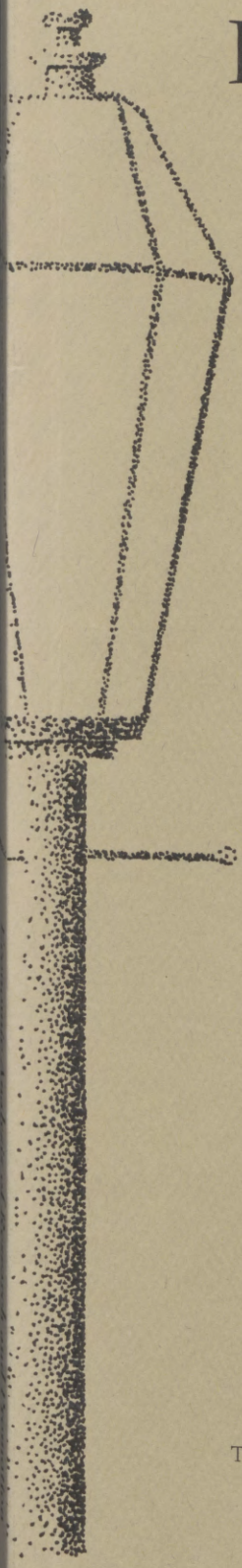

Economic Analysis of Research and Promotion

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Australia's Rural Research & Development Policies & Infrastructure

A Speech by The Honorable John Kerin
(Delivered by Frances Cassidy)

By a combination of good luck, active policy-making, and good management, Australia has a reasonably efficient and effective system of rural research and development. As a result of policy reaction and counterattack, Australia has a scientifically credible, subject in-depth, responsive science and technology, and research and development infrastructure (R&D).

However, over three-quarters of recorded rural R&D is *funded by the government* and up to 95 percent is performed within the *public sector*. State government expenditure on rural R&D has risen to twice that of the Commonwealth (Central) government. Government involvement commenced in the states in the 1850s, and the precursor to the Commonwealth Scientific Industrial Research Organization (CSIRO) was established in 1916. Australian universities have been involved in agricultural R&D since their earliest days. It is the *public* nature of rural R&D that has caused particular policy actions to be taken.

During the time I was involved in public political life (1972-1993), R&D, particularly regarding the role and functions of the CSIRO, was subject to assessment, review, and policy appraisal (e.g., strategic direction of research agencies). The constant review process has intensified through the last 15-20 years as Australia moves more to the magic of "the market" and more and more away from notions of any sacrifice or priority for the common good. Due to the onslaught of overall economically rational policies by government, and its worship of the business sector and public choice theory, no molecule of research money now goes unscrutinized. In Australia, much of this rationality of economics as the only paradigm for government policy-making was necessary as a counterbalance to failed policies of industry protection and market intervention, the impact of computer and communications technology, financial deregulation, and economic globalization. We are, after all, only a small to medium-sized trading nation (18th to 19th in the world?)

However, the demands for review, from whatever source or reason, and the obsession with research accountability, has meant that not much of the ongoing debate has been about science and technology and/or R&D per se, other than within the largely ignored scientific community. The debate, which still continues, is principally about money, and the better scientists keep their heads down, fingers crossed, or head overseas.

So, rightly or wrongly, most of the debate in recent years on rural R&D has been about the following:

1. A sterile debate about fundamental or basic/pure research vs. applied or strategic/commercial research **(see Appendix A)** with government and the media ignorantly insisting that more and more research results be quickly usable — a move away from pure research and the denigration of matters intellectual per se. The debate is sterile because there should be room for all, whatever the semantics, and in reality, most research is "fuzzy" with many examples of serendipity and chance as well as hard grind. Further, it is not possible to carry out first-class research without wasting some money — I don't see accountants any better placed than scientists to discern when a research direction should be terminated. If research is only carried out with short-term expected returns in view, the research infrastructure will quickly atrophy.

2. Because agriculture now only contributes less than 3 percent of our G.D.P., "relative spending on rural R&D should decline." This was particularly the view of Labor Cabinet colleagues. In some areas, it has but without ongoing research, the necessary productivity growth to keep the sector alive won't happen. The cost-benefit ratios still hold up well and results are able to be captured by the farm sector far more easily than by other sectors. Manufacturing industry-type R&D notice it's far harder to find commercial backers for inventions with enormous potential returns.

3. "Research is prone to duplication" as a result of the information and communications explosion (we'll soon be able to get everything off the Internet — even our university degrees?). The counterview is that, problems of language and culture apart, libraries and access to worldwide databases prevents simple duplication but what is not properly prevented is groups of people or individuals working on the same problem. Scientific collaboration is growing, not declining, and we need to understand training is going to have continued importance as knowledge grows. As an aside, in another area of our science infrastructure, Australia has 4,500 geologists, geophysicists, etc., and a first-class mining sector. China has 500,000 geologists, so in general, we are not over-indulging ourselves regardless of what the Department of Finance and its myrmidons thinks.

