Economic Analysis of Research and Promotion

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The Australian Grains Research and Development Corporation: a Commonwealth[1] and Industry-funded Research Investment Corporation

Sharon Till[2]

Introduction

Australian grain growers produce an average annual total production in excess of 23,500Kt of which 70-80 percent is exported, accounting for 10-15 percent of world grain trade. The Grains Research and Development Corporation (GRDC) is a Commonwealth statutory corporation. Its functions, powers, and objectives derive from the Primary Industries and Energy Research and Development (PIERD) Act of 1989. The GRDC's charter is to combine the funding resources of individual grain producers and to encourage a culture for increasing investment in grain industry research. It does this through

- agreement by members of the industry to impose a levy on output to provide funds for research into industry problems; and
- agreement by the Commonwealth government to match half of the research expenditure up to a maximum of 0.5 percent of the gross value of production, provided the Commonwealth contribution does not exceed growers levies.

The GRDC is one of several industry-specific research and development corporations (RDCs) including cotton, the fishing industry, forests and wood products, meat, sugar, wool, pig, horticulture, dairy, grape and wine, and tobacco. There are three other RDCs: the Rural Industry RDC (RIRDC), whose mandate includes the development of new agricultural industries; the Land and Water Resources RDC, with a mandate to investigate these natural resources; and the Energy RDC, which investigates more efficient and environmentally-friendly

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[1] The Commonwealth refers to the Commonwealth, or alternatively, federal government of Australia governing Australia overall. Each state of Australia also has its own state government.

[2] The author acknowledges significant input from Steven Lack, Manager Policy and Evaluation at GRDC.

energy sources. These three are majority-funded by the Commonwealth. RDCs fund approximately 30 percent of all agricultural research in Australia[3].

The GRDC was established in October 1990 and in its first nine months, total operating revenue was $25,063.385[4]. In 1995-96, the annual operating revenue was $78,928,268[5]. The GRDC continues to grow with a projected budget for 1997-98 of $80.4 million. This makes it the largest RDC. GRDC expenditure accounts for approximately 40 percent of Australian grain research and development investment[6]. As a result of the rapid expansion of the GRDC, there have been continuing changes in demands on management and, in particular, increased accountability requirements from the two main stakeholders, the growers and the Commonwealth.

Evolution of the RDC Model

Historically, Australian agricultural research has been predominantly funded through the public sector with consolidated revenue used to support

- infrastructure and salary costs for state Departments of Agriculture, CSIRO[7], and universities;
- research grants to universities through the Australian Research Council; and
- taxation concessions for private companies in the processing sector.

In 1992-93, approximately $698 million, or 11 percent, of Australia's total expenditure on research and development was invested in the agriculture sector. Of this, 90 percent was performed in state Departments of Agriculture, Commonwealth government agencies, and the higher education sector (50, 26, and 14 percent, respectively)[8].

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[3] Industry Commission 1995, Research and Development. Australian Government Publishing Service.

[4] GRDC, 1991. GRDC Annual Report

[5] GRDC, 1996. GRDC Annual Report

[6] GRDC, 1997. 1997-98 Levies Paper: An advise paper to be applied to the determination of levy rates for grain commodities in the coming year.

[7] Commonwealth Scientific and Industrial Research Organization, a Commonwealth-funded research organization.

[8] Industry Commission 1995, Research and Development. Australian Government Publishing Service.

The main economic arguments for providing government assistance to research activity are

- research and development has 'public good' characteristic;
- risk and uncertainty associated with research and development;
- trading in the results of research and development is limited by the fact that to be fully informed, research and development information must be acquired;
- large amounts of capital required to produce research results which may be applicable to many firms; and
- the common pool problem where the rush to invest in new ideas to exploit them before others results in overinvestment in research and development[9].

In particular, agricultural research is often high-risk, outcomes often cannot be captured by the firm investing in the research but can be captured by all of those in the industry, and there are public good benefits such as improved water quality that might result from the research. In the absence of government support, it is considered that these instances of market failure would lead to underinvestment in research. The major policy response in Australia has been for governments to either undertake their own research programs or to provide an incentive for increased private research.

Australian rural sector involvement in research funding originated in the 1950s when 90 percent of the wheat growers in Western Australia levied themselves voluntarily to establish a soil fertility research fund. This led the Commonwealth and state governments to agree to a Wheat Tax Act in 1957 which imposed a levy of 1/4d per bushel to all wheat delivered to the Australian Wheat Board in each mainland state. This levy was matched by Commonwealth government contributions. By 1985, 15 industries (barley, chicken meat, cotton, dairy, dried fruits, fishing, honeybee, meat, oilseeds, pig, poultry, wheat, wine, and tobacco) had rural industry trust funds, each administered by a research council or committee.

