ACIAR and public funding of R&D

Submission to Productivity Commission study on public support for science and innovation

September 2006

Australian Government
Australian Centre for
International Agricultural Research

The Australian Centre for International Agricultural Research (ACIAR) operates as part of Australia's international development cooperation program, with a mission to achieve more-productive and sustainable agricultural systems, for the benefit of developing countries and Australia. It commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

ACIAR seeks to ensure that the outputs of its funded research are adopted by farmers, policy makers, quarantine officers and other intended beneficiaries.

In order to monitor the effects of its projects, ACIAR commissions independent assessments of selected projects. This series reports the results of these independent studies.

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ACIAR, *ACIAR and public funding of R&D. Submission to Productivity Commission study on public support for science and innovation*. Impact Assessment Series Report No. 41, September 2006.

This report may be downloaded and printed from <www.aciar.gov.au>.

ISSN 1832-1879

Editing and design by Clarus Design
Printing by Elect Printing

Australian Government

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23 August, 2006

Professor Michael Woods
Presiding Commissioner
Science and Innovation Commissioned Study
Productivity Commission
PO Box 80
Belconnen ACT 2616

Dear Professor Woods,

Re: Australian Centre for International Agricultural Research (ACIAR)
Submission to - Science and Innovation Commissioned Study

ACIAR is pleased to provide the enclosed submission to your important study.

As our submission points out we believe ACIAR has a unique and interesting role to play which transcends both Australia's aid program and its innovation system. It was established with a vision that effective aid to help reduce poverty and improve world security is most effective if the outcomes are sustainable for a considerable period of time and especially if they are generated by activities which produce real mutual benefits.

By funding collaborative research between Australian scientists and scientists in developing countries addressing problems of mutual importance to both countries, we believe that ACIAR provides effective aid but also contributes in a range of ways to Australia's innovation system.

Our submission provides a summary of the Australian innovation system interactions which we feel will be of interest to your study. The submission was developed by the Centre for International Economics (CIE) in conjunction with ACIAR, as we believe this has provided an important dimension of independence. As the submission has drawn heavily from two independent studies ACIAR has commissioned during the last 18 months, I have enclosed copies of these reports. The first 'A review of the returns to ACIAR's bilateral R&D Investments' (Impact Assessment Series Report No 35) reviews the impact studies ACIAR has commissioned during the last 15 years. This focuses primarily on the aid dimension of ACIAR's activities and the robustness of the past studies. The other 'Benefits to Australia from ACIAR funded research' has just been sent to professional editors for publication in our Impact Assessment Series. The published version of the second report will be available in 3-4 weeks.

ACIAR
Part of Australia's development assistance program

www.aciar.gov.au

I hope you find our views on ACIAR's contribution to Australia's innovation system interesting and of relevance to your study. If you would like to discuss any of the issues in more detail please do not hesitate to contact me (on 02 6217 0520) or Dr Jeff Davis who is the Policy Linkage and Impact Assessment program manager (on 02 6217 0522).

I look forward to reading your draft report and providing more details on ACIAR's activities.

Yours sincerely

Peter Core
Director

Foreword

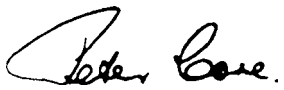
In March 2006, the Productivity Commission (PC) was asked by the government to undertake a study on public support for science and innovation in Australia.

The Australian Centre for International Agricultural Research (ACIAR) has a unique and interesting role to play that transcends both Australia's overseas aid program and Australia's innovation system. While many in Australia have a clear understanding of ACIAR's overseas aid mandate, we felt that fewer in the broader community appreciate the contribution it makes to the wider Australian innovation system. This PC study provided an opportunity to highlight this important Australian benefit of ACIAR. We feel that it could also provide an important illustration of one of the many subtle relationships which make up a very complex innovation system in Australia.

This publication has been developed to make this story available to a wider audience. It includes the following documents about ACIAR's submission to the PC study: a copy of the letter of submission; a copy of the formal submission; and the terms of reference from the government to the PC for the study.

ACIAR engaged the Centre for International Economics (CIE) to help it prepare the submission with the view that this would add an important dimension of independence. I acknowledge the contributions of Dr Jenny Gordon, Mr Bob Warner and Mr David Pearce from CIE to this submission.

Finally, I note that this submission draws extensively on the Impact Assessment Series reports that ACIAR publishes, especially 'Review of the returns to ACIAR's bilateral R&D Investments' (IAS No. 35) and 'Benefits to Australia from ACIAR-funded research' (IAS No. 39). These are available on our web site at <http://www.aciar.gov.au/web.nsf/publicationsbysubject?openform&category=Impact%20Assessment>.



Peter Core
Director, ACIAR

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Introduction

The Australian Centre for International Agricultural Research (ACIAR) was established in 1982 as part of Australia's international development assistance program. Its mission is to achieve more productive and sustainable agricultural systems for the benefit of developing countries and Australia. ACIAR commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. In 2005–06 it allocated just over $41 million for research across a number of scientific and technical disciplines, including: livestock production systems, animal health, fisheries, crop improvement and management, crop protection, horticulture, forestry, land and water resources, soil management and crop nutrition, postharvest technology, and smallholder farm systems. ACIAR also supports economic and social-science research in its agricultural development policy and agricultural systems economics and management programs.

In allocating investment, ACIAR brings together the agricultural research and development (R&D) priorities of the partner countries with the interests and capabilities of Australian researchers or research groups. ACIAR also supports International Agricultural Research Centres (IARCs), primarily those operating under the umbrella of the Consultative Group on International Agricultural Research (CGIAR), to undertake R&D of common interest to Australia and developing countries in our region.

ACIAR has a unique position as a funder of R&D: it is part of Australia's innovation system as well as part of the development-assistance program. ACIAR is also unusual as it has had an extensive program of impact evaluations in place since 1986, with a strong focus on developing the methods of evaluation. For these reasons, ACIAR is well placed to contribute to the Productivity Commission's 'Public support for science and innovation' study and is pleased to provide this submission.

This submission introduces ACIAR's position in Australia's overseas aid and innovation systems, and briefly discusses the:

- effectiveness of R&D as a form of development
- pathways in developing countries by which ACIAR's R&D delivers public benefits, and relevance for the Australian innovation system
- spillovers to Australia of this international R&D—which are both demonstrable and substantive
- evaluation approaches and methods that ACIAR has developed over the past 20 years.

ACIAR's institutional location

ACIAR sits at an interface between two systems that, while administratively distinct, have strong linkages. ACIAR is primarily a part of Australia's aid program, funding research that, when successful, generates significant and lasting productivity benefits for agriculture in developing-country partners. As with supporting construction of physical infrastructure or delivery of education, support for research is a form of aid that has the potential to continue to deliver benefits well after the funding has ceased.

