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Impact of private sector involvement in ACIAR projects: a framework and cocoa case studies

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Impact of private sector involvement in ACIAR projects: a framework and cocoa case studies

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The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. 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.

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Foreword

The Australian Centre for International Agricultural Research (ACIAR) has a strong imperative to build up its engagement with the private sector, based around the positive experience of recent projects. ACIAR can offer the private sector strong partnerships built on trust, transparency, complementarity and mutual benefit. Such partnerships enable greater innovation in research for development and, as a result, direct and indirect benefits to the economies of developing countries and Australia. In return, the private sector can open up pathways to greater scale and impact; provide access to value chain knowledge, technologies and innovation capacity; leverage opportunities for private sector investment; and give access to markets.

This report provides a general framework for thinking about the impact of private sector involvement in the research and development activities funded by ACIAR. It comprises a review of recent literature pertaining to the subject and a case study of some ACIAR cocoa projects that involved considerable private sector participation.

It is gratifying that the findings from the cocoa case study were overwhelmingly positive, with all concerned parties expressing strong satisfaction with the research process and outcomes achieved. But we now recognise the inherent challenge to ensure that the cocoa experience is replicable across other projects.

ACIAR will continue to assess private sector engagement and capacity constraints in agricultural research for development, and consider how to incorporate this engagement with the private sector into existing planning and project cycles. In every instance, these are undertaken with the need to maximise spillover benefits to smallholders in mind.

The material in this report is a valuable resource. Author David Pearce has sought answers to some very relevant questions: Which aspects of private sector involvement are most beneficial to the projects? How should projects be developed to maximise the beneficial impact of private sector partners? What are the risks and trade-offs involved in engaging with the private sector? The answers to these questions touch the heart of our own present deliberations. Thus, this report provides us with a timely overview as we chart our future private sector engagement, and will be an excellent reference for others beyond ACIAR seeking closer involvement.

Nick Austin
Chief Executive Officer, ACIAR

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Abbreviations

ACIAR	Australian Centre for International Agricultural Research
IPR	intellectual property right
PNG	Papua New Guinea
R&D	research and development

Acknowledgments

This report was prepared in conjunction with an impact evaluation of ACIAR-funded cocoa projects, including projects involving considerable private sector involvement (Pearce 2016). The author would like to acknowledge the key contributors to those projects who also contributed to the more general findings in this report:

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- Edwina Heyhoe, Centre for International Economics
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Summary

- This report considers, from an impact assessment perspective, the potential effects of private sector involvement in undertaking Australian Centre for International Agricultural Research (ACIAR)–funded research projects.
- This report provides a broad framework for thinking through the potential impacts of private sector engagement. It also considers recent literature in the field and a case study of recent ACIAR-funded projects on cocoa research, which involved considerable private sector participation.
- The broader literature and the cocoa case study presented in this report show clear evidence of potential benefits from private sector engagement in undertaking agricultural research and development in developing countries.
- The findings from the cocoa case study were overwhelmingly positive, with all concerned parties expressing strong satisfaction with the research process and outcomes.
- Although positive, the success of the cocoa case study also creates a challenge for ACIAR to ensure that this experience is replicable across other projects.
- More generally, the challenge for ACIAR in undertaking more private sector engagement is to ensure genuine research additionality, along with maximising spillover benefits to smallholders.
- This report suggests some broad checklists and evaluation activities that will be valuable at the start and finish of research activities involving private sector partners.

1 Introduction

In recent years, the Australian Centre for International Agricultural Research (ACIAR) and other international development agencies have become increasingly aware of the importance of the private sector's involvement when undertaking research, and in the chain that ultimately delivers research benefits to farmers and smallholders.

ACIAR is interested in continuing to improve its engagement with the private sector, build on the positive experience in recent projects and continue to develop new ways of collaborating with private sector organisations.

In the context of ACIAR's systematic process of impact evaluation, this raises the crucial question of how to measure (and therefore how to monitor and maximise) the effect of explicit private sector involvement on the impact of ACIAR-funded research and development (R&D). That is, how does it change the beneficial impact on stakeholders? To answer this question, it would be ideal to undertake a controlled experiment and conduct a series of projects with and without private sector involvement to systematically observe the differences between them.

An alternative method could be to analyse a large database of projects, with and without private sector involvement, to assess whether there are any statistical differences in returns between projects with and without private sector involvement. Although such an exercise has been undertaken previously to compare returns to Australia under different specifications (Pearce et al. 2006), in the case of the private sector, there are insufficient data points to be able to observe statistical differences.