In 1985, the Australian Meat and Livestock Research and Development Corporation was established under its own Act[10] and became the first RDC within the Commonwealth primary industry portfolio. Refocusing of the Commonwealth's rural research and development in 1986 marked the introduction of research councils with revised procedures for operations to manage the trust funds. These procedures were designed to encourage the development of clearly

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[9] Industry Commission 1995, Research and Development. Australian Government Publishing Service.

[10] Commonwealth of Australia, 1985, Meat Research Corporation Act.

defined industry goals for research and development through formulation of five-year plans in consultation with industry. In 1987, the Horticultural Research and Development Corporation was also established under its own act.

A 1989 review of primary industry research and development recommended more flexible administrative structures for fund management with various restrictions being removed to make arrangements more efficient and responsive to changing needs. The rationale for changing the focus was that the dominant model for technology transfer relied upon the notion that research is done by scientists independent of the wants and constraints of stakeholders[11]. This simplistic linear model was

research ⇒ knowledge ⇒ **transfer** ⇒ adoption ⇒ diffusion

where the extension officer was the bridge between researchers and farmers. Several studies indicated that the chance of successful adoption increased if all parties with a vested interest co-created the change. Therefore to maximize adoption, end-users should be involved in all stages of the research and development process, setting priorities, funding, implementation, dissemination, and evaluation.

One of the key outcomes of the review was the PIERD Act. The PIERD Act's main objective is '*to make provision for the funding and administration of research and development relating to primary industries with a view to:*

> *a) increase the economic, environmental, and social benefits to members of primary industries and to the community in general by improving the production, processing, storage, transport, or marketing of the products of primary industries;*
> *b) achieving the sustainable use and management of natural resources;*
> *c) making more effective use of the resources and skills of the community in general and the scientific community in particular; and*
> *d) improving accountability for expenditure upon research and development activities in relation to primary industries.*[12]

The Act makes provision for the establishment of RDCs in respect of a primary industry or class of primary industries. These corporations are body corporates and are bound by Australian company law. The functions of the corporation are

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[11] Russell, D. 1990, A Critical Review of Rural Extension, National Conference on Agricultural Extension, Canberra.

[12] Commonwealth of Australia (1989), Primary Industries and Energy Research and Development Act. s3.

- to investigate and evaluate requirements for research and development, and prepare and revise plans including an annual operating plan;
- coordinate research and development activities;
- monitor, evaluate, and report on funded activities; and
- facilitate dissemination, adoption, and commercialization.

The Act makes a provision for industries to have a levy declared--this is collected by the Commonwealth and forwarded to the industry RDC. The Act also makes a provision for the Commonwealth to match payments up to 0.5 percent of the gross value of production as determined by the Minister. Various other provisions concerning the powers, operation, accountability, and structure of the RDCs are made in the Act. The legislative mechanisms for collection of the levies is found in several Commonwealth Acts and their accompanying regulations.

Therefore, the Act is designed to improve research efficiency by coordinating research in one industry through one national body, the RDC, and to increase industry funding of research by providing an incentive in the form of matching Commonwealth funds. The attractions to the stakeholders from such a model are:

- *for industry*--an incentive to invest in research and development, a national approach, and access to an integrated portfolio of research and development, and
- *for government*--community benefits, investment in high-risk research and development, and the free-rider problem is addressed.

In 1995-96, RDCs funded 30 percent of Australian agricultural research.

Evolution of the GRDC

In 1957, the enactment of the Wheat Research Act legislation introduced a mechanism to collect funds from wheat growers. Expenditure was controlled by a Commonwealth wheat industry research committee in cooperation with state committees. The Commonwealth committee recommended how the Commonwealth government's contributions should be spent while each state committee recommended how funds collected in that state should be spent. One stipulation in the legislation was that each state committee should consist of a majority of growers. The Act also specified that projects were only to be funded if it was judged that in the absence of wheat industry money, the project would not be undertaken by the CSIRO, or a university or state Department of Agriculture.

In 1986, the procedural operations of Commonwealth research council and state committees were refocused with the criteria for selection of the committees and councils changed to enhance the setting of industry-orientated research directions. The council was required to produce a five-year plan that

concentrated on the supply side of the market. The council concentrated on wheat research, with limited power to consider cross-commodity issues.