4. Scientific R&D asset fixity, i.e., how do you turn experts off, tear down labs, curtail lines of research, and accentuate directional change? "Contestability" became a key concept for R&D expenditure in the 1980s. Apart from the necessity for sound general administration, it would appear that scientific peer groups are as well placed to take care of this problem as macroeconomists, accountants, non-relevant bureaucrats, and grand-standing politicians are.

5. The problems of research administration and research coordination which haven't been solved by the cherished views of governments and their fiscal

advisers in requiring more reviews and restructurings (about once every two years for the CSIRO). Coordination is the hardest task for government and administration — you need ministers and department heads who understand the problem and are prepared to tackle it. But demands for accountability are now such that up to 20 percent of funding for some agencies is expended in meeting the desires of the "Fiscal Fiend" (the mythical creature who inhabits departments of treasury and finance worldwide — a hydra-headed creature with no heart or legs).

6. Commercialization and the role of private sector corporatization (which reduces to discussion of intellectual property rights, patents, and copyrights, etc.) means to find the D and the marketing of research results if there is a potentially saleable product or process. Given the atomistic production nature of agriculture, it's not easy to fund researchers trying to find a particular "invention" which can only be used by one firm (in mining, where up to 90 percent of R&D is paid for by the private sector, it's a lot easier). There is a view in Canberra that the private sector is just out there, waiting to fund research and commercialize public research if only they weren't "squeezed out." This is bullshit. Most of Australia's industry is composed of small and medium enterprises and the finance sector currently has a time horizon for lending of about a year. We used to joke about it, but the window of opportunity for small companies for niche products is now available for about 15 minutes.

   Large multinational firms tend to be interested in incremental improvements in a context of monopolistic competition, not in scouring research agencies for every new idea.

7. Keeping the clients of research satisfied, and here, one must say that the farmers and graziers are a contented group. Most do have a medium to long-time horizon on research and do understand the importance of breeding better plant species and eliminating animal diseases. These primitive concepts are foreign to many of the best and brightest in central government agencies; hence, R&D organizations are required to have vision statements, mission statements, strategic plans, annual operating plans, corporate plans, conduct performance appraisals, strike performance agreements, and provide annual reports as well as regular reviews every two years as a minimum. And, of course, the path to economic salvation lies in retrenchment; therefore, R&D agencies should always be seeking ways to adopt Q.A. systems, downsize, find efficiency dividends, outsource, benchmark, and corporatize. If this isn't done fast enough, governments will take the lead and deregulate and chop out funding, forcing R&D to be privatized. Research administration is not easy, and compliance costs are now high due to government requirements in their aim to reduce the public sector (appointments of staff under 25 to the

Australia Public Service have dropped 74.1 percent since 1985-86).

8. Finally, a constant debate about the economic justification for rural research and the consequent need for research agencies to raise at least 30 percent of their funds from the private sector. One suspects that much of the hunt to keep the research dollar down has not only been based on free market ideology but on the need to meet a budget line, regardless of priority, with governments concerned about getting budgets back into balance. The most offensive ideological view of research is the one that government is trying to "pick winners" (never backing "proven performers").

The general background that has been given on the Commonwealth R&D debate, which has been just as intense at the cash-strapped state government level, is that the current institutions and levels of funding developed over the past 15 years or so, can be better understood by people not familiar with the Australian debate and scene.

Despite all the nonsense that has gone (and will continue to go) on as politicians want to reform institutions and rename them, rural R&D survives because it can be economically justified and because some of the changes in recent times have been demonstrated to be exceptionally beneficial. The swing away from basic research to the development of new technologies hasn't destroyed all basic research. Even the Industries Commission (a reviewing body) concedes returns to research for each dollar expended in our pasture industries average up to 250 percent, for livestock — 138 percent, and even for CSIRO's work in entomology — 23 percent. One case study by the Grains R&D Corporation gave a return of 2,970 percent (**see Tables 1 and 2**)!

A study of 10 projects in the CSIRO's Division of Plant Production and Processing gave present cost value of $161 million and a benefit of $2,371 million[1].

The theoretical economic basis for public funding of research is still those provided by Arrow (1962) centering the theory of public good.[2]

The literature contains much that is generally supported with exploration of the concepts of the "free-rider" problem, market failure, risk, spillover, long planning horizons, the need for large R&D institutions to avoid risk, disembodied technologies, etc. The public good/free-rider argument has the most force and in an "information age," information provides a very good

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[1]CSIRO "Rural Research — The Pay-Off," Occasion Paper No. 7.

[2]Arrow, K. "Economic Welfare and the Allocation of Resources for Invention," in Nelson, R. (Ed.), Rate and Direction of Inventive Activity, Princeton University Press, New Jersey, 1962.

example of market failure.

