subsequent researchers from wasting their efforts on similar ventures. Wherever there are such external benefits there is a risk of market failure — either important outcomes for the community are not achieved or private benefits are achieved at public expense. Expenditure on RD&E can also be sub-optimal as those who pay for the research may fund it only up to the point at which it benefits themselves rather than the whole community.

In the case of grains, the industry levy directly addresses these market failures by coordinating funding across growers. Moreover, there are benefits associated with GRDC-funded research activities that accrue to parties other than the growers themselves. Some of these benefits arise from the strong linkages between benefits on-farm and to the community more widely — particularly with respect to land stewardship and natural resource outcomes — while others are due to operators along the supply chain being able to bargain away or capture the savings associated with productivity improvements on-farm.

1.2. CONSIDERATIONS SPECIFIC TO RURAL RESEARCH

The security of the food supply is a national as well as a global concern. The last few years have seen strong growth in populations and in incomes across the world, which has led to growth in the global middle-class and through it, growth in the demand for food. At the same time, there are limits to the extent to which the supply of food can be increased simply by using more inputs such as land, labour and capital. Productivity growth in primary industries is crucial to ensuring that the increasing demand for food is met, with food remaining reasonably affordable and accessible. In the absence of regulatory intervention or public support, this burden would be placed almost entirely on the rural sector. Largely in recognition of this, almost all countries provide some level of support to enterprises in the rural sector and there are many forms that this public support can take. One such form is through the provision of direct support to the rural sector, such as redistributing income and wealth via taxes and subsidies. Many countries have adopted this approach, including developed countries such as the USA and much of Europe.

In addition to market failure, continuing productivity and innovation challenges are likely to be effectively met through providing an environment for a coordinated approach to RD&E

[2] The concept of 'market failure' is not defined in the Issues Paper for this inquiry. For this submission, the definition used is taken from the Office of Best Practice Regulation's 2007 *Best Practice Regulation Handbook*, where market failure is defined as 'a situation in which the free market fails to generate an efficient outcome or maximise net benefits. Examples include information asymmetries, externalities and natural monopolies.'

that connects research institutions and encourages them to be more involved. To ensure efficiency, the government has an important role in the coordination of the rural R&D system and in ensuring that demand-led approaches are used to generate new knowledge, which is in turn translated into viable innovations.

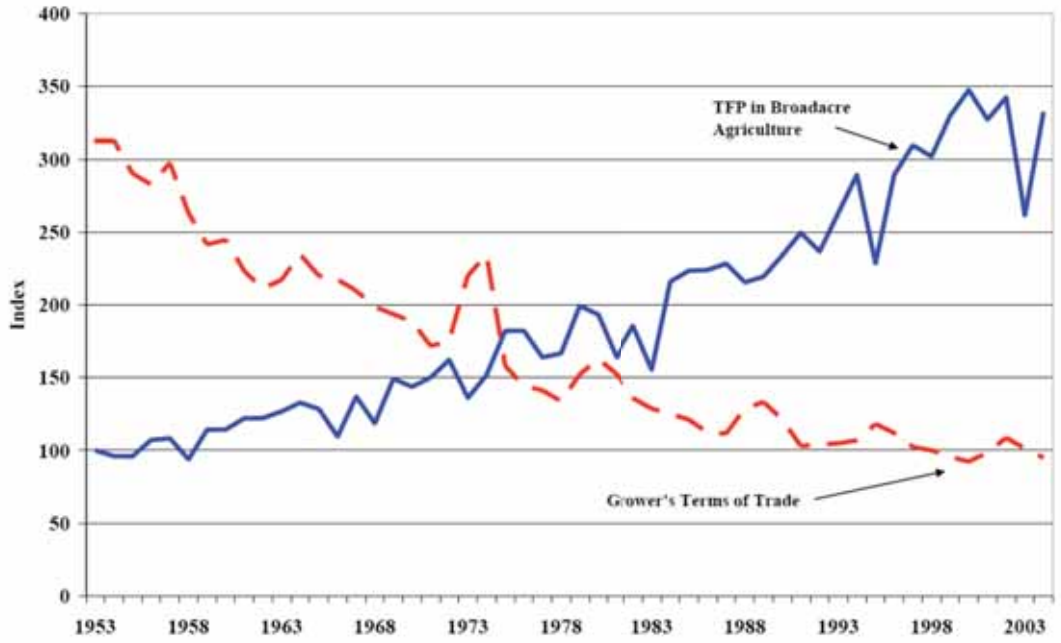
Unlike in many other developed countries, in Australia there is little in the way of direct assistance to the rural sector (with the exception of drought relief). Instead, most of the support extended to the rural sector is through public support to rural RD&E. The Australian Government recognises the risk of under-investment in private expenditure on R&D in all industries, and provides funding support to mitigate this risk. One of the mechanisms by which this is done is through the R&D Tax Concession, however, the overwhelming majority of growers are partnerships, rather than corporations, and are therefore ineligible to claim the Tax Concession. In addition, with respect to grains in Australia, a large number of growers are small price-takers in a perfectly competitive market and cannot easily or meaningfully differentiate themselves or their products in the marketplace. One of the consequences of this is that these individual growers are limited in their ability to fully capture the benefits associated with innovative practices or farming systems. It is critical that the following issues are addressed in the market for rural research in Australia:

- Individual growers are unlikely to have the necessary information or perspective in order to be able to identify, coordinate and prioritise research needs for the sector appropriately, particularly across regions, jurisdictions, crops and over time, to fill gaps and to minimise duplication.
- Growers' income streams are highly volatile since revenue is dependent on yields and profits, which in turn depend on unpredictable external factors such as rainfall, climate variability, outbreaks of pests, exchange rates, and world prices for grains. This makes it difficult for individual growers to plan for and manage the payments associated with commissioning RD&E.
- There are scale and market power disadvantages associated with the structure of growers in Australia, which have implications for the ability of the vast majority of individual growers to negotiate with researchers, or manage milestones and quality assurance.
- Growers are also geographically dispersed, meaning that they are not directly connected to the institutions that actually carry out the RD&E. This results in individual growers being poorly placed to initiate, negotiate, manage and verify research outputs even if they are willing or able to fund them.

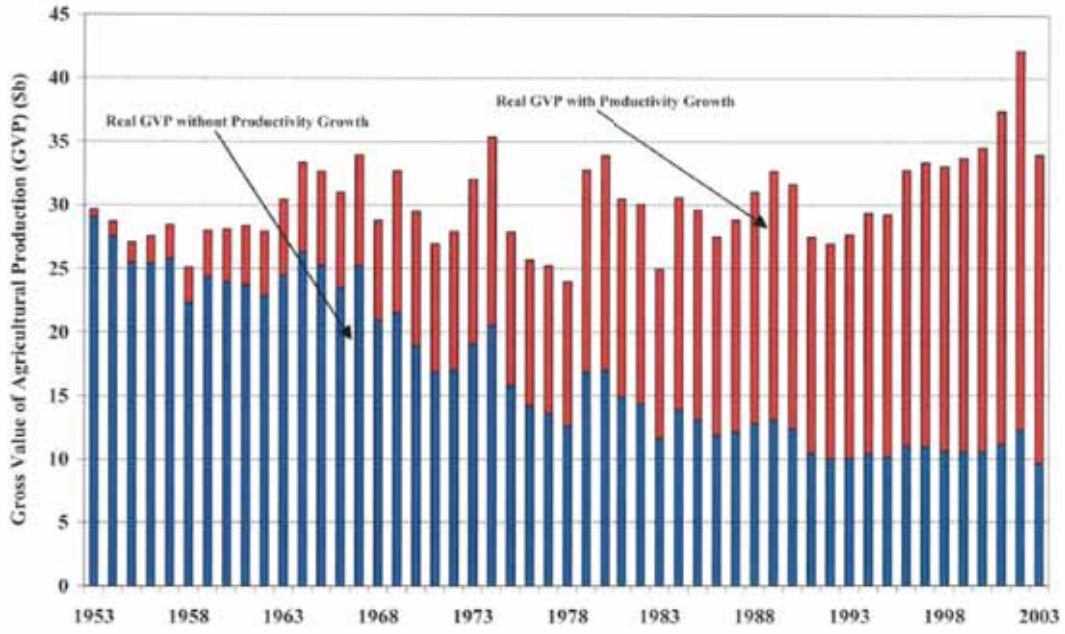
In the grains industry, these market and coordination failures are addressed to some extent by the statutory levy that is collected from growers and used to fund the GRDC. At the same time, there are benefits from GRDC-funded RD&E that accrue to beneficiaries other than the growers themselves. This is illustrated by the decline in growers' terms of trade (measured as the price of what growers sell divided by the price of what growers buy) in the same period that total factor productivity in broadacre agriculture grew, as shown in Figure 1.1.

Figure 1.1

TOTAL FACTOR PRODUCTIVITY AND TERMS OF TRADE, 1953-2003



REAL GVP AND TOTAL FACTOR PRODUCTIVITY, 1953-2003



Source: Mullen, JD & Crean, J 2007, *Productivity Growth in Australian Agriculture: Trends, Sources and Performance. Research Report*, Australian Institute, Surry Hills, Australia.

In addition to this traditional argument about externalities and market failures inherent in the conduct of RD&E in general, there are a number of further considerations that are specific to rural research. These relate to the characteristics of the rural industries in Australia, the imbalance of market power between growers and research institutions, the imbalance of

market power between growers and supply chain partners, myopia on the part of private investors who may need to justify their investments with short-term gains, the difficulties in attributing benefits to the research that generated them, particularly when such benefits may not be fully realised within the same generation, and the strong linkages between benefits on-farm and to the community more widely. If there were no organisation playing a coordinating role, there are a number of potential adverse outcomes, which include:

- The livelihood of growers and the productivity of the industry have strong linkages with the sustainability of the land, water quality and other natural resource management considerations. For example, more robust crop varieties lead to less spraying for weeds and pests which reduces costs to growers but also generate improved environmental and health outcomes. An example of a GRDC-funded research project that demonstrates these inter-linkages particularly strongly is shown in Box 1.1. However, all of GRDC's projects generate a combination of benefits to growers as well as the community more widely — it is just the proportion of public to private benefit that varies across projects.

- For some projects, there are long lags between the initiation of research and the realisation of benefits. Even there, the attribution of benefits to research that generated them can be complicated by the external factors and volatilities noted above. For example, the analysis of the observed decline in the rate of productivity growth in the farm sector must take into account the impact of the drought, and climate variability.

- Related to the above is the fact that compared to other countries, Australia has a unique, drought prone climate and our status as an island nation means that quarantine arrangements are also unique. As a result, crop varieties or farming systems developed by researchers in other countries are usually not directly applicable to growers in Australia, and large, multinational grains researchers have little incentive to adapt their products for use or take-up in a relatively small market like Australia.

- Relative to other industries, international markets for agriculture are highly distorted by subsidies and other forms of domestic assistance to growers in other countries. As estimated by the OECD, the level of assistance that growers in Australia receive from the government is very low when compared to assistance provided by its trade partners, and aside from drought assistance, the input that the rural sector *does* receive from government is support for RD&E, rather than direct assistance or cash handouts.

- Government funding in rural RD&E is important: to the economy; to maintaining capacity in the research community, amongst growers and through industry jobs creation and maintenance; and in sustaining rural communities. For example, some research bodies have the GRDC as their only or principal funding source. Government funding is a catalyst for private investment in rural RD&E —without public support private investors would invest less as the information stocks that they draw on would be in decline. They would not increase the information stocks themselves, due to their inability to capture adequate benefits. The offer of public funding support (up to a defined maximum) provides an incentive to growers to agree on a non-zero levy in order to obtain the benefit of the matched contribution from government. If public support is withdrawn, there is a risk that growers will opt for a zero levy.

Box 1.1

CARING FOR OUR COUNTRY — GRDC FUNDING OF $6 MILLION OVER 4 YEARS

Program description

Mixed farmers account for the majority of broad-acre landholders in Australia and have a large accountability for current management practices due to the need to balance the mix between feeding livestock and maintaining adequate ground cover levels to minimise erosion. Ground cover levels of at least 50% are needed to minimise wind erosion, and at least 65% to minimise water erosion. This program aims to provide greater confidence in decision-making and influence change on-ground to manage this risk by supporting a farming system that is losing the skills, knowledge and infrastructure to be sustainable. The proposed program will focus on a broad range of sustainable resource issues, as well as those that influence productivity and profitability. The sustainable land management practices of focus within this program are diverse, and include stubble retention, use of perennials, more effective use of rainfall, enhanced grazing management, nutrient use efficiency, use of fodder crops, effective use of non-cropped land and other facets of the farming system. This partnership approach between the Australian Government's Caring for our Country and the GRDC aims to provide the capacity and networks to research, demonstrate and extend to mixed farmers the adoption, measurement and evaluation of those key farming practices that positively impact on whole farm biomass production, wind and hill slope erosion control, soil carbon and on-farm biodiversity.

GRDC's role

GRDC facilitated the integration of 6 universities, 18 NRM bodies, 23 grower groups, 5 State Departments of Agriculture or Primary Industries, 3 divisions of CSIRO and Agribusiness into a single, focussed application for Caring for our Country funding. The application was successful and GRDC is supervising the initiative. GRDC has recognised the need to have a clearly articulated plan to address environmental issues associated with grains production. This resulted in the development of 'A responsible lead: An environmental plan for the Australian Grains Industry'. The plan is based on accepted principles of ecologically sustainable development and examines the risks and opportunities of 8 environmental issues across 14 agro-ecological zones. The Caring for our Country program addresses key issues identified in the environmental plan while also contributing to growers' bottom line.

Outcomes

Through this partnership the program will achieve improved production and management of whole-farm biomass and other farm practices leading to reduced soil erosion, enhanced soil carbon and improved productivity by: increasing uptake of management practices that reduce wind and hill-slope erosion, and increase soil carbon storage; and increasing landscape scale biodiversity through improving planning and management. These outcomes will be based on improved skills and capacity of mixed farmers and advisors to better adapt to changing circumstances

Benefits — on-farm

Decreased soil erosion contributes to long-term sustainability as well as short and long term productivity.

Stubble retention, while contributing to soil erosion control, also impacts on moisture conservation, which can have a significant effect on yield.

Better matching land use to land capability provides the opportunity to increase productivity by minimising inputs into less productive areas.

Increased biodiversity on-farm can have potential positive impacts on production through providing habitat for beneficial insects.

Benefits — industry-wide

As consumers become more discerning, a number of companies are adopting sustainability initiatives to demonstrate their environmental credentials.

Benefits — public

Decreased soil erosion contributes to community benefits by decreasing the number and severity of dust storms with accompanying health and economic benefits. Lower soil erosion also contributes to minimising pollution of waterways with soil and associated fertilisers and pesticides.

Better matching land use to land capability provides the opportunity to minimise inputs into less productive areas thereby minimising the use of pesticides and manufactured fertilisers.

Increased biodiversity on-farm can have potential positive environmental impacts through the identification of land areas for protection as natural buffer zones.

Increased long-term production capability of land enabling food production for future generations.

1.3. OTHER CONSIDERATIONS

It is well recognised that rural RD&E is different to research and development in manufacturing or in services. This recognition is embodied in Australian Government policy such as the Rural Research and Development Priorities, and the National Research Priorities, and of course, the creation of the rural RDCs. Under these circumstances, there are a number of other rationales for government support for rural RD&E, which are not necessarily specific to rural RD&E, but which are relevant all the same.

The first is that by providing co-funding support, the Australian Government has a voice in how RDCs are run, and how research, development and extension are prioritised across the portfolio. Rural research, development and extension work is critical to improving productivity and addressing sector wide issues such as adaptation to climate change, increased global competition, furthering food and bio-security objectives, improving food security and fostering regional development. These issues are fundamental to the long-term sustainability of the agrifood industry in Australia. Given the way in which private and public benefits are intertwined, if government funding was to be reduced, RDCs could be expected to focus their research efforts on RD&E that was more heavily weighted to generating on-farm benefits, or short-term outputs (for example, the Home Grown Cereals Association in the United Kingdom, which is funded solely through an industry levy, and which focuses primarily on research with short-term goals). The provision of Australian Government funding provides RDCs with the ability to fund projects that generate relatively more industry or public benefits than on-farm benefits — in the absence of public funding, RDCs may not be able to secure levy-payers' approval for projects with high potential for benefits post farm gate.

Secondly, by being a stakeholder in RD&E, the Australian Government is in an ideal position to ensure coordination between various parts of the rural R&D system. This mitigates the possibility of systems failure where RD&E activity does not translate to productivity increases.

Thirdly, improvements in productivity on-farm have implications for the security of the food supply — both within Australia, and in the rest of the world given Australia's status as an exporter of grains. Recently, forecasts of rapid population growth and uncertainty surrounding production and yield in times of drought, floods, and a changing climate, as well as the expanding use of grains beyond food and into fuel, have raised questions regarding international food security. This means that there may also be implications for national security, particularly if Australia has a secure food supply while other countries do not. By providing public funding support to rural RD&E work — rather than direct assistance — Australia is able to export some of the outputs of this RD&E to other countries so that they can implement more efficient or innovative practices.

Related to this is the fact that there has been an observed decline in productivity growth in agriculture, as reflected by a decline in the rate of TFP growth — 'recent data suggest that, similar to other developed countries such as the United States, Germany and the Netherlands, productivity growth in Australian agriculture may have slowed. In particular, the long-term annual growth rate of productivity in the broadacre cropping and livestock industries has declined from 2.1% between 1978 and 1999, to 1.5% between 1978 and 2007'.[3] This decline in productivity growth has been linked to the reduction of public funding support. From a risk management perspective, further reducing public funding could

[3] Sheng, Y., Mullen, J. D. and Zhao, S. 2010, Has growth in productivity in Australian broadacre agriculture slowed? ABARE, Canberra.

have serious consequences for productivity outcomes, and yet these outcomes may not be realised until twenty or thirty years into the future.

The fourth rationale for government funding support is also linked to the decline in productivity growth. Another reason given for the decline — in addition to adverse climate conditions and the reduction in public funding — is the ageing of the workforce in the agricultural sector, and concerns about the sustainability of Australia's rural communities. Rural communities are experiencing a drain on human capital as young people opt to move to and work in the metropolitan centres. As a result, human capital (in the form of good farming practice or efficient techniques) is not being passed down from one generation to the next as reliably as it was in the past. Furthermore, there is as yet no knowledge transfer mechanism that has been developed to fill this gap (see Box 1.2 for more on this).

Box 1.2

GENERATIONAL IMPACTS ON FARM PRODUCTIVITY

ABARE has recently analysed the relationship between operator age and productivity (Zhao et al. 2009). This study found productivity was highest for farmers between 55 and 60 years old. This may reflect the accumulation of skills and knowledge useful for the operation of a cropping enterprise.

The study also found that, while the productivity of younger farmers was relatively low, the growth of productivity of this group was much higher than for older farmers. Accordingly, increases in the skills and knowledge of relatively young farmers will have the greatest effect on overall productivity growth.

It was also argued that more young people contributed indirectly to productivity growth by encouraging older producers to invest in new technology. While the extent to which this argument is relevant for the grains industry is difficult to measure, it fits with the suggestion that factors other than profitability are an important determinant of productivity performance.

Source: Jackson, T 2010, *Harvesting Productivity: a report on the ABARE-GRDC workshops on grains productivity work*, ABARE, Canberra, Australia.

The fifth rationale, also related to productivity, is that on-farm productivity and natural resource outcomes are closely interlinked. While this point has been raised already, it is particularly relevant in light of the fact that the United Nations' Food and Agriculture Organisation has identified on-farm activities as having the greatest potential for climate change mitigation and adaptation. In addition, there are clear stewardship outcomes, with growers reinvesting productivity gains back into the land to ensure the sustainability of their farms — by reducing wind erosion, acid soil, salinity and water quality. All of these things are environmental and social benefits, but because they are tied to growers' assets, the public and private benefits are strongly interlinked.

Finally, there is the issue of funding research for which the benefits accrue to supply chain partners rather than to growers, or to the wider community. Benefits to growers are covered off by the industry levy, and benefits to the wider community are covered by the co-funding from government. Currently, however, there is a funding gap for benefits that accrue to supply chain partners. The GRDC addresses this issue by identifying supply chain operators such as bulk handlers, marketers, exporters and so on, and obtaining a contribution for the research. While this works well for the GRDC, it may not be possible for some of the other RDCs. Requiring supply chain partners to pay a levy to fund the research is one way of addressing this funding gap. However for practical purposes, it may be difficult to identify who should pay the levy, and how much should be paid, although the Home Grown Cereal Authority in the United Kingdom does levy traders and end users, and presumably is able to achieve appropriate compliance. The public funding support given to RDCs addresses this issue in a cost-effective way, overcoming the difficulties associated with identifying supply chain partners, calculating their share of any levy, and ensuring that it is correctly measured and collected. This is since there is a risk of double-counting a levy on the supply chain since

grain is traded between operators as it moves along the supply chain, and the same volume of grain may be levied more than once.