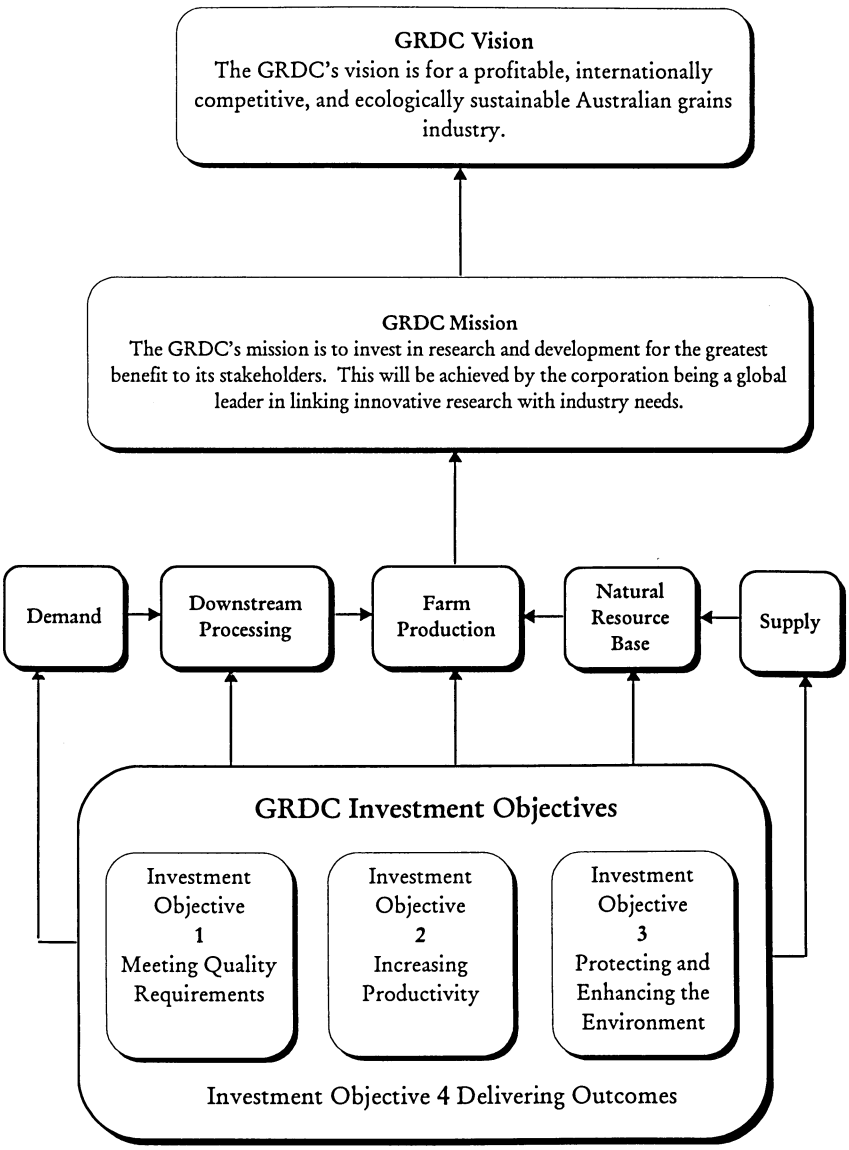
From 1986 to 1989, similar industry arrangements were made for other commodities including barley, grain legumes, and oilseeds. Fourteen such councils and the RIRDCs triticale portfolio were amalgamated with the formation of the GRDC in 1990 under the PIERD Act.

The Operating Structure of the GRDC

In order to enhance management of the research portfolio to achieve the GRDC vision and mission, the GRDC has divided the research portfolio into four investment objectives. The following diagram shows the GRDC operating model[13]. Each research objective is broken down into programs and subprograms. A current list of the GRDC programs is attached in Appendix A.

[13] GRDC 1997, GRDC Five-Year Plan 1997-2002, Partners for Profit.

Figure 1 The GRDC Operating Model

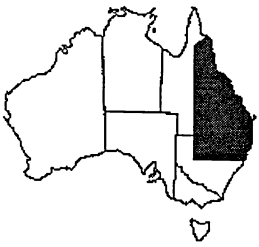


Note: The research priorities shown in this diagram are from the upcoming 1997-2002 five-year plan and have been slightly modified since the first five-year plan.

The traditional geographical division of Australian research based on state boundaries has been abandoned by the GRDC with adoption of three regional areas in Australia considered to have similar grain growing conditions. These regions are shown on the diagram below and are managed as regional units.

Figure 2 GRDC Regions

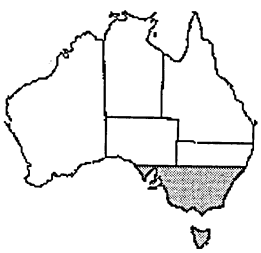
Northern Region



Characteristics

- tropical / subtropical climate
- high inherent soil fertility
- yield depends upon conservation of soil moisture from subtropical rainfall
- substantial enterprise size
- diversity in crop choice, need for new crops, e.g., pulses
- premium on high-protein wheat for export and domestic markets
- high potential yields
- competition with cotton

Southern Region



Characteristics

- temperate climate
- relatively infertile soils
- yield depends upon reliable spring rainfall
- smaller enterprise size
- diverse production patterns and opportunities
- large and diverse domestic market
- lay farming innovator
- shift in intensive livestock production and demand for feed grains to this region

Western Region

Characteristics

- Mediterranean climate
- low soil fertility
- yield depends upon good winter rains as spring rainfall is generally unreliable
- large enterprise size
- narrower range of crop options
- export market dominant, domestic market smaller
- leader in grain storage practice
- transport advantage to SE Asia

The GRDC board manages the fourth region and at present, there is little grain grown in this region.