Table 1. Economic Benefits from 16 Grains Industry Research Projects

Project Number and Name	NPV (million dollars) at 10% as at 1991	B:C ratio at 10% discount rate	IRR (%)
1. National Chickpea Breeding	7	12:1	65
2. Suppression of Grain Dust	14	54:1	143
3. Disease Resistance in Faba Beans and Peas	35	28:1	68
4. Fertilizer Application at Sowing	61	76:1	113
5. Lupin Breeding and Evaluation	331	10:1	51
6. Brown Spot Control in Lupins	6	8:1	209
7. Oat Breeding for Cereal Cyst Nematode	36	34:1	57
8. Storage of Oilseeds	na	na	na
9. Nitrogen Use on Wheat	na	na	na
10. Decision Support Systems	na	na	na
11. Breeding Resistance to Yellow Spot	126	36:1	42
12. High-yielding Agronomic Packages	30	29:1	205
13. Noodle Quality of Wheat	12	7:1	38
14. Quality of Wheat for Middle East	na	na	na
15. Wheat Variety Improvement	4	3:1	84
16. Quality Assessment of Breeding Programs	1	4:1	40
17. Enhanced Evaluation of CIMMYT Germplasm	15	21:1	52
18. Central West Wheat Variety Trials	1	4:1	34
19. Molecular Mapping Program	na	na	na
20. Increasing Crop Production on Acidic and Compacted Soils	121	297:1	561
21. Disease-resistant Barley Varieties	176	129:1	64

Note: na — not available.
Source: Brennen, J. P. and Davis, J. S. "Economic Evaluation of Agricultural Research in Australia and New Zealand," A.C.I.A.R. Monograph No. 39, 80 pp., 1996.

Table 2. Nominal and Real Expenditure on Rural Research in Australia

Year	Nominal Expenditure				Real Total ($'000)
	Departments of Agriculture ($'000)	Universities ($'000)	CSIRO ($'000)	Total ($'000)	
1953	5,295	326	3,407	9,028	9,028
1954	6,093	452	3,554	10,099	9,755
1955	7,536	1,289	3,971	12,796	11,940
1956	7,814	583	4,473	12,869	11,218
1957	8,164	738	4,609	13,512	11,365
1958	9,323	812	5,400	15,536	12,829
1959	9,501	1,126	6,189	16,817	13,754
1960	9,666	1,562	7,125	18,354	14,096
1961	10,773	1,779	7,849	20,400	15,151
1962	11,249	2,113	9,374	22,736	16,425
1963	12,410	2,334	10,143	24,888	17,748
1964	14,224	3,693	11,746	29,663	20,389
1965	14,806	3,672	14,244	32,722	21,497
1966	17,073	4,162	14,413	35,648	22,780
1967	21,433	4,484	17,013	42,929	26,144
1968	23,998	5,001	18,565	47,564	27,772
1969	26,347	5,295	18,608	50,251	28,076
1970	29,297	5,588	22,471	57,356	30,268
1971	32,826	7,063	26,427	66,316	32,206
1972	37,175	7,749	28,581	73,504	32,675
1973	42,411	6,920	30,230	79,561	32,519
1974	48,960	8,181	38,713	95,855	34,138
1975	64,749	9,617	47,609	121,976	34,583
1976	73,481	11,216	51,740	136,437	33,608
1977	79,669	11,024	56,240	146,932	32,571
1978	92,845	14,829	89,823	197,497	40,517
1979	97,418	14,840	63,352	175,610	33,870
1980	110,602	17,037	76,389	204,028	35,510
1981	124,463	19,261	92,187	235,912	36,562
1982	141,447	21,111	111,708	274,266	37,616
1983	163,624	24,538	126,907	315,069	30,974
1984	173,253	26,415	105,076	304,744	35,573
1985	188,039	32,074	115,725	335,838	36,948
1986	205,284	38,613	132,962	376,859	38,724
1987	208,971	39,035	129,365	377,370	36,585
1988	226,555	39,058	131,561	397,174	36,969
1989	241,799	43,091	115,789	400,680	35,458
1990	270,298	47,640	126,446	444,384	37,438
1991	264,934	55,535	161,846	482,315	38,896
1992	266,205	55,203	172,893	496,709	38,805
1993	266,963	58,523	173,885	505,141	38,560
1994	280,486	61,811	173,727	530,461	40,126

Source: Brennen, J. P. and Davis, J. S. "Economic Evaluation of Agricultural Research in Australia and New Zealand," A.C.I.A.R. Monograph No. 39, 80 pp., 1996.

This is not the place for a theoretical economic discussion of R&D.