ACIAR's success in generating benefits for developing-country partners builds on its ability to attract Australia's scientific resources into looking at a particular class of problem. This use of Australian research resources provides the link to Australia's innovation and research system.

These linkages are illustrated in Figure 1, which depicts how ACIAR enables a number of important interactions. The best-known interaction is illustrated in quadrant II of the chart: the delivery of research outcomes to developing-country agriculture.

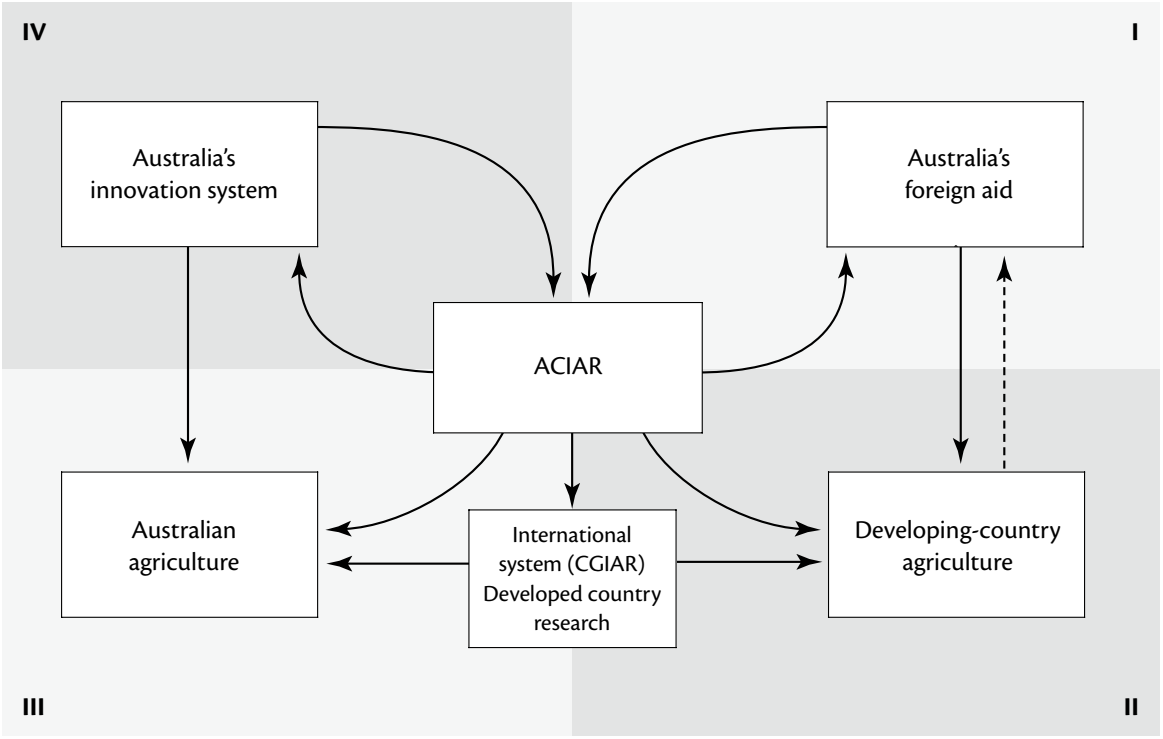

Figure 1. ACIAR: aid and Australia's innovation system. Source: CIE (2006a)

This is an effective way of transforming aid funds into benefits, and explains why ACIAR was established as part of Australia's international development cooperation program (quadrant I of Figure 1). ACIAR funds R&D projects in cooperation with agencies in developing-country partners. It draws on resources in the international agricultural research system, such as the IARCs under the CGIAR umbrella, and other research undertaken in developed countries.

ACIAR-funded research also delivers direct benefits to Australian agriculture (quadrant III). These benefits arise through ACIAR's ability to access the global knowledge base and to combine aid funding with Australian research expertise, to examine issues that are of benefit to agriculture in partner countries and around the world.

ACIAR's activities also interact with Australia's innovation system (quadrant IV). This comes about largely through the involvement of Australian researchers and research institutions (universities, state departments of agriculture and government research bureaus, Cooperative Research Centres and the Commonwealth Scientific and Industrial Research Organisation). These include:

- leveraging funding into areas of importance for Australian agriculture
- providing access to a broader pool of researchers for problems of interest—that is, providing access to international expertise and environments
- increasing the overall research base for agricultural issues of interest to Australia
- contributing to the overall stock of knowledge in an international context and thus helping identify both promising areas for research, as well as 'dry holes'.

Another dimension of this interaction is the contribution that ACIAR makes to the pursuit of the government's National Research Priorities (NRPs).[1] Around 57% of ACIAR's research project funding in 2004–05 targeted priority goals identified in the NRPs, and contributions from collaborating institutions nearly doubled this funding (Table A1 in Appendix A). In particular, ACIAR's emphasis on agricultural research to achieve sustainable development and natural-resource management funds research that directly contributes to Australia's pursuit of better outcomes in areas such as water management, soil degradation, biodiversity and climate-change responses. Similarly, ACIAR's projects dealing with food safety, animal and crop health, and biosecurity concur with and contribute to Australia's need to maintain and enhance its agricultural and food health and safety status.

1 These priorities, announced in December 2002 cover four main themes: 1. An environmentally sustainable Australia; 2. Promoting and maintaining good health; 3. Frontier technologies for building and transforming Australian industries; and 4. Safeguarding Australia.

The effectiveness of agricultural R&D as development assistance

'Australian aid: promoting growth and stability', the recent white paper on the Australian Government's overseas aid program, identifies the critical role that support to rural development and agricultural productivity can play in increasing incomes, stimulating development of the non-farm economy and generating employment opportunities in rural areas. The paper articulates the government's commitment to supporting agricultural R&D given the potential for advances in agricultural technology to increase farm productivity. The logic behind this commitment is compelling.

Agricultural productivity growth is essential for economic development

Agriculture remains a large sector of the economy in most of Australia's development partners, and is the source of livelihoods for the majority of the people. Moreover, rural people typically comprise the bulk of the population living below or near the poverty line. Improving the productivity of agriculture is therefore essential to reducing poverty and to economic growth through promoting domestic savings and releasing labour for alternative uses.

The returns on agricultural R&D are high in developing countries

The returns on agricultural R&D are high in developing countries. Agriculture in many developing countries is land- and labour-intensive. Productivity is hampered by lack of access to capital and often to inputs such as suitable varieties, water and fertiliser. Agricultural activities are regularly exposed to pests and diseases, and producers respond to this risk by diversifying their activities. This limits the scope for economies of scale in production. There is considerable scope for R&D to address or overcome these constraints and to improve productivity through reducing the costs and variability of production and improving quality.