The GRDC is structured on corporate lines, with its board responsible for developing corporate policies and governing the operation and performance of the corporation. A critical element in the model is the role of the board in fulfilling its 'dual' accountability requirements to Parliament and the Australian grains industry. The GRDC's decision-making structure is shown in Figure 3. The responsibilities and decision-making processes are summarized below.

- A Board of Directors, responsible for the overall direction of the GRDC and the investment balance across its four investment objectives:
  - in order to undertake its tasks efficiently, the GRDC board utilizes three committees: an Executive Committee to process board business between formal meetings; a Finance and Audit Committee to assist the board in the discharge of its financial reporting responsibilities, and a Research Committee which advises on strategic initiatives.

- A Market Advisory Group (MAG) to provide advice and signals to the GRDC board on broad trends and developments in grain end-product markets:
  - the MAG is made up of senior marketing practitioners whose day-to-day work keeps them constantly up-to-date with national and international developments.

- GRDC Management, responsible for realizing the board's priorities, resourcing and evaluating research programs, and enabling the board to meet its accountabilities.

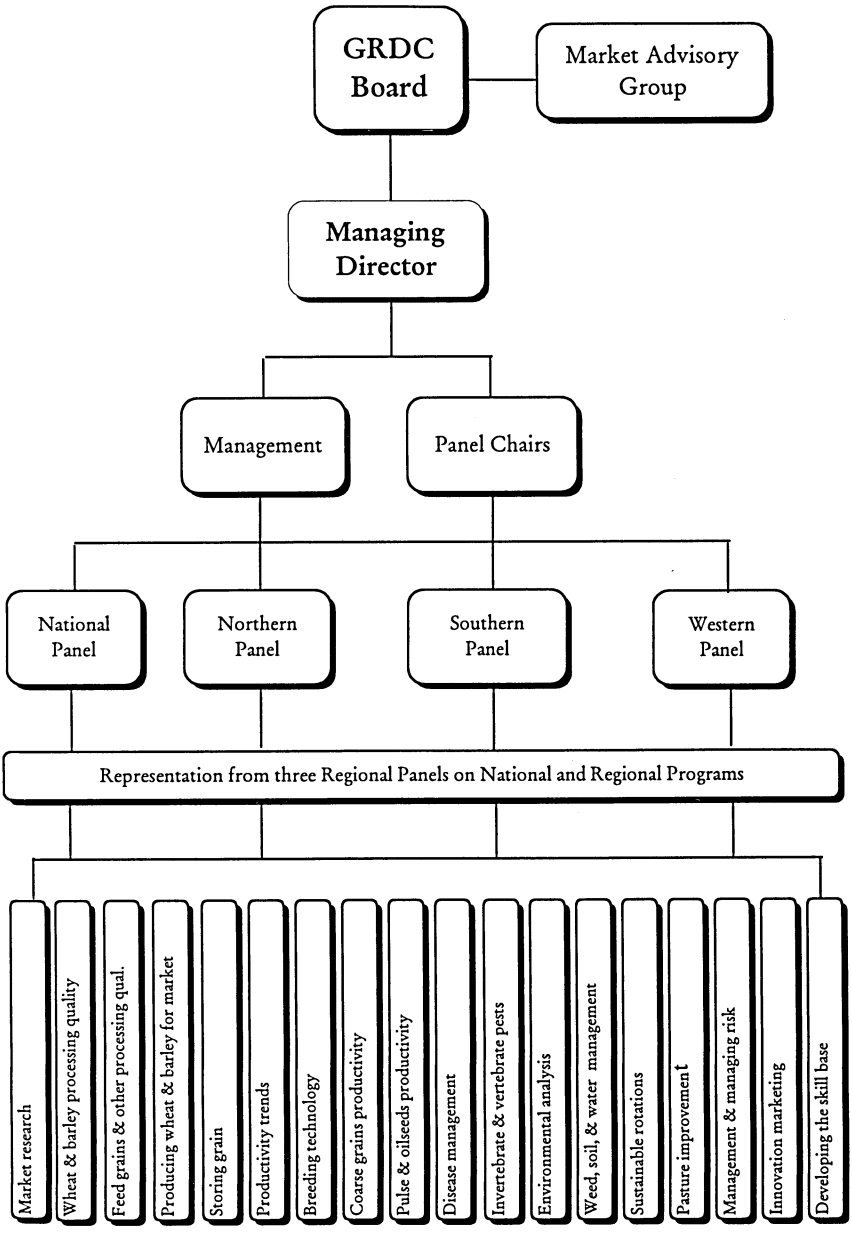
- A National Panel which addresses R&D priorities across national programs and advances recommendations on investments to the board:
  - consisting of the managing director (chair), panel chairs, and GRDC managers, the national panel assists the board in meeting reporting requirements and plays a significant role in communications with research providers and stakeholders.

