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29 January 2010

Committee Secretary
House of Representatives Standing Committee
on Industry, Science and Innovation
PO Box 6021
House of Representatives
Parliament House
CANBERRA ACT 2600

Dear Committee Secretary

Inquiry into Australia's International Research Collaboration

Please find attached ACIAR's submission to the inquiry into Australia's international research collaboration.

The ACIAR contact officer for the inquiry is Dr Simon Hearn, Principal Adviser. Dr Hearn can be contacted on 02 62170547 or hearn@aci-ar.gov.au.

I trust the attached submission is of assistance. My best wishes for a successful and productive inquiry.

Yours sincerely

Nick Austin
Chief Executive Officer



Australian Government

**Australian Centre for
International Agricultural Research**

SUBMISSION TO THE

**HOUSE OF REPRESENTATIVE STANDING
COMMITTEE ON INDUSTRY, SCIENCE AND
INNOVATION**

**INQUIRY INTO AUSTRALIA'S INTERNATIONAL
RESEARCH COLLABORATION**

JANUARY 2010

Contents

Background.....	1
Introduction.....	1
Australia’s research partnership approach	2
Agricultural productivity growth for economic development	4
Australia’s research capacities	5
ACIAR R&D benefits to developing partner countries.....	5
Public good research	5
The joint benefits of collaborative R&D	6
Evaluating research impact	7
Evaluation of policy research.....	8
Evaluation of poverty impacts.....	9
Conclusion	10
References.....	12

*House of Representatives Standing Committee on Industry, Science and
Innovation
Inquiry into Australia's international research collaboration*

Background

The Australian Centre for International Agricultural Research (ACIAR) is a statutory authority that operates within the Foreign Affairs and Trade portfolio. The Centre's activities are part of Australia's aid program, with the objectives of advancing Australia's national interest through poverty reduction and sustainable development. ACIAR was established in 1982 to assist and encourage agricultural scientists in Australia to use their skills for the benefit of developing countries while at the same time working to solve Australia's own agricultural problems.

ACIAR commissions research groups and institutions, including universities, CSIRO and state departments of primary industry, private consultants and non-government organisations (NGOs) to carry out agricultural research projects in partnership with their counterparts in developing countries (covering 25–30 countries). This includes:

- commissioning research into improving sustainable agricultural production in developing countries
- funding project-related training (postgraduate and short training courses)
- communicating the results of research
- conducting and funding development activities related to research programs, including capacity building
- administering the Australian Government's contribution to the International Agricultural Research Centres (IARC).

Research funded by ACIAR aims to help developing countries to help themselves, by contributing to solving agricultural problems and building research capacity. As such ACIAR's activities relate directly or indirectly to the inquiry's broad terms of reference covering:

- the nature and extent of existing international research collaborations
- the benefits to Australia from engaging in international research collaborations
- the key drivers of international research collaboration at the government, institutional and researcher levels
- the impediments faced by Australian researchers when initiating and participating in international research collaborations and practical measures for addressing these
- Principles and strategies for supporting international research engagement

Introduction

ACIAR commissions collaborative research between Australian and developing country researchers in areas where Australia has special country relevant research competence. In 2008-09 it allocated just over \$59 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.

ACIAR is unique in that it is part of Australia's innovation system while also being an integral part of the development assistance program. ACIAR has had an extensive program of impact evaluations in place since 1998, with a strong focus on developing the methods of evaluation which are addressed in summary format in this submission. Extensive information is also communicated on impact evaluations on the ACIAR website: www.aciar.gov.au.

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 international 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 last 20 years.