The *criteria* for public funding of R&D are that it should be undertaken only where:

- The benefits to society as a whole are expected to be greater than the cost.
- The research would not be undertaken by private investors because they could not appropriate sufficient benefits to cover their research costs, and
- Public funding is the least cost method of overcoming this market failure.[3]

It may also be helpful to itemize the guidelines for *R&D policy design* set out in the Industry Commission's recommendations in its comprehensive inquiry into research and development in 1995. They are as follows:

1. Diversity should be encouraged.
2. Private incentives should be built on where possible.
3. Assistance schemes should be simple and transparent, with well-defined criteria.
4. Assistance levels should be broadly consistent.
5. Research should be monitored and evaluated.
6. "Contestability" should have a major role in research funding.
7. The government's role in sponsoring R&D should be clear and its requirements clearly articulated.[4]

An overview of total rural R&D expenditure by public research institutions is shown in Table 2. Expenditure by the public sector on rural research as a percentage of all public expenditure on research has fallen from some 35 percent in 1965 to about 15 percent in 1995. In 1992-93, it was estimated that private sector rural R&D had risen from about 1 percent of all rural R&D in 1976-77 to about 10 percent. Real rural R&D intensity (GDP-based) increased from 0.6 percent in 1953 to 1.1 percent in 1994, after a peak of 1.9 percent in 1974. This indicates public sector support for rural R&D has been declining since the early 1970s. The table shows that the CSIRO is the largest single rural research body in Australia, but that as a group, state departments of agriculture account for the largest share of expenditure on agricultural research.

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[3]ABARE. Government Research Agencies Research Report 94-2, 1994.

[4]Industry Commission. Research & Development, Volume 2, 1995.

Universities make only a relatively small contribution to rural R&D and rely heavily on external grants for funding.

Research funding and research performance are not the same thing, and the role of rural R&D Corporations and Councils (RDCs), Cooperative Research Centres (CRCs), and fund shifting will be dealt with later. State rural R&D organizations have undergone dramatic change within state agricultural departments in recent years. Western Australia is close to a privatized model, Southwestern Australia has a separate research organization, Victoria has an institute structure, New South Wales has a rationalized, and Queensland is closer to the Commonwealth SMA model (i.e., before the recent change in government).

The CSIRO

Funds for CSIRO rural research were cut most severely in 1984 and 1985, provoking more heavy reliance on outside funding sources and research alliances. These years were the ones commencing a swing to applied research, rationalization, and constant review and restructuring.

Until March 18, 1996, the CSIRO had six institutes and 33 divisions, 14 of which could be classified as carrying out rural R&D (fisheries, forestry, and water resources included). The structure since March 1996 has four alliances and 33 divisions, with rural R&D still being carried out in 14 of them. However, in June 1996, the four alliances became five with 22 sectors further divided into 20 categories for socioeconomic objectives, which are subject to six performance indicators, one of which is external earnings (32.6 percent of total income in 1995-96). CSIRO participates as an equity holder, funder, and in-kind contributor to 16 rural R&D CRCs plus three to four others more environmental in approach, but of direct relevance to the rural and farm sector (soil and land management, catchment hydrology, tropical savannas, and freshwater ecology). The CSIRO's annual report no longer shows expenditure by divisions, concentrating more on corporate overview, corporate development, human resources development, technology transfer, and communication. Research is covered as "research highlights." Research funding for 1995-96, other than by way of Parliamentary appropriation, includes $41.0 million from RDCs (6.22 percent of total CSIRO budget of $659.5 million), and $30.9 million from CRCs (4.69 percent of total). Total private sector contributions to CSIRO amounted to $65.5 million or 9.93 percent of funds employed in 1995-96.

The Rural Research & Development Corporations and Councils (RDCs)

Prior to the establishment of the current RDC network, the only primary industries with anywhere near adequate research funding other than directly via the CSIRO were the wool and, to a lesser extent, cattle, and sheep industries. For example, in 1973-74, research *and* promotion expenditure for wool was $43.6 million, for wheat

$0.8 million, for dairy research *and* promotion $2.8 million (with a research levy of $2.4 million), for fruit research *and* promotion $3.4 million, for cattle, sheep, and pig meat research *and* promotion $6.1 million. Total CSIRO rural research expenditure was $26.6 million in that year.

There were four main motivations to set up the RDCs: to get more dollars into research, to combat a cost-cutting budget cabinet not sympathetic to or understanding of the rural sector, to get research more at arm's length from Statutory Marketing Authorities (which were then producer-dominated), and to make research provisions more contestable (two divisions of CSIRO were highly dependent on Wool Corporation levy funds with universities able to attract little funding). It was at a later stage that the current funding formula was used widely to act as an incentive and for producers to contribute more to R&D via the tax deductible, levy payment system. The figure of 0.5 percent GVP was picked because it was roughly the level of wool research funding.

The meat RDC was the first of the commodity-based RDCs to be established in 1985. It was established under its own act — the Meat Research Corporation Act, 1985. Subsequently, the Horticultural RDC, too, was established under its own act. It is a tribute to Frances Cassidy that the HRDC was established. The Meat Research Corporation Act, 1985, as amended, was largely used as a model for the Primary Industries and Energy Research and Development Act, 1989 (PIERD). Eight commodity-based RDCs have been established under this act. These are the cotton, dairy, fisheries, forest and wood products, grains, grape and wine, pig, and sugar RDCs. Funding for the commodity-based RDCs came half from the relevant industry and half from the Commonwealth government.