Evaluations of ACIAR's projects indicate the high returns that can be realised from this kind of research. A recent review of the returns to ACIAR's bilateral R&D investments showed that the benefits from projects accounting for 7.8% of total investment had a benefit–cost ratio of about 40:1 (Raitzer and Lindner 2005). The benefits from this selection of projects alone represent more than three times ACIAR's total bilateral investment to date of $1.1 billion (real 2004 dollars[2]).

Examples include:[3]

- research into conservation tillage for dryland cropping in China, which is estimate to generate benefits of $1 billion dollars for a total project cost of $5 million, giving a benefit–cost ratio of 205:1 (Vere 2005)
- research into the breeding and feeding of pigs in Vietnam and Australia that generated estimated benefits of $878 million for an outlay of $4.9 million, with a benefit–cost ratio of 118:1 (Tisdell and Wilson 2001)

2 Note that all values reported in this submission are in 2004 dollars unless otherwise stated.

3 The references are to the original assessments of the projects: the benefit and cost values, in 2004 dollars, are from a revaluation presented in CIE (2006a).

- research into controlling the weed *Phalaris minor* in the Indian rice–wheat belt that generated estimated benefits of $422 million for a total project cost of $1.5 million, with a benefit–cost ratio of 275:1 (Vincent and Quirke 2002).

But countries lack the scientific capacity to exploit these opportunities

The potential returns to R&D in agriculture in developing countries are particularly high as there are scientific capacity constraints, and the stock of knowledge is often low. The need for adaptation of technologies to local conditions limits the ease of direct transfer of knowledge, technologies or germplasm.

And the operating environment may be lacking to exploit the benefits

ACIAR has also recognised that the enabling environment for agriculture is critical for harvesting the full return on potential productivity growth. The policy and institutional environment influences the flow of agricultural inputs and outputs, and shapes the incentives for investments in new ways of doing things and in physical and human capital. Consequently, ACIAR also supports policy-oriented research that complements the technical R&D, with the objective of better realising the potential benefits by removing barriers to adoption and improving market access.

Australia is well placed to share agricultural R&D expertise with development partners

Australia is particularly well placed to provide agricultural R&D across a range of commodities, because it has a long history of agricultural R&D in public institutions such as the state departments of agriculture, CSIRO and the universities.

ACIAR facilitates the undertaking of agricultural R&D in developing-country partners by working with the countries to identify their needs. These are matched with Australian providers who identify the opportunities to extend their work to meet developing-country needs in agricultural science. ACIAR also funds R&D to assess and enhance the policy environment affecting the adoption of the results of the R&D.

ACIAR's processes add value to this potential

ACIAR adds value by forming partnerships with international agricultural R&D organisations, Australian organisations and the research agencies in the developing-partner countries. This enhances the effectiveness of the R&D undertaken. Co-funding opportunities and access to expertise and the Australian stock of knowledge lie at the core of these productive partnerships.

ACIAR R&D delivers significant benefits to developing-country partners

ACIAR's impact assessment program provides robust evidence of the size of the benefits being delivered by its activities. It is estimated that the 65 ACIAR-funded projects that have been subject to impact assessments have delivered benefits that total $6.4 billion to developing-country partners and Australian agriculture for the expenditure of $134 million on those projects (and a total cost of $248 million). Around 88% of the benefits accrued to developing-country partners: the remaining 12% accrued to Australian agriculture.

A meta analysis of these evaluations (CIE 2006a) has extended Raitzer and Lindner's 2005 review of returns to ACIAR's bilateral investments. Figure 2 summarises the aggregate results of this analysis. It shows that, if the benefits from the activities are 'attributed' to ACIAR on the basis of ACIAR's share in total project costs, then the total benefits attributable to ACIAR are $3.5 billion, with benefits net of ACIAR's costs of $3.3 billion.

Figure 2 also illustrates the uncertainty around the total benefit estimates. Using information on the benefit estimates within the sample of project evaluations, the review estimated that the 95% confidence interval for the total net benefits is between $3.2 billion and $9.6 billion, and that the comparable confidence interval for net benefits attributed to ACIAR is between $1.8 billion and $5.7 billion. The analysis revealed that the assessed projects showed a wide range of benefits, with benefit–cost ratios ranging from 10:1 to 200:1. It also showed that, while the distribution is skewed towards the lower end of the distribution, there is a high probability of a very

healthy return and a low probability of an exceptional return.[4] This result is consistent with the findings of a much larger meta analysis of returns to agricultural R&D in developed and developing countries (Alston et al. 2000) which concluded that, while the average rate of return on research and extension studies was 81%, the median rate of return was 44% (a still healthy central tendency).

These benefits accrue through a number of pathways. The most obvious is through direct productivity improvements from new production technologies or techniques, or through new breeds and varieties. ACIAR research has also led to benefits from management of, and protection against, disease and pest incursion, increased demand in third country markets by meeting food safety, quarantine and quality requirements, and environmental, biodiversity and sustainability improvements associated with management of natural resources. Figure 3 summarises the main pathways for these benefits to accrue to developing countries.

The focus is on R&D for the public good, rather than public-good R&D

Public goods are defined as non-rival and non-excludable in consumption. Technology is making it easier to exclude consumer segments, so that most previously public goods are now 'club' goods, non-excludable only to those in the club. Knowledge is a classic club good, available free to those who have the capacity to access (and use) the information.