- Three Regional Panels which address R&D priorities across regional programs and advance recommendations on investments to the board:
  - regional panels are uniquely placed to enhance liaison with, and feedback from, research providers and stakeholder representatives in their regions, and to promote awareness of the GRDC's investments. Panels report to the board through their chairman via the managing director. Panel members include representatives from growers, research, and other industry participants.

- 25 Program Teams which are responsible for evaluating, prioritizing, monitoring, and reviewing the R&D components within individual programs:
  - each GRDC program is the responsibility of a program team which, typically, has representation from the three regional panels and a program manager (PM) or program consultant (PC). Program teams provide recommendations to the regional panels for regional programs and to the national panel for national programs.

In a dynamic and heterogeneous grains industry environment, this structure achieves tasks practically on a scale and scope appropriate to national, regional, commodity, and multicommodity challenges.

Figure 3 The GRDC's decision-making structure

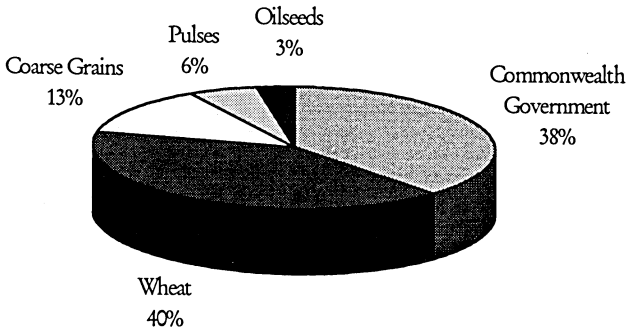


Operation of the GRDC

Income

There are, at present, 25 leviable crops within the GRDC's portfolio spanning temperate and tropical cereals, oilseeds, and pulses.[14] The levy for these crops has been agreed with industry to be 1 percent of value at first point of sale. The Commonwealth matching funds has a ceiling of 0.5 percent of gross value of production. Therefore there is an excess of industry funds that will not attract Commonwealth matching funds. The source of GRDC funds from 1992-97 is shown in the following figure. The projected income for 1997-98 is $78.5 million. A detailed breakdown of 1997-98 income is shown in Appendix B.

Figure 4 **Source of GRDC funds from 1992 to 1997**



The levy is collected by the Department of Finance and forwarded onto the GRDC.

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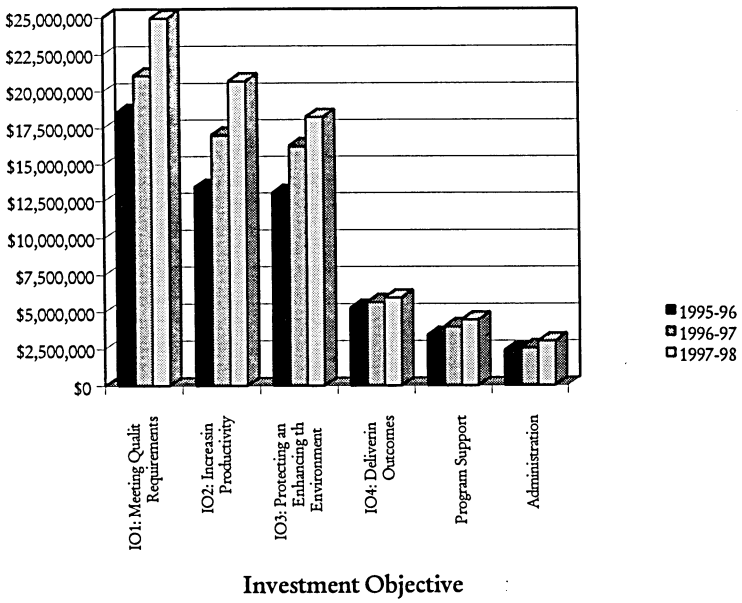
[14] **Wheat**; **Coarse Grains**: barley, oats, sorghum, maize, triticale, millets / panicums, cereal rye, canary seed; **Pulses**: lupins, field peas, chickpeas, faba beans, vetch, peanuts, mung beans, navy beans, pigeon peas, cowpeas, lentils; **Oilseeds**: canola, sunflower, soybean, safflower, linseed.

Expenditure

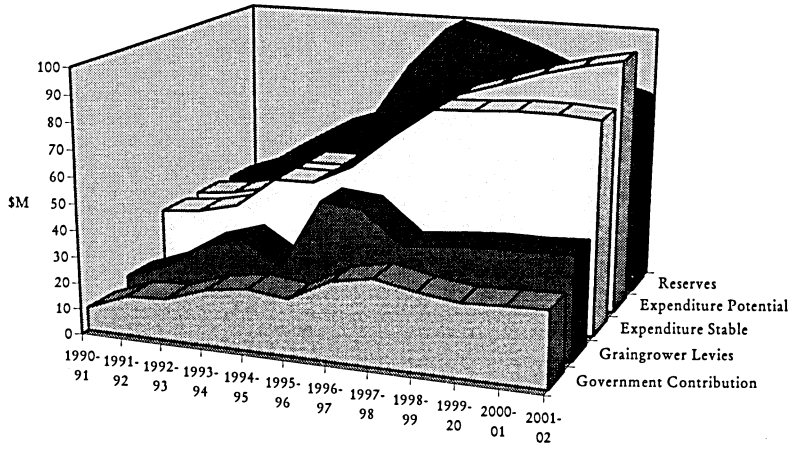
GRDC expenditure from 1994-95 to 1996-97 is shown below.