Australia's research partnership approach

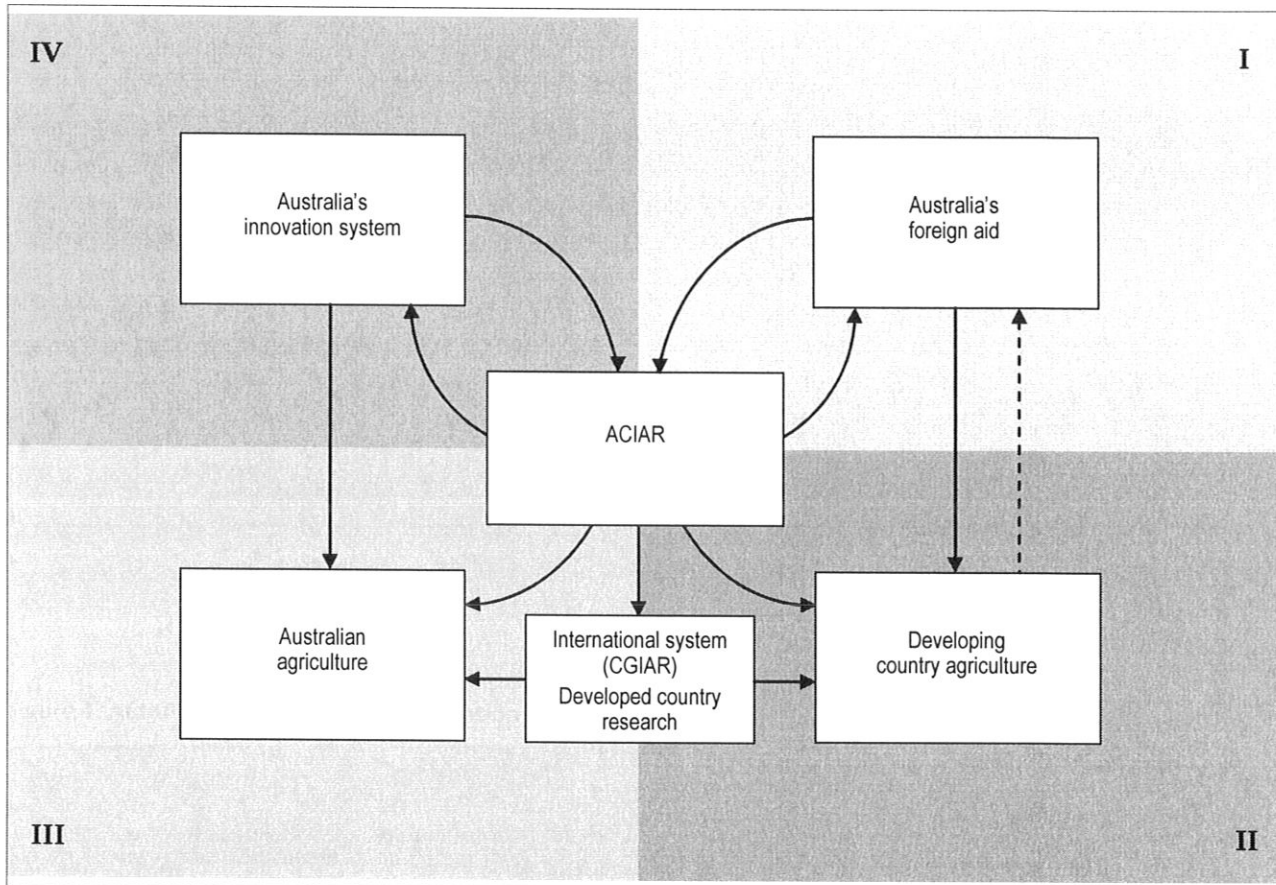
ACIAR's success in generating benefits for developing country partners builds on its ability to attract Australia's scientific resources into looking at particular categories of agricultural problems. This use of Australian research resources provides the link to Australia's innovation and research system.

These linkages are illustrated in figure 1. Schematically, ACIAR enables a number of important interactions. The best known interaction is illustrated in quadrant II of the figure, the delivery of research outcomes to developing country agriculture.

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 the figure). ACIAR funds R&D projects in cooperation with agencies in developing partner countries. 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. The extent of these mutual research benefits varies from project to project and the focal issues of each research endeavour.

Figure 1: ACIAR, aid and Australia's innovation system



Source: Pearce, Monck, Chadwick and Corbishley, 2006

ACIAR's activities interact with Australia's innovation system (quadrant IV) 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 (CSIRO)). 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 and the less prospective 'dry wells'.

In particular, ACIAR places an emphasis on agricultural research to achieve sustainable development and natural resource management by funding 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. This achievement is partially a reflection of the fact that many developing countries with which ACIAR engages in research partnerships experience similar environmental and biosecurity challenges as Australia. In some instances research undertaken in

developing countries can constitute a more cost effective means of information generation than research undertaken in Australia alone.

Agricultural productivity growth for economic development

Agriculture remains a predominant sector of the economy in most of Australia's development partners, and is the source of livelihoods for the majority of the people. Typically rural people 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 achieving economic growth through promoting domestic savings and releasing labour for alternative uses.

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 the risk management response of high degrees of diversification limits scale economies. There is considerable scope for R&D to address these constraints and to improve productivity through reducing the costs, variability, quality and variety of production.

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 11.1 per cent of total investment had a benefit:cost ratio of about 54:1 (Harding, Jiang and Pearce 2009). The benefits from this selection of projects alone represent more than three times ACIAR's total bilateral investment to date of \$2.1 billion (2008 dollars).

Examples include¹:

- research into conservation tillage for dryland cropping in China, which is estimated to generate benefits of just over a 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 \$2 billion for an outlay of \$16.8 million, with a benefit:cost ratio of 119:1 (Fisher and Gordon 2008)
- research into controlling 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).

The returns to R&D in agriculture in developing countries are particularly high as there are frequently 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.