1.4. THE NEED FOR A LEVY

For all of the reasons discussed in sections 1.2 and 1.3, some form of intervention is needed to address the strong potential for market and coordination failures associated with rural RD&E in Australia. The statutory levy addresses these problems in two ways. The first is that it minimises the free rider problem — individual growers cannot offer a differentiated product, and so there is little benefit to RD&E that individual growers can retain for themselves. Requiring all growers to pay a levy ensures that anybody who can benefit from the research has paid for it.

The second way in which the levy promotes efficient outcomes is through the manner in which growers take up the benefits of research and implement them on-farm. Since growers are required to pay a levy, a profit-maximising levy payer will want to get the most that they can out of the research that they fund. Requiring growers to pay a levy provides them with a strong incentive to engage in the RD&E process and engagement improves the rate of take-up of GRDC commissioned findings — both of which have implications for productivity and sustainability. GRDC's Regional Panels operate in order to provide growers with a forum through which they can be engaged at all points along the process, from identifying research needs, to providing updates on progress, to handing down and implementing findings.

That being said, the levy funding is only appropriate in cases where an investor cannot fully or mostly retain the private benefits associated with grains research. The GRDC regularly evaluates its research programs. In cases where it is clear that there are strong *private* benefits to the research, the GRDC assess whether these benefits can be fully or mostly captured by individual entities (for example, through the formal recognition and protection of intellectual property) with minimal spillovers within the industry or to the public more widely. Where these circumstances are accompanied by adequate market size to allow competition, or where there is a low risk than an individual entity can gain or exploit monopoly power, these programs are transitioned out of the GRDC's research portfolio and over to the growers directly. An example of one such program is wheat breeding, as shown in Box 1.3.

Box 1.3

CASE STUDY: WHEAT BREEDING

Until 2001, wheat breeding in Australia was publicly funded and embedded within the state departments of agriculture and universities. The GRDC's role used to be to co-fund State-based wheat breeding programs. The main incentive in breeding programs was to commercialise varieties. This did not necessarily mean that varieties needed to be accepted by growers and the industry more broadly, because breeding investment was not linked to how well new varieties performed. Additionally, investment in breeding needed to grow faster than what the stakeholders could realistically sustain.

With the advent of End Point Royalties (EPRs) the GRDC and others realised that there was an opportunity to transfer public wheat breeding to the private sector (at least the closer to market aspects of applied breeding) and have efficiencies driven through competition. The GRDC worked through the options with State agencies until a future scenario was agreed and helped put a transition process in place providing support for restructuring.

As a result, the past decade has seen radical changes in the structure and ownership of wheat breeding in Australia, all aimed at the rapid production and subsequent adoption of superior varieties. It takes an extraordinary breadth of knowledge and skills, including scientific, agronomic, organisational and business skills, to develop a product with superior genetic makeup.

Because product development and testing may take up to eight years from first crossing to the release of a new variety, wheat breeding is a commitment for the long term. Wheat breeders must therefore have a reliable source of income to sustain their breeding operations.

However, mounting pressure on available public funding required rationalisation of these breeding operations. This was achieved by:

- merging the many small and local breeding programs into fewer, more cost-effective entities with the ultimate goal to be self-sustaining and serving a national client base; and
- continuing to attract private investment and technology.

As a result Australia now has an environment that supports world-leading, best-practice wheat-breeding activities, which will be sustained through a robust value capture system and where competition will drive efficient use of resources.

The transition from publicly funded breeding organisations to commercially operating breeding companies was possible with the introduction of the *Plant Breeder's Rights (PBR) Act* in 1994, which granted proprietary rights to breeders for their varieties.

2. IS THE RDC MODEL FUNDAMENTALLY SOUND?

2.1. OVERVIEW

Given the flexibility around structure, governance, research portfolios, and funding inherent in the RDC model, this section discusses the features of the RDC model as they apply to the GRDC, rather than to the RDC model more generally. The model is set up so that the RDCs manage and commission research rather than undertaking the research themselves (as is the case, for example, with Cooperative Research Centres). Having a single industry defined body to coordinate research on a national level means that the industry's and government's needs can be identified and prioritised across: types of crops; regions and jurisdictions; RD&E work; National Research Priorities, Rural R&D Priorities, the needs of growers; and projects that have a short, medium or long term focus. The existence of a single industry body such as the GRDC directly addresses the issues noted in the previous section in relation to the small size of individual growers, and their lack of market power with respect to research institutions and operators along the supply chain. For example, the GRDC can manage research milestones and payments, coordinate funding to ensure a smooth expenditure flow in spite of booms and busts in the agricultural sector, and manage, purchase or introduce international intellectual property on behalf of growers as a whole.

Another strength of the model is that the GRDC manages research, rather than undertaking research itself, so that the research portfolio is flexible and responsive to emerging trends and issues, with funding being able to be allocated to concerns before they become critical. Managing, rather than undertaking, the research means that the GRDC regularly engages with the research community, and has a strong knowledge of the researchers, their strengths and weaknesses are, and what they are working on. This puts the GRDC in a very strong position to take a 'big picture' view of grains research in Australia, and facilitate research coordination — particularly given that there is a wide range of diverse researchers whose individual research focus can often be quite specific Having an RDC purely manage, rather than undertake, research also minimises the risk of conflicts of interest — which may occur, for example, if the funding were managed by a research institution that wanted to undertake certain projects itself rather than allocating them externally to where they might be completed to a higher standard. Other countries — in particular, Canada and the USA — have recognised these strengths of the RDC model, and noted that they would seek it replicated elsewhere.

The function of the rural RDCs is defined in Section 11 of the PIERD Act. This defines the role of an RDC as being (amongst other things):

- to investigate and evaluate the requirements for research and development in relation to the primary industry or class of primary industries in respect of which it was established;
- to coordinate or fund the carrying out of research and development activities that are consistent with the annual operational plan prepared by the RDC and in force at the time; and
- to facilitate the dissemination, adoption and commercialisation of the results of research and development in relation to the primary industry or class of primary industries in respect of which the RDC was established.

Given the various market and coordination failures associated with rural RD&E, there is a critical role to be played in terms of identifying and prioritising the research needs of

growers, identifying agricultural researchers and managing their output, managing funding to maintain a smooth expenditure flow in light of a volatile revenue stream, assessing the impact of implemented research and verifying its quality, and finally, addressing the traditional forms of market failure associated with research and development. This role is filled by the GRDC with respect to the grains industry in Australia.

As discussed in section 1 of this submission, the public and private benefits of rural research are strongly interlinked. As much as anything else, RDCs play a role in connecting 'public benefit'-driven research with tangible outcomes by facilitating their take-up through industry interfaces. These industry interfaces link the public good outcomes (for example, improved health or environmental outcomes) with direct on-farm benefits such as improved profitability and productivity. In the absence of this interface, the ability to achieve practice change for public benefit outcomes would be severely hampered. In this way, RDCs are ideally placed to act as a translator between government and industry, to ensure that the appropriate research outcomes are identified in the investment planning, and then that those outcomes are implemented on-farm.

All of the projects that are funded by the GRDC are linked to Australia's National Research Priorities, as well as to DAFF's Rural R&D Priorities. In so doing, GRDC-funded research achieves outcomes that are in the national interest as well as those of the individual levy payers.[4] In addition, the GRDC plays a major role in the coordination of grains research in Australia more widely, with the most significant example being its input into the development of the Grains National RD&E Strategic Plan.

2.2. STAKEHOLDER ENGAGEMENT AND REPORTING

The GRDC has embraced a range of mechanisms to assist in aligning its RD&E investments with the priorities of its key stakeholders — grain producers and the Australian Government. The current mechanisms provide effective identification of the issues, however, detailed analysis is required to determine whether the issue is best addressed through research, development or extension. In recognition of this, the GRDC is in the process of reinvigorating its engagement with multiple parties (growers, grower groups, government, consultants, resellers and researchers). This is so that the GRDC can accurately formulate the RD&E questions associated with the problems or concerns that stakeholders identify with respect to constraints on grains productivity and sustainability. In this way, solutions to these problems can be targeted more precisely, and generate stronger outcomes once they are implemented. As part of this process, the GRDC has identified the need to provide feedback to these parties regarding the action, if any, being considered in response. A greater understanding by all parties of the issue, the outcomes desired and the relative roles of research, development and extension will not only ensure that gaps in investment are addressed but also provide greater transparency in GRDC investment processes.

Clear communication is essential to identify and prioritise research needs, as well as to translate new knowledge to benefits across the industry and ensure best practices are integrated into farming systems and grower programs quickly. Given the recent, long standing drought, and the uncertainty about how climate variability and adaptation will be managed, the grains industry is currently going through a period of adjustment and growers' profitability is relatively low. In addition to this, the price of grain received by Australian growers is affected not only by the global price of grains but also the exchange rate. Under these circumstances, it is more important than ever that the GRDC intimately engages with its industry stakeholders, and ensures that their research needs and concerns are reflected in

[4] This is discussed in greater detail in the Impact Analysis Framework prepared by the Allen Consulting Group, which is included as an appendix to this submission.

the RD&E portfolio. The recent changes in grower representation have increased the challenges in communications with growers.

Communication with the community is also essential to ensure the broader benefits of GRDC-funded research are realised. The GRDC has an active extension strategy and implementation plan — see the example shown in Box 2.2. Extensive networks have been established through the GRDC customer relationship management system, the GRDC's strategic involvement with the State Extension Leaders Network[5] and face-to-face workshops with growers and extension officers across the country. Further, GRDC hosts regular meetings of the National Agribusiness Reference Group.[6]

Extension and stakeholder engagement are also important to collect information from growers, and other researchers and the broader community, to feed back into GRDC investment priorities, as well as for the GRDC to provide feedback or reports on how research is progressing, and growers' needs are being met. The GRDC uses a number of mechanisms to engage with stakeholders, reflecting the fact that stakeholder groups may prefer different types and frequencies of engagement, including:

- consultation meetings with Grains Council of Australia (GCA) and affiliates (for example, state farming organisations);
- adviser and grower updates in all regions;
- Spring Tours in all regions and Autumn Tour in the North (where the regional panels meet key growers and researchers over a period of a week);
- Research Advisory Committee (RAC) meetings in the North and the South;
- research organisation visits;
- specialist workshops on themes such as crown rot, frost and other technical issues;
- regional agribusiness reference groups (in addition to NARG, noted above);
- panel members' networks of growers, researchers and industry contacts;
- grower survey (every second year);
- regional visits and tours undertaken by GRDC's Board; and
- publication and dissemination of Ground Cover, as discussed earlier.

2.3. INVESTMENT PLANNING

In order to ensure that the aforementioned RD&E priorities are met, as are the identified needs of levy payers, stakeholder engagement is critical to the GRDC's function. Grain grower interests are served by ensuring the GRDC Board and the GRDC's national and regional panels (see Box 2.1) have grains industry expertise, and through consultation and reporting relationships established by statute between the GRDC and the grains industry's

[5] The State Extension Leaders Network (SELN) is a gathering of Government extension leaders and influencers from each State and Territory of Australia. For more information, see http://www.seln.org.au/

[6] The National Agribusiness Reference Group (NARG) provides the focal point for GRDC communication with the agribusiness community in Australia. NARG has regional groups, meets with GRDC regularly and prioritises issues needing RD&E investment. See: http://www.grdc.com.au/director/about/stakeholder_engagement/narg.

representative organisation, currently the Grains Council of Australia (GCA). Each year the GRDC provides a Stakeholder Report to the GCA. The Stakeholder Report focuses on the achievements of the GRDC in meeting the industry priorities as well as the projected revenue and expenditure for the following financial year. The Stakeholder Report assists the GCA to formulate its advice to the Minister for Agriculture, Fisheries and Forestry on setting the research levy rates for the Australian grain commodities. The GRDC has in place the following system of reporting to demonstrate how research is identified and prioritised and to communicate the outcomes of GRDC-funded research:

- Strategic research and development plan — sets out the GRDC's high-level goals, strategies and performance measures for a five-year period, developed in consultation with stakeholders and approved by the Minister for Agriculture, Fisheries and Forestry.
- Stakeholder report — meets legislative requirements for reporting to the grains industry's representative organisation, currently the Grains Council of Australia.
- Investment plan — informs potential research partners about some of the GRDC's new investment priorities for the next financial year and invites interested parties to submit research proposals.

GRDC's investment planning aims to collect and collate grains industry RD&E issues, determine the RD&E question that must be addressed and therefore what RD&E is required. The process then identifies any existing RD&E that may already be in place to address these issues. If there are gaps in existing RD&E, a strategy is formed for GRDC investment to fill these gaps.

Box 2.1

REGIONAL PANELS

To advise GRDC on strategic issues and investment priorities, the GRDC has within its structure a system of regional panels. The panels cover the northern, southern and western grain growing regions of Australia. They are made up of grain growers, agribusiness practitioners, scientists and the GRDC's executive managers, with provision for other industry experts to participate as appropriate.

The panels work closely with grower groups and organisations, and have formal interactions with local Research Advisory Committees, which refer research issues to the panels on an annual basis.

Supported by GRDC staff, panel members assess regional investment proposals. The regional panels help to ensure that the investment plan responds to the regional and national priorities of grain growers and the Australian Government, and is aligned with the GRDC's corporate strategies and line of business (LOB) strategies.

This process requires expertise not only to identify the gaps and prioritise investment, but to work out the best structures for investment, and how the benefits will be distributed. Through the RDC model, the GRDC is able to add significant value in this regard. As the GRDC identifies many more RD&E proposals than can be funded, all potential investments are prioritised using a matrix system of assessment involving GRDC's managers and also the regional panels. A meeting of a National Panel, whose membership comprises the three regional panel chairs and the GRDC Executive Management Team, ensures that national priorities, including those of the government stakeholder, are being addressed appropriately.

This process of consultation ensures that the investment portfolio is balanced with respect to:

- RD&E outcomes;

- representation across the different regions and types of crops;
- prioritisation of desired outcomes on-farm, along the value chain and to the community more widely; and
- the timing of research outcomes from short-term outcomes with an immediate pay-off, to long-term concerns such as maintaining research capacity in Australia's research institutions.[7]

RESEARCH PRIORITIES

Australian grain grower priorities are identified through the GRDC's consultations with the GCA, local research advisory committees, grower groups and grower organisations and individual grain growers. RD&E needs identified through these consultations are communicated through a National Panel that recommends proposals for the national elements of the GRDC's research investments. Priorities listed in the 2008-09 annual report included:

- **environmental**: climate change, water use efficiency, resource management and soil health and biology;
- **farm management:** integrated farming practices and technologies, integrated management of weeds, diseases and pests, and herbicide resistance management;
- **varietal development:** biotechnology for improving genetic gain, superior new varieties and new and innovative product development; and
- **capacity building:** improving skills training and education in agriculture and farm business management.

The Productivity Commission has raised concerns that the structure of the RDC model will implicitly place too much research emphasis on levy payers (grain growers) compared to other stakeholders along the supply chain. While in theory the levy should apply to all industry stakeholders and research coordinated accordingly, the complexity of the supply chain makes this difficult for the reasons discussed earlier. The GRDC has mechanisms to engage industry wide stakeholders and therefore considers industry wide research needs when setting priorities.

The Australian Government's research priorities have been clearly articulated to the GRDC through the National Research Priorities outlined by the Prime Minister in December 2002 and the key rural research priorities announced to the GRDC by the Minister for Agriculture, Fisheries and Forestry. All of GRDC's research can be linked to one or more of the National Research Priorities, and the Impact Analysis Framework in the appendix demonstrates the value to the public of the research managed by the GRDC. In the absence of public funding support for RDCs, there would be little incentive for RDCs to undertake this work, or even to document the links between their research portfolios and the National Research Priorities.

[7] Greater detail on the GRDC's investment planning process can be publicly accessed at the following web address: http://www.grdc.com.au/director/events/groundcover?item_id=7F8D06B2D0030B908FE673525122EEDC&article_id=9545F673D110A5B1A9A1ACAACE99FFD4

Box 2.2

CASE STUDY: NORTHERN GROWERS ALLIANCE

The adoption of RD&E outcomes is a critical aspect of realising improvements in productivity and sustainability. The outcomes of R&D expenditure are limited if they do not result in significant change on-farm. Grower groups are increasingly important in providing a critical avenue for the dissemination of the results of R&D undertaken on behalf of the GRDC. In recent times, grower groups are also increasingly performing aspects of applied research development and extension in their own right.

The Northern Grower Alliance (NGA) was established in 2006 as an incorporated variation of the many farming systems' projects supported by the GRDC in the north. In effect it is not actually a grower-based group, but rather a group of around 70 skilled farming systems' consultants that represent a very large grower client base in the northern cropping zone of New South Wales and southern Queensland. These consultants have filled a gap in the region in that grower-based groups capable of disseminating R&D results are much less common in the northern part of the country.

The geographic reach of the NGA is large, covering areas of different soil and climatic types. To ensure that it maintains local relevance to both its consultant members and their grower clientele, NGA operates a series of five regional nodes covering Goondiwindi, Moree, Narrabri, Walgett and the Liverpool Plains. Each of these nodes has a grower-based Local Consultative Committee (LCC) responsible for identifying issues at the grass roots level and for maintaining close association with NGA activities throughout the process of innovation development.

The GRDC was fundamental in the development of NGA in response to industry and grower concerns. NGA does not receive GRDC funding to exist but rather is funded to undertake specific projects related to the validation of new research results and technologies and the facilitation of their adoption. NGA identifies and facilitates on-farm research to test and validate agronomic issues in the region, meaning that results are available to growers faster. The desired outcome is improvement in the production performance and sustainability of grain-based farming systems in the south-western area of the northern grain zone through effectively targeted and managed, focused on-farm validation work providing collaborative linkages for research agencies in the region.

THE GRDC'S PLACE WITHIN THE RURAL RD&E FRAMEWORK

Given the range of rural research institutions and number of different funding sources, it is important that research is well coordinated and avoids unnecessary fragmentation and duplication. This is particularly the case since research in areas such as climate variability, drought, and the management of weeds or pests have broad applicability outside a single primary industry. The RDC model allows for effective collaboration across RDCs when research programs offer scope for research benefits to be spread across a number of rural industries — for example, see Box 2.3. Further the Council of Rural Research and Development Corporations (CRRDC, formerly Council of Rural Research and Development Corporation Chairs) links all the RDCs, and provides a formal forum for collaboration.

As well as co-funding the RDCs, the Australian Government provides implicit and explicit funding to rural research projects in organisations including the CSIRO and ABARE, the research arms of the state and territory departments of agriculture and primary industries, the universities, and the CRCs. These research institutions receive funding directly from the Australian Government and compete with each other for RDC funding through a system of competitive grants. With respect to grains, the GRDC estimates that in 2007-08, a total of $325 million was allocated to grains research, development and extension work in Australia, disaggregated as follows:

- state and territory departments — $123 million (37%);
- GRDC — $88 million (28%);

- CSIRO — $45 million (14%);
- universities — $39 million (12%);
- private investment — $30 million (9%).

State government departments still provide the largest proportion of rural research funding within Australia. State government funded research is largely conducted regionally, reflecting the need to locate extension services close to clients. Recently, some state departments have started to withdraw from providing extension services, and have outsourced more development and extension services to private contractors and agribusiness. The GRDC ensures that its portfolio complements the extension services provided by the private sector rather than compete with or duplicate this activity. Many growers have become more directly involved with extension through membership of grower groups or farming systems groups. A considerable number of the private contractors who now provide the extension services are former state government department employees, which means that the provision of this service may not be sustainable once the current generation of providers has retired.

The GRDC portfolio also complements Australian Research Council (ARC) funding of research that can eventually lead to benefits to the grains industry. The GRDC considers the private investment environment in Australia, and establishes strategies to engage with private technology provides (for example, as in the case with wheat breeding shown in Box 1.3). The GRDC recognises that at times it is more efficient to invest with research and development agencies overseas. For example, the GRDC has participated in global genome sequencing efforts. This was not only the most effective mechanism for conducting the work, it also ensured that the resulting information is made available globally.