Framing a potential experiment exposes one of the key issues, however. All projects involve the private sector in some capacity. The private sector is just not always identified as an explicit research participant (although it is very frequently identified as the 'next user' in the research impact pathway). In the vast majority of cases, the private sector is essential to aggregate new inputs that might be the result of research (such as new seed varieties) or to ensure adoption of other research outputs (research is seldom adopted without a market to sell to). As the cocoa case studies discussed in this report indicate, virtually all international cocoa R&D projects have involved some form of private sector involvement.

The challenge then is to develop a method of assessing the importance and impact of explicit private sector involvement in the research process in the same sense in which the private sector has been closely involved in recent cocoa projects, including in Indonesia and Papua New Guinea, which form the basis of the case studies in this report. Related questions include:

- Which aspects of private sector involvement are most beneficial to the projects?
- How should projects be developed to maximise the beneficial impact of private sector partners?
- What are the risks and trade-offs involved in engaging with the private sector as research partners?

This report

This report provides a general framework for thinking about the impact of private sector involvement in ACIAR-funded R&D activities. This includes working through the determinants of private sector involvement and the ways in which private sector involvement could contribute to known factors that determine adoption and project success.

The report then reviews the broader literature on this issue and uses recent cocoa projects as a case study of the importance of private sector involvement.

Finally, the report makes some recommendations about the process of engaging the private sector to maximise the impact of the funded R&D.

2 A framework for private sector involvement in research and development

This chapter discusses a framework for thinking about private sector involvement in research and development (R&D), which provides context for this report.

What is the private sector?

There is no simple, single definition of the private sector; it can be understood in a variety of ways.

In its simplest form, private refers to activities that occur independently of government funding. A more sophisticated version of this is where private refers to a system of voluntary trade that agents enter into with the expectation of some form of gain. Voluntary trade is distinct from some form of coercion, which may occur through taxation or the regulatory system.

Private is sometimes conflated with the 'profit motive' under the expectation that private agents seek some form of personal return. This is in contrast to the public sector, where there is not necessarily an expectation of commercial return. However, some return is always expected of government activity.

In many ways, the private sector is concerned with the provision of private goods rather than public goods, although this distinction is not always clear-cut.

Definitions of private sector are further complicated by the fact that, in many economies, there is a very close relationship between government and the private sector. This is either through direct government funding of particular activities, through regulatory arrangements that may grant monopolies to private sector operations or through tax arrangements designed to specifically advantage firms in particular sectors of the economy.[1] A private firm with a government monopoly enforced through the powers of the state is very different from a private firm operating in a competitive market with no particular regulatory advantages.

A further confusion arises in that there are many legal arrangements for the establishment of private sector activities—cooperatives, partnerships, limited liability corporations, companies listed on a stock exchange and companies established through private capital are a number of elements within an overall spectrum. The different legal, financial and contractual bases of private sector activities may have a substantive influence on the research-related behaviour of private sector organisations.

Private sector activities also range considerably in scale and coverage, from small local trading companies (including sole traders or other microbusinesses) to very large, multinational food-processing corporations. Incentives and capabilities clearly differ considerably between these two extremes.

[1] The Indonesian export tax on raw cocoa beans is an example that is highly relevant to recent ACIAR projects. This tax disadvantages smallholders (part of the private sector) to the advantage of local cocoa-processing companies (also mostly private sector, sometimes multinational).

Who should do the research?

The argument for government funding

Research and development is often considered a public good. The new knowledge it generates is non-rival (i.e. it can be consumed more than once), and it is often difficult, once generated, to exclude or control the uses to which it is put. Knowledge is, therefore, a very different product from the goods and services typically provided by private sector agents in largely private markets. At the same time, new knowledge from R&D often has substantial spillover benefits (benefits that accrue to parties other than those that undertook the original research).

For these broad reasons, there is a general expectation that the private sector will not provide R&D (or that it will be underprovided). The private sector will be reluctant to provide the full amount of R&D that is socially optimal, because it may not be able to appropriate sufficient returns from R&D (i.e. to fund the costs of the R&D and to generate a return on capital).

This is the general argument underlying government funding of R&D. In most countries, governments are involved in either directly undertaking R&D or providing funds to subsidise private sector involvement in R&D. At the same time, governments have implemented patent and other intellectual property regimes that are also designed to encourage R&D.