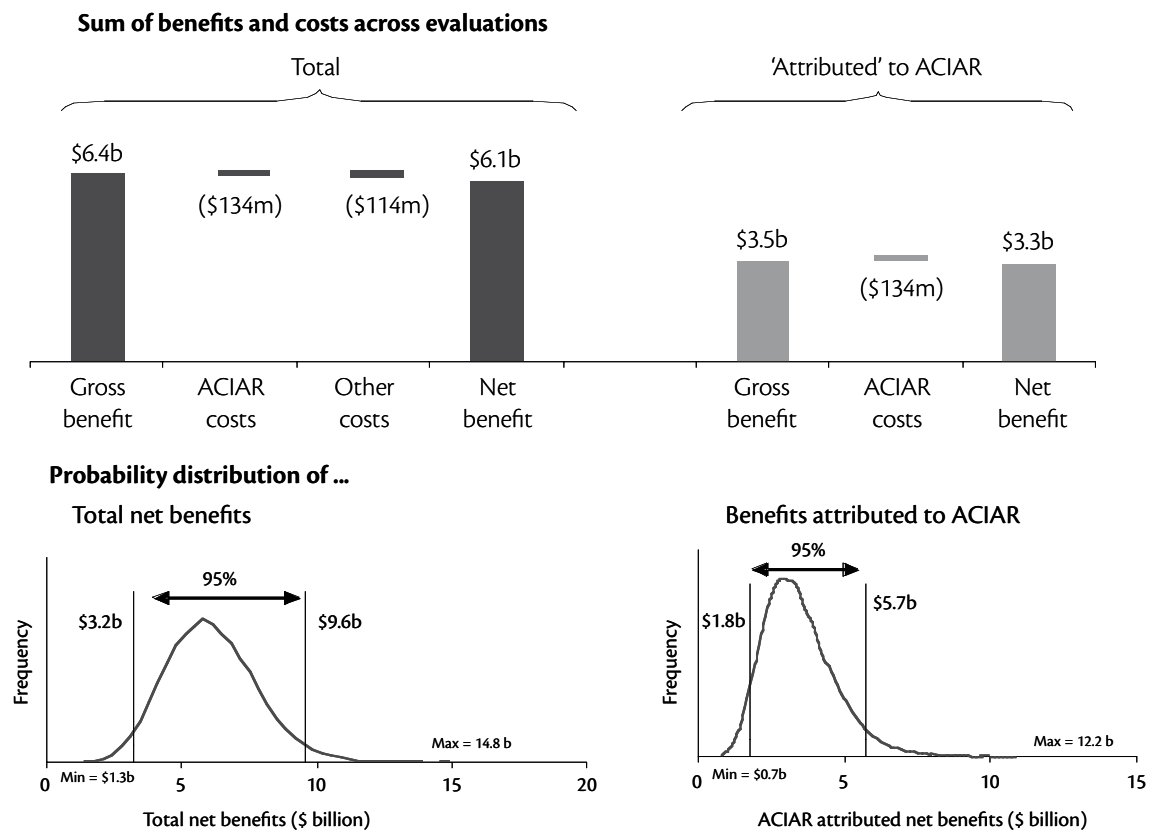

Figure 2. Total benefits of projects contained within assessments. Source: CIE 2006a

4 Because of the criteria used to select projects for the impact assessments, the sample covered by this analysis may not be representative of all ACIAR-funded projects.

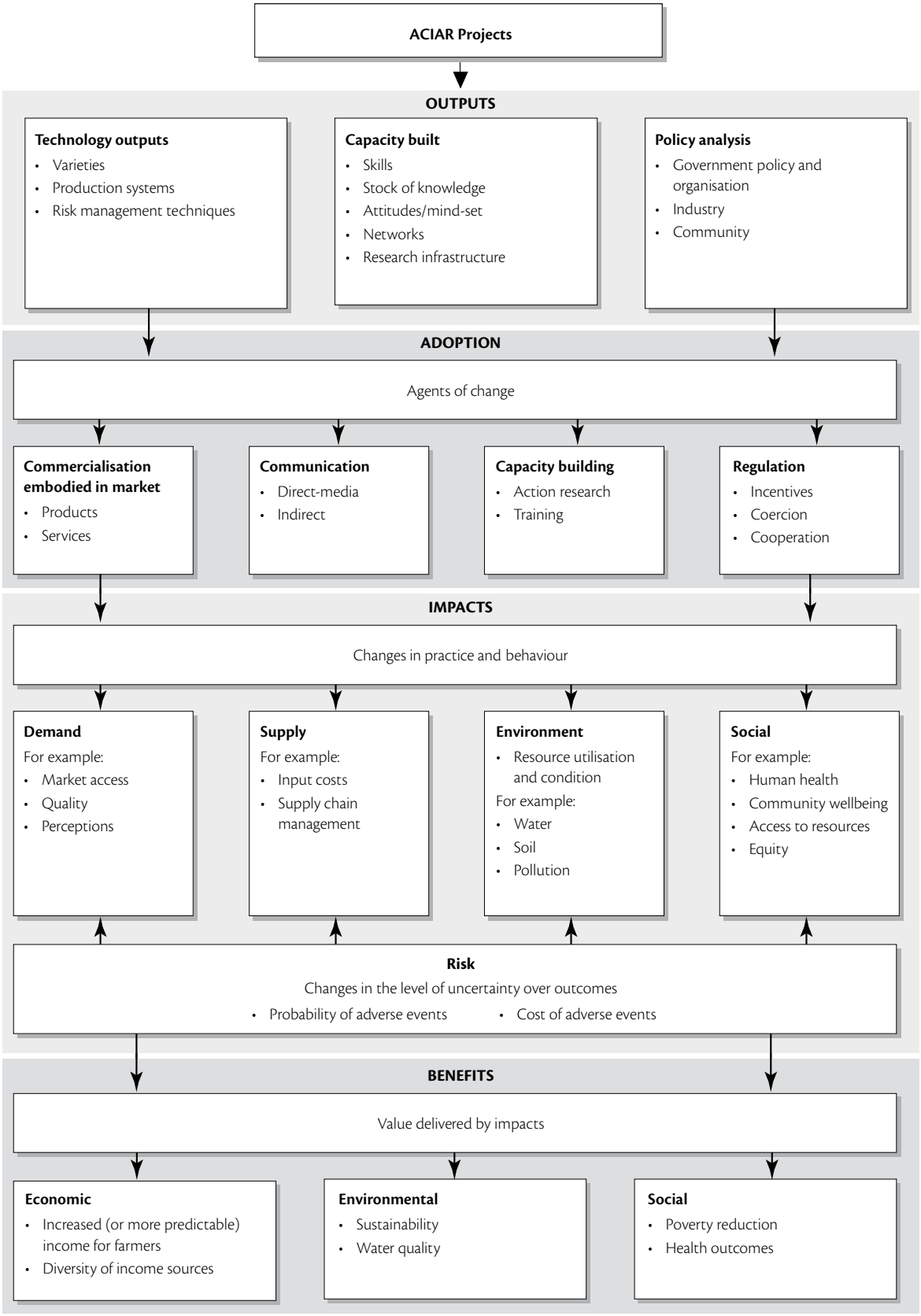

Figure 3. Pathways to benefits to developing countries from ACIAR projects

That said, R&D that delivers a pure public good tends to have very high returns. A project aimed at developing and delivering biocontrol of the banana skipper pest in Papua New Guinea, generated estimated benefits of $555 million for an outlay of $2.1 million (benefit–cost ratio of 258) (Waterhouse et al. 1998).

Public benefits can be delivered through commercial arrangements

Partnership with commercial players in the distribution of publicly funded R&D outcomes is a common pathway for adoption of new varieties and, in some cases, techniques. Partnership at the R&D stage has also raised the level of R&D funding and provided a pathway for adoption. A good example is the development of the hybrid pigeonpea by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) in partnership with a seed company. ACIAR funded the early research on the short-duration pigeonpea that was fundamental to the development of the hybrid technology. The low income level of farmers and price sensitive demand, combined with low marginal costs, means that the seed company's optimal strategy is to price for maximum adoption, maximising the benefits from the research. The value of this R&D for India is estimated at $130 million.