An example for GRDC partnering with international parties to bring technology to market in Australia is in the area of soil biologicals. Currently there are two phosphate solubilising inoculants being brought to market by a joint venture company in which GRDC has a 50 % share. They are JumpStart (designed for cereals and canola), and TagTeam (for legumes). The technical proof of concept for phosphate solubilising inoculants was completed at Australia research institutions with investment by the GRDC. However, after an expression of interest seeking partners to develop these products through to market, there was found to be a lack of expertise and capital in Australia to take these products to market. The GRDC therefore created a partnership with a Canadian company that already had experience in soil biologicals and that could exploit this product in Australia and international markets.[8] This means that there are two ways in which the GRDC's research activities help in increasing the global food supply — firstly through increased yields on the part of Australian growers that can be exported to the rest of the world, and secondly through the development of RD&E findings that can also be exported to the rest of the world.

[8] The impact of this work is examined in: http://www.grdc.com.au/uploads/documents/GRDC_ImpAss_SoilBiology1.pdf.

Box 2.3

CASE STUDY: COLLABORATION WITH THE COTTON RDC — SPRAY DRIFT MANAGEMENT

The judicious application of pesticides and herbicides is an important part of Australian agricultural productivity and make a significant contribution to the maintenance of world food production. However, pesticide applications that result in spray drift can have negative impacts on other crop types and locations such as native landscapes. For example, cotton crops are especially susceptible to the commonly used herbicide 2,4-D and therefore are susceptible to off-target drift of such chemicals if incorrectly applied. To address such potential negative impacts, the GRDC and the CRDC have jointly funded spray drift training and awareness programs.

The GRDC is the major sponsor of this program and was instrumental in the development of the joint project, together with the CRDC. Managers from both agencies have been, and continue to be, involved in the development of workshop content and delivery to ensure that growers and contractors are provided with the most up to date information relating to spray drift. Spray drift management was identified as a common issue in the cotton and grains industries through twice annual meetings between CRDC and GRDC program managers. Within the GRDC the issue was identified through ongoing consultation with industry (through Regional Advisory Committees) and through the panel process.

During the next two years, more than 100 workshops will be held for grain and cotton growers, as well as contractors, on the practices required to minimise the risks associated with spray drift. The outcome desired is a demonstrable decrease in incidences of off-target impacts of pesticide application in the cotton and grains industries.

The GRDC and the CRDC have also been working with Cotton Australia and NuFarm to develop a web-based mapping initiative to locate cotton crops using a Google Maps platform (www.cottonmap.com.au). The initiative allows growers to identify how fields where they intend to plant cotton are situated with respect to other crops. The map also allows identification of the location of sensitive crops in an area prior to spray operations being undertaken so that appropriate precautions can be put in place. Currently, the map is produced on a seasonal basis and is available from September 1 each year.

Benefits — on-farm:

Prevention of spray drift limits off-site damage to other crops and loss of production within the farm operation.

Prevention of spray drift limits off-site damage to other crops and loss of production to neighbouring operations, with a decreased exposure to litigation.

Greater adherence to regulatory requirements, and lower possibility of legal action, as well as lower possibility of increased regulatory requirements in response to incidents.

Lower potential of exceeding minimum residue levels in final products – lower possibility of product rejection.

Benefits — industry-wide:

Prevention of spray drift decreases damage to crops and locations off-farm (negative externality – not always possible to determine who is responsible).

Greater adherence to regulatory requirements lower possibility of legal action, lower possibility of increased regulatory requirements in response to incidents.

Lower potential of exceeding minimum residue levels in final products – lower possibility of product rejection.

Benefits — public:

Decreased exposure of growers and the wider public to hazardous pesticides with commensurate health benefits and associated economic benefits.

Environmental benefits associated with potential lower levels of pesticide impact on both farming and native landscapes including potential impact on waterways.

GRDC also engages with the Cooperative Research Centres (CRCs), which are joint agreements to undertake research in a particular area. CRCs were first established in 1990 with the aim of increasing links between industry and public research institutions. Currently, there are approximately 24 rural CRCs operating across Australia. The new CRC guidelines appear to make it easier for a rural-based CRC to obtain approval — in particular, it was

anticipated that greater emphasis on public good outcomes would be advantageous. In practice, however, the GRDC's experience with the 'Cereals CRC' bid, which was unsuccessful last year, suggests that competition is still extremely strong and funds available for new bids are limited — in spite of feedback from the CRC Secretariat that the programs and science in the bid were excellent. GRDC continues to engage with the CRCs to ensure that any duplication of research in CRCs that have a rural focus is minimised or appropriately addressed. The GRDC has a good relationship with the current CRCs, and undertakes to collaborate with them where appropriate — for example, see Box 2.4.

Box 2.4

CASE STUDY: COLLABORATION WITH CRC FOR NATIONAL PLANT BIOSECURITY - POST-HARVEST INTEGRITY RESEARCH PROGRAM (PHIRP)

This Program is a partnership between the CRC for National Plant Biosecurity research, the GRDC and three of Australia's major bulk grain handling companies. The total funding for this project is $26 million over five years, of which the GRDC is contributing $8.4 million, and the CRC is contributing $13 million, with the rest is coming from industry. The Program addresses post-harvest grain storage issues faced by the whole of industry that impact on trade and market access for Australian grain. The single biggest grain storage issue facing the Australian grains industry is the development of widespread insect resistance to the fumigant phosphine. Phosphine is central to insect management in the Australian grains industry and its continued effectiveness is essential to the sustainability of grain biosecurity and market access for Australian grains. In the past 10-15 years, resistance to phosphine in target insect pests has increased in both frequency and strength, such that it now threatens effective control. There is currently no alternative fumigant.

The GRDC's participation in the Program has: facilitated a pre-competitive approach to research for the management of insect phosphine resistance, from understanding the molecular basis of phosphine resistance, to improvements in grain storage structures to enable effective fumigations; ensured that research also addresses the grain storage issues faced by smaller grain storage operators such as grain growers storing grain on-farm; and ensured that research outcomes are translated into improvements in grain storage practices and are communicated and extended to grain growers.

Outcomes from the first 3 years of the Program include:

- The development of a science-based, industry-endorsed Strategy to Manage Phosphine Resistance in the Australian Grains Industry.
- The implementation of a national insect phosphine resistance monitoring program to track insect phosphine resistance over time and space and to identify 'hot spots' of insect resistance for targeted eradication and education on appropriate grain storage management practices;
- The development of effective protocols to eradicate the strong resistant strains of flat grain beetle.
- Identification of two gene regions responsible for conferring resistance to phosphine and the development of faster tests to determine the resistance status of grain insect pests.
- The gathering of preliminary data on the population genetics and the movement of grain insect pests on and around grain storages to support an integrated pest management approach to insect resistance management for grain storage and handling.

The outcomes from the Program benefit the whole of the Australian grain storage, handling and marketing supply chain. This includes grain growers, grain accumulators, private storage operators, silo manufacturers and grain marketers. Understanding the genetic basis for phosphine resistance and the grain storage management practices that have led to such resistance will lead to improvements in grain storage and handling practices that relieve the selection pressure on phosphine and increase the lifespan of this important grain fumigant in Australia.

2.4. GENERATING OUTPUTS

RESEARCH COORDINATION

The RDC model and governance structures ensure that resources are allocated efficiently and research priorities are closely aligned with industry and government needs. Since the GRDC manages research, rather than undertaking research itself, the research portfolio has an inbuilt flexibility allowing funding allocations to be changed and adapted as necessary. This also means that the GRDC regularly engages with researchers, is abreast of who the researchers are, their strengths and weaknesses, and what they are working on, and is in a position to facilitate the coordination of grains research more widely. The GRDC has an influential role in grains RD&E, as demonstrated in Box 2.5.

Box 2.5

MEASURES OF CENTRALITY

GRDC is highly regarded as a national funding body, strongly grounded via its grower constituents, but also very well connected to science and to the wider (private-sector) industry. GRDC has traditionally been regarded as an arms-length R&D funding organisation but has moved toward more direct hands-on support of RD&E, and in particular its 'Crop Updates' role is extremely highly valued.

Studies by Peter Phillips from the University of Saskatoon that GRDC plays a major role in Centrality measures (Degree, Betweenness, Eigenvector) in the Australian Grains industry as shown in the following table.

n=43	**Centrality measures***		
	Degree	Betweenness	Eigenvector
GRDC	69.05 ****	45.42 +	62.20 ***
CSIRO		11.39 *	
VDPI			30.10 *
DAFWA	30.95 *		37.18 *
CRC FFA			31.35 *
CRC PBS	30.95 *	10.81 *	33.61 *
U of Adelaide	28.57 *		
Mean	*15.39*	*2.90*	*18.04*
Std Dev	*11.27*	*7.05*	*11.85*

The GRDC is the natural and accepted de facto focus of formation and implementation of national R&D strategy and has a very large component of operational cash funding.

Note: *Three Types of Centrality are measured, where 'degree centrality' is an index of exposure and greater opportunity to directly influence or to be influenced by its relationships, 'betweenness centrality' implies gate keeper role, controlling the flow of information as it lies along the shortest path between other actors, and 'eigenvector centrality' means that the organisation is not only centrally positioned but connected to well connected nodes, which enhances influence.
Each * signifies one SD greater than the mean, and each + signifies one SD less than the mean.

The GRDC is influential and coordinates research in the following two ways. The first is by providing strategic leadership in grains RD&E at a national level. The second way is by identifying and eliminating gaps or duplication in the research framework. With respect to the leadership role that the GRDC plays, one of the major examples of this sort of work is GRDC's role in developing the Grains National RD&E Strategic Plan. In April 2005, the Primary Industries' Ministerial Council (PIMC) endorsed the concept of national research with regional development and local extension. A statement of intent containing a set of

principles to facilitate further cooperation between agencies was signed, and in 2007, RDCs were approached to put a representative on the PISC Research and Development Sub-committee. The GRDC took on this role, and was proactive in bringing the RDCs together in their approach to sectoral research and the development of strategic plans. This process was also instrumental in developing cross-sectoral RD&E programs such as the Climate Change Research Strategy for Primary Industries. The Grains National RD&E Strategic Plan is being prepared by a grains sub-committee, chaired by the GRDC and made up of representatives from the PISC agencies (state governments, CSIRO), a representative for the universities and a grower from each of the northern, southern and western regions. The plan responds to the growing recognition that Australia's limited science, technology and extension resources need to be aligned through a national strategy that facilitates collaboration in identifying needs and finding solutions.

The GRDC has consistently provided a leadership function in RD&E including on grains specific issues such as breeding and pre-breeding activities as well as cross-sectoral issues such as natural resource management and climate change. As regards the latter, the GRDC will supervise the investment of more than $9 million of special purpose funding in 2009-10. This $9 million is in addition to the funding that the GRDC received from the industry and the government co-funding arrangement, and is invested into initiatives under the Australian Government's Australia's Farming Future, Caring for our Country, and Managing Climate Variability programs. The GRDC currently leads the Nitrous Oxide Research Program, a national initiative within the Australia's Farming Future framework that measures the release of nitrous oxide under different farming systems, and explores methods for its mitigation. Also within this framework, the GRDC is contributing to RD&E on the effects of increased carbon dioxide on cereal growth through the Free Air Carbon Dioxide Enrichment (FACE) program, and is also investing in the quantification of soil carbon and the contribution that soils might play in carbon capture and storage.

Recently, the GRDC has also committed to co-funding and leading the National Adaptation and Mitigation Initiative within the DAFF Climate Change Research Program. The program aims to demonstrate climate variability adaptation measures on-farm as part of a national extension exercise. The GRDC has also led a successful bid for funding from the Australian Government 'Caring for our Country' scheme. The GRDC worked with farmers, advisers and researchers in regional Australia to develop a nationally integrated RD&E program to address natural resource management issues in mixed farming systems. The program will invest $12 million of GRDC and government funding over the next four years.

The GRDC not only initiates the leadership of collaboration programs, but also supports the programs initiated by others. Indeed, the GRDC has been an enthusiastic supporter of the cross RDC Grain and Graze and Managing Climate Variability (MCV) programs previously administered by Land and Water Australia (LWA). With the demise of LWA, the GRDC has assumed a leadership role in these important RD&E exercises. The MCV program, for example, is a program that brings together six partners in a coordinated effort to better prepare producers to manage climate risk on the ground. The partners in the program are the GRDC, Dairy Australia, DAFF, Meat and Livestock Australia, the Rural Industries RDC and the Sugar RDC. The program is focussed on providing better weather forecasting, increasing the predictive capability associated with some key events (e.g. heat and frost) and providing better support for decision making on farm.

Another example of the leadership role played by the GRDC includes the 'Pulse Breeding Australia' program. This is a review process determined that investment in pulse breeding would benefit from coordination and integration and resulted in the rationalization of previously independent breeding programs into PBA. PBA provides a single world class breeding and germplasm enhancement program for chickpeas, field peas, faba beans, lentils and lupins in Australia. PBA's outcomes are directed at growers, however, the delivery of

improved varieties to growers will also have beneficial flow-on effects. Pulse varieties are a vital part of crop rotations, fixing atmospheric nitrogen to reduce the fertiliser requirement of following cereal crops, helping to reduce the incidence of cereal diseases and providing opportunities to manage herbicide resistance, leading to better financial and environmental outcomes not only for growers, but also the Australian grains industry and the environment. The broader community benefits from the rotation of crops incorporating pulses. This is because it leads to greater sustainability of the resource base and improved weed, disease and pest control, which translates to reduced chemical spraying.

As noted above, the second way in which GRDC plays a coordinating role is by identifying and addressing gaps or duplication. Examples include:

- Barley Breeding Australia (BBA) — the strategic outcome of GRDC's investment in BBA has been a smooth transition of barley breeding from a highly fragmented, unsustainable funding model for state-based breeding programs to a more cost-efficient, coordinated, national breeding effort at three cooperating breeding nodes. Further evolution of BBA can be expected as two of its breeding nodes now prepare to transition to self-sustaining, commercially focused barley breeding. The beneficiaries of this investment are all sectors of the barley value chain, including growers, handlers, processors and end users.

- National Brassica Germplasm Improvement Program (NBGIP) — The GRDC with industry has established a Canola Breeders Group (CBG) which acts as the interface between the NBGIP and the private breeding companies. The CBG has established transparent operating principles and agreements. It meets six monthly to approve changes in direction/strategy, provide a forum for reporting on trait development and co-ordinate activities to enhance trait development. Private breeding companies in Australia will have advanced canola germplasm containing identified priority traits. Ultimately Australian growers will have access to cultivars that allow them to compete effectively in world markets.

In managing RD&E investment, decisions as to whether or not to continue funding a particular avenue of research can be made by reallocating funding across existing RD&E areas within the GRDC portfolio, rather than shutting down or setting up research facilities.

RESEARCH OUTPUTS

The GRDC's research activities can be grouped into four major categories:

- **varieties** — gene discovery, germplasm enhancement, wheat and barley breeding, and pulse, oilseed and summer coarse grains;

- **practices** — agronomy, soils, crop protection, validation and integration, extension and grower programs, and environment and climate change;

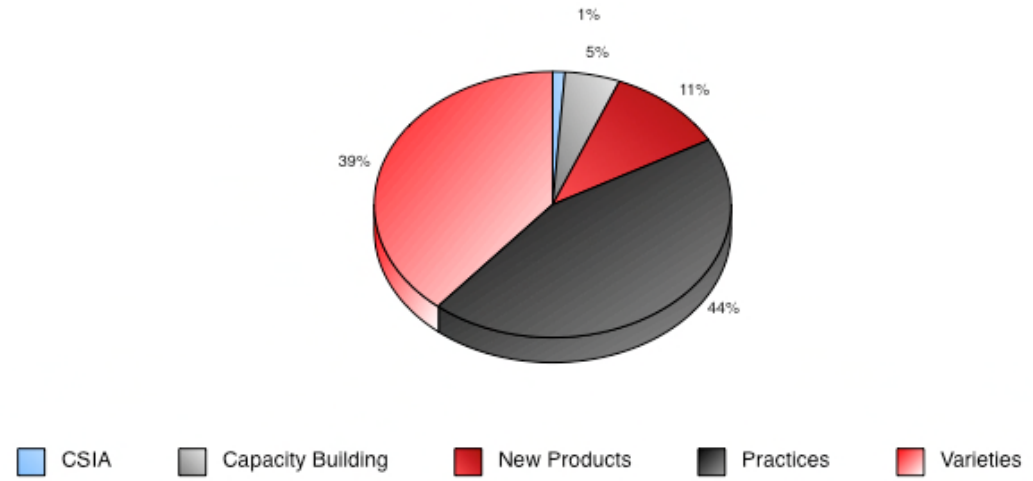
- **new products —** new farm products and services, and new grain products; and

- **communication and capacity building —** building research capacity, corporate communications, and enhanced management.

In 2010-11, the GRDC plans to fund a total of 600 research projects, with a research portfolio worth around $140 million. Research into grains varieties and growing practices will be the largest research categories by research funding, accounting for 39 % and 44 % respectively of the total GRDC budget, as shown in Figure 2.1.

Figure 2.1

GRDC RD&E PORTFOLIO 2010-11



Note: CISA is Corporate Strategy and Impact Assessment.

GRDC-funded projects are planned and selected in order to maximise the benefits not just to growers, but also to generate benefits along the supply chain, and to the community more widely — for example, see Box 2.6. The benefits of GRDC-funded research are widespread, accruing to growers, other farmers, upstream and downstream agricultural industries, other non-agricultural industries, consumers and the broader community. While the benefits from rural research can be categorised in theory, they are inherently interrelated and therefore measurement and evaluation of the specific private, industry and public benefits flowing from rural research is complex. Such complexity makes an accurate economic assessment of the appropriateness of current funding arrangements difficult.

The Allen Consulting Group has developed a logical framework that can be applied to assist in assessing the relative mix of private, industry and public benefits. The logic and key elements of the framework are described, and GRDC's research portfolio is assessed, with respect to the potential for benefits to growers, industry and the community more widely, as well as the extent to which the GRDC is administered and managed in such a way that those benefits can be realised. The GRDC conducts regular project specific evaluations to determine the types of on-farm, industry and public benefits that stem from GRDC-funded research. A detailed description of these benefits can also be found in the attached Impact Analysis Framework.

Box 2.6

CASE STUDY: AUSTRALIAN CEREAL RUST CONTROL PROGRAM (ACRCP)

Program description

The estimated current average annual costs of rust diseases in the main winter cereals in Australia are $30 million in barley and $147 million in wheat. Control of these diseases is currently achieved through the application of fungicides and the growing of varieties with varying levels of genetic resistance to the disease under integrated management practices. If the current control measures were lost, the average annual costs of rust to the Australian barley and wheat industries would be $150 million and $1.669 billion respectively. The ACRCP undertakes pre-breeding for genetic resistance to different rust diseases, development of DNA markers for improved breeding selection and development of GM strategies providing non-race specific resistance for three types of rust. The program also provides a screening facility to detect new pathotypes of the disease as well as a service to determine the level of resistance in breeding material from different companies.

GRDC's role

Given the current and potential impact of rust diseases on the grains industry, the GRDC has been a core supporter of the ACRCP since 1991. The ACRCP represents one of the more substantial investments undertaken by the GRDC and a recent economic analysis undertaken by AgTrans Research suggests that the investment has been effective with an estimated benefit cost ratio of almost 23 to 1.

Outcomes

The ACRCP aims to provide germplasm to Australian (and international) cereal breeders with quantified levels of resistance to the major current and potential rust pathogens. The program is also responsible for monitoring outbreaks of rust each season as part of a wider national surveillance program to detect and react to any new forms of rust diseases. More recently, with the privatisation of public wheat breeding programs, the ACRCP has introduced cost recovery screening services for commercial wheat lines. Evidence to date suggests that this aspect of the program (delivering private benefit) continues to receive strong support from the private breeding companies.

Benefits — on-farm

The introduction of new sources of rust resistance in modern varieties increases on-farm productivity and profitability by decreasing the loss of yield associated with rust outbreaks and limiting the need to apply fungicides with associated cost savings.

The surveillance program allows farmers to make a rapid decision on when and if to apply fungicides as well as providing a mechanism for the early detection of new types of rust allowing for a more rapid response by breeders and minimising the period where new varieties with genetic resistance are not available.