In addition, there are three predominantly government-funded corporations. These are the Energy Research & Development Corporation, the Land and Water Resources Research & Development Corporation, and the Rural Industries Research & Development Corporation (Rural Industries RDC).

The "generic" Rural Industries RDC was established to look after the R&D needs of small and emerging rural industries, as well as issues affecting all rural industries. For instance, it manages and funds research for rice, deer, sorghum, maize, oats, goat fibre, and cashew industries, and funds research into climate change, and pest and disease control. In addition, there are five R&D councils under its umbrella. They are the: Chicken Meat, Dried Fruits, Egg Industry, Honeybee, and Tobacco R&D Councils. They represent those industries judged large enough to conduct their R&D in a relatively independent way, and to all intents and purposes, they operate identically to the commodity-based corporations.

On December 1, 1993, the Wool Research and Promotion Organization took over the responsibilities of the Wool Research & Development Corporation. On the

recommendation of the Wool Industry Review Committee, this new body has also taken on the promotion function previously carried out by the Australian Wool Corporation.

Under the PIERD Act, the main functions of an RDC are:

- To investigate and evaluate the requirements for research and development in relation to the primary industry in respect of which they are established.
- To fund that R&D, consistent with a five-year R&D plan, and an annual operational plan prepared by the corporation in consultation with its stakeholders.
- To facilitate the dissemination, adoption, and commercialization of the results of research and development in relation to the primary industry in which they are established.

To carry out these functions, they have the power to do all things necessary including:

- Enter into agreements for the carrying out of R&D.
- Make applications, including joint applications, for patents.
- Join in the formation of a company.
- Do anything incidental to any of its powers.

The RDCs do not perform R&D themselves, although the Act makes provision for the corporations to carry out R&D "with other persons." Many of the corporations interpret their role very widely, and are involved in funding basic, strategic, and applied research, market research, extension and technology transfer, commercialization, and education and training.

Most of the commodity-based RDCs are funded through a statutory levy matched by the Commonwealth government up to a maximum of 0.5 percent of the gross value of production (GVP). GVP is calculated as the average GVP of the current ("relevant") year and two preceding years. Levies are generally based on units of production (e.g., tons of sugar cane), but in a very few cases, on the value of production (e.g., for some of the grains). The size of the levy is determined each year by the relevant industry.

Some of the councils operate on voluntary levies, matched by the government in the same way. That said, it is expenditure as it is spent on R&D, which is matched by the government. Any levy income set aside as reserves is not matched until it is

actually spent, and then only when expenditure falls below 0.5 percent of GVP.

The Fisheries Research and Development Corporation, in addition to receiving an amount to match levy receipts to 0.25 percent of GVP, receives an unmatched amount equivalent to 0.5 percent of GVP, on the basis that it is the Commonwealth's role to manage the fisheries resources. The levy is compulsory for Commonwealth fishermen only.

The Land and Water Resources RDC and the Rural Industries RDC (other than the levy-based councils) are funded by direct Commonwealth appropriations because of the large public good component of the research they facilitate. These corporations do, however, commission R&D in partnership with industry, with all industry contributions on a voluntary basis. In 1992-93, the Land and Water Resources RDC received $10.4 million. In addition to just over $2 million to match levy receipts, the Rural Industries RDC in 1991-92 received $8.4 million from Parliamentary appropriations.

Total expenditure for all RDCs in 1993-94 is estimated at $262 million, with around 55 percent contributed by the Commonwealth government. Individual expenditure ranged from around $300,000 by the Honeybee RDC to $51 million by the Grains RDC.

The Department of Primary Industries and Energy (DPIE) is responsible for the collection and administration of the levies, with the corporations being charged for levy collection costs.

The corporations are headed by boards of directors which are appointed by the Minister on the recommendation of a selection committee, which in turn is appointed on the recommendation of the industry concerned. The function of the selection committee is to nominate persons who collectively possess an appropriate balance of expertise in a range of fields related to the particular industry, including production, processing, marketing, management, and conservation of natural resources, science, technology transfer, economics, administration of R&D, finance, and business management.

The PIERD Act of 1989 makes the corporations accountable to both the Minister and the industry they represent. Like all statutory bodies, the corporations and councils are required to prepare annual reports and submit them to their stakeholders (e.g., their "representative organization(s)" and the Minister).

In addition, the Act requires both corporations and councils to prepare a five-year plan in consultation with industry organization(s) designated by the Minister as their "representative organization." The plan must include a statement of objectives and priorities, and an outline of strategies to be used, and must be submitted to the Minister

for approval. It must be reviewed annually and before varying the plan, corporations and councils must consult with their representative organization(s).

To support the five-year plan, corporations and councils must prepare an annual operational plan, again in consultation with their representative organization(s) and this must also be submitted to the Minister for approval.