But commercialisation as a pathway to benefits can be limited

In some developing countries where ACIAR works, the policy and institutional environment may not be conducive to the operation of commercial supply of new technologies. Alternative pathways have to be utilised or developed, such as public-sector extension systems or linkages with other development-assistance programs. That said, commercial operations seem to thrive even in the most intimidating of environments, and ACIAR is seeking to further develop ways of supporting the dissemination of new ideas that do not crowd out private initiative.

The public benefits of private-good R&D are higher in developing countries

The IARCs are committed to delivering R&D for public benefit, and to this end are working to define what R&D will satisfy this requirement. International public goods are defined as non-rival and non-excludable across a number of countries. This narrow focus would, however, exclude many R&D investments that can deliver considerable public benefits.

ACIAR's work on forestry in transition economies is an interesting example. ACIAR, along with a number of other organisations, supported the development of high-yielding eucalypt plantations in China over a 20-year period. While the research delivered productivity improvements in an essentially commercial activity, there were considerable benefits in terms of improving the living standards of rural people in southern China. The activity resulted in significant environmental benefits from sources such as reduced pressure on natural forests, provision of biological corridors, reduced water-borne soil erosion, improved water quality, and protection of agricultural crops from winds, sandstorms and soil erosion.

In many developing countries, lack of capital, skills, and communication mechanisms to access information mean that people are often excluded from using information that is potentially useful to them. In these circumstances, participative R&D allied with communication and extension strategies can deliver public benefits. The difference compared to Australia's innovation system is that, in Australia, access to capital, skills and communication are not, at least to any great extent, limited by education levels, public policy, or state and private monopolies.

What public agricultural R&D in developing countries has in common with public R&D in Australia is the non-rival and often complementary nature of the use of the products of the R&D activity (new ideas, new techniques and so on). Where outputs are non-rival, the use of them by one producer does not affect the use by another. More importantly, when the use of R&D by one producer complements the use by another, exclusion of some users (where technically possible) may not be in the best interests of the users of the R&D, especially where the R&D enhances product quality or consistency, or improves the control of pests and diseases.

There are substantial spillover benefits to Australia

Impact evaluations of ACIAR-funded projects suggest that they have delivered significant benefits to Australian agriculture. There are 20 projects for which benefits to Australia have been quantified. In present value terms, they come to $735 million, more than covering the total cost of the projects of $60 million.

These quantified benefits arise in four main categories:

- direct production benefits (44% of the total) arising through research findings that directly improve the productivity of Australian agriculture
- indirect protection from disease or pest incursion (35% of the total) that arises from applications of research findings that lower the chance of a disease or pest ever entering Australia
- direct protection from disease or pest incursion (12% of the total) arising from research findings that allow more-effective quarantine or more-effective control of disease or pests incursions
- increased trade benefits (9% of the total) arising through research that increases the value of Australian exports.

It is not possible to attribute all of the benefits to ACIAR alone. Given the highly networked nature of Australian agricultural research, the benefits to these projects are likely to have emerged because of a combination of ACIAR funding and past funding from other agencies. At the same time, there are further sources of benefits to Australian agriculture that are difficult to quantify. These include improvements in biodiversity in partner countries that may be valued by Australians, training of researchers, and general increases in the stock of knowledge that may be applicable in the Australian context and may increase the probability of success or lower the cost of other research.

As well as these direct benefits, ACIAR's activities are extremely popular in developing-countries partners, enhancing Australia's recognition in the region.

ACIAR's comprehensive program of impact evaluations guides investment

ACIAR has been undertaking impact evaluations of its projects since 1986. To date, it has commissioned detailed impact evaluations of 65 completed projects.

Evaluating research impact

Most evaluations have focused on measuring the economic surplus resulting from the adoption of the R&D outputs. Methods of estimating economic surplus changes have varied depending on the nature of the outcomes. All evaluations:

- establish an explicit counterfactual—what would have happened in the absence of the R&D, which may have been a decline in productivity
- look at the net effect of adoption, including the opportunity cost of the resources used in implementation
- take into account the impact on market prices of changes in volumes and quantities and the flow-on effects
- track the changes over a specific time period (usually 30 years) and apply a discount rate to the net benefit flows.

ACIAR has a strong process to validate the results. These involve the conduct of meta analyses, peer reviews, and use of an internal skill base.

ACIAR continues to develop its methods for impact evaluation and to cooperate with international agricultural research organisations in doing so. ACIAR is currently writing comprehensive guidelines to improve the consistency and quality of its impact evaluations, in conjunction with the Standing Panel on Impact Assessment of the CGIAR. These will be shared with the research agencies of developing-country partners to help them in undertaking their own impact evaluations.

Evaluating capacity-building activities

ACIAR projects often involve substantial training, usually through learning by doing, for collaborating scientists in developing-country partners. ACIAR also funds the John Allwright Fellowship Scheme, and works closely with the Crawford Fund Training Program, which funds formal training programs in-country and in Australia for agricultural researchers and policy-makers. ACIAR and the Crawford Fund have recently collaborated to develop a framework for evaluation of the capacity-building components of projects. The framework is summarised in Figure 4.