Benefits — industry wide

The breeding industry benefits from the provision of new germplasm with improved resistance to rust with flow-on yield effects to the wider industry and back to the farm. The existence of the ACRCP to undertake surveillance and pre-breeding germplasm development also allows for the provision of a commercial screening service at marginal cost. This obviously has a benefit to the private breeding companies but also has advantages to farmers in that a higher cost of screening may deter breeding companies from undertaking focussed screening resulting in the release of varieties with sub-optimal levels of rust resistance.

As the rust pathogen is readily spread via wind and people movement, there are benefits associated with the widespread planting of resistant varieties to address the negative externalities associated with rust outbreaks from the planting of susceptible varieties.

Benefits — public

The use of rust resistant cultivars limits the need for fungicide application and therefore decreases off-target effects of pesticide use in the wider environment and possible negative effects on human health.

Varietal resistance also minimizes yield losses associated with severe rust outbreaks thus contributing to overall productivity and food security at the national and international levels.

The outputs of GRDC-funded research are communicated to stakeholders in a variety of ways. Some of these have been discussed earlier (particularly the extension activities and regional forums), but the GRDC also undertakes formal reporting such as:

- Annual operational plan — specifies the annual budget, resources and research priorities that give effect to the strategic RD&E plan during a given financial year.
- Annual procurement plan — makes procurement information publicly available through the Australian Government's AusTender procurement management website.
- Annual report — provides information on RD&E activities and their performance in relation to the goals set in the annual operational plan and portfolio budget statement for a given financial year.
- Growers' report — provides performance information to growers on R&D activities for a given financial year.
- Portfolio budget statement — as part of the Australian Government budget process, summarises the planned outputs, outcomes, performance information and financial statements for a given financial year.
- Ground Cover — a free, bi-monthly newspaper published by the GRDC, which provides technical information for grain growers including updates on research, trials, new varieties, farmer activities and case studies.

2.5. VALUE FOR MONEY

Once funding arrangements have been established, the primary objective is to maximise the expected economic and social welfare from rural research. In other words, resources must be allocated to research that has the maximum potential to generate private and public benefits. However, this is challenging as the benefits of research are hard to determine ex ante, due to considerable uncertainty surrounding the nature of the outcomes associated with rural RD&E work. Further, estimating the environmental benefits of research is difficult, given both the complexity of environmental relationships and the uncertainty over the social valuation of environmental benefits.[9]

Nevertheless, once research funding has been allocated, it is imperative that programs are evaluated, and the economic benefits derived from rural RD&E work are substantiated. Independent research by the Productivity Commission and studies undertaken by the CRRDC suggest that the returns from rural RD&E are high. The Productivity Commission examined 75 individual research and development case studies and concluded that on average benefits exceeded costs by 40 to 1.[10] While this average is biased upwards by some very high performing projects (delivering benefits of 751 times the costs) it provides a strong indication that the benefits of research are significantly higher than the costs.

The CRRDC conducted two studies into the specific quantitative benefits of RDC research (2008 and 2010). In the latest study, 59 individual programs were evaluated, representing $676 million in RDC investment. The programs covered a range of industries and RD&E activities.[11] The results show that on average, benefits were 10.5 times greater than the costs.

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[9] Mallawaarachchi, T., Walcott, J., Hughes, N., Gooday, P., Georgeson, L., and Foster, A., 2009, *Promoting productivity in the agriculture and food sector value chain: issues for R&D investment*, ABARE, Canberra, Australia.

[10] Productivity Commission 2007, *Public Support for Science and Innovation,* Research Report, Productivity Commission, Canberra, Australia.

[11] Council of Rural Research and Development Corporations 2010, Impact of investment in research and development by the rural Research and Development Corporations — Year 2 Results, CRRDC, Canberra, Australia.

Further, the results show that benefits accrue quickly with 60 % of projects showing a positive net present value after 5 years. In addition, there was no evidence that the RDCs are investing in projects that will deliver negative returns, with all projects delivering benefits over a 10 year time frame. These results are similar to those from the 2008 study, which estimated that for every $1 spent, $11 of benefits were derived.[12]

In addition to quantitative benefits, the CRRDC identified numerous qualitative community and environmental benefits of RDC funded research. The majority of the reported community and environmental benefits were derived from reduced chemical use and runoff, improvements in food safety, reduced soil erosion and increased water use efficiency. Furthermore, the Allen Consulting Group has undertaken an independent assessment of GRDC's research portfolio, and the distribution of the associated benefits. The assessment finds that GRDC's research portfolio generates strong public benefits, and that the proportions of potential benefits associated with planned projects are consistent with the funding mix from industry and government. The assessment is contained in the appendix to this submission.

[12] Council of Rural Research and Development Corporations 2008, *Submission to the National Innovation System Review*, CRRDC, Canberra, Australia.

3. FUNDING LEVEL ISSUES

3.1. OVERVIEW

The majority of GRDC's funding comes from the industry levy and the matched contribution from the Australian Government. Unlike most other RDCs, the GRDC receives industry funding over and above the amount that attracts the maximum co-payment from government. In recent years, GRDC's funding mix has demonstrated a 2:1 industry to government funding ratio, which in turn demonstrates the value that growers place on the GRDC. This is particularly the case given that the levy is set in consultation with the industry representative organisation (currently Grains Council of Australia), which can recommend a zero levy. This is distinct from a voluntary levy, where GCA would set the levy amount and individual growers would decide whether or not they wished to pay from year to year. Having a statutory levy — regardless of the amount — allows for the GRDC to plan over the longer term. In addition, a voluntary levy would reintroduce the free-rider issue, with some growers paying for the research while all growers potentially benefit from it.

3.2. ALLOCATION OF FUNDING

Box 3.1 shows GRDC's income and expenditure for the past five financial years.

Box 3.1

GRDC — INCOME AND EXPENDITURE ($M)

	2008-09		2007-08		2006-07		2005-06		2004-05	
Total income	**$150.4**		**$127.2**		**$98.6**		**$116.9**		**$111.2**	
Commonwealth contributions	*$43.9*		*$37.6*		*$35.8*		*$43.1*		*$35.7*	
Industry contributions	*$89.2*		*$76.7*		*$50.9*		*$60.9*		*$64.2*	
Other	*$17.3*		*$12.9*		*$10.8*		*$11.2*		*$10.1*	
Total expenditure	**$121.3**		**$102.5**		**$118.2**		**$127.4**		**$120.2**	
Overhead Expenses	**$**	**%**	**$**	**%**	**$**	**%**	**$**	**%**	**$**	**%**
Employee benefits	*6.1*	*5.0*	*5.8*	*5.7*	*5.6*	*4.7*	*5.2*	*4.0*	*4.9*	*4.1*
Staff Travel & Accommodation	*1.0*	*0.8*	*1.0*	*1.0*	*0.9*	*0.8*	*1.1*	*0.8*	*0.9*	*0.7*
Panel & Program Team	*1.4*	*1.2*	*1.3*	*1.3*	*1.2*	*1.0*	*1.4*	*1.1*	*1.5*	*1.2*
Levy Collection Costs	*0.5*	*0.5*	*0.5*	*0.5*	*0.6*	*0.5*	*0.5*	*0.4*	*0.6*	*0.5*
Other	*2.7*	*2.2*	*2.9*	*2.8*	*3.0*	*2.5*	*3.0*	*2.4*	*3.2*	*2.7*
Total Overheads	**11.7**	**9.7**	**11.5**	**11.2**	**11.3**	**9.6**	**11.2**	**8.8**	**11.1**	**9.3**
No. of Staff Positions	**52**		**52**		**53**		**52**		**48**	

Note: 'Other' sources of income include grants income, project refunds, profits from asset sales, advertising revenue from *Ground Cover*, and so on.

Income — which is linked to growers' output — has shown significant variation in the most recent years, with income received for 2008-09 being over 50 % more than income in

2006-07. One of the strengths of the RDC model is the ability for funding to be managed so that expenditure is smoothed irrespective of temporary peaks and troughs in agriculture. 0 also shows that GRDC administrative overheads usually amount to less than 10 % of expenditure, demonstrating that the GRDC is able to use its scale and size to good advantage.

Despite the proportionally greater industry funding compared with many other RDCs, the GRDC does fund research projects that generate strong benefits to the community more widely, as well as to growers. Indeed the GRDC actively plans and prioritises research that has the potential for strong community-wide benefits in their own right. Examples of such projects include DAFF Australian Farming Futures 1 and 2 (discussed earlier) and Caring for our Country — discussed in Box 1.3. There are research programs that are more heavily weighted toward generating on-farm benefits, but as noted earlier, the GRDC regularly evaluates its funded programs, and those that are shown to be generating purely private benefits — in an environment where there is scope for both competition and effective value capture — are transitioned out of GRDC's research portfolio and over to industry directly (for example, wheat breeding as shown in Box 1.3).

Measuring the actual public and social benefits of RDC research projects is difficult for a number of reasons. These are in large part because there is no agreed upon framework for identifying these benefits, let alone for correct attribution to the research that generated them. Nor is there agreement for placing a value — monetary or otherwise — on economic and social benefits such as improved environmental outcomes, greater diversity in grains products, or greater certainty around the quantity and timing of yields. Indeed, measures of research performance are usually based on aggregated, high level indicators, such as growth in total factor productivity across an entire industry, or improvements in welfare (measured as increased consumption) at a national level.

As noted in the Impact Analysis Framework, the benefits of RDC research appear to be heavily weighted on-farm. In the case of the GRDC, this is because benefits on-farm are easiest to measure. A related point is that the GRDC has reporting arrangements in place to communicate the benefits and impacts of GRDC-funded research to growers. There are currently no reporting requirements or frameworks for measuring public benefits and, as a result, these are not directly measured or reported in a quantitative or monetised manner. Assessing the environmental or social benefits associated with individual research programs is therefore by necessity a subjective and essentially qualitative discussion.

This means that there is need for care in allocating public funding across RDCs, and how this funding can be tied to outcomes. The withdrawal of public funding support would remove the incentive to RDCs of prioritising projects with relatively higher public benefits — particularly if another body is scheduled to manage this research. In managing publicly funded RD&E separately, it is unclear how public good outcomes would be achieved without using the industry interfaces of RDCs. Having publicly funded RD&E separate simply adds a further layer of management complexity in achieving public good outcomes. In addition, the withdrawal of public funding would have implications even for the research that generates private benefits, because RDCs would come under increasing pressure from industry to justify their funding, and the focus will shift from a balanced research portfolio to one that is heavily weighted towards short-term programs with high on-farm benefits — as has been observed in some other developed countries. Furthermore, there is a risk that without public funding support, industry will withdraw research funding altogether — a significant risk, given that this was the initial justification for the provision of matched Australian Government funding to begin with.

4. IMPROVING THE RDC MODEL

4.1. OVERVIEW

Australia's RDC model is well set up to address the potential market and coordination failures associated with rural RD&E, and its strengths have been recognised by other countries, who wish to emulate the model.[13] At the same time, there are ways in which the current model can be improved in order to realise greater efficiencies and increased effectiveness. In GRDC's view, making adjustments to individual aspects of the current RDC model — while leaving the overall model intact — can achieve this outcome. There are also ways in which the RDC model could be altered or replaced through the implementation of more significant changes. Rather than speculate on what these alternative models might look like, or what they should be, this section includes a discussion of factors to take into consideration, and the potential for adverse outcomes, associated with large scale changes to the RDC model.

4.2. MODIFICATIONS TO EXISTING ARRANGEMENTS

FUNDING

The industry levy is collected by the Levy Revenue Service (LRS) in DAFF. The levy is collected via a self-assessment process based on returns lodged by eligible levy payers. Based on production and/or sales data supplied by levy payers the LRS levies system automatically calculates the levy payable at the current levy rate as stated in the relevant levy charging legislation and checks that all mandatory data fields have been completed. To gain assurance over the accuracy of the production and/or sales data supplied by individual levy payers, LRS undertakes a combination of data analysis and compliance activities, including monthly review and follow up of:

- the value of current month and year-to-date actual levy returns against the same period in the prior year, to identify any decline in levy returns that is not supported by current trends in production, changes in climatic conditions and/or market trends;
- the value of current month and year-to-date actual levy collections against the same period in the prior year, to identify any unexpected decline in levy collections; and
- system generated listings of potential missing returns; i.e. prior year levy payers who have not submitted a return in the current period, with appropriate follow up to obtain outstanding returns, including automated email advice to all levy payers who do not lodge by the due date; plus:
- field inspections of levy payer records and record management processes that support the levy returns lodged by those levy payers conducted on a rotational basis;
- review of regional and industry newspapers and media releases for evidence of new levy payers and/or industry trends; and
- active follow-up of outstanding levy payments relating to lodged but unpaid levy returns, with potential legal action where debts over 90 days old remain unpaid.

To further ensure the completeness of levy revenue and collections, LRS also undertakes targeted inspections of levy payers where either they have been assessed as higher risk due

[13] Appendix 2 demonstrates this international recognition of the RDC model, and GRDC's strong performance.

to their relative size, poor results of previous inspections, or industry requests that LRS undertakes a targeted review. Where a targeted review is undertaken at the request of an industry, the additional costs of that review are charged directly to that industry.

As the Australian grains industry has many individual growers but is a bulk commodity system, LRS collects the majority of levies from traders on behalf of growers (that is, traders deduct the levy from payments to growers). Collecting levies from sales outside of the bulk commodity system is more complex. The GRDC believes that there is potential for some non-compliance with levy collection. For example, new growers could escape the levy by virtue of not being an existing levy payer; not advertising grain for sale; or selling grain in the domestic market without going through one of the bulk handlers.

Aside from the collection of the levy, there are ways in which the co-funding arrangement could be improved. Currently, having a cap at 0.5% of GVP on the government contribution to RDC funding limits the funding available for rural RD&E — many industries will only provide funding up until they have exhausted the contribution they can obtain from the Australian Government. Additional industry contributions could be induced by raising the cap on government funding, but lowering the co-funding ratio after a certain point. For example, the government contribution could continue to be one-for-one until it reaches the current limit, after which the public contribution could be $1 for every $2 raised by the levy.

ADMINISTRATION AND GOVERNANCE

As the largest RDC, the GRDC has the scale to minimise administrative costs as a proportion of total expenditure. GRDC's administrative overheads have consistently come in at less than 10 % over the last five years (see 0) without compromising high quality governance outcomes. This compares favourably to the average for RDCs, which the Productivity Commission's Issues Paper noted ranged from 10 % to as high as 20 % . The GRDC is not in a position to comment on the performance of other RDCs, but notes that there are a number of advantages associated with having sufficient scale.

One of the ways to create scale efficiencies, but without compromising the independence of individual RDCs' industry-defined functions, is through the consolidation and sharing of back-office functions. The RDCs (including the GRDC) continue to review several aspects of administration and are continuing to review others, including:

- Contracts and common procurement of legal services, such as the development of a suite of standard research agreements, consulting business managers in other RDCs about common issues before seeking formal legal advice, and perhaps establishing a common legal unit that is accessible to all RDCs (subject to regulatory issues around licensing and indemnity insurance).
- Accommodation, such as physically co-locating smaller RDCs within the same building, or arranging to share rooms for meetings, storage, documents and archives, or board rooms.
- Sharing accounting, financial and IT resources, such as having common software procurement, management and support.

Related to this is to restructure the Boards of individual RDCs so that there is an overlap of Board members. A number of the skills required by the various RDC Boards are common requirements — such as government relations, finance, risk and administrative skills, legal background, and research and science based skills. The appointment of a small number of common Directors with these types of generic skills and agricultural backgrounds to a number of RDC Boards will have a minimal financial impact in total but may add to the ability of the various Corporations to collectively achieve common objectives. It is noted,

however, that this introduces greater potential for conflicts of interest, which would need to be identified and managed appropriately.

The RDC Boards also have the ability to appoint a government representative if appropriate. Following the release of the Uhrig Review, the directors that were appointed by the Minister for Agriculture, Fisheries and Forestry to represent DAFF were removed from RDC Boards. The impact of these changes has been the desired Uhrig outcome of removing the conflict of interest of the DAFF Directors between the government and the RDC. However it has also removed the very close link and ownership of the various RDCs and their outcomes within government. A further refinement to the RDC model would be having regularly updated and clearly articulated stakeholder expectations. In practice, this relies not only on government, but also on having effective representative organisations.

Finally, there are a number of administrative arrangements relating to the statutory nature of the GRDC which inhibit efficiency. One of the major examples is that the Minister's approval of GRDC's Annual Operational Plan — on a financial year timeframe — secures and commits GRDC's forward research portfolio. The plan is signed off in July, while the growing season begins with growers sowing in April-May. This means that the new trials and varieties associated with the funding in the Annual Operational Plan cannot be planted until the *following* planting season, after the plan is approved and signed off in July. A simple solution would be to obtain Ministerial approval earlier, say in March.

EVALUATION AND REPORTING

The GRDC undertakes independent assessments of GRDC-funded projects, as well as of the GRDC's Board and governance arrangements. As shown in the Impact Analysis Framework attached to this submission, the GRDC performs strongly in both regards. However, this reporting is initiated by GRDC's management, and is not part of the governance or reporting requirements for Statutory Corporations. As noted earlier, Statutory Corporations are not required to formally report the impact of their research other than being expressed as a Ministerial expectation and, as a result, the perception that RDC research is heavily weighted to on-farm benefits may be due to the fact that these are the types of benefits that are most reliably and regularly reported. Reporting guidelines and frameworks are necessary in order for RDCs to adequately demonstrate the benefits of RDC research to industry and to the public more widely.

Under these circumstances, the GRDC recommends that all RDCs be required to commission an independent, external review of their operations and impacts every three years. For all RDCs — industry owned as well as statutory corporations — this should occur on the same timetable, and against the same terms of reference. This is so that the impacts and findings of individual RDCs can be aggregated in order to draw conclusions about the RDC model as a whole. In addition, guidelines around the identification and measurement of the benefits of RD&E should be provided in order to facilitate this aggregation. These guidelines would apply to estimation of benefits to all three types of beneficiaries — on-farm, industry wide and public — as well as all three types of benefits — economic, environmental and social. Guidelines to assess the health of the rural RD&E system as a whole may be beneficial, particularly the linkages between participants and mechanisms to achieve knowledge diffusion, practice change and technology adoption.

COORDINATION AND COLLABORATION

The GRDC is proactive in identifying and funding research that has applications beyond grains, co-funded with other RDCs or research partners. Many examples of successful collaborative ventures have been provided in section 2 of this submission. The primary purpose of RDCs, as managers of research, is to facilitate collaboration between research institutions to achieve the best possible outcomes for their stakeholders. That said, RDCs are

industry defined, and collaboration between RDCs is not always appropriate. The GRDC supports collaborative ventures across RDCs where these work well — in particular with other broadacre RDCs, such as Meat and Livestock Australia, and the Cotton RDC, where there are many common stakeholders and similar RD&E issues. Successful collaborative ventures are due to a shared research interest or goal, with outcomes and milestones known and agreed upon in advance, but most importantly, the ability to generate a higher benefit for the same cost (or the same benefit at a lower cost) than if the collaborative partners were operating independently. Some collaborative ventures have failed this test, and while benefits are generated, this occurs with a loss of efficiency. An example of one such is shown in Box 4.1.

The GRDC's view is that the coordination of research and collaboration between RDCs should proceed when:

- research interests are aligned;
- the benefits — with respect both to the type of benefits and the type of beneficiary — are established and appropriately targeted; and
- there are clear savings or advantages from collaborating across RDCs, rather than funding projects individually.

Overall, the RDC model has the potential to increase effectiveness, if it could operate in an environment where rural RD&E were more connected and coordinated. Elements that may help achieve this include:

- coordination of Australian and state government funding, through agreed strategies and evaluation frameworks; and
- clear articulation of the nature of activities and rationale for investment by:
  - governments (CSIRO, state and territory departments, ARC);
  - industry (through levy); and
  - private (through IP protection and service provision).

Box 4.1

CASE STUDY: PASTURES AUSTRALIA — GRDC FUNDING OF $1.64 MILLION FROM 2005-06 TO 2009-10

Pastures form an important part of mixed farming enterprises as well as specialist cropping and animal production systems. Pastures are an intermediate product, they do not produce an economic commodity in themselves. Farmers gain value from pastures through animal products (meat, wool, milk) produced from them or through the benefits pastures provide to cropping systems (atmospheric fixed N from leguminous pastures, weed and disease break).

In recognition of the wide range of indirect benefits from the use of pastures, Pastures Australia was established in 2006 as a collaborative effort between the GRDC, Meat and Livestock Australia (MLA), Australian Wool Innovation (AWI), Dairy Australia (DA) and the Rural Industries RDC (RIRDC). The objective of Pastures Australia was to increase returns from pastures plant improvement through coordination and engagement with the whole pasture value chain.