The difference between the corporations and the councils in this context is that the councils are required to present their plans and annual reports to the Rural Industries RDC before submitting them to their stakeholders.

For the preparation of their five-year and annual operating plans, the corporations are required to consult with industry. The corporations have developed a variety of ways of going about this process.

Generally, on an annual basis, and on the basis of the R&D plan and annual operational plan, research providers are invited to submit proposals for research projects. Applications are assessed on the basis of the extent to which they address the objectives and priorities set out in the plans.

The corporations do not perform any R&D themselves. Most of it is contracted out to CSIRO, state departments of agriculture, universities, and federal research bureaus. Some small amount is conducted in facilities established by the corporations themselves and some in private laboratories. Table 3 shows estimates of who performed R&D for individual RDCs in 1992-93, and Table 4 shows expenditure by type and quantity for 1994-95.

Table 3. Allocation of RDC Expenditure, 1992-93

Corporation/Council	State Departments of Agriculture	CSIRO	Universities	Other
	(Percent)			
Grains RDC[a]	54	13	25	8
Meat RC	16	20	11	54
Wool RDC	15	60	18	7
Horticultural RDC	60	7	9	24
Dairy RDC	33	14	19	34
Fisheries RDC	58	26	6	10
Sugar RDC	3	9	5	83
Pig RDC	35	12	41	12

Cotton RDC	29	48	19	4
Grape and Wine RDC	23	7	6	65
Chicken Meat RDC	20	22	52	5
Tobacco RDC[b]	97	0	0	3
Dried Fruits RDC	44	38	16	1
Egg Industry RDC	18	19	48	15
Honeybee RDC	30	10	51	15

[a]Entry for CSIRO includes all Commonwealth research organizations.
[b]Proposed 1992-93 expenditure.

Source: Overview Industry Commission, 1995.

Clearly, there is great variability between individual RDC funding allocations, but with the states receiving marginally more than CSIRO in total. Both the Sugar and Tobacco RDCs stand out as exceptions with very high proportions of funding to one category. In the case of the Sugar RDC, more than $6 million, or 74 percent of total research, was carried out by the Bureau of Sugar Experiment Stations, a Queensland statutory authority under the Sugar Industry Act, 1991. The sugar industry, being the dopiest industry any Australian Minister has to deal with, was reluctant to accept the Commonwealth's matching dollars for research.

Table 4. RDC Research Investment, 1994-95

R&D Corporation/Council	Basic	Strategic	Applied	1994-95 Budget
	(Percent)			(Millions)
Cotton R&D Corporation	25	28	47	$ 6.06
Dairy R&D Corporation	13	32	55	18.36
Dried Fruits Research Council	4	13	83	1.50
Energy R&D Corporation	0	0	100	17.12
Fisheries R&D Corporation	15	45	40	14.00
Forest and Wood Products R&D Corporation	2	13	85	3.20
Grains R&D Corporation	13	22	65	51.00
Grape and Wine R&D Corporation	19	44	37	3.80
Horticultural R&D Corporation	5	20	75	21.48
International Wool Secretariat	0	22	78	32.82
Land and Water Resources R&D Corporation	15	65	20	21.98
Meat Research Corporation	15	20	65	52.73
Pig R&D Corporation	38	20	42	7.90
Rural Industries R&D Corporation	5	22	73	15.63
Chicken Meat	15	35	50	1.66
Egg	16	37	47	1.23
Honey	0	60	40	0.32
Sugar R&D Corporation	7	50	43	9.44
Tobacco Research Council	7	41	52	1.29
Total (millions)				$281.52
Percent	11	27	62	100.00

Source: Brennen, J. P. and Davis, J. S. "Economic Evaluation of Agricultural Research in Australia and New Zealand," A.C.I.A.R. Monograph No. 39, 80 pp., 1996.

The Bureau of Agricultural and Resource Economics (ABARE)

The predecessor to ABARE was the Bureau of Agricultural Economics (BAE) established in 1945 on the U.S. model of a similar bureau. Unlike the U.S., BAE still maintains an independent status within DPIE, and sets its own economic research priorities after consultation with a broad range of bodies and individuals, and publish widely, not always at a time of the Minister's or government's choosing. In choosing its objectives, ABARE identifies high-priority domestic and international issues in which there is likely to be a high payoff, and the bureau must strive for quality, carry out industry surveys, disseminate results widely, and make forecasts. ABARE services the minerals and energy as well as the rural sector and with 1995-96 outlay of $16.487 million (30 percent of which is cost recovered), it employs about 230-250 people. Estimates of the proportion of rural R&D range from 66 to 75 percent.

The Bureau of Resource Sciences (BRS)

This organization, as well as the RDC network, was established during my time as Minister. The justification for it is now put quite eloquently, but it was not only fought by DPIE--at the time it was also difficult to establish. It was set up so that we could address environmental and conservation issues (later sustainability), so that the Commonwealth could actually talk to the states on real world agricultural issues, and to give balance to the only advice I was likely to be given on policy issues (i.e., solely economic).