Agricultural research and development in developing countries

In the case of agricultural R&D, particularly in developing countries, there are a number of additional arguments for government involvement (including through international aid programs):

- Developing country governments often have limited resources to directly support agricultural R&D activities.
- Smallholder producers, by their nature, have limited resources to collectively fund R&D activities.
- R&D in developing countries may appear more risky from the perspective of private providers, because facilitating institutional arrangements, such as intellectual property rights, are less well developed.

Why look to the private sector?

For the reasons listed previously, it should come as no surprise if there is limited private sector funding of agricultural R&D in developing countries. This is the niche that the Australian Centre for International Agricultural Research (ACIAR) operates in. Limited private sector involvement would suggest that ACIAR is working in an appropriate area—one where incremental government funding can make a contribution with limited risk of crowding out private provision of R&D. Why consider the private sector at all?

In reality, the picture of incentives for undertaking R&D in developing countries is considerably more complicated. Rather than a clear distinction between private and public provision of R&D, there is a continuum between the two.

Further, the notion that private sector firms have limited incentive to undertake R&D needs to be considered in much more detail, on a commodity-by-commodity basis. There are cases where the private sector has strong incentives to undertake R&D, as the cocoa case study discussed in this report illustrates very clearly.

All research and development funding comes back to the private sector

In the context discussed in the previous section, it is worth noting that all R&D funding comes back to the private sector in some way (Figure 2.1). The policy discussion is about how to best redistribute these funds.

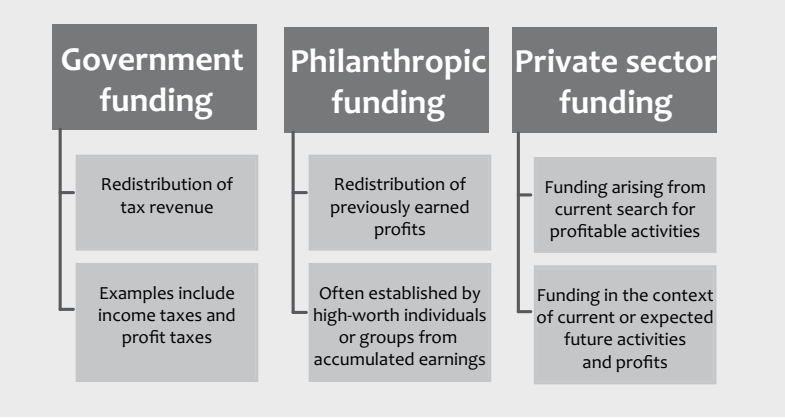
A spectrum of responsibilities and incentives

Given the complexity of modern market chains, there is clearly a spectrum of responsibilities and incentives for R&D (Figure 2.2).

At the one extreme, it is easy to imagine cases where there are very large spillovers from research and very limited private incentives. Here, R&D activities need to be almost exclusively publicly funded, or funded through organisations such as ACIAR.

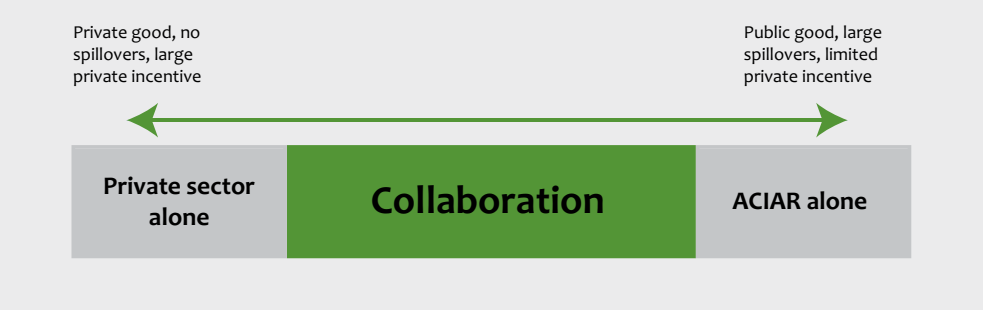
At the other extreme are cases where there are strong incentives for private sector R&D, such that involvement from public organisations is unnecessary or potentially counterproductive.

Between these two extremes is a potentially large area of collaboration between private and public agencies. As discussed further, there are good reasons to believe that this collaboration will improve R&D outcomes. It is also crucial, however, to ensure that engagement with the private sector does not crowd out areas where the private sector already had sufficient incentive to undertake R&D.