The GRDC had been involved in a long standing and successful partnership with AWI , CSIRO and State Department's of agriculture in the National Annual Pasture Legume Improvement Program (NAPLIP). NAPLIP had released 26 pasture cultivars since 1985 with most releases becoming the most widely grown cultivars in their target zone. Building on this success, AWI and the GRDC recognised the potential benefits in a wider collaborative program that included all pasture species (not just annuals). In addition, there was recognition that if the pasture industry was to expand, stronger links needed to be made with private sector seed companies so that the use of pastures could be marketed more widely.

A recent internal review of the Pastures Australia program has concluded that while it delivered a number of overall benefits and enjoys considerable goodwill from the industry, it has been unable to achieve all its stated objectives to date and was unlikely to deliver on either its 2010 or 2015 objectives. Many of problems with Pastures Australia arise due a difference in understanding between the wider pasture industry and within the RDCs as to why Pastures Australia was established. The most fundamental point of difference is whether Pastures Australia was established by the RDCs to meet the needs of RDC stakeholders (e.g. government and growers) or whether Pastures Australia was established on behalf of the RDCs and the pastures industry in which case the stakeholders would include all supply chain participants.

These differences have been detrimental to the effectiveness of Pastures Australia and have been exacerbated by differing degrees of commitment by different RDCs. The goals of Pastures Australia were highly ambitious and on the whole poorly communicated. Despite this, the potential benefits of a collaborative model remain clear if differences in understanding across stakeholders can be addressed.

4.3. ALTERNATIVES TO THE RDC MODEL

GRDC believes that the RDC model as it currently stands works well, generates a high rate of benefit to investment, and that the distribution of these benefits can be shown to be proportional to the sources of funding received. If seeking to materially change the current RDC model, or indeed remove government funding support, it is necessary to consider the following possible outcomes:

- The removal of both government funding support *and* the industry levy will lead to a significant decline in expenditure on rural RD&E, which will have an adverse impact on productivity and food prices for the reasons discussed in section 1. The removal of government funding will also have implications for GRDC's governance and administration arrangements, particularly given that the GRDC currently has limited discretion with respect to:
  - budget deficits, which must be approved by the Department of Finance and Deregulation;

- requirements in relation to the annual report, annual operational plan, five year plan, accounting policies and timing of financial year end, over which the Department of Finance and Deregulation has oversight;
- the requirement to implement an Enterprise Agreement with specific Australian Government requirements;
- the requirement to comply with Australian Government procurement guidelines;
- the general requirement to comply with general Australian Government policies that may not always be in the best interests of the GRDC, including real property purchase and sale and transfer of leave accruals with government related entities; and
- the requirement to prepare for and attend Senate Estimates hearings.

- Retaining the industry levy while removing government funding support would lead to a shift in RDCs' research portfolios towards projects generating on-farm benefits, with public or industry wide benefits being accidental, rather than prioritised targets as they currently are in GRDC's portfolio. Furthermore, without government funding support, it is unlikely that the GRDC would remain a Statutory Corporation, which has further implications with respect to governance and reporting arrangements.

- One option that may be considered is to use the government funding component for a separate body that had oversight over a rural research program geared towards pure public benefits or projects that cut across more than one RDC. Some of the concerns around a model such as this (in addition to the issues pertaining to the simple removal of public funding support discussed above) are:
  - The public and private benefits associated with RDC research are difficult to unbundle, particularly with respect to extension work. A separate body might be able to manage the research, but it would still need to partner with individual RDCs to ensure that the outcomes of the research were taken up on-farm — as was the case with Land and Water Australia.
  - A separate body would most likely still be required to manage research in the same way currently undertaken by the RDCs. Given the links between public and private benefits to rural RD&E, an organisation that manages rural research with purely public benefit goals in mind would need to engage with the same research community that the RDCs currently do. This is because the realisation of benefits relies on both public and on-farm benefits being generated out of the industry interface discussed earlier.
  - It is unclear whether a sound funding approach for this body could be determined. The amount could be equal to the current public contribution to RDCs, however, this amount relies on government matching industry funding. If industries' RDCs did not directly receive the matched funding, it is likely that there would be pressure from industries for a reduced levy.

- Another possibility that has been raised is that, rather than having a separate body to conduct the rural research with strong public benefits, the total pool of public funding could be made contestable, with RDCs competing for public funding. In addition to the issues already noted, particular considerations for this model include:
  - It is unclear whether there would be sufficient incentive for RDCs to compete for the funding, particularly if RDCs are continuing to manage the industry contribution. This is because the government would no longer be a key stakeholder

of RDCs and therefore would not receive the same emphasis in RDCs' strategic plans. In addition, government grants do not always provide for management expenses. As an alternative to a contestable process, the shared pool of funding could be directed to RDCs that have demonstrated strong performance in delivering benefits to stakeholders other than their own levy payers.

- Assuming that there is no change to the current levels of industry contributions, having a contestable pool of public funding means that most RDCs will have lost up to half of their operating budget. Even if RDCs are able to transition appropriately to any new arrangements, having to compete for funding would make forward planning and budgeting much more difficult.

Another option suggested has been the establishment of a Crown Institute model such as New Zealand Crop and Food Research, and Queensland's Bureau of Sugar Experiment Stations (BSES). These organisations are funded by a mixture of block grants and competitive grants, and revenue raised by commercial services such as plant breeding. In preparation of the Grains National RD&E Strategic Plan, the option of establishing a Crown Institute model for grains RD&E in Australia was considered, but was rejected by the PISC agencies and was not further developed. Besides rejection by the agencies, another difficulty in establishing a Grains' Institute would be that wheat breeding is already in commercial structures, and would not be included. This would reduce commercial funding opportunities.

APPENDIX 1 — INQUIRY TERMS OF REFERENCE

ToR: Examine the economic and policy rationale for Commonwealth Government investment in rural R&D.

This ToR is addressed in sections 1.2, 1.3, 2.5 and 4.2.

ToR: Examine the appropriate level of, and balance between public and private investment in rural R&D

This ToR is addressed in sections 1.3, 1.4, 2.3, 2.4 and 3.2, and in Appendix 3.

ToR: Consider the effectiveness of the current RDC model in improving competitiveness and productivity in the agriculture, fisheries and forestry industries through research and development

This ToR is addressed in Chapter 2 of this submission, with further support provided in the letters contained in Appendix 2.

ToR: Examine the appropriateness of current funding levels and arrangements for agricultural research and development, particularly levy arrangements, and Commonwealth matching and other financial contributions to agriculture, fisheries and forestry RDCs

This ToR is addressed in sections 1.2, 1.4, 3.2 and 4.3, and in Appendix 3.

ToR: Consider any impediments to the efficient and effective functioning of the RDC model and identify any scope for improvements, including in respect to governance, management and any administrative duplication

This ToR is addressed in Chapter 4.

ToR: Consider the extent to which the agriculture, fisheries and forestry industries differ from other sectors of the economy with regard to research and development; how the current RDC model compares and interacts with other research and development arrangements, including the university sector, cooperative research centres and other providers; and whether there are other models which could address policy objectives more effectively.

This ToR is addressed in sections 1.2, 1.3, 2.3, and 2.4.

ToR: Examine the extent to which RDCs provide an appropriate balance between projects that provide benefits to specific industries versus broader public interests including examining interactions and potential overlaps across governments and programs, such as mitigating and adapting to climate change; managing the natural resource base; understanding and responding better to markets and consumers; food security, and managing biosecurity threats.

This ToR is addressed in sections 2.3, and 2.4, and in Appendix 3.

ToR: Examine whether the current levy arrangements address free rider concerns effectively and whether all industry participants are receiving appropriate benefits from their levy contributions.

This ToR is addressed in Chapter 3.

APPENDIX 2 — LETTERS OF SUPPORT

ICRISAT
Science with a human face

International Crops Research Institute
for the Semi-Arid Tropics

18 June 2010

Mr Philip Weickhardt
Commissioner
Productivity Commission
Level 28, 35 Collins Street
Melbourne VIC 3000, Australia

Dear Mr Weickhardt, Philip

I am very pleased to contribute to the review of Research and Development Corporations from an international perspective through various interactions with the Grains Research and Development Corporation (GRDC).

Commencing 2003, the GRDC developed a strategic alliance with the International Maize and Wheat Improvement Center (CIMMYT) based in Mexico. This alliance has enabled the Australian grains industry to access global collections of wheat genetic resources and global research and development (R&D) efforts in the public domain that it may not have accessed normally; certainly not in a strategic manner. For example, Australian researchers at the University of Sydney now participate in a major initiative of the Bill and Melinda Gates Foundation aimed at developing durable resistance to stem rust, potentially a major threat to the Australian wheat industry. The alliance is proving to be a win-win situation for Australian producers and for CIMMYT in its work with smallholder farmers in the developing world.

Similar alliances have been developed or will be initiated in the near future with the International Center for Agricultural Research in the Dry Areas (ICARDA) in Syria, the International Plant Genetic Resources Institute (now known as Bioversity) in Rome and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in India. GRDC has been a very effective mechanism by which the Australian grains industry may interface with international organisations engaged in relevant R&D, replacing previous, largely *ad hoc* collaborative arrangements. GRDC is to be commended for internationalising R&D efforts in Australia and for proving to be a very efficient single entry point for the expanded agenda.

The RDC model, and GRDC in particular, offers unique opportunities for Australian industry (and government) to interact with the international R&D community in an efficient manner with emphasis on those areas for which national programs alone cannot be expected to be effective; specifically:

- Access to international genetic resource collections;
- Access to international R&D networks, especially in the public domain, and funding opportunities that surround those networks; and,
- Access to strategic global initiatives that may provide early warning systems for new pests and diseases of key commodity crops in Australia.

The RDC model in Australian is unique and, based on my experience, the envy of many other OECD countries, and should be encouraged in view of the globalisation of agricultural R&D. In this context, the vision of GRDC in developing links with international agricultural research centres is to be applauded.

Best regards,

Yours sincerely

Peter Ninnes
Director- Resource Planning and Marketing

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Thomas A. Lumpkin
Director General

June 11, 2010

John Harvey
Executive Manager, Varieties
Grains Research and
Development Corporation
Level 1, Tourism House
40 Blackall Street,
Barton ACT 2600

Dear John,

I am pleased to provide this letter of support to the GRDC and its collaboration with CIMMYT.

As an internationally funded not-for-profit research and training organization, CIMMYT is committed to improving farmers' livelihoods in developing countries. CIMMYT's work in wheat has provided spillover benefits in Australia, benefitting poor farmers in the developing world as well as Australian grain growers.

GRDC-supported projects have facilitated the Australian wheat breeding programs' access to and use of germplasm from CIMMYT, resulting in yield increases in Australia due to varieties developed from these genetic materials. These projects span scientific exchange as well as the coordinated targeting, importation, distribution, and evaluation of CIMMYT germplasm and the development of associated supporting tools.

With an integrated suite of projects on information coordination/communication, synthetics germplasm evaluation, international nursery selection and export, international adaptation trial and ICIS maintenance and support, the GRDC-CIMMYT Strategic Alliance optimized the delivery of information and better-targeted and diverse germplasm for the faster development of improved varieties in Australia. Of prime importance is GRDC's facilitative role in these projects.

Complementing this is CIMMYT's access to an extensive gene bank of genetic diversity, its leading edge technology on synthetics, and a network for monitoring changes in pathogen populations that can assist in pre-emptive selection for resistance to disease (especially rust). CIMMYT also has strong competitive advantage in shuttle breeding and integrated disease control, as well as a strong multidisciplinary program with breeding, physiology, molecular biology, abiotic and biotic stress components. GRDCs strategic relationship with CIMMYT encompasses our core competencies and expertise in wheat breeding, in particular in the abiotic stress of water and biotic stress of rust.

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We endorse the effectiveness of the GRDC in delivering the benefits of wheat research to Australian farmers and the international community. No doubt, the unique RDC model that combines public and industry research funding through a partnership between Australian grain growers and Australian government, a levy system that provides for collective support of R and D, and a panel system that enables growers to have a strong say in decision making, is central to this success. This strong national mechanism for coordinating research has ensured that scientific breakthroughs are translated into productivity gains for Australia and makes the GRDC a leader in the global arena of grain research.

We hope that Australia will continue to partner with us in research that will provide mutual benefit for Australia and CIMMYT, and to the rest of the developing world where wheat is an important crop.

We look forward to an even closer and more fruitful collaboration with the GRDC.

Yours sincerely,

Thomas A. Lumpkin

Thomas Lumpkin
Director General
CIMMYT

APPENDIX 3 — IMPACT ANALYSIS FRAMEWORK

The Allen Consulting Group

Grains Research and Development — Impact analysis framework

Supporting Research for GRDC submission to Productivity Commission Inquiry into Rural Research and Development

July 2010

Report to the Grains Research and Development Corporation

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Contents

Chapter 1

Purpose of this impact framework

1.1 The Inquiry

The terms of reference for the Productivity Commission's inquiry into the Australian Government Research and Development Corporations model are shown in Box 1.1. A submission to this inquiry will therefore need to directly address these terms of reference, and in particular, present evidence of what the impact of the GRDC's research outputs are, and whether or not these impacts or these outputs would have been realised in the absence of the GRDC.

Box 1.1

PRODUCTIVITY COMMISSION INQUIRY TERMS OF REFERENCE

The review will:

- examine the economic and policy rationale for Commonwealth Government investment in rural R&D;
- examine the appropriate level of, and balance between public and private investment in rural R&D;
- consider the effectiveness of the current RDC model in improving competitiveness and productivity in the agriculture, fisheries and forestry industries through research and development;
- examine the appropriateness of current funding levels and arrangements for agricultural research and development, particularly levy arrangements, and Commonwealth matching and other financial contributions to agriculture, fisheries and forestry RDCs;
- consider any impediments to the efficient and effective functioning of the RDC model and identify any scope for improvements, including in respect to governance, management and any administrative duplication;
- consider the extent to which the agriculture, fisheries and forestry industries differ from other sectors of the economy with regard to research and development; how the current RDC model compares and interacts with other research and development arrangements, including the university sector, cooperative research centres and other providers; and whether there are other models which could address policy objectives more effectively;
- examine the extent to which RDCs provide an appropriate balance between projects that provide benefits to specific industries versus broader public interests including examining interactions and potential overlaps across governments and programs, such as mitigating and adapting to climate change; managing the natural resource base; understanding and responding better to markets and consumers; food security, and managing biosecurity threats;
- examine whether the current levy arrangements address free rider concerns effectively and whether all industry participants are receiving appropriate benefits from their levy contributions.

Source: Productivity Commission, 2010

1.2 Developing an impact framework

This impact framework has been developed for GRDC to assist in:

- identifying the key outputs and outcomes of GRDC funded activities; and
- categorising these outcomes according to their potential benefits, and how they are distributed across the grains industry, other researchers or research organisations, and the Australian community more widely.

There is currently no single method that has been agreed upon for identifying and measuring the benefits of research and development. The Productivity Commission, in its research report on public support for science and innovation (Productivity Commission, 2007), discusses several ways in which benefits of research can be identified and valued, noting that, ideally, estimates of benefits would:

- indicate the extent of the benefit and its uptake within industry or the community;
- be measured in the same way across different projects, so that the costs and benefits of different projects can be compared on the same basis; and
- take into account indirect effects, such as 'failed' research projects that indicate unprofitable research pathways (Productivity Commission, 2007, pp. 105-6).

The analysis in this paper does not seek to measure benefits from individual GRDC-funded research projects, but rather assess the potential range and extent of benefits given the scope of GRDC-funded research areas. On this basis, the analysis in the impact framework is intended to:

- provide evidence of the potential types of benefits that can be achieved from research funded by the GRDC;
- comment on whether the combination of funding split across industry and the Australian Government is appropriate, given the types of benefits expected from research funded by GRDC; and
- identify the extent to which GRDC's approach provides the best conditions to achieve these benefits.

Chapter 2

Framework elements

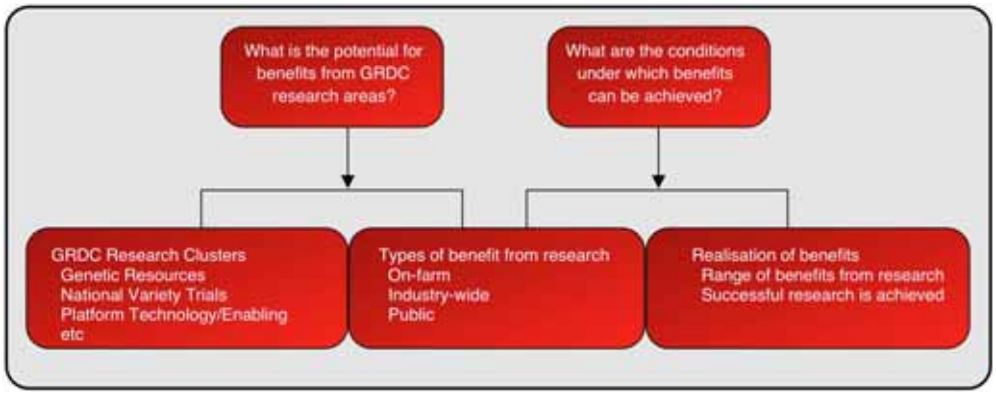
2.1 Impact framework logic

The logic and key elements of the impact framework are set out in Figure 2.1 below. The three key elements that the framework links together are:

- the GRDC's research, development and extension (RD&E) portfolio — the research clusters in which the GRDC invests;
- the potential types of benefit from research — broken down into on-farm, industry-wide and public benefits; and
- realisation of benefits.

Figure 2.1

IMPACT FRAMEWORK LOGIC



2.2 Research funded by the GRDC

The GRDC is a statutory authority established in 1990 under the *Primary Industries and Energy Research and Development Act 1989*, to plan for and invest in RD&E for the Australian grains industry. The primary objective of the GRDC is to support effective competition by Australian grain growers in global grain markets, through enhanced profitability and sustainability. To achieve this objective, the GRDC links innovative research with industry needs and is primarily responsible for the allocation and management of investment in grains research and development.

GRDC's research portfolio covers 25 crops spanning temperate and tropical cereals, oilseeds and pulses, worth over $7 billion a year in farm production (GRDC 2009). GRDC is co-funded as a partnership between industry and Government, where industry funding is provided through a levy on grain growers that is recommended each year by the grain industry peak body, the Grains Council of Australia (GCA) to the Minister for Agriculture, Fisheries and Forestry, who then sets the levy rate. The Australian Government matches levy funding up to a legislated ceiling. For many of the other RDCs, the industry contribution is roughly the same as the Australian Government contribution — with respect to grains, the industry contribution is roughly double that of the government.

The GRDC's RD&E activities are grouped into research clusters, which are shown in Table 2.1 below. A brief description of the nature of the activities covered within each of these clusters is provided in the appendix. The types of benefits generated vary significantly from one cluster to the next. For example, Crop Breeding and National Variety Trials will produce benefits that are strongly weighted towards growers. Environment/Climate and Soil Nutrition/Biology have public benefit associations, through environmental and natural resource management outcomes, while the work done under Genetic Resources and Capacity Building generate strong benefits to researchers and extension providers by contributing to growth in stocks of knowledge.

Table 2.1

RESEARCH AREAS TO BE ASSESSED

Research area	Total investment 2010-11 ($M)	Proportion of total investment (%)
Genetic Resources	$2.3	1.9
National Variety Trials	$5.7	4.5
Platform Technology/ Enabling	$5.0	3.9
Crop Breeding	$14.4	11.5
Pre-Breeding	$25.5	20.3
Crop Protection	$17.9	14.2
Environment/Climate	$7.8	6.2
Farming Systems	$13.5	10.7
Capacity Building	$11.8	9.3
Soil Nutrition/Biology	$5.9	4.7
Tactical Crop Management	$8.6	6.8
Supply Chain and Markets	$6.0	6.0

Source: GRDC 2010

2.3 Linking potential benefits to GRDC-funded research activity

One of the key aspects of the Productivity Commission's inquiry is the extent to which the distribution of the benefits of the rural RDCs' research aligns with the mix of funding that the rural RDCs receive from government and industry. The funding arrangement for the rural RDCs is that the Australian Government will match the industry funding, up to 0.5 per cent of that industry's gross value of production over a three year moving average. The GCA has currently endorsed a levy that is 0.99 per cent of the farmgate value of production of all leviable crops (except for maize, which is set at 0.69 per cent). This level of levy income means that, of all of the RDCs, the GRDC has the highest industry funding to Australian Government funding ratio in 2008-09 — more than 2:1 (see Table 2.2).