BRS seeks to provide quality scientific advice and information on the sustainable use and development of Australia's resources. This is to collect, collate, and analyze available data on our natural resources and on issues such as food safety, quarantine, and animal and plant health issues (including quarantine risk). The outlay for BRS in 1995-96 was $25.191 million with 191 staff years as a staffing estimate.

Other DPIE R&D Agencies

The Plant Variety Rights Scheme, Exotic Animal Disease Preparedness Council, Rural Industries Business Extension Scheme, World Best Practice Incentive Scheme and Innovative Agricultural Marketing Program, the Australian Animal Health Laboratory, National Landcare Program, and Murray Darling Basin Initiative all have some elements of rural R&D in them but mostly as minor funding agencies.

Rural R&D in Departments/Portfolios other than DPIE or CSIRO

The Australian Centre for International Agricultural Research carries out rural R&D in developing countries. Funding of about $22-$25 million per annum, as part of Australia's aid or development assistance budget, gives Australia spillover benefits to primary industry as well as training of scientists and technologists.

The Agri-Food Council and Food Quality Advisory Committee funded by the Department of Industry, Science, and Tourism (once called Technology) also assists agriculture and fisheries with program (and some research) benefits.

To be comprehensive, some recognition needs to be given to higher education R&D funding and some of the major linkage programs. The most important of these is the Australian Research Grants Committee, which essentially made grants on the basis of the Committee's view on the excellence of study proposals. This organization was replaced in 1988 by the Australian Research Council (ARC) which, via four main committees, makes grants to individuals and research teams. The ARC in turn administers the Research Grants Program, some of which finds its way into rural R&D. There are also Collaborative Research Grants, an Australian Post-graduate Awards Scheme, a Research Fellowship Scheme, Special Research Centres, Key Centres of Teaching and Research, etc.--all possibly involving some funding for rural R&D.

The CRCs

The first CRCs were established by July 1991 as a Prime Ministerial initiative on the advice of the chief scientist, Professor Ralph Slatyer. The major principle of purpose in establishing the CRCs was to invigorate synergy and encourage research coordination by getting together the CSIRO, universities, state agencies, and private business. The initiative has been particularly successful and has worked in bringing focus, relevance, concentration, communication, and efficiency to the research task.

The education and training component of the CRCs has been exceptionally valuable in funding doctorates and post-doctorates in vital subjects where there was little attraction for students (e.g., Australia had only three full-time academics teaching weed management systems — weeds cost Australia $3 billion per annum).

Of the 64 or so CRCs now in existence, 19 are involved in agricultural or rural-based manufacturing or relevant environmental rural R&D. Twelve such CRCs and their membership are shown in Appendix B. All rank CSIRO amongst their core participants. Many of them list state government departments as members, and universities are well represented. So far, private sector participation is not very large and "free-riding" is becoming noticed. The CRC for Sustainable Cotton Production has the Cotton RDC as a core participant, and the RDCs are large funders of some of them (e.g., the Grains Research and Development Corporation due to its large funding base).

For some divisions of the CSIRO, CRC funding represents an add-on; in others, the CRC tends to have a diversion effect, and there are problems in defining in-kind contributions. However, it is quite clear that the RDCs and CRCs have enabled rural R&D to be carried out and maintained and, in some cases, enhanced.

Total resources committed to all the CRCs over the initial period of the program were about $580 million over seven years (about $158 million directly from the Commonwealth government). Industry originally committed about $60 million for the same period. The scheme was regarded as quite successful by the government, and after a comprehensive review covering four years, Commonwealth funding and the number of CRCs expanded. Funding by the Commonwealth government in 1995-96 was $132.7 million and the year ahead is projected to be $145.1 million.

Summary

This brief paper has set out the main features of Australia's rural R&D infrastructure plus some instances of the work being carried out. The writer chairs five CRCs and two private companies involved in agricultural biotechnology and is very pro research. The "throw away" line is that it will be a nation's education, science and technology, and research and development input that will increasingly separate the wheat from the chaff in the international competitive stakes. Australia is a small trading nation, overall, with a currency subject to commodity price trends, speculatively due to

the new activities of money market players. Agriculture and mining require at least a 3 and 5 percent a year increase in productivity to survive as they are always dealing in buyer's markets. This, again, reemphasizes the need for ongoing R&D.

The emphasis given in this paper to the nature of the fight for research dollars is because for the last 15 years or so, the economically (ir)rational treasury view has been dominant. There are valid reasons for this, but some in central bureaucracies now regard government as market failure. The public nature of rural R&D has caused many tensions--the most evident of which is the requirement for accountability (e.g., CRCs have to undergo one-year, two to three-year, and five-year external reviews, have to provide monthly figures, endless plans, subject themselves to scientific and stakeholder consultation, and engage in communication such that, like senior academics, the effective working time of the most important researchers is halved). I regard economic research to be just as important as scientific research. It's a pity that economists spend so much time in Australia's system of government in attacking scientists. As I've said earlier, despite all this, Australia still has a credible rural R&D performance.