Figure 5 GRDC Expenditure 1994-95 to 1996-97



The most substantial element of the GRDC's budget is its investment in continuing R&D activities--financial reserves perform a key function in cushioning the GRDC from the frequent fluctuations in income receipts that would otherwise threaten the continuity of its research investment expenditure. The GRDC's continuing commitment in 1997-98, for example, is $48 million within a total research budget of $80 million. The following diagram shows the levy, reserve, and expenditure levels into the future.

Figure 6 GRDC expenditure, revenues, and reserves 1990-91 to 2001-02



GRDC investment decision processes

Corporate Level

Research priority-setting at the corporate level is a decision-making process where optimal solutions regarding the allocation of resources are sought within a political, social, and institutional framework. At this level, the board of the GRDC is concerned with

- the role of the GRDC and its relationship to other participants within the operating environment;
- linkages with stakeholders, e.g., the appointment of committees and others involved in the decision-making process;
- monitoring of the system, e.g., human and physical resources; and
- assessing overall performance against stakeholder expectations.

Program Level

The general process for the establishment and development of a research program is to identify a clear industry/community objective, the actions needed to meet this objective, and the resources required to deliver the R&D outcomes. Programs should be of sufficient size to warrant discrete management.

When allocating research resources, the GRDC currently uses historical precedence, modified to take into account changes in its operating environment. At the program/subprogram level, the previous year's investment is regarded as a base at the beginning of each budget cycle. Hence, investments across programs/subprograms are initially tied to past experience. While this approach allows for continuity of investment, there is the potential to continue to support research that has lost its relevance. Over time, the GRDC's operating environment changes as a result of

- its own initiatives, e.g., research outcomes, market analysis, economic evaluation, benchmarking studies, and technical reviews; and
- external processes, e.g., new information and skills, new markets, deregulation, and changing commitments/investment from industry sources.

Generally, this information is not contained within any one body but dispersed among different groups--producers, merchants, processors, marketers, scientists, research administrators, economists, and others within the general community. This is where the GRDC has a role to facilitate interaction across industry sectors and between researchers. Coordination processes range from local workshops through to cross-sectoral groups with the support of peak industry bodies. This information is used by the GRDC to make judgments about increasing or decreasing investments from historical levels.

Administrative procedures

The GRDC produces an annual information paper that identifies the aims, scope, and needs for each of the programs. These are determined by the subprogram teams in consultation with industry. The information paper therefore constitutes an invitation to apply to the GRDC for funding for specific research projects that will aid the industry in achieving these objectives. Researchers forward a preliminary research proposal that summarizes the proposed work. These are approximately two pages in length. Included in the summary are research details, staff details, budget details, and the likely impact, scale, and adoption of any outcomes of the research. These are assessed by the relevant subprogram team and prioritized. At this stage, it is not uncommon for the GRDC to request that two or more parties working on similar areas produce a cooperative application.

While this above process is proceeding, the regional and national panels meet and make recommendations on the relative expenditure that should be made across the subprograms in their region.

The recommendations from the above two procedures go to the board, who then set the GRDC budget for the upcoming year. Once the budget is determined, full proposal submissions can be requested.

Those requested to prepare a full proposal are required to provide considerably more detail about their project including budget, detailed research information, management of the project, a benefit cost analysis, and annual milestones which will allow for the monitoring of the research. Once again, these are assessed by the same teams as the preliminary proposals, and recommendations for investment are made to the board.

If accepted, the GRDC then agrees to invest in the research proposal subject to a research agreement, which is a contract that incorporates the research proposal, being signed. The GRDC does take equity in the outcomes of contracted research based on the levels of investment of the parties to the contract.

An alternative way in which the GRDC invests in research is where the industry identifies strategic areas of importance and negotiates for this work to be done. Such research is subject to a research or consultancy agreement.

Therefore, investments are made against priorities agreed upon by stakeholders and maintained via milestones and progress reports to achieve agreed outcomes.

Monitoring and Evaluation of GRDC Research Investment

At the project level, the GRDC assesses its on-going research by way of progress and milestone reports that identify progress against the aims of the project and the milestone(s) scheduled to occur during the period under report. This approach provides for a broad level of accountability based on the researcher's documented progress against agreed upon milestones. Assessments are undertaken 'in-house' by the subprogram team and progress against milestones is the basis for the making of payments to research providers.