Table 2.2

RESEARCH AND DEVELOPMENT EXPENDITURE BY RDCS ($M), 2008-09

	Levy Income	Australian Government	Ratio
Cotton RDC	2.37	2.44	0.97
Fisheries RDC	9.52	5.3	1.80
Grains RDC	89.21	43.9	2.03
Grape and Wine RDC	13.33	11.7	1.14
Land and Water Australia	0	13.02	n.a.
Rural Industries RDC	1.84	16.54	0.11
Sugar RDC	4.32	5.11	0.85
Australian Egg Corporation	1.09	0.91	1.20
Australia Meat Processor Corp.	10.55	0	n.a.
Australian Pork Ltd	3.1	2.76	1.12
Australian Wool Innovation	10.29	11.4	0.90
Dairy Australia	19.17	19.17	1.00
Forest and Wood Products Australia	5.06	3.73	1.36
Horticulture Australia Ltd	40.91	39.8	1.03
LiveCorp Ltd	1.96	0	n.a.
Meat and Livestock Australia	31.44	31.44	1.00
TOTAL	**244.16**	**207.22**	**1.18**

Source: Productivity Commission, 2007

There is a well-established rationale in the economic literature for the role of government in coordinating and in some cases, assisting with funding, research and development. This rationale only sets out the *potential* case for government intervention in private investment in research and development. From a practical perspective, government funding should be allocated to where it is most effective — not just in terms of generating a return on the research investment, but in ensuring that the positive externalities associated with successful research projects are actually realised. It is therefore important to identify the nature of the benefits that are generated by GRDC's activities, and where those benefits accrue, in order to meaningfully comment on whether the funding mix is appropriate, and whether there is a case for Australian Government funding.

2.4 Categories of benefits from rural research and development

The types of benefits derived from research will vary depending on the nature of the research undertaken. On this basis, it is possible to develop a set of criteria, or assessment questions, to determine the extent to which a research area has a stronger or weaker potential for realising particular types of benefit. The potential benefits derived from rural research and development can be categorised into three groups:

- direct on-farm benefits;
- industry benefits; and
- public benefits.

The assessment questions used to determine which category a particular benefit falls under are shown in Table 2.3.

Table 2.3

KEY ASSESSMENT QUESTIONS

Benefit	Key assessment questions
On farm	• Will there be changes to cost/yield per hectare? • Will there be reduced risk or uncertainty associated with yield? • Will the direct on-farm uptake of innovative practices for those farms for which the research was targeted increase? • Will efficiency gains free up/reduce the cost of resources across the sector?
Industry-wide	• Will there be improvements to the knowledge and skills of other researchers? • Do the problems addressed apply across the agricultural sector, rather than grains in particular? • Will there be improved outcomes for supply chain partners?
Public	• Will there be applications outside of the grain sector? • Is there potential for improved environmental outcomes? • Will research outcomes improve the sustainability/survival of rural communities? • Will there be improved health outcomes?

Direct on-farm benefits

Direct on-farm benefits from research and development typically arise through improvements to on-farm productivity. This can occur where new, or improved, technology/varieties or improvements in farm practices are adopted. In turn, these improvements increase returns through increased efficiency, increased yield, increased value added, or a reduction in farm production costs. Examples of direct on-farm benefits from GRDC funded research have been documented in the *GRDC Impact Assessment Report Series.* Table 2.4 below provides a summary of the direct on-farm benefits listed in these reports.

Table 2.4

DIRECT ON-FARM BENEFITS FROM GRDC-FUNDED RESEARCH

Report title	On-farm benefits
An Economic Analysis of GRDC Investment in Farming Systems in the Northern Region (2009) *Benefit-cost ratio: 5:1*	***Nature of benefits*** Improved profitability from monitoring of soil water and nitrogen. Yield improvements from reduced tillage and improved stubble management. Increased use of more profitable crop rotations. Improved access to information detailing best management practices. ***Assessment assumptions*** Benefit per hectare for area benefiting: $10-$30 /ha Adoption lag: 3 years Adoption rate: 0.5 – 1.5 practices per decade
An Economic Analysis of GRDC Investment in Western Australian No Tillage Farming Association (2009) *Benefit-cost ratio: 34:1*	***Nature of benefits*** Improved soil moisture storage from reduced soil disturbance. Increased ability to grow crops in dry years. Increased average yields. Enhanced pest control. ***Assessment assumptions*** Average yield gain from no till: 5% pa Adoption profile: increased in Western Australia from 20% of farmers in 1993 to 88% of farmers in 1993 For those practising no till the proportion of total crop sown with no till: 85%
An Economic Analysis of GRDC Investment in Summer Coarse Grains-Breeding in the Northern Region (2009) *Benefit-cost ratio: 2:1*	***Nature of benefits*** Yield increases and reduced yield variability for sorghum growers and maize growers in some locations. Reduced insecticide costs. Increased profitability of sustainable crop rotations. ***Assessment assumptions*** (for sorghum only) Lag before change: 6 years Per cent yield increase: 1.75 to 2.0 Per cent yield increase attributable to GRDC investment: 0.2 to 0.5 of tonnes per hectare

Report title	On-farm benefits
An Economic Analysis of GRDC Investment in Oilseeds breeding (2009) *Benefit-cost ratio: 4:1*	***Nature of benefits*** Yield increases to canola and soybean growers. Yield increases to wheat growers when oilseeds are used in rotation. Enhanced weed management. Reduced fertiliser application. ***Assessment assumptions*** (for canola only) Average percent yield increase from all sources: 0.8 per annum Yield gain due to cultivar development: 33% Proportion of yield gain due to cultivars attributed to GRDC investment: 50%
An Economic Analysis of GRDC Investment in the Australian Winter Cereals Molecular Market Program (2009) *Benefit-cost ratio: 5:1*	***Nature of benefits*** Increased rate of genetic gain in wheat and barley. Access to knowledge generated overseas. ***Assessment assumptions*** Traditional yield gain from wheat and barley breeding: 1% per annum Additional gains from use of markers: 0.05% to 0.10%
An Economic Analysis of Investment in the GRDC Soil Biology Program (2009) *Benefit-cost ratio: 3:1*	***Nature of benefits*** Increased yields. Reduced yield losses. Reduced fertiliser application. ***Assessment assumptions*** Differ for inoculants, disease and nutritional aspects of projects within the cluster Generally only 1/3rd of the benefits would be realised in the absence of GRDC investment Benefit lag: 5 years
An Economic Analysis of GRDC's Investment in Barley Breeding (2008) *Benefit-cost ratio: 8:1*	***Nature of benefits*** Increased productivity via the development of 22 variety improvements and associated yield improvements. Increased access information regarding best practice management. ***Assessment assumptions*** Rapid increase in barley production (area and yield) in the southern region Traditional yield increase: 0.75% per annum Rapid adoption of new varieties National Variety Trial data translates to the field

Source: Agtrans Research 2008-2009
Note: Benefit-cost ratios are estimated over a twenty year period.

Some rural research and development provides benefits that accrue across the entire industry. Agricultural industries are made up of many small enterprises with similar (and observable) production processes, producing relatively homogeneous products. Therefore, new technologies, crop varieties or production processes can be widely applicable across many different types of farm enterprises. Further, some rural research and development promotes practices that are designed to have a broader sector benefit, rather than being focused on a particular variety or region. Benefits under this category are considered to be those that are realised within the grains sector.

Industry benefits

Industry benefits are benefits that fall in between the benefits that can be captured by growers, and the benefits that have applications for the wider community. These benefits accrue to operators who are not levy payers, but who operate within industry either as producers or as researchers. There are three types of beneficiaries associated with industry benefits generated by GRDC's research. These are:

- primary producers other than growers;
- the research community; and
- operators along the supply chain between the farm gate and the final consumer.

Inter industry benefits occur as some agricultural research is not industry specific. Therefore, research and development in one agricultural industry can create knowledge that is applicable across all agricultural industries. For example, GRDC-funded RD&E that reduces the frequency or severity of soil erosion can have applications to growers outside of grains, and perhaps to the agricultural industry as a whole. Other examples include (but are not limited to) research and development pertaining to: pest, weed or disease management; adaptation to drought and climate change; and biosecurity and quarantine.

The second category of beneficiaries consists of those in the research community who benefit from GRDC-funded research. One of GRDC's major contributions in this area is building and maintaining capacity in grains research in Australia, and ensuring that this capacity is utilised to generate the highest possible pay-off for funded research. Benefits to researchers can be as simple as the spillovers associated with knowledge accumulation and contributions to the stock of human capital from both successful and unsuccessful research ventures, to more deliberate benefits such as the sponsorship of students, conferences, or courses.

The third category consists of the supply chain partners. With respect to grains, the supply chain partners include those who specialise in marketing or, the storage and handling of grains, manufacturers and exporters, and so on. Many of the benefits to supply chain partners come as a result of growers being small, perfectly competitive price-takers and supply chain partners being larger organisations with greater market power. Productivity gains with respect to increased yields and efficiencies in the use of inputs may not be able to be directly captured by growers if the savings are passed onto industry in the form of lower prices for grains.

Public benefits

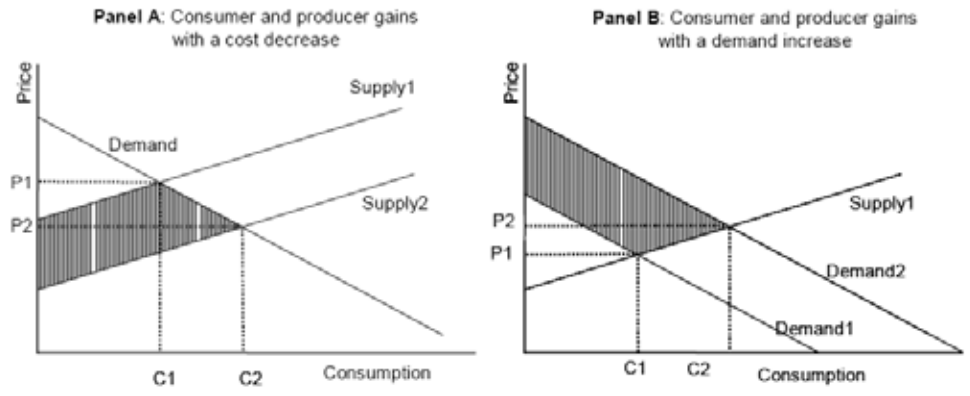
In many cases, the benefits from rural research and development can also accrue to the wider community, such as when the benefits are associated with improvements in health, environment or social outcomes. The end consumer can also benefit from lower prices for grains and derivative products — as shown in the main body of GRDC's submission. All other things being equal, a price reduction will increase consumer surplus. Consumer surplus can also be increased when the quality of a product is improved, as long as the price rises are less than the additional amounts consumers are willing to pay for that additional quality. These consumer benefits are represented graphically in Figure 2.2 below.

Finally, there is large scope for environmental and human health benefits to flow to the broader community as a result of rural research and development, including for example:

- increased water use efficiency;
- improved water quality and biodiversity;
- reduced chemical usage;
- reduced waste;
- reduced greenhouse gas emissions;
- improved land use and soil management;
- reduced salinity;
- ecosystem protection;
- improved food quality and safety; and
- increased resilience in rural communities.

Figure 2.2

PECUNIARY BENEFITS TO DOWNSTREAM CONSUMERS



Source: Productivity Commission 2007

A specific example of potential health benefits from GRDC-funded research is GRDC's planned investment in sequencing the lupin genome, which will begin in July 2010. While the investment is targeted at improving the drought tolerance, disease resistance and yield of this essential rotational crop, GRDC indicate that the investment will be made through The Centre for Food and Genomic Medicine (CFGM), based at the Western Australian Institute for Medical Research at the University of WA in order to ensure maximum public leverage for this investment. The CFGM research facility has been set up primarily to tackle the twin epidemics of diabetes and obesity and has a strong focus upon the development of lupin-based healthy foods. The GRDC-funded lupin genome sequencing will enable CFGM health researchers to determine the genetic basis of lupin flour components that contribute human health benefits.

With respect to environmental benefits, there are direct environmental benefits associated with reduced spraying, soil erosion and so on. At the same time, RD&E activities can also provide growers with the knowledge and the means to maintain or enhance the stewardship of the land and environmental — resources with which past government policies have effectively entrusted them. This also ensures the sustainability of land and water resources, which in turn improves the life of growers' assets, and enhances the sustainability of both the industry, and the rural communities that depend upon it.

2.5 Effectiveness of GRDC approach in achieving potential benefits

The analysis so far has discussed how the potential benefits of GRDC's research portfolio can be identified, but this says nothing about the extent to which these benefits are being realised, or are likely to be realised. Without a full measurement of benefits at the project level this is difficult to determine., It is, however, possible to assess the extent to which current structures and practices within the GRDC model provide the best conditions to achieve these benefits.

As discussed by the Productivity Commission (2007), to determine whether the necessary conditions are in place so that the *potential* benefits of GRDC-funded research can be realised, GRDC's approach can be assessed against the following three key criteria:

- the quality of GRDC-funded research;
- the efficiency of knowledge diffusion mechanisms; and
- the quality of governance arrangements.

The quality of GRDC-funded research

To maximise the gains from GRDC-funded research, research must be of a sufficient quality, and one of the ways in which the quality of research can be assessed is using the indicators that were identified in the Research Quality Framework.[1] The framework describes core elements that can be used to demonstrate the quality of research. These include:

- internal self-assessment;

[1] We note that the Research Quality Framework has since been replaced by the Excellence in Research for Australia Initiative. As it currently stands, the latter has a focus on research done by higher education institutions, whereas the former had a focus on all forms of publicly funded research. As a result, the indicators from the Research Quality Framework are used in this discussion.

- international/national peer review (as qualitative assessment);
- external endorsement; and
- quantitative metrics such as the number of highly cited papers published, the number of papers in high quality journals; or the number of highly cited patents.

With respect to the last metric, GRDC funds research rather than undertaking or publishing findings in its own name. As such, it would be useful for GRDC to undertake its own monitoring of the citations, patents or journal rankings associated with the research projects that it funds.

The efficiency of knowledge diffusion mechanisms

The full benefits of research and development are only meaningful to the extent that they are understood and adopted. To ensure that these benefits are maximised, it is essential that research findings be communicated effectively to beneficiaries. These can be targeted at beneficiaries along the entire spectrum, from growers (for example, through the extension work) or the wider community (for example, through awareness campaigns aimed at improving dietary or health outcomes). A lack of clear communication will erode the benefits of any research, regardless of the quality.

One way to assess the efficiency of knowledge diffusion would be to assess the degree to which research has resulted in real productivity improvements across the industry as a whole. However, there is often a lag between knowledge diffusion and the realisation of real productivity improvements. Therefore it is useful to understand how effectively knowledge is being communicated on an on-going basis. The following criteria can be applied to assess the extent to which knowledge diffusion is facilitated by GRDC's activities:

- presentations given at industry sponsored conferences;
- presentations given at academic conferences;
- presentations given at learned societies;
- distribution of research newsletters and other media to industry stakeholders;
- meetings attended with potential industry adopters of research;
- results from surveys of government and industry research managers as to who they regard as 'high impact' academic researchers; and
- the number of research students that are subsequently employed within industry.

The quality of governance arrangements

Good governance is essential to ensuring that the appropriate research activities are funded in the correct amounts, and that appropriate institutional processes and complementary inputs such as IT, field equipment and laboratories support GRDC-funded research. There are several ways in which the quality of governance can be assessed. The Australian National Audit Office's *Better Practice Public Sector Governance* guide (2003) sets out a framework that incorporates the following elements:

- leadership, ethics and performance culture;
- stakeholder relationships;
- risk management;
- external conformance and accountability;
- internal conformance and accountability;
- planning and performance monitoring;
- information and decision support; and
- review and evaluation of governance arrangements

Similarly, there is an Australian Standard (2003) that provides advice regarding good governance principles for Australian organisations. The principles loosely follow the OECD *Principles of Corporate Governance* and assess five areas. Those relevant to the GRDC include:

- the role, powers and responsibilities of the board;
- disclosure and transparency obligations; and
- the role of stakeholders in corporate governance.

Some of these principles will be more relevant to the GRDC's governance structure than others. Further, some of the principles will be more easily measured while others will require a more qualitative judgement. However, all principles are important considerations when assessing good governance practices.

Chapter 3

Applying the framework to GRDC funded research areas

3.1 Potential benefits of GRDC-funded research

The potential benefits of GRDC-funded research have been identified based on the assessment questions set out in the previous chapter, and applying these questions across the research clusters.

Potential for on-farm benefits

As is to be expected given the 2:1 industry to public funding split, GRDC's research portfolio has strong potential for on-farm benefits, and the results of internal impact assessments by GRDC indicate that these benefits are being realised and enjoyed by levy payers.

For example, GRDC has invested in research to enhance the productivity of grain crops through improved rotations, which has generated benefits associated with increases in grain yields. The improved crop rotations have also improved pest and weed control and soil fertility, which has resulted in a reduction in production costs via a decrease in insecticide, herbicide and fertiliser application. Further, the improved crop rotations have diversified farm income through increasing the profitability of break crop rotations.

GRDC-funded research has also generated significant on-farm returns by increasing crop resistance to pests, weeds and diseases. For example, pest resistance research has resulted in an increased longevity of pest protectants such as phosphine in grains. This reduces losses associated with pests while grains are in storage providing a benefit on-farm and to industry. Further, more effective weed control strategies have improved yields and decreased costs associated with herbicide application. Finally, research has also resulted in significantly increased profits as a result of improved rust resistant varieties.

GRDC has also invested in research surrounding gene discovery, germplasm enhancement, and germplasm exchange. All research programs are generating significant on-farm benefits. Specific benefits include:

- increased yields;
- increased market opportunities through diversification of grain quality and targeting quality to particular markets; and
- improved crop resilience resulting in reduced crop losses and chemical application.

Significant benefits have also been derived through investments to improve farm systems and farm management techniques. For example, reduced tillage practices have improved soil structure and increased soil moisture content. This has reduced soil losses to runoff and erosion, reduced operational costs and increased crop yield in some years. Further, increased soil moisture retention has enhanced the potential to higher yielding and therefore more profitable crops in dry years. Improved stubble retention has also assisted to enhance soil structure and biological content.

GRDC-funded research has also improved farm profitability through the development of new tactical crop management techniques. For example, GRDC-funded research has assisted growers to time fertiliser application to the economic optimum, taking account of individual risk preferences. Further, the use of biochar is being investigated for its ability to increase cation exchange capacity of soils so as to support plant growth with reduced rates of fertiliser application.

Potential for industry-wide benefits

GRDC-funded research into new farm management techniques and different grain varieties has assisted farmers to reduce yield variability. Reduced yield variability benefits the entire supply chain by increasing the consistency of Australian grains supply, and reducing uncertainty. Further, increased consistency of supply allows for more efficient investment decisions into grains storage and transportation infrastructure across the entire industry, as well as investment and expenditure decisions by manufacturers and exporters.

A proportion of GRDC funding is also invested into research projects that improve knowledge surrounding grain quality differentiation. This has enabled grain supplies to better match grain quality with end-user manufacturing processes. Increased knowledge surrounding grain quality differentiation has improved the ability of the supply chain to coordinate different varieties and ensure product quality is preserved. Such processes have increased the confidence of export markets in Australian grain quality and assisted to strengthen demand — particularly given that Australia's competitors also focus on these aspects of delivery.

The governance structure and coordination role of the GRDC is also important in generating industry wide benefits. The leadership of the GRDC within the Australian grains industry continually increases overall research capacity. Further, GRDC collaborations with international research organisations have increased knowledge spillovers to the Australian grains industry from research conducted overseas. This is discussed further below, but GRDC's activities with respect to the efficiency of knowledge diffusion play a major role in maintaining grains research capacity in Australia.

Potential for public benefits

A significant proportion of the total benefits from GRDC's research can be considered to be public in nature, since they fall under the following categories:

- environmental benefits;
- health benefits;
- enhanced skills and innovation;

- increased social capital; and
- increased productivity.

Direct examples of how these benefits have been generated through GRDC funded research are outlined in Table 3.1 below.