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 investment in new ways of doing things and investment 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. The Centre is

¹ The references are to the original assessments of the projects: the benefit and cost values are from a revaluation presented in Pearce, Monck, Chadwick and Corbishley, 2006.

increasingly relating its economic and policy research projects to the scientific investments, recognising that successful science uptake depends heavily on establishing the most suitable policy and institutional settings in recipient countries.

Australia's research capacities

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

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

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

ACIAR R&D benefits to developing partner countries

ACIAR's impact assessment program provides robust evidence of the size of the benefits being delivered by its activities. It is estimated that the 90 ACIAR-funded projects that have been subject to impact assessments have delivered benefits that total \$12.6 billion to developing country partners and Australian agriculture for a total outlay of \$234 million. Approximately 90 per cent of the benefits accrued to developing country partners: the remaining 10 per cent accrued to Australian agriculture.

A meta-analysis of these evaluations (Harding, Jiang and Pearce, 2009) has extended Raitzer and Lindner's review of returns to ACIAR's bilateral investments (Raitzer and Lindner, 2005). 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 \$6.8 billion, with benefits net of ACIAR's costs of \$6.7 billion.

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 from meeting food safety, quarantine and quality requirements, and environmental, bio-diversity and sustainability improvements associated with management of natural resources.

Public good research

Public goods are defined as a good or service that is non-rivalled and non-excludable. This means that access to, or consumption of, the good or service by one individual does not reduce availability of the good or service for consumption by others, and that no one can be effectively excluded from using the good or service. It is generally provided to the public without profit. Technology can be exclusive where knowledge is essential and benefits are limited to those who have the capacity to access (and utilise) the information.

Experience shows public good R&D tends to deliver very high returns. For example, a project aimed at developing and delivering bio-control 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 258:1) (Waterhouse, Dillon and Vincent 1998).

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 can also raise 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.

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 including NGOs. ACIAR is continuously seeking to further develop a greater diversity of both public and private partnerships to support the dissemination of new ideas that do not crowd out private initiative.

The joint benefits of collaborative R&D

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 a valid example. ACIAR, along with a number of other organisations, supported the development of high-yielding eucalyptus 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 participatory R&D partnerships 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 the same extent, limited by education levels, public policy or state and private monopoly impediments.

Independent impact evaluations of ACIAR-funded projects suggest that these have delivered significant spillover benefits to Australian agriculture. There are over 20 projects for which benefits to Australia have been quantified. In present value terms, these benefits come to \$1.2 million.

These quantified benefits arise in four main categories:

- Direct production benefits (44 per cent of the total) arising through research findings that directly improve the productivity of Australian agriculture
- Indirect protection from disease or pest incursion (35 per cent of the total) that arises from applications of research findings that lower the chance of a disease or pest ever entering into Australia
- Direct protection from disease or pest incursion (12 per cent 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 per cent 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 well acknowledged in partner developing countries, enhancing Australia's recognition in the region. ACIAR's comprehensive program of impact evaluations guides investment in consultation with developing countries. ACIAR has been undertaking impact evaluations of its projects since 1998. To date it has commissioned detailed impact evaluations of 90 completed projects.

Evaluating research impact

Most evaluations have focused on measuring the economic surplus resulting from the adoption of the R&D outputs while 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 cooperate with international agricultural research organisations in doing so. Recent development includes guidelines for impact evaluation of capacity building activities undertaken with the Crawford Fund. In 2008 ACIAR published comprehensive guidelines for impact assessment to improve the consistency and quality of their evaluations.

ACIAR projects often involve substantial training, usually through learning by doing, for collaborating scientists in developing partner countries. 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 collaborated to develop a framework for evaluation of the capacity building components of projects.

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 (Gordon & Chadwick, 2007). 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 previous 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 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.

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 to 30
Establishment of a protected area in Vanuatu	4.5

Source: Pearce, 2005, McWaters and Templeton, 2004, Watson 1998, Mullen, 2004 and Centre for International Economics, 1998

This approach reflects the 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 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 ensure 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).

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 headcount 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 assess 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.

ACIAR has commissioned reviews of the poverty impact of some of its projects. One example is the project targeting bio-control 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 (Warner and Bauer 2003).

Conclusion

ACIAR's operation at an interface between Australia's innovation system and its development assistance program provides for some insights that may be useful for this House of Representatives Standing Committee on Industry, Science and Innovation inquiry into Australia's international research collaborations.

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. As so many poor people in the developing countries targeted by Australia's aid program are dependent on rural activities for their livelihoods, aid which 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, showing 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 impacts on 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.

Despite its limited size, some of the lessons from ACIAR's experience will be pertinent to the Committee's terms of reference, with particular application to:

- the nature and extent of existing international research collaborations
- the benefits to Australia from engaging in international research collaboration
- the key drivers of international research collaboration at government, institutional and researcher levels.

To ensure that public research expenditures are 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 by the relevant users. 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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