Source: Centre for International Economics

Figure 2.1 The private sector's involvement in research funding



ACIAR = Australian Centre for International Agricultural Research
Source: Centre for International Economics

Figure 2.2 A spectrum of responsibilities and incentives for publicly and privately funded research and development

Determining private sector interest in research, development and extension

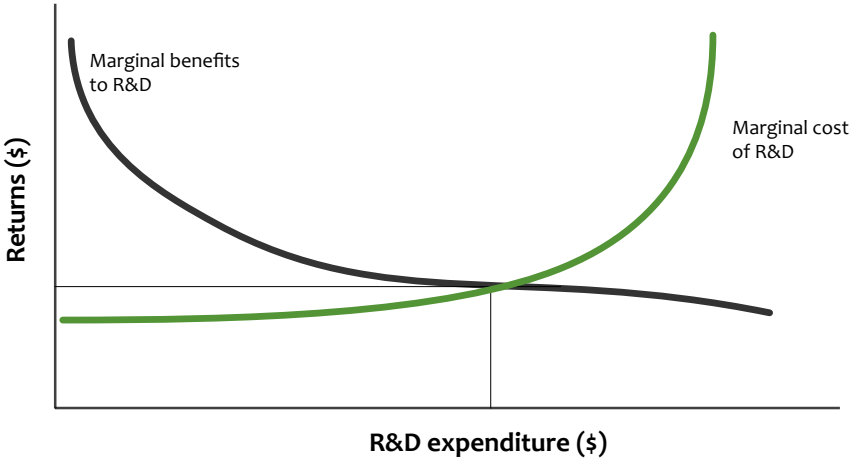
Figure 2.3 provides a general schema for considering the determinants of the level of private sector funding of (or other engagement in) R&D. In this scheme, spending on R&D can take a variety of forms, ranging from expenditure on specific research facilities owned and operated by the company, to commissioning of research by employing other specialist organisations, to entering research partnerships with other organisations.

Expenditure on R&D (the horizontal axis) is determined by the benefits to the private sector organisation compared with the costs to the organisation of that R&D level. In particular, it is the marginal benefits (represented by the downward sloping schedule) compared with the marginal costs (represented by the upward sloping schedule) that determine the ideal level of R&D expenditure from the perspective of the firm. (Of course, these private benefits are also likely to be associated with a range of spillover and public benefits, but, in determining the firm's incentive to undertake research, it is the benefits that accrue to the firm that are relevant.)

The marginal benefits schedule can be thought of as a profile of all the different spending options facing the firm, ranked in order of benefits. The projects with the highest benefits are undertaken first, and those with the lower benefits later. The marginal benefits curve will, in general, be sloping downwards; the incremental returns from each additional dollar of spending will be lower. However, the slope of the marginal benefits curve (i.e. whether benefits decline slowly or rapidly) depends very much on the circumstances of the firm and the market in which it operates.

Benefits themselves may consist of a variety of elements. In the most general terms, they refer to the monetised value of any beneficial outcome that the firm values. For firms in the private sector facing competition, these benefits will most likely be estimated as the present value of the increase in the future stream of profits that arises as a consequence of the impact of the research.

One of the important determinants of the marginal benefits of research is the appropriability of research outcomes—that is, the extent to which



R&D = research and development
Source: Centre for International Economics, David et al. (2000)

Figure 2.3 The private firm's research and development spending

the benefits of research actually accrue to the firm undertaking the expenditure.

Research costs refer to all expenditure, or real resource use, incurred in undertaking the research. Like benefits, these will most often be expressed in present-value terms over the life of the research project. In the most general terms, the costs refer to the opportunity cost of the resources devoted to the research. This will include cash, along with the opportunity cost of in-kind resources devoted to joint projects, for example.

The marginal cost curve will be upward sloping because the opportunity cost of additional resources will increase. Any firm has multiple calls on its resources in addition to R&D; expenditure devoted to R&D will involve lost opportunities elsewhere in the firm. The exact position and slope of the marginal cost curve will depend very much on the circumstances of the individual firm, and may vary considerably by industry and with the organisational structure of the individual company. The marginal cost curve will also depend on general macro-economic and financial conditions as key elements of the cost of debt or equity, which will, in part, be determined by prevailing real interest rates and the general state of the economy.

The intersection of the two curves determines the amount of R&D that the organisation will be prepared to undertake. Table 2.1 summarises the factors that affect the position and slope of the benefit and cost curves.