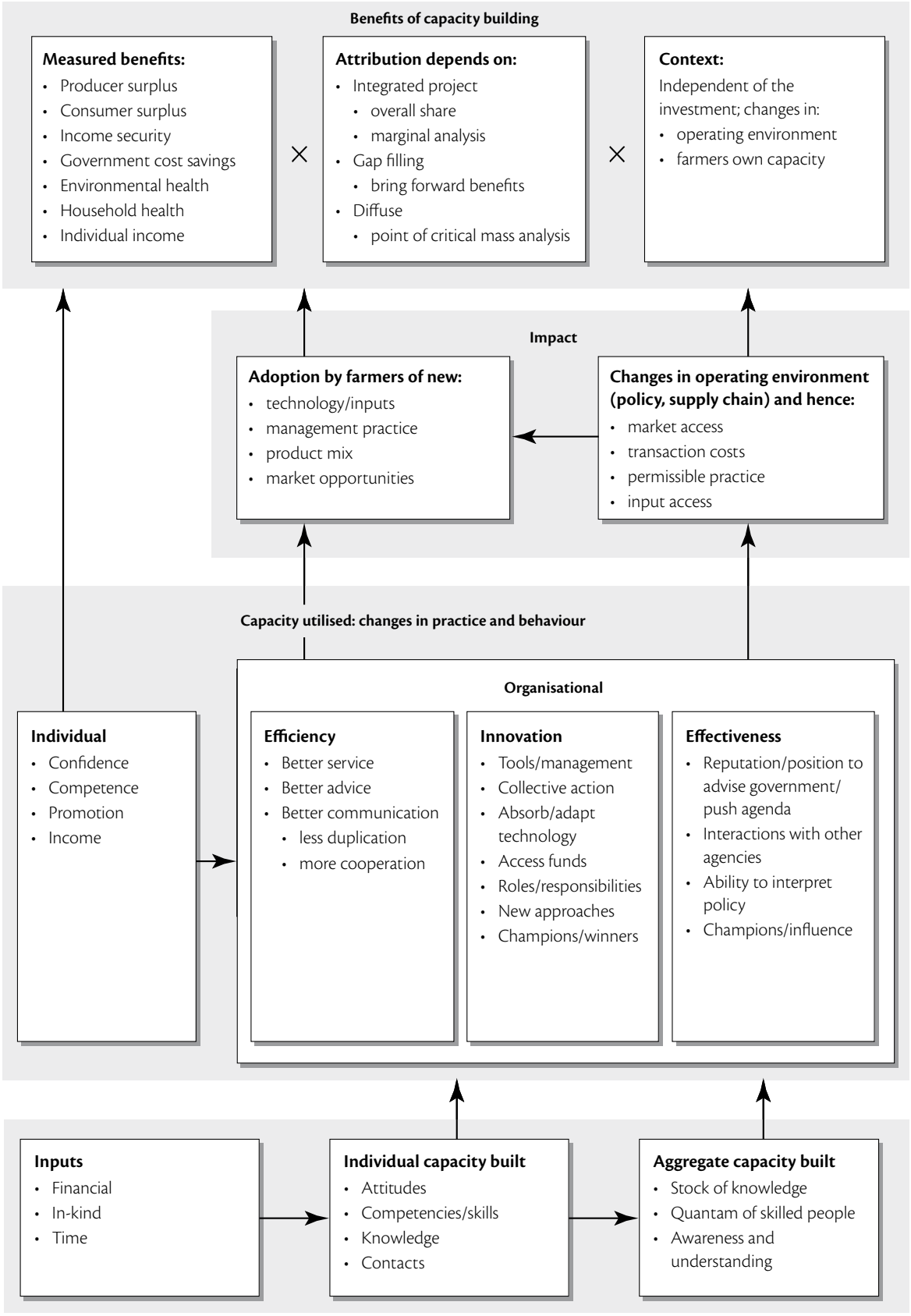

Figure 4. Pathways for benefits from capacity building

The framework identifies:

- capacity built
  - at the individual level this is the knowledge, skills, competencies, attitudes and contacts acquired as a result of the training
  - at the organisational level it is the addition to the stock of knowledge of the organisation (not embodied in the individual), the quantum of skilled people and the overall awareness and understanding
- capacity utilised
  - at the individual level this is the application of the capacity built to raise their own productivity and/or achieve promotion
  - at the organisational level, utilisation of capacity is reflected in improved efficiency (productivity), innovation or effectiveness
- impact on farmers (the usual target):
  - directly through adoption of new varieties and technologies

  OR
  - indirectly through improvement in the operating environment that enhances market access, access to resources, diversification or reduced uncertainty, so enhancing income security, or lowering transaction costs.

ACIAR has started to commission evaluations using this methodology. One has looked at the training component of the ACIAR investment in pigeonpea breeding research at ICRISAT. The project had aimed to develop Australian germplasm for use in India, but it turned out to be unsuitable. However, the techniques learned and understanding gained clearly brought forward the development and adoption of a suitable short-duration variety by several years. Thus, the main value of the project came from the process of undertaking the R&D not the output of the R&D. The capacity-building activities associated with the project were estimated to produce benefits with a net present value of close to $68 million (CIE 2006b). The work also identified the way forward for the subsequent development of hybrid varieties, an increment in knowledge that generated a new research agenda.

Evaluation of policy research

Evaluation of policy research also presents significant challenges. A review and meta analysis of ACIAR's policy research (Pearce 2005) identified some of the key challenges.

- **Attribution:** research is almost never the sole factor triggering policy change.
- **Circularity:** the benefits of policy research are typically evaluated using the same tools that are themselves products of the policy research.
- **Implementation difficulties:** one of the most plausible approaches to evaluating the effects of policy research, Bayesian decision analysis, requires obtaining 'before' and 'after' probabilities from decision-makers.
- **Valuation:** the value of policy changes that are public goods cannot easily be imputed using observed market prices and costs (as can the impacts of technical research).
- **Poison wells:** not all ideas generated by economic research are worth implementing—evaluation of policy research inevitably involves judgments about the usefulness of the ideas that emerge.

Some policy research projects have been covered by ACIAR's impact assessment work. Table 1 summarises the estimated benefit–cost ratios for these projects.

The review reinforced the logic of a decision made by ACIAR's Board of Management in May 2004 to approve a strategy to make greater use of pilot or scoping studies to assess policy issues before making major technical research investments. The ACIAR Board considered that it may also be important to have research on these important policy issues and their economic implications undertaken alongside or integrated with the technical research. This can be important to ensure that the technical research takes the possible impacts into account or works to foster improvements in policies.

The Board's position reflected its recognition that policy settings have the potential to be a major influence on the effectiveness and impacts of particular technical research projects. Policy settings may negatively affect

Table 1. Benefit–cost ratios for selected ACIAR policy projects

Project	Estimated ratio of benefits to costs
Analysis of socioeconomic and agribusiness developments in the Chinese beef and cattle industry	60
Raw wool production and marketing in China	40
Emergence and integration of regional grain markets in China	6–30
Establishment of a protected area in Vanuatu	4.5

Sources: CIE (1998), Watson (1998), Mullen (2004), McWaters and Templeton (2004), Pearce (2005)

the incentives that shape the willingness of producers to undertake the investments associated with adopting the results of technical research. Policy distortions can lead to situations in which the introduction of new techniques has counter-intuitive and sometimes counter-productive effects. ACIAR considers that undertaking policy and related economic assessments at the same time as the technical research can therefore be important to ensuring maximum uptake and adoption of the technical results.

Evaluation of poverty impacts

ACIAR has also worked on the development of a framework for measuring the impacts of its research projects on poverty. Box 1 summarises the issues that have been identified in attacking this problem (Pearce 2002).

ACIAR has commissioned reviews of the poverty impact of some of its projects. One example is the project targeting biocontrol of the banana skipper pest, which was estimated to lift some 43,000 people in Papua New Guinea above the poverty line, through averted income losses and cost increases (Bauer et al. 2003).

Box 1. Measuring the impacts of research projects on poverty

Measuring the impacts of a project on poverty requires a good understanding of:

- the technical impacts of the project
- the pathways by which the project will affect the incomes, risk profiles and expenditure of different groups within the affected community
- the merits and pitfalls of different definitions of poverty
- the merits and pitfalls of different quantitative measures of poverty within any given definition (when will the head-count ratio be misleading? when should inequality be measured? how should a poverty line be established? and so on)
- how to establish a baseline estimate of poverty, including the use of household surveys and other data-collecting techniques
- how to measure and simulate the income and expenditure patterns of different groups within the affected community
- how to asses economic interactions between different groups in the community.