Some projects are selected for more extensive review based on the level of risk to the corporation if the project fails to meet its aims. Examples of potential risks are

- failure of high-risk R&D projects to produce a result;
- misdirected R&D not producing a result useful to industry;
- failure of a key project with flow-on effects to linked projects or programs; and
- premature publication or release of technology in which the corporation has expectations of commercial rights.

Some underlying considerations when selecting the projects for a detailed assessment are the amount of money invested, the type of research being undertaken (basic, strategic, applied), the research provider's characteristics (new or established provider), and the time interval since the last assessment. Projects selected in this way undergo more detailed examination by the subprogram team.

The above process is complemented by the GRDC's strategic review process where the GRDC commission reviews areas of strategic importance. Examples include the "National Review into Crop Improvement in the Australian Grain Industry" in June 1992.

In the future, it is planned to introduce *ex poste* economic analysis of program performance within which the GRDC portfolio of investments falls--with the view to determine those areas with the greatest returns to industry.

Achievements of the GRDC

The GRDC has achieved several outcomes that would indicate that it is providing industry leadership. These include investment in strategic plans for wheat, barley, pulses, oilseeds, and feedgrains, as well as involvement in quality assurance programs, commercialization of results of research, and formation of international linkages and cooperative investment ventures.

One major advantage of the GRDC is that incoming levies are not conditional upon being spent on research in the same commodity. Therefore fledgling crops can have significant investment in research in excess of the income from levies. An illustration of the success of such a program is the increase in canola production. In 1993-94, levies were $14,396, however, the GRDC invested considerably more into canola research because the use of it in the rotational cycle was considered important for the industry. The result has been development of canolas suitable for Australian conditions and levy receipts from canola are estimated to be $2.6 million in 1997-98. This indicates rapid and successful adoption of research outcomes. Generic outcomes across the GRDC's portfolio are summarized below.

Demand side outcomes

The Australian grains industry is geared primarily to meet export markets, with approximately 80 percent of production being exported to a range of destinations, principally in the Middle East and Asia. Traditionally, Australia's comparative advantage in international markets has been grain cleanliness, dryness, and white color. Over the past five years, however, greater emphasis has been placed on quality characteristics; in the case of wheat, for example, protein content, grain hardness, milling extraction, and dough properties required to satisfy the

increasingly precise specifications required by customers. In this environment, research supported by the GRDC has

- identified significant and emerging end-products in major markets;
- identified quality requirements for end-products, taking into account processing trends; and
- communicated this information to Australia's plant breeding programs.

Supply side outcomes

Productivity growth has been a key element in maintaining the competitive advantage of Australia's grain producers. Research targeted at increasing crop yield, combined with progress in farm management systems, has been instrumental in improving on-farm productivity and enhancing the reliability of supply. Productivity in the grains sector, for example, is estimated to have grown at 4.6 percent a year from 1978 to 1993. This compares with 3.2 percent on mixed crops/livestock farms, 1.6 percent on beef specialist farms, 1.0 percent on sheep specialist farms, and 2.1 percent on sheep/beef farms. The productivity performance of the grains industry is associated with significant changes in cropping technology and production methods over the past 20 years. Since 1992, the GRDC, farmers, and scientists have built on this trend through ongoing varietal improvements, better pest, disease, and weed control strategies, and improved farm management practices.

Environmental outcomes

While there is a need to maintain progress toward environmental and economic sustainability, the grains industry has a good record of adoption of the results from farming systems research. Developments over the past five years--refinement of reduced tillage systems and stubble retention techniques, rotational cropping, herbicide technology, and disease control strategies--have provided the industry with the skills to manage the on-farm resource base more competently than a decade ago. The conservation farming systems being adopted are also having a positive impact on the resource condition. This has provided for increased understanding of Australia's natural resource base and the need to adopt grain production systems and business strategies better suited to unpredictable rainfall and poor soils.

Communication

The GRDC considers adoption of the new technology to be a critical measure of its success.

The GRDC's major technology-adoption investment strategy, developed during 1992-1997, is the TOPCROP Australia network. TOPCROP Australia coordinates grower groups working with checking packages to analyze management and marketing issues. TOPCROP enables growers to compare their performance against district-best practice, yields, and profitability. The TOPCROP network represents some 300-farmer discussion groups across Australia. It is this type of action-learning initiative that has, over the past five years, encouraged more than two-thirds of all graingrowers to adopt new farming practices, or to change their grain crops and varieties with the aim of sustainable profitability.

A GRDC-funded survey of growers found that 59 percent had changed practices in the past two years and 76 percent had changed in the past five years, while 64 percent of growers believed that turnover had increased in the last five years.

External Review of the RDC Model

The major review of the RDC model was undertaken by the Industry Commission as part of their review into research and development in Australia in 1995[15]. While commenting on the limited experience with RDCs (most were only a few years old), the report concluded *'the evidence so far is favourable. The system has increased the financial contribution of farmers to rural R&D and the R&D that is done appears to be carefully assessed and directed to the needs of the sector.'*

The support of the GRDC's industry can be assessed by the growers' acceptance of the GRDC's reports at grower meetings and continued financial support through voting and accepting a levy in excess of that which will attract Commonwealth funding.