Table 2.1 Factors affecting benefits and costs (the position and slope of the benefit and cost curves)

Benefits	Costs
The technical opportunities in the market in which the firm operates. How easy is it to generate profitable innovations? How susceptible is the general area of activity to research?	General policy measures (such as the tax treatment of R&D expenditures) that affect the private costs of undertaking R&D
The state of the product market in which the firm operates. What is the size of the market? Is demand strong? How responsive is demand to changes in price? What is the nature and extent of competition in the market?	The availability of retained earnings within the firm to fund R&D (particularly important for private companies not listed on a stock exchange)
Government regulatory and other interventions that influence the ability to sell products with new R&D embedded in them	The general condition of bond and stock markets in cases where funding is raised through public equity offerings
General institutional arrangements in the countries in which the firm operates that influence the appropriability of the benefits of the research	The availability and terms of venture capital finance, and the tax treatment of capital gains
Firm-specific characteristics, including the culture of innovation within the firm	General macro-economic conditions determining the cost of borrowing funds (funding is particularly relevant to private companies in cases of debt, rather than equity)

R&D = research and development
Source: Centre for International Economics, David et al. (2000), Naseem et al. (2006)

A key influence on private incentives is the ability to appropriate returns from research. This in turn depends on the nature of the markets involved. Much private sector agricultural research is concerned with providing improved inputs to farmers (e.g. improved seeds, fertilisers or pesticides). These products are sold within the market sector and, in many cases, private sector firms are able to appropriate returns from this research.

At the same time, there are also various incentives to undertake production research (research on the processes of growing or producing agricultural products), depending on the nature of the product market.

As Table 2.2 illustrates, private sector incentives to engage in production R&D will vary by product. The highest incentives are likely to be in export markets for very differentiable products, where the private sector organisation is more likely to be able to retain large benefits through sales on large markets. In this case, production research will help to ensure supply of a key product (e.g. cocoa) that can largely be sold in developed country markets. A final product such as chocolate is highly differentiable in final consumer markets, which means the private sector organisation is able to appropriate substantial benefits from the original research. In contrast, export products that are not differentiable in their final use provide considerably lower potential for firms to appropriate benefits of research.

Products for sale in domestic markets within developing countries also provide very limited incentive for private sector research.

Could private sector involvement improve the impact of ACIAR-funded research?

There are two mechanisms by which private sector engagement could increase the impact of ACIAR-funded research:

- by increasing the resources available for research
- by improving the productivity of the research.

Increasing resources available for research

To the extent that private sector organisations are prepared to devote resources to R&D (see the discussion above), engagement with the private sector may have the effect of increasing the total amount of resources available for ACIAR projects. By virtue of this scale effect, impacts should also increase.

There are, however, two crucial caveats to this point. First, an increase in scale will not necessarily, of itself, increase marginal (or even average) returns. If there are declining marginal returns to an R&D activity, then increased scale may lead to lower measured impacts (e.g. in the form of benefit:cost ratios). This means it is crucial to carefully consider the content of the private sector engagement.

Table 2.2 Private sector incentive to undertake research and development in production

Type of market	Commodity products (not differentiable)	Differentiable product in final use
Export	Limited incentive	High incentive
Domestic	Low incentive	Low incentive

Source: Centre for International Economics

Second, ACIAR entering into arrangements with private sector agencies may simply result in the substitution of ACIAR funds for funds that would otherwise have been spent by the private sector organisation. There is no guarantee of an increase in resources.

The second point is the most important, and raises the controversial issue of crowding out. If ACIAR (or any other public agency) funds research in an area where the private sector was otherwise prepared to undertake research, there is a risk of crowding out. Whether this is the case, and the extent of the crowding out, depend on a variety of factors. There is a very large debate on this in the broader R&D literature (see, for example, David et al. 2000 and R&D reports published by the Productivity Commission).

Of course, on the other side of crowding out is the possibility of 'crowding in'—that is, increasing net resources by increasing the effectiveness of private sector research.

The broad framework set out above can be used to think about crowding-out issues. A range of possibilities is summarised in Table 2.3.

Table 2.3 Key channels for public funding effects on private research and development

Factors that change returns	Factors that change costs
Lowering returns	**Increasing costs**
Outputs of publicly funded research may lower returns to existing or future private R&D activities	Public sector funding may draw on research inputs that would otherwise have been used in the private sector
Returns to other firms not engaged with the public sector may be lowered	
Increasing returns	**Lowering costs**
Publicly funded R&D may lower common costs of research, thus increasing returns per unit	Direct subsidies will lower the cost of R&D, but the net increase in R&D spending will not necessarily be the amount of the subsidy—it depends on the slope of the marginal cost curve
Learning and training effects may increase returns	
Publicly funded test facilities may increase returns	
Government-funded R&D may signal future demand for R&D outputs	

R&D = research and development

Source: Centre for International Economics, David et al. (2000)