If Australia is to properly evaluate its rural R&D and overall research effort, a far broader approach needs to be taken. Government needs to formulate a national science policy as part of its industry policy. The old chestnut of Australia not being able to capture all the benefits of its research will continue as long as a narrow fiscal approach is taken. Venture capital will continue to be hard to raise for as long as the current taxation regime prevails (dividend imputation and the capital gains tax penalize small, technology-exploiting firms). Farmers need to be educated or encouraged to go on-line. Our business community has to embrace and come to grips with the Internet and the onrushing computer technology, rather than waiting for the government to take the lead or try to do it for them. Above all else, as a nation, we have to realize what we are good at, what our real strengths are, and concentrate our efforts in those directions.

APPENDIX A
A Short Glossary of R&D

Pure Basic Research — Experimental and theoretical work undertaken without looking for long-term benefits other than the advancement of knowledge.

Strategic Basic Research — Experimental and theoretical work undertaken to acquire knowledge directed towards specified broad areas in the expectation of useful discoveries. It provides the broad base of knowledge necessary for the practical solution of recognized problems.

Applied Research — Original work undertaken to acquire knowledge with a specific application in view. It is undertaken either to determine the possible uses of the findings of basic research or to determine new ways of achieving some specific and predetermined objectives.

Experimental Development — Systematic work, using existing knowledge gained from research or practical experience, that is directed to producing new or improved products or processes.

Technological Innovation — A new or improved product or method of production; also, the process by which such improvements are brought about.

Commercialization — The set of activities involved in producing and marketing an innovation.

Spillover — Any unpaid benefit (or unrecompensed cost) from R&D that flows to individuals or organizations other than those undertaking the R&D. It is the difference between the private and social returns from R&D.

Appropriability — The extent to which an innovator can capture the gain from an innovation.

Contestability — The extent to which the provision of a good or service is open to alternative suppliers.

Research and Development — Overview Industry Commission, 1995.

Source: Overview Industry Commission, 1995.

APPENDIX B
Agriculture and Rural-Based Manufacturing CRCs

CRC	Core Participants	Research Focus
CRC for Plant Science	CSIRO, ANU, Biocem Pacific Party Limited	Applying new technologies to problems in plant biology
CRC for Tropical Pest-Management	University of Queensland, Queensland Department of Lands, Queensland DPI, CSIRO	Pests and pesticides in tropical Australia
CRC for Temperate Hardwood and Forestry	CSIRO, University of Tasmania, Forest Commission of Tasmania, APPM, ANM, Forest Resources, APM	Genetic improvement, soil and stand management, resource protection
CRC for Legumes in Mediterranean Agriculture	Western Australia Department of Agriculture, University of Western Australia, CSIRO, Murdoch University	Provide strategic and basic research and training for sustainable agriculture in Mediterranean Australia on legumes
CRC for Tropical Plant Pathology	University of Queensland, CSIRO, Queensland DPI, BSES Pacific Seeds, Queensland University of Technology	Provide new and more effective ways of controlling plant diseases
CRC for Hardwood Fiber and Paper	Australia Pulp and Paper Institute, Monash University, University of Melbourne, CSIRO, Pulp and Paper Man Federation of Australia	Properties of hardwood fibers, relationships between properties and fibers, methods for evaluating fiber properties
CRC for Viticulture	University of Adelaide, Australian Wine Research Institute, Charles Sturr University, New South Wales Agriculture, CSIRO, Southern Australia Department of Agriculture, Victoria Department of Agriculture, Phytotech, Australia	Enhance the technical advantage of Australian grapes and grape products
CRC for Premium Quality Wool	UNE, CSIRO, Western Australia Department of Agriculture, University of Western Australia, University of New South Wales, Wool RDC	Research and education to improve the quality and competitive position of Australian wool
CRC for Cattle and Beef Industry	UNE, CSIRO, New South Wales Agriculture, Queensland DPI	Improve the quality and consistency of beef for export to Asia and domestic preferences
CRC for Aquaculture	University of Tasmania, Queensland DPI, Tasmania DPIE, New South Wales Fisheries, James Cook University, Sydney University of Technology, AIMS, University of Central Queensland, Southern Australia R&D Institute	National research strategy, technological basis for sustainable, competitive, and environmentally acceptable industry
CRC for Sustainable Cotton Production	CSIRO, UNE, University of Sydney, Queensland DPI, New South Wales Agriculture, Cotton RDC	Develop and implement sustainable cotton cropping systems
CRC for Food Industry Innovation	University of New South Wales, CSIRO, Arnott's, Burns Philip Mauri, Goodman Fielder Wattle	Generate improved and novel natural food ingredients

Source: Overview Industry Commission, 1995.