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[15] Industry Commission 1995, Research and Development. Australian Government Publishing Service.

Appendix A
Research Objective 1: Developing Products for Markets

No.	Key Program	Mode	Subprogram
Processing			
1.1	Market research	Nat.	Market research
1.2	Wheat processing quality	Nat.	Noodles
			Bread, biscuits, industrial, and pasta
			Generic quality
1.3	Barley processing quality	Nat.	Beer
1.4	Feed grains quality	Nat.	Feed grains for end-user industries
1.5	Other processing quality	Nat.	Pulse processing quality
			Oilseeds processing quality
On-farm			
1.6	Producing wheat for market	North	Genotypes for wheat Regional variety evaluation & agronomy
		South	Genotypes for wheat Regional variety evaluation & agronomy
		West	Genotypes for wheat Regional variety evaluation & agronomy
1.7	Producing barley for market	North	Genotypes for barley Regional variety evaluation & agronomy
		South	Genotypes for barley Regional variety evaluation & agronomy
		West	Genotypes for barley Regional variety evaluation & agronomy

1.8	Storing grain	Nat.	Storing clean grain safely Occupational health & safety

Research Objective 2: Improving Production Efficiency

Productivity measurement

2.1	Productivity trends	Nat.	Productivity determinants / logistics

On-farm

2.2	Breeding technology	Nat.	Breeding technology
			Genetic Resource Centres
2.3	Coarse grains productivity	North	Genotypes for sorghum/maize/millet/canary Regional variety evaluation & agronomy
		South	Genotypes for oats/triticale/rye Regional variety evaluation & agronomy
		West	Regional variety evaluation & agronomy
2.4	Pulse productivity	North	Genotypes for chickpeas/mung beans/navy beans/peanuts Regional variety evaluation & agronomy
		South	Genotypes for field peas/lentils/faba beans Regional variety evaluation & agronomy
		West	Genotypes for lupins/vetch/lathyrus Regional variety evaluation & agronomy
2.5	Oilseeds productivity	North	Genotypes for soybean/sunflower Regional variety evaluation & agronomy
		South	Genotypes for canola/linola/mustard/safflower Regional variety evaluation & agronomy
		West	Regional variety evaluation & agronomy

2.6	Disease management	North	Foliar & root diseases
		South	Foliar & root diseases
		West	Foliar & root diseases
		Nat.	Rusts
2.7	Invertebrate pests	Nat.	Management of Heliothis & other pests

Research Objective 3: Optimizing the use of the Natural Resource Base

Environmental indicators

3.1	Environmental analysis	Nat.	Indicators of sustainability

On-farm

3.2	Vertebrate pests	Nat.	Vertebrate pest management
3.3	Weed management	North	Integrated weed management
		South	Integrated weed management
		West	Integrated weed management
3.4	Soil & water management	North	Management of soil & water / fertilizer / stubble / machinery
		South	Management of soil & water / fertilizer / stubble / machinery
		West	Management of soil & water / fertilizer / stubble / machinery
3.5	Sustainable rotations	North	Sustainable rotations
		South	Sustainable rotations
		West	Sustainable rotations
3.6	Pasture improvement	Nat.	Medics / sub-clover / lucerne
3.7	Managing risk	North	Climate variability / risk management
		South	Climate variability / risk management
		West	Climate variability / risk management

Research Objective 4: Enhancing Portfolio Management

No.	Key Program	Mode	Subprogram
Industry development			
4.1	Innovation Marketing	Nat.	Industry Communication
			Delivery Networks
			Strategic Communication
4.2	Developing the skill base	Nat.	Training awards and conferences
Management			
4.3	Management	Nat.	BCA/Evaluation
			Emerging Issues
			Program support
			Administration
			Australian Crop Accreditation System

Appendix B
Sources of GRDC funds excluding Commonwealth contribution 1997-98

Levies

Commodity	$ 1997-98
wheat	23,989,799
barley	5,658,018
sorghum	1,793,330
oats	480,850
triticale	367,500
maize	288,000
millets \ panicums	88,200
canary seed	36,000
cereal rye	25,452
lupins	1,206,189
fieldpeas	493,270
chickpeas	467,168
peanuts	326,927
lentils	277,426
faba beans	222,930
mung beans	86,778
vetch	28,509
navy beans	37,646
pigeon peas	8,417
cowpeas	1,707
canola	1,982,028
sunflower	348,382
soybean	217,958
safflower	56,608
linseed	26,530
Total	**$38,515,622**

Estimated income other than levies, penalties, & Commonwealth matching

Other income 1997-98	$M
Interest on cash investments	5.50
Other income	1.30
Total	**$6.80M**