Poverty evaluation is very much more complex than standard benefit–cost evaluation, as it requires that something be said about the impact of the projects on different groups. Further, some of the largest poverty effects of a project may be indirect, so more attention must be paid to the interactions between those groups affected.

Conclusion

ACIAR's operation at an interface between Australia's innovation system and its development-assistance program provides for some insights that are useful for the Productivity Commission's review of public support for science and innovation.

ACIAR funds collaborative research that draws on resources from parts of the innovation system and targets the pursuit of more productive and sustainable agricultural systems for the benefit of developing countries and Australia.

Funding R&D in agriculture, forestry and fisheries is an effective form of development assistance, as increased productivity in these sectors is a critical ingredient to growth. Because so many poor people in the developing countries targeted by Australia's aid program are dependent on rural activities for their livelihoods, aid that improves their incomes or helps them better manage risk can make an important contribution to reducing poverty. ACIAR's R&D funding thus targets R&D for the public good, a target made somewhat larger in many countries because the institutions that create incentives for private R&D are often very weak.

ACIAR has a long-standing program of quantitative evaluation of the impact of its activities. The evidence from this program confirms that the returns from agricultural R&D in developing countries are high, but that the distribution of the benefits is skewed, suggesting that there is a high probability of a healthy return, but a low probability of an exceptional return. The assessments also show that there have been significant benefits to Australian agriculture from this research, indicating that research does not have to be done in Australia to provide direct benefits to Australia.

ACIAR continues to refine and extend its assessment program, and is working on methodologies to evaluate the impact of policy research and capacity building. The evaluation program directly influences ACIAR's portfolio allocation. For example, evidence on the extent to which policy and institutional factors influence the conduct and uptake of technical research has led to an increased focus on pilot or scoping studies to assess policy issues before making major investments. It has also led to assessments of the policy and institutional environment at the same time as technical research.

Some of the lessons from ACIAR's experience may be pertinent to the questions concerning public support for science and innovation in Australia being dealt with by the Productivity Commission. To ensure that public money is well spent requires assessing the likely impacts of prospective research, and the actual impacts of completed projects. It also requires being assured that the policy and institutional environment supports appropriate levels of adoption of research results. And to make the best ongoing contributions, research needs to be conducted in an environment in which the stock of knowledge held by individuals and organisations is available to a broader research community.

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Raitzer D.A. and Lindner R. 2005. Review of the returns to ACIAR's bilateral R&D investments. ACIAR, Canberra, Impact Assessment Series Report No. 35.

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Appendix A ACIAR and the government's National Research Priorities

Table A1. ACIAR's investment in National Research Priorities and co-funding by collaborating organisations (themes 1 and 4)

Theme and goal	ACIAR investment		Co-funding	
	2004–05 (actual) $m	2005–06 (budget) $m	2004–05 (actual) $m	2005–06 (budget) $m
1. An environmentally sustainable Australia				
1.1 Water — a critical resource	3.67	3.53	3.59	3.78
1.2 Transforming existing industries	0.98	1.54	0.0	0.94
1.3 Overcoming soil loss, salinity and acidity	3.02	3.07	2.93	2.05
1.4 Reducing and capturing emissions	0.55	0.57	0.93	1.05
1.5 Sustainable use of Australia's biodiversity	2.30	2.14	1.69	2.41
1.7 Responding to climate change and biodiversity	0.20	0.36	0.14	0.24
Total theme 1	10.72	11.21	9.28	10.47
4. Safeguarding Australia				
4.1 Critical Infrastructure	0.02	0.0	0.0	0.0
4.2 Understanding our region of the world	1.71	1.99	0.57	0.97
4.3 Protecting Australia from invasive diseases and pests	6.82	7.46	5.13	7.40
Total theme 4	8.55	9.45	5.70	8.37
Totals themes 1 and 4	19.26	20.66	14.98	18.84
Totals as percentage of total ACIAR research project funding	57	59	na	na

na = not applicable

Note: The Australian Government's National Research Priorities 2002 cover four main themes: 1. An environmentally sustainable Australia; 2. Promoting and maintaining good health; 3. Frontier technologies for building and transforming Australian industries; and 4. Safeguarding Australia.

Appendix B Terms of reference for the Productivity Commission study

Terms of reference

PRODUCTIVITY COMMISSION ACT 1998

The Productivity Commission is requested to undertake a research study on public support for science and innovation in Australia.

Background

The Australian Government has identified science and innovation as one of its strategic priorities, recognising its contribution to Australia's economic and social prosperity. The Government has provided significant support for science and innovation, which it has augmented since 2001 through Backing Australia's Ability (BAA) , and funding now exceeds $5 billion per annum. In light of this investment, the Government considers that a study of public support for science and innovation is warranted. This study will complement the ongoing and planned reviews of BAA programmes.

Scope of the study

The Commission is requested to:

1. Report on:
   - the economic impact of public support for science and innovation in Australia and, in particular, its impact on Australia's recent productivity performance;
   - whether there are adequate arrangements to benchmark outcomes from publicly supported science and innovation and to report on those outcomes as measured by the benchmarks.

   The analysis should cover all key elements of the innovation system, including research and development, taking into account interaction with private support for science and innovation, and paying regard to Australia's industrial structure.

2. Identify impediments to the effective functioning of Australia's innovation system including knowledge transfer, technology acquisition and transfer, skills development, commercialisation, collaboration between research organisations and industry, and the creation and use of intellectual property, and identify any scope for improvements.

3. Evaluate the decision-making principles and programme design elements that:

   a. influence the effectiveness and efficiency of Australia's innovation system; and

   b. guide the allocation of funding between and within the different components of Australia's innovation system;

   and identify any scope for improvements and, to the extent possible, comment on any implications from changing the level and balance of current support.

4. Report on the broader social and environmental impacts of public support for science and innovation in Australia.

Although the Commission is not requested to review individual programmes, it can, where necessary, undertake case studies of particular types of public support for science and innovation. It should also draw on relevant international experience.

The Commission is to produce a draft report and a final report within 12 months of the receipt of this reference. The report is to be published.