Table 3.1

PUBLIC BENEFITS FROM GRDC-FUNDED RESEARCH

Type of public benefit	Specific examples from GRDC-funded research
Environmental	• improved stewardship engagement, and natural resource management capabilities; • reduced erosion and runoff through improved farming practices; • reduced off-farm export of chemicals through improved farming practices; • reduced chemical usage through the development of more resistant grain varieties and integrated management practices; • increased capacity to control national weed resistance risks; • reduced emissions and air pollution as a result of a decline in stubble burning and better farming practices; • improved efficiency of fertiliser application reducing contamination of local water ways and risks of eutrophication
Health	• reduced off site movement of chemicals resulting in less local water way contamination; • potential health benefits from high amylose wheat and low gluten barley; • improved pest and disease resistant plant varieties and integrated management resulting in a reduction in chemical use during production and storage;
Skills and Innovation	• increased Australian scientific capacity; • enhanced rural and remote regional leadership capacity and stronger regional networks; • enhanced entomology and taxonomy skills; • enhanced molecular biology skills capacity; • improved international collaboration in grains research; • increased access to knowledge generated overseas;
Social Capital	• increased social well being of people living in rural communities; • increased the resilience of rural communities through the development of drought management including drought resistant crops; • improved understanding of climate variability; • increased rural community resilience through stronger networks; • improved the profitability of the sector and created rural jobs
Improved national productivity	• reduced seasonal variability through better farm management techniques; • improved national food security through increased productivity; • improved market access and facilitated trade.

Source: GRDC Impact Assessment Series

Overall assessment

This analysis has identified significant individual on-farm, industry and public benefits. It is necessary, however, to review GRDC's research portfolio as a whole, in order to draw conclusions as to whether the relative mix of potential on-farm, industry and public benefits is appropriate given the current mix of funding. In the absence of an objective framework or robust metrics as to how to quantify the potential benefits of GRDC's research, the assessment of the research portfolio as a whole is necessarily subjective. At the same time, it is possible to conduct the qualitative discussion using a transparent framework, so that the logic by which the conclusion is achieved is clearly visible.

Table 3.2 presents a scorecard for GRDC's portfolio, disaggregated by research cluster, and by type of benefit. The Allen Consulting Group has given a score of between 0 and 3 to each of the research clusters, against each of the types of benefits. A score of zero indicates that the research cluster has no potential to generate benefits of that type. A score of one indicates a relatively low potential for benefits, a score of two indicates a medium potential, and a score of three indicates a relatively high potential. The scores are based on the nature of the research funded in each cluster, and the description and discussion of the types of benefits that they generate, as shown in the appendix to this report.

It is important to note that the scores assigned to types of benefits in each cluster are scores and not rankings. For example, the Tactical Crop Management cluster is assessed as having high potential benefits on-farm and to the public more widely. As a result, a score of three is assigned against both of these types of benefits for this research cluster. It should also be noted that the scores are to be interpreted as ordinal, rather than cardinal — that is, a score of two should be interpreted as a cluster being assessed to generate *more* of a type of benefit than if it had received a score of one, and less than if it had been given a score of three, instead of twice as many, or two-thirds as many benefits. For example, the scores shown below should not be taken to mean that the Supply Chain and Markets cluster has the potential to benefits on-farm that are one half of what might be generated in the Environment Climate cluster. In the same way, the scores should not be taken to mean that the industry benefits generated in the Supply Chain and Markets cluster are 2.5 times greater than those on-farm, and for this reason, it is not meaningful to aggregate the scores across rows.

To assess the GRDC's research portfolio as a whole, the scores are aggregated down the columns by type of benefit. Before this can be done, however, the clusters need to be weighted because different clusters receive different amounts of funding and operate a different number of projects to one another. The weights are calculated based on the value of research funding allocated to each cluster rather than the number of projects, because the number of projects does not capture the implications of a few long term, large projects and several short term, smaller projects. The weighted scores can then be summed down the column for each type of benefit to produce a final score out of a maximum of three. This final score indicates the overall potential for benefits of this type from GRDC's portfolio.

Table 3.2

OVERALL ASSESSMENT OF POTENTIAL BENEFITS

Research area	Weight	On-farm	Industry	Public

		benefits	benefits	benefits
Genetic Resources	1.9	2.00	2.00	1.50
National Variety Trials	4.7	3.00	1.00	1.50
Platform Technology/ Enabling	3.9	2.00	3.00	1.00
Crop Breeding	11.9	3.00	1.50	1.50
Pre-Breeding	21.2	2.00	1.00	2.00
Crop Protection	14.9	2.50	1.00	3.00
Environment Climate	6.5	2.00	1.00	3.00
Farming Systems	11.2	3.00	1.00	1.50
Capacity Building	6.6	3.00	2.50	1.00
Soil Nutrition/Biology	4.9	2.50	1.00	2.00
Tactical Crop Management	7.2	3.00	1.00	3.00
Supply Chain and Markets	6.2	1.00	2.50	1.00
Portfolio Result	**100.0**	**2.48**	**1.36**	**2.00**

0 to 1 indicates relatively low potential, 1 to 2 indicates medium potential for benefits, and 2 to 3 indicates high potential for benefits.

For example, activities within the Tactical Crop Management cluster target investments that develop improved approaches to managing crop inputs for optimising yield and grain quality of varieties. Benefits include increased grain grower profitability, increased levels of organic matter in the soil, improved air quality, and reduced water and wind erosion. This has the potential to generate high on-farm and public benefits, but comparatively lower industry benefits, such as higher predictability of supply chain use. The Supply Chain and Markets cluster, on the other hand, can be expected to generate relatively high industry benefits, and relatively low direct on-farm and public benefits.

Another example is provided from activities within the Crop Breeding and Pre-Breeding research clusters. Crop breeding activities offer the largest potential for benefits to growers through increased productivity. However, low to medium public and industry benefits may also be generated through increased knowledge surrounding plant genetics and improvements in grain quality that better suit various markets. Therefore public and industry benefits have been given low to medium scores, reflecting that there are benefits associated with more profitable or sustainable farms, but that these benefits are indirect.

Activities in the 'Crop Protection' cluster are primarily aimed at reducing losses in production due to weeds, pests and disease. As expected, these clusters have a high potential to deliver on-farm benefits. However, the development of resistant varieties will also reduce pesticide, herbicide and fungicide applications. Reduction in on-farm chemical applications has strong potential to deliver public benefits associated with meeting consumer expectations for safe, residual free food, reduced environmental contamination and protection of Australia's international reputation as a 'green' primary producer.

As a final example, activities in the Soil Nutrition/Biology research cluster have the potential to produce high on-farm and public benefits, but only low industry benefits. The rationale for these scores is that improvements to soil health will provide direct on-farm benefits through increased yields and a reduction in fertiliser application. However, soil biology is also vital in supporting healthy eco-systems. Therefore improvements in on-farm soil biology will also deliver high environmental public benefits.

Table 3.2 shows the identified potential for on-farm, industry and public benefits from GRDC investments, with the on-farm benefits scoring the highest potential. This is not surprising given the vast range of on-farm benefits that have been previously identified from GRDC-funded research. There is also a good deal of potential for GRDC-funded research to generate public benefits, with public benefits scoring a 2 out of a possible 3. The scorecard has identified that GRDC-funded research has the lowest potential to generate industry wide benefits, scoring 1.36 from a possible 3.

These results are consistent with the actual mix of benefits identified in GRDC's impact assessments. Since funding comes from growers and from government, the methodological emphasis in these assessments is to identify the benefits to levy payers and to the wider community. This also reflects the investment planning process, which takes account of the research needs of the growers and balances them against the Australian Government's National Research Priorities and Rural Research Priorities. As a result, GRDC's research portfolio is strongly geared toward generating returns that are in line with the sources of its funding. Industry benefits comprise externalities to the benefits generated by the GRDC research portfolio, and there is less emphasis on the identification of types of benefits and their magnitude — in large part because GRDC's reporting of impacts are heavily geared towards growers. Overall, therefore, the potential for benefits from GRDC's research portfolio is broadly in line with the sources and composition of funding received.

3.2 Are there appropriate conditions within the GRDC model to achieve these benefits?

A core element of the impact assessment framework is an assessment of how effective GRDC is in achieving research benefits. Effectiveness is assessed in terms of:

- the quality of GRDC-funded research;
- the extent of knowledge diffusion; and
- the quality of governance arrangements.

The quality of GRDC-funded research

The quality of GRDC-funded research can be assessed based on its internal self-assessment process, the level of external endorsement and the adoption of GRDC recommended technologies or practices across the Australian grains industry by growers.

The GRDC conducts rigorous internal self-assessment through its economic impact assessments. The impact assessments are designed to examine economic, environmental, and social benefits of GRDC's investment in projects. GRDC uses these impact assessment studies to understand how effectively it is delivering desired outcomes to its key stakeholders and where improvements can be made.

The GRDC conducts its impact assessments based on guidelines used for assessing impacts across all RDCs. These guidelines have been reviewed by key economic agencies of the Australian Government including Treasury, Department of Finance & Regulation, Department of Agriculture, Fisheries & Forestry (DAFF), Productivity Commission and the Australian Bureau of Agricultural and Resource Economics (ABARE).

External endorsement of GRDC can be inferred from a number of sources. Firstly, the GCA-endorsed grower levy has constantly been set above the amount required to attract maximum government funding. This suggests that the GCA and growers perceive there to be high value from GRDC-funded research beyond maximising the contribution from the Australian Government. Secondly, the IPSOS GRDC Organisational Performance Research in 2008, in which 1,200 growers are surveyed across all three grain growing regions of Australia, identified that 68 per cent of growers rated GRDC's performance as *very* or *fairly* high and 61 per cent of growers stated that they directly benefited from GRDC activities or initiatives. As referenced in a recent GRDC annual report, 'an independent survey of growers showed that 83 per cent of those surveyed believed that the GRDC was delivering value in terms of research dollars invested' (GRDC 2009).

GRDC performance can also be assessed by its longer term contribution to productivity growth. GRDC's contribution in terms of productivity growth has been assessed in the ABARE 2010 report, *Harvesting Productivity (Jackson 2010).* The report outlines the importance of GRDC-funded research, particularly in plant breeding, to improving productivity across the Australian grains industry.

Finally, further endorsement of GRDC can be inferred from the level of 'grants' income it is receiving. This is money received from other organisations (such as DAFF and other RDCs) in order to manage projects on their behalf. GRDC's grants income exceeds $9M in 2009-10. Examples of programs where GRDC receives grant income and then manages the investment are Australia's Farming Future, Climate Change Research Program Caring for our Country as well as the Managing Climate Variability programs.

The efficiency of knowledge diffusion

The benefits of research can only be realised to the extent that the research is understood and implemented. If there is no mechanism for knowledge diffusion, or if the mechanism is inadequate, then the benefits from research will be well below potential. GRDC is conscious of the importance of communication and knowledge distribution and has an active extension strategy and implementation plan. Extensive networks have been established through the GRDC customer relationship management system, GRDC's strategic involvement with the State Extension Leaders Network and face-to-face workshops with growers and extension officers across the country. In addition to the above, the GRDC uses a number of mechanisms to engage with stakeholders, as shown in the main body of this submission.

The GRDC also sets itself performance targets in terms of grower knowledge and understanding of its work. The results of the 2008 growers' survey revealed that most growers were aware of GRDC-funded research. However, some growers felt that they should know more about the specifics of GRDC-funded research. The survey also revealed that *Ground Cover* remains the key, most highly valued information source on GRDC and is an effective means of communication. Performance against specific targets could continue to be improved.

GRDC's performance against the knowledge diffusion activities described earlier is shown in Table 3.3, and there is strong recognition of the GRDC's efforts in this regard. In an article titled 'A word for our sponsors' published in The Australian in 2008, Julian Cribb wrote:

> Almost none of the main science funding agencies insist on effective communication to Australians as a condition of their grants. A creditable exception is the Grains Research and Development Corporation, which invests about 15 percent of its annual budget in science transfer. Among the agencies, only CSIRO and a tiny handful of co-operative research centres and other centres make a serious endeavour to share their findings with the shareholders.

Table 3.3

GRDC KNOWLEDGE DIFFUSION PERFORMANCE

Criteria	Performance
Presentations given at industry sponsored conferences?	✓
Presentations given at academic conferences?	✓
Presentations given at learned societies?	✓
Distribution of research newsletters and other media to industry stakeholders?	✓
Meetings attended with potential industry adopters of research?	✓
Industry survey as to who's research is valued	✓

The quality of governance arrangements

The quality of governance arrangements can be assessed in terms of: the roles and responsibility of the Board; disclosure and transparency obligations; and the role of stakeholders in corporate governance. GRDC performance against these criteria is discussed below. The GRDC Board has commissioned an external governance and performance review by Blake Dawson lawyers every three years since 2003. Blake Dawson reviews the current performance of the GRDC's Board, and GRDC's progress in implementing recommendations from the previous reviews. In each case the review is confidential for the Board only, to obtain as open and honest an assessment as possible.[2] The recommendations from the reviews are built into GRDC's work plans and the Board periodically reviews progress in implementing the recommendations.

[2] A public summary of the 2009-10 governance review — which concluded that the GRDC continued to attain a high standard of governance — is attached at: **http://www.grdc.com.au/director/about/corporategovernance.**

Furthermore, in recognition of GRDC's strong governance and administration, the Corporation has been nominated for and/or awarded the following:

- Institute of Public Administration Australia (ACT Division) Annual Report Awards — Gold Award in CAC Act category for the 2008-09 Annual Report;
- NAB Agribusiness Awards — winner of Risk Management Award (2009, 2008) and short-listed for Governance Award (2008, 2009)
- Australian Reporting Awards — Silver Award (annually, 2000 to 2009); and
- GRDC participates in the Comcover risk management benchmarking program each year — detailed results for 2010 are not yet available, but in summary GRDC was rated 7.2 out of 10 (the "peer group" of 22 small agencies' average was 6.12 out of 10), and topped several elements in the peer group. The 2009 benchmarking survey rated GRDC in the top 3 per cent of small agencies participating.

The role and responsibility of the Board

The Australian Standards provide recommendations and guidance surrounding the roles and responsibilities of boards, and the roles and responsibilities of GRDC's Board are closely aligned with those recommended in section 3.2.3 of the Australian Standard *Good Governance Principles*, which contains recommendations on a number of aspects of board performance and administration. GRDC board performance against these criteria is presented in Table 3.4 below.

Table 3.4

GRDC BOARD PERFORMANCE AGAINST AUSTRALIAN STANDARD GOVERNANCE PRINCIPLES

Area of governance	Australian Standards principles	Score	Evidence
General responsibilities	The board should be responsible for strategic direction, approval of budgets and other performance indicators, compliance with applicable laws, entity risk assessment, general policy implementation and compliance appointment of the chief director.	✓	The board's objectives, structure and operations are consistent with the general principles and guidelines established by Australian Standards, and in line with the operating and reporting arrangements that GRDC is required to undertake as a Statutory Corporation (for example, the Annual Operations Plan, Risk Management Plan, Annual Report and so on).
Board independence	• Majority of board members should be independent of management. • Board chairperson should be independent of management. • Clear procedures surrounding conflict of interest. • Directors should be actively involved in setting meeting agenda's.	✓	All board members except the managing director, including the chair and deputy chair, are non-executive and independent of management. Clear dispute resolution guidelines are set out in the GRDC Operating Manual. Finally, GRDC board meeting attendance is very good (for example, over the last two years, all Board members have attended 90 per cent of meetings), with all members also involved in meeting agenda setting.
Board appointments	• Appointment process and decisions should be recorded. • Terms and conditions of appointment should be provided to the new director. • Performance of the board must be periodically assessed.	✓	GRDC board selection is a clear and documented process. The Minister selects and appoints the chair of the board with the Managing Director selected by the board. The rest of the board is selected through nominations made by a selection committee, appointed by the Minister.
Board skill set	Collectively, the board should have an appropriate level of skills and experience required to fulfil its responsibilities.	✓	Collectively, the current board members have experience and skills in: business management; corporate governance; commodity production, processing and marketing; finance; risk management; conservation of natural resources and the environment; R&D administration; science, technology and technology transfer; IP management and public administration. These skills are considered appropriate given the GRDC's role.
Board induction and training	Directors should take on appropriate induction and training on appointment.	✓	New board members go through a formal induction process, and there is a process of continuous education for all directors.
Code of conduct	The board should approve a written Code of Conduct.	✓	The code of conduct is documented in the GRDC operating manual.
Board committees	All board committees should have their own charter, setting out responsibilities surrounding membership, meeting frequency and core agenda items, authority and reporting obligations.	✓	GRDC board has appointed two committees: the Finance, Risk and Audit Committee and the Remunerations Committee. Each has its own members and terms of reference.

Disclosure and transparency obligations

According to Australian Standards *Good Governance Principles*, entities must ensure that the annual report provides performance information that demonstrates accountability for the expenditure of public monies and for the efficient and effective operation of that entity. This is achieved through the GRDC Annual Report, in which GRDC provides an overview, a measurement of performance and a description of operations. GRDC also undertakes the reporting shown in Box 3.1 to its various stakeholders.

Box 3.1

GRDC REPORTING

The elements of the GRDC's corporate planning and reporting approach include:

- strategic R&D plan—sets out the GRDC's high-level goals, strategies and performance measures for a five-year period, developed in consultation with stakeholders and approved by the Minister;
- investment plan—informs potential research partners about some of the GRDC's new investment priorities for the next financial year and invites interested parties to submit research proposals;
- annual procurement plan—makes procurement information publicly available through the Australian Government's AusTender procurement management website;
- annual operational plan—specifies the annual budget, resources and research priorities that give effect to the strategic R&D plan during a given financial year;
- portfolio budget statement—as part of the Australian Government budget process, summarises the planned outputs, outcomes, performance information and financial statements for a given financial year;
- annual report—provides information on R&D activities and their performance in relation to the goals set in the annual operational plan and portfolio budget statement for a given financial year;
- growers' report—provides performance information to growers on R&D activities for a given financial year;
- stakeholder report—meets legislative requirements for reporting to the grains industry's representative organisation, the Grains Council of Australia; and
- statement of intent—describes how the GRDC will meet the requirements of the Australian Government's Statement of Expectations during a given financial year.

Source: GRDC

The role of stakeholders in corporate governance

The Australian Standards *Good Governance Principles* also include principles for working with stakeholders. Notably, a system of good governance should consider the interests of stakeholders and encourage co-operation between stakeholders. Specifically, Australian Standards Good Governance Principles require:

- that the interests of stakeholders are protected by law are respected;
- where stakeholder interests are protected by law, stakeholders should have the opportunity to obtain effective regress for violation of their rights;
- that the system of governance should permit performance-enhancing mechanisms for stakeholder participation; and
- that where stakeholders participated in the corporate governance process, they should have access to relevant information.

GRDC has an extensive network of stakeholders that it engages with on a regular basis. There is no evidence to suggest that GRDC is operating outside of any of the principles Australian Standards propose for stakeholder engagement in corporate governance.

Chapter 4

Conclusion

4.1 Summary

As discussed in the opening, the analysis and discussion in this report aim to achieve the following three outcomes:

- provide evidence of the potential types of benefits that can be achieved from research funded by the GRDC;
- comment on whether the combination of funding split across industry and the Australian Government is appropriate, given the types of benefits expected from research funded by GRDC; and
- identify the extent to which GRDC's approach provides the best conditions to achieve these benefits.

GRDC's research portfolio is balanced to meet the research needs of growers, as well as aligning with Australian Government research priorities, and there are research clusters that specifically target beneficiaries on farm, within the industry (other primary producers, researchers and supply chain partners), and in the community more widely. Using the scorecard approach described in section 3.1, there is strong evidence of a good balance of potential benefits to the different types of beneficiaries across GRDC's portfolio as a whole, and that the portfolio proposed for 2010-11 aligns well with sources of funding to GRDC — particularly the recent 2:1 ratio of industry to Australian Government funding that dominates GRDC's revenue.

Furthermore, the conditions to realise these strong potential benefits are also in place. The quality of GRDC-funded research is high — as evidenced by the take-up of innovative practices by growers, and the improvements to total factor productivity. GRDC has in place the appropriate arrangements to ensure that projects are selected and funded under a model of good governance and administration, and that the necessary mechanism exists for converting theoretical concepts into tangible outcomes for all beneficiaries.

4.2 Rationale for public support

As the analysis in section 3.1 shows, there is potential for industry, and public benefits from GRDC-funded research — many of which are already being realised — and the proportions of these benefits are broadly in line with sources of funding. In addition to the funding received through the levy and the associated funding from the Australian Government, GRDC is also able to obtain and leverage funding from supply chain partners, as well as additional funding from the Australian Government, to manage projects with outcomes targeted to beneficiaries within the supply chain, or to the community more widely. This would not happen if these organisations felt that GRDC were not qualified or were not capable of achieving the necessary outcomes, and generating the associated benefits.

GRDC performs strongly in terms of the quality of its funded research, the quality of its governance arrangements, and the mechanisms it uses to diffuse the benefits of research. Given that there is strong evidence that the GRDC research portfolio has the capacity to generate benefits to all three types of beneficiaries discussed, there is a strong case for continued government funding support to GRDC. If public funding is withdrawn, the case for continued grower funding is likely to be called into question, and this has implications for the composition of GRDC's research portfolio, as well as GRDC's governance and reporting structure.

An important consideration in all of the analysis contained in this report is that currently, GRDC's reporting of benefits from GRDC-funded research is heavily weighted toward its levy payers. For example, the impact assessments of GRDC funded projects use methodologies that quantify benefits on-farm — such as reduced costs or improved yields — but only qualitatively discuss the benefits across industry or to the community more widely. There is a limit to the extent that individual growers can benefit from improved productivity, given that they are small, competitive price-takers in a large market. As such, one of the major benefits to growers is GRDC's work in ensuring the sustainability of the industry, and expanding the industry as a whole. Unlike the Industry Owned Corporations, GRDC is not required to conduct a periodic review of itself and the impact of the research it funds, although it reports research outcomes (including social and environmental) to the Council of Rural RDCs as part of the CRRDC's evaluation activities. In addition, whilst the Australian Government has clearly conveyed their expectation for RDCs to develop and use common performance measures across all the RDCs to quantify performance and public spill-over benefits, there are no formal guidelines as to the appropriate metrics to use in compiling these measures.

Appendix A

GRDC research areas

This Appendix provides a brief description of each of the GRDC research clusters.

Genetic resources

Projects in this group aim to preserve plant genetic resources to conserve crop diversity, to locate new lines with attributes of potential use in the Australian environment and to facilitate exchange between Australian researchers and breeders within groups around the world.

An example of such a project is the Rome-based Global Crop Diversity Trust (GCDT), which is an effort to rescue and conserve endangered crop varieties and their wild relatives. Endangered germplasm is identified, collected, screened for certain traits and the information is made available in a searchable format so that researchers and breeders can have access to lines of interest in the collection. GRDC co-funds this work at the GCDT with the Bill and Melinda Gates Foundation.

National Variety Trials (NVT)

The NVT program delivers scientifically robust, impartial variety information on the performance and characteristics of new cereal, pulse and oilseed varieties to Australian grain growers. It is a system of 626 trials at around 320 different locations across Australia. NVT is a close-to-market activity that assists growers and their consultants with their varietal decisions through providing independent information. The site and yield data are also used by agricultural research scientists working on frost, nutrient and quality projects. Quality data can be accessed by breeders for classification purposes, and are available to handlers and processors (i.e., maltsters) for assessing the suitability of the variety for their requirements (i.e., screenings and plumpness data for barley). Lines nominated to enter NVT must be available for growers to purchase on a commercial scale within one (canola), two (cereals) or three (pulses) years. Yield, quality and agronomic data on lines are collected as well as site characteristics including soil tests and rainfall, dates of sowing and harvest, fertiliser and chemical inputs and rotation information. GRDC funds NVT and the information is made available through the NVT Online website run by Australian Crop Accreditation System (ACAS).

Platform Technology/Enabling

Within the GRDC 2010-11 RD&E portfolio of investment, there are a number of projects with outputs underpinning a range of applications in different crop species (Platform Technology) or that facilitate supply chain coordination for industry progress (Enabling functions). Examples of platform technology investments are:

- recurrent selection in hexaploid wheat, which trials a different breeding strategy to what is generally used in Australian breeding programs (modified pedigree method);
- molecular tools to support genotyping in cereals ;

- the Australian Winter Cereals Molecular Marker Program;
- real time sensing in crops;
- next steps in precision agriculture; and
- microspectrometer technology for assessment of soil and grain parameters in broad acre agriculture.

GRDC directly undertakes or facilitates the dissemination, adoption and commercialisation of Platform Technologies. For example, GRDC undertakes to provide through direct support or projects:

- statistical support that is accessed by many different GRDC-funded RD&E projects across multiple crop types and across multiple regions;
- improvements in the efficiency of end point royalty collection by bringing breeders and the seed industry together to collaborate with grain marketers and end-users;
- support for breeders to provide market signals and R&D priorities to pre-breeders; and
- support for pre-breeders to share information through the Australian winter cereals pre-breeding alliance.

These 'enabling' activities increase the efficiency of RD&E investment through reducing duplication and fragmentation and making sure that investment is market driven. The Australian government recognises enabling technologies as "the basis for building knowledge-intensive industries that can provide sustainable, high-skill, high-wage jobs for Australians".

Also included in this cluster as enabling functions, are projects with ABARE that investigate productivity trends and ways to increase productivity growth.

In September 2009, Agtrans Research evaluated a similar investment to the molecular marker project above. The benefit-cost ratio of GRDC investment in the Australian Winter Cereals Molecular Marker Program (AWCMMP) was estimated to be 5:1 over 20 years. The principle benefits were economic, but there were environmental benefits in the form of reduced chemicals in the farm environment and also in the community. The major social benefit from the AWCMMP was the building of human capability.

Crop Breeding

Plant breeding has been and will continue to be a major path to increasing grain growers' profitability and productivity through increased yields, reduced costs and better disease resistance. Breeding also delivers improvements in grain quality to suit various markets. It also provides the path to market for up-stream investment in plant genetics, which often has public-good aspects that are best delivered in association with private industry benefit. Plant breeding provides significant industry (private) benefit, but as Australian grain exporters are price-takers, most, not all, benefit is captured as improved profit. It is more likely to generate productivity growth, which benefits the community through its contribution to food affordability (food security), Australian international balance of payments and attaining improved living standards.

The dominant activity in the Crop Breeding cluster is applied breeding, which is making a cross to develop a commercial cultivar and then selecting progeny that display a range of advantageous characteristics over current varieties. In other words, applied breeding involves development, evaluation of lines and commercialisation. The uniqueness of the Australian environment means that breeding (crossing) is necessary rather than screening lines introduced from overseas. Typically for cereals, the time from making the cross to the variety being available to growers in commercial quantities is 6-8 years.

Through Plant Breeders Rights (PBR), plant breeding is able to recoup some investment through collecting end point royalties (EPRs). The value that can be captured through EPRs is dependent on the size of the varietal market, production levels and risk. Therefore GRDC and its partners in breeding have adopted different strategies for the breeding of different crops.

An example of activities in the crop breeding cluster is barley breeding. Based on the impact assessment of barley breeding completed in November 2008, the benefit to cost for GRDC investment in this area has been 8:1 over twenty years. Economic, social and environmental benefits are outlined in the barley impact assessment report.

Pre-breeding

The Pre-breeding cluster is a large and diverse portfolio of projects involving genetic approaches to crop improvement that are up-stream to applied breeding. Therefore the Pre-breeding cluster contains technology discovery and development as well as the closer-to-market germplasm development. Project outputs from this series are generally knowledge, markers for advantageous traits that can then be transferred to applied breeding programs, and/or parental lines that applied breeding programs can use in crosses. There are significant time lags (8-25 years) before benefits are realised from pre-breeding investments.

An example of investment in this cluster is the triple rust initiative, which is a co-investment between GRDC and CSIRO. Rust is a fungal pathogen, which, when unchecked, has a devastating effect on wheat yields. As part of the Australian Cereal Rust Control Program (ACRCP), the objective of the triple rust project is to rust-proof Australian wheat varieties against stem (including strain Ug99), leaf and stripe rust by identifying DNA markers and additional adult plant resistance genes for use by plant breeders. The markers will assist breeders 'stack' multiple resistance genes in each variety to increase breeding efficiency and the durability and life span of rust resistant varieties. The project also involves developing synthetic resistance gene technology that can be used to generate transgenic wheat resistant to multiple forms of rust. The project links to the Global Rust Initiative, which offers protection to Australian grain growers from external rust threats.

This R&D will contribute to grain grower profitability and productivity by protecting crop yields in the face of evolving pathogen populations. It is also a component of global food security and develops 'human capital' as researchers increase their capability to create and deploy synthetic genes.

GRDC has previously assessed the impact of similar series of pre-breeding projects that have genetic information as the key output. These projects focussed on genomics of cell wall and grain development in cereals and their relationship with grain quality. The benefit to cost for GRDC investment in this area has been estimated to be 1.4:1. Economic, social and environmental benefits are outlined in the Functional Genomics Program impact assessment report, which was completed in April 2008.

GRDC also assessed the impact of the Australian Cereal Rust Control Program (ACRCP), which falls within the Pre-breeding cluster. The ACRCP focuses on improving germplasm and providing screening services for breeders. Its objectives are:

- to monitor and produce information on cereal rust pathogens throughout Australia;
- to identify and characterise new sources of rust resistance in cereals; and
- to assist Australian cereal breeders to incorporate rust resistance into new cultivars.

The benefit to cost ration for GRDC investment in the ACRCP has been estimated to be 23:1.

Crop Protection

Crop Protection covers RD&E activities to combat losses of crop production due to weeds, pests and pathogens. Outputs from projects in the Crop Protection cluster span a wide time range for exploitation and therefore for benefits to flow to industry and the broader community. For example, there is GRDC investment to generate data to assist in registration of minor use chemistries, which provides a greater range of pesticides for grains' industry use. There are significant public benefits associated with this (maintaining diversity of food types, meeting consumer expectations for safe, residue-free food products, protection of the environment, managing Australia's international reputation for food production, reducing impediments to free trade, flow-on effects to other industries). There are other projects in the cluster such as national surveillance of grains to manage biosecurity, food and feed safety risks, and also projects that contain fundamental science.

Due to the diversity in the portfolio, an example of RD&E in each of the areas of weeds, pest and pathogens is provided.

Weeds: GRDC has examined the benefits likely to flow from a series of 11 weeds projects established in response to increasing concerns of herbicide resistance. The investment is expected to result in a benefit cost ratio of 3.5:1 and the benefits flow to grain growers, other industries, to the public and to other countries.

Pests: An example of GRDC investment in this sub-category of Crop Protection is the National Invertebrate Pest Initiative (NIPI III), which is a co-investment between GRDC, CSIRO and the University of Western Australia (UWA). The main outcomes from the project are capacity building to provide leadership in the area of integrated pest management and improved extension of information through collaborative networks leading to improved pests management.

Pathogens: GRDC is investing in the northern region to reduce losses from diseases of winter cereals and chickpeas through improved integrated disease management. The project develops new management approaches and extend disease management options to growers. It will also provide diagnostic support and surveillance support to industry along with pathology support to winter cereal breeding programs.

Environment – Climate

The projects forming this cluster generally address on-farm greenhouse gas emissions (for example fertiliser management), increasing organic matter in soil (carbon), adapting to climate change including improved weather forecasting (seasonal forecasting and more localised) and increasing our understanding of frost and heat stress with the aim of developing management approaches to minimise these risks.

Within the Environment-Climate cluster, GRDC co-invests with grants from the Department of Agriculture, Fisheries and Forestry (DAFF) in the program Australia's Farming Future, which equips primary producers to adopt mitigation measures and adjust to the impacts of climate change.

In May 2008, Agtrans Research evaluated a series of similar projects in a 'Climate Cluster' that expanded beyond managing climate variability to adapting to climate change. Although the benefits from this investment were difficult to quantify, the benefit-cost ratio for GRDC investment was estimated to be 1.5:1 over 20 years. Industry benefit was in the form of improved productivity; environmental benefits were farming systems more attuned to the rainfall pattern thereby reducing erosion and fertiliser leaching. The key social benefits were improved personal capacity of land managers and communities to understand and manage climate variability and climate change and to reduce risk.

Farming Systems

The high level objective of farming systems' investments is to develop sustainable farming systems adapted to a range of agroecological regions. All of the investments fit into an overall framework that investigates and extends knowledge in relation to:

- Matching investment in different crops/enterprises with appropriate land use (for example, defining water limited constraints to production and conveying how to adjust management to maximise profitability)
- Considering the status of the paddock (for example, what was grown in that paddock last season, how will that affect nitrogen status, were there weed issues?)
- How was the stubble managed? For example, was it grazed? Was there appropriate ground cover retained?
- During the crop growing season, examining the division and distribution of crop water use (for example, how do different crop management techniques alter the ratio of water transpired through the plant rather than evaporated from the ground?).

- Farming systems' RD&E tends to consider the whole farming system including crop and variety choice, agronomic practices and alternative management strategies. Different farming systems' projects have different weightings between the environmental, social and private benefits they deliver.
- As part of investing in the Farming Systems' cluster, GRDC works with multiple farming systems' groups around Australia. These groups have different interests and capabilities and undertake development and extension on particular aspects of the framework. Investing in these groups provides for a participatory approach to RD&E.
- In April 2009, a group of 18 farming systems' projects in the northern region were evaluated for their likely impact. Benefits were identified as being predominantly, but not exclusively, private benefits to grain growers in the region. These benefits were in the form of improved profitability and productivity. The estimated benefit-cost ratio of the GRDC investment is in the order of 5:1. Environmental benefits achieved included reduction in soil loss due to decreased erosion, reduction in deep drainage, reduction in off-site movement of herbicides and pesticides, improved maintenance of soil fertility, higher soil biological activity and organic matter. Social benefits included increased industry, community and research capacity; increased ownership by grain growers of approaches to solving local concerns, and more effective social networks.

Evaluation of 9 farming systems projects from all GRDC regions was performed by Hassall & Associates in 2004. They estimated for GRDC investment a benefit-cost ratio between 2.7-5:1.

Capacity Building

There are two main targets for GRDC's Capacity Building Program: (a) industry, including grain growers, and (b) researchers. Capacity building for researchers takes the form of PhD scholarships, GRDC-funded professorial positions in areas of strategic importance to the grains industry (Graeme Hammer, Richard Oliver, Robert Park et al) and specifically targets areas of endeavour where there is likely to be a shortage of expertise in the future. GRDC also supports conferences to encourage knowledge transfer and invests in programs to raise the awareness of agriculture in schools.

Industry capacity is increased through GRDC-funded activities such as technical workshops, up-skilling extension providers, formal education programs for sustainable grains production, and numerous projects where consultants, with agribusiness run demonstration trials to increase growers' knowledge.

GRDC also supports a series of projects that are broader than the grains industry and aim to improve leadership capability. These projects are:

- The Australian Rural Leadership Program;
- The Nuffield Scholarship Program;
- The BHP Billiton Science Awards; and
- The Science and Innovation Awards for Young People in Agriculture.

Whilst the benefits from capacity building investments such as awards, leadership training and scholarships are long term in nature and difficult to value, an attempt has been made by Agtrans Research in 'An Economic Analysis of GRDC Investment in Aspects of Capacity Building'. The estimated benefit-cost ratio over 30 years is 4.2:1.

Soil Nutrition/Biology

Projects in the Soil Nutrition/Biology cluster research soil-based issues, develop solutions and extend information to growers to support soil health. Activities are based around themes of:

- maintaining organic matter and groundcover;
- balancing the application of inputs to maintain soil fertility;
- managing diseases for healthy plant growth;
- managing for soil structural stability;
- managing soil constraints, including how to match enterprise activity to land-use capability; and
- balancing production, and ecological and environmental services.

An example of investment in this cluster is the soil biology program which encompasses the use of microbial inoculants to increase crop yields. These inoculants act by solubilising phosphorous so it becomes available for uptake by plant roots. GRDC also co-invests with the private sector to ensure product formulation, application, distribution and marketing chains are developed to meet the needs of Australian growers. Based on the impact assessment of the soil biology program in September 2009 , the benefit to cost for GRDC investment in this area has been estimated to be 3:1 over 20 years. The economic, social and environmental benefits are outlined in the soil biology impact assessment report.

Tactical Crop Management

The Tactical Crop Management cluster has investments that develop improved approaches to managing crop inputs for optimising yield and grain quality of varieties. Approaches include using selective herbicides and fungicides effectively, no-till and stubble retention and precision agriculture to better match inputs to very localised paddock and crop conditions.

Examples of agronomy activities funded by GRDC are:

- herbicide-tolerance trials for cereals and pulse crops;
- foliar fungicide trials to establish the economic impact of relying on inherent variety resistance verses a package of variety resistance and strategic use of fungicides;
- 'agronomic packages' for growing semi-dwarf barley varieties in WA and for herbicide-tolerant canola. These packages contain detailed information such as time of sowing, seed rates, herbicide sensitivity, growth habitat and maturity;

- agronomic packages for a range of entirely new crops that offer significant potential for Australia including dual-purpose canola and canola-quality mustard; and
- improving the profitability of broadleaf crops with the aim of increasing the diversity of crops grown in rotation.

Agtrans Research evaluated one aspect of Tactical Crop Management in June 2009, which was the GRDC-supported Western Australian No Tillage Farming Association (WANTFA). Benefits included increased grain grower profitability, increased levels of organic matter in the soil, improved air quality, and reduced water and wind erosion. The estimated benefit-cost for GRDC investment in WANTFA is 36:1.

Similarly GRDC investment in to variable rate technology has been evaluated with the estimated benefit-cost being 7.0:1 over 20 years. The benefits readily identified from the investment in precision agriculture are predominantly private benefits and will be captured by grain producers. The benefits associated with natural resources and lowered contaminants in waterways (stemming from less available nutrients and herbicides) as well as decreased emissions due to less fuel consumption for tillage can be considered public benefits that are spillovers from the productivity-driven management changes.

Supply Chain & Markets

Projects in the Supply Chain & Markets' cluster are developing processes to enhance existing markets for Australian grain or to create new markets through the development of new grain products. Supply chain participants and/or end-users are involved in these activities. The characteristics of projects in the Supply Chain and Markets' cluster are illustrated through the following examples and include:

- developing a new baking process for Asia that suits Australian wheat
- increasing feed grain digestibility through use of additives
- ensuring that barley grain purity continues to be of a high standard in the future by applying molecular techniques for variety identification
- developing diagnostics to improve fermentation control in the brewing industry
- developing new industrial products (for greater detail, see Crop Biofactories Initiative (CBI) below)
- new grain products for new foods providing improved health outcomes:
  - high amylose wheat (for greater detail, see Arista Cereal Technologies below)
  - low gluten barley
- providing a system of quality control for malting barley varieties destined for different markets (Pilot Brewing Australia)
- providing a system of quality grades for wheat through wheat variety classification (see below).

The Crop Biofactories Initiative (CBI) is a partnership between GRDC and CSIRO. CBI requires researchers to identify components of synthetic pathways in plants, transfer them to the crop species of choice and manipulate each component so as the plants are viable and produce commercially significant quantities of oils meeting certain quality specifications. The need to address challenging technical hurdles in this project has generated significant research capacity in the area of transgenics, lipid chemistry and biosynthesis. Should the project be successful, it will open up a new area of economic activity for the grains industry by providing a new market and potentially value-adding opportunities prior to export of the product. The lead time prior to producing the product in commercial quantities for this sort of project is in the order of 15 years.

Arista Cereal Technologies Pty Ltd is a joint venture between GRDC, CSIRO and the French ingredient company Limagrain Cereal Ingredients to deliver high amylose wheat to market. High amylose grains produce resistant starch which is important in bowel health and has a lower glycaemic index than other starches, with benefits for losing weight and stabilising blood sugar levels. Resistant starch is currently supplied from Hi-Maize flour which cannot be incorporated into wheat-based products at high levels, or through chemical modification of flour. Arista is pursuing both GM and non-GM solutions to deliver a wheat with high amylose content to satisfy the market demand for a wheat with increased resistant starch that retains the important functional properties of wheat. The first high amylose wheat variety is projected to be available in the next five years. Negotiations with commercial partners in a number of territories are underway to put in place the necessary supply chain arrangements to grow, process and deliver high amylose wheat to market.

With deregulation of the single desk in Australia for bulk wheat exports, GRDC was requested to take over wheat variety classification, which is a system supporting segregation of wheat into different quality grades suitable for particular end uses.

In September 2008, two projects fairly typical of some other projects in the Supply Chain & Markets' cluster were evaluated by Agtrans Research. Project outputs included new knowledge of market requirements and revised noodle processing methods (including identifying suitable flour types) to suit the Taiwan market. The benefit-cost ratio for GRDC investment in these two projects was estimated to lie between 0 – 5.0:1. The primary beneficiaries were wheat exporters through achieving better returns from exporting to Taiwan.

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