CHRIS PEARCE

[Reference received 10 March 2006]

IMPACT ASSESSMENT SERIES

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Centre for International Economics (1998)	Control of Newcastle disease in village chickens	8334, 8717 and 93/222
2	George, P.S. (1998)	Increased efficiency of straw utilisation by cattle and buffalo	8203, 8601 and 8817
3	Centre for International Economics (1998)	Establishment of a protected area in Vanuatu	9020
4	Watson, A.S. (1998)	Raw wool production and marketing in China	8811
5	Collins, D.J. and Collins, B.A. (1998)	Fruit fly in Malaysia and Thailand 1985–1993	8343 and 8919
6	Ryan, J.G. (1998)	Pigeon pea improvement	8201 and 8567
7	Centre for International Economics (1998)	Reducing fish losses due to epizootic ulcerative syndrome—an ex ante evaluation	9130
8	McKenney, D.W. (1998)	Australian tree species selection in China	8457 and 8848
9	ACIL Consulting (1998)	Sulfur test KCL–40 and growth of the Australian canola industry	8328 and 8804
10	AACM International (1998)	Conservation tillage and controlled traffic	9209
11	Chudleigh, P. (1998)	Post-harvest R&D concerning tropical fruits	8356 and 8844
12	Waterhouse, D., Dillon, B. and Vincent, D. (1999)	Biological control of the banana skipper in Papua New Guinea	8802-C
13	Chudleigh, P. (1999)	Breeding and quality analysis of rapeseed	CS1/1984/069 and CS1/1988/039
14	McLeod, R., Isvilanonda, S. and Wattanutchariya, S. (1999)	Improved drying of high moisture grains	PHT/1983/008, PHT/1986/008 and PHT/1990/008
15	Chudleigh, P. (1999)	Use and management of grain protectants in China and Australia	PHT/1990/035
16	McLeod, R. (2001)	Control of footrot in small ruminants of Nepal	AS2/1991/017 and AS2/1996/021
17	Tisdell, C. and Wilson, C. (2001)	Breeding and feeding pigs in Australia and Vietnam AS2/1994/023	
18	Vincent, D. and Quirke, D. (2002)	Controlling *Phalaris minor* in the Indian rice–wheat belt	CS1/1996/013
19	Pearce, D. (2002)	Measuring the poverty impact of ACIAR projects—a broad framework	
20	Warner, R. and Bauer, M. (2002)	*Mama Lus Frut* scheme: an assessment of poverty reduction	ASEM/1999/084
21	McLeod, R. (2003)	Improved methods in diagnosis, epidemiology, and information management of foot-and-mouth disease in Southeast Asia	AS1/1983/067, AS1/1988/035, AS1/1992/004 and AS1/1994/038
22	Bauer, M., Pearce, D. and Vincent, D. (2003)	Saving a staple crop: impact of biological control of the banana skipper on poverty reduction in Papua New Guinea	CS2/1988/002-C
23	McLeod, R. (2003)	Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia and the epidemiology and control of bovine ephemeral fever in China	AS1/1984/055, AS2/1990/011 and AS2/1993/001
24	Palis, F.G., Sumalde, Z.M. and Hossain, M. (2004)	Assessment of the rodent control projects in Vietnam funded by ACIAR and AUSAID: adoption and impact	AS1/1998/036
25	Brennan, J.P. and Quade, K.J. (2004)	Genetics of and breeding for rust resistance in wheat in India and Pakistan	CS1/1983/037 and CS1/1988/014
26	Mullen, J.D. (2004)	Impact assessment of ACIAR-funded projects on grain-market reform in China	ANRE1/1992/028 and ADP/1997/021
27	van Bueren, M. (2004)	Acacia hybrids in Vietnam	FST/1986/030

IMPACT ASSESSMENT SERIES <CONTINUED>

No.	Author(s) and year of publication	Title	ACIAR project numbers
28	Harris, D. (2004)	Water and nitrogen management in wheat–maize production on the North China Plain	LWR1/1996/164
29	Lindner, R. (2004)	Impact assessment of research on the biology and management of coconut crabs on Vanuatu	FIS/1983/081
30	van Bueren, M. (2004)	Eucalypt tree improvement in China	FST/1990/044, FST/1994/025, FST/1984/057, FST/1988/048, FST/1987/036, FST/1996/125 and FST/1997/077
31	Pearce, D. (2005)	Review of ACIAR's research on agricultural policy	
32	Tingsong Jiang and Pearce, D. (2005)	Shelf-life extension of leafy vegetables—evaluating the impacts	PHT/1994/016
33	Vere, D. (2005)	Research into conservation tillage for dryland cropping in Australia and China	LWR2/1992/009, LWR2/1996/143
34	Pearce, D. (2005)	Identifying the sex pheromone of the sugarcane borer moth	CS2/1991/680
35	Raitzer, D.A. and Lindner, R. (2005)	Review of the returns to ACIAR's bilateral R&D investments	
36	Lindner, R. (2005)	Impacts of mud crab hatchery technology in Vietnam	FIS/1992/017 and FIS/1999/076
37	McLeod, R. (2005)	Management of fruit flies in the Pacific	CS2/1989/020, CS2/1994/003, CS2/1994/115 and CS2/1996/225
38	ACIAR (2006)	Future directions for ACIAR's animal health research	
39	ACIAR (2006)	Benefits to Australia from ACIAR-funded research	
40	Corbishley, J. and Pearce, D. (2006)	Zero tillage for weed control in India: the contribution to poverty alleviation	CS1/1996/013
41	ACIAR (2006)	ACIAR and public funding of R&D, Submission to Productivity Commission study on public support for science and innovation	

ECONOMIC ASSESSMENT SERIES (DISCONTINUED)

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Doeleman, J.A. (1990)	Biological control of salvinia	8340
2	Tobin, J. (1990)	Fruit fly control	8343
3	Fleming, E. (1991)	Improving the feed value of straw fed to cattle and buffalo	8203 and 8601
4	Doeleman, J.A. (1990)	Benefits and costs of entomopathogenic nematodes: two biological control applications in China	8451 and 8929
5	Chudleigh, P.D. (1991)	Tick-borne disease control in cattle	8321
6	Chudleigh, P.D. (1991)	Breeding and quality analysis of canola (rapeseed)	8469 and 8839
7	Johnston, J. and Cummings, R. (1991)	Control of Newcastle disease in village chickens with oral V4 vaccine	8334 and 8717
8	Ryland, G.J. (1991)	Long term storage of grain under plastic covers	8307
9	Chudleigh, P.D. (1991)	Integrated use of insecticides in grain storage in the humid tropics	8309, 8609 and 8311
10	Chamala, S., Karan, V., Raman, K.V. and Gadewar, A.U. (1991)	An evaluation of the use and impact of the ACIAR book Nutritional disorders of grain sorghum	8207
11	Tisdell, C. (1991)	Culture of giant clams for food and for restocking tropical reefs	8332 and 8733
12	McKenney, D.W., Davis, J.S., Turnbull, J.W. and Searle, S.D. (1991)	The impact of Australian tree species research in China	8457 and 8848
	Menz, K.M. (1991)	Overview of Economic Assessments 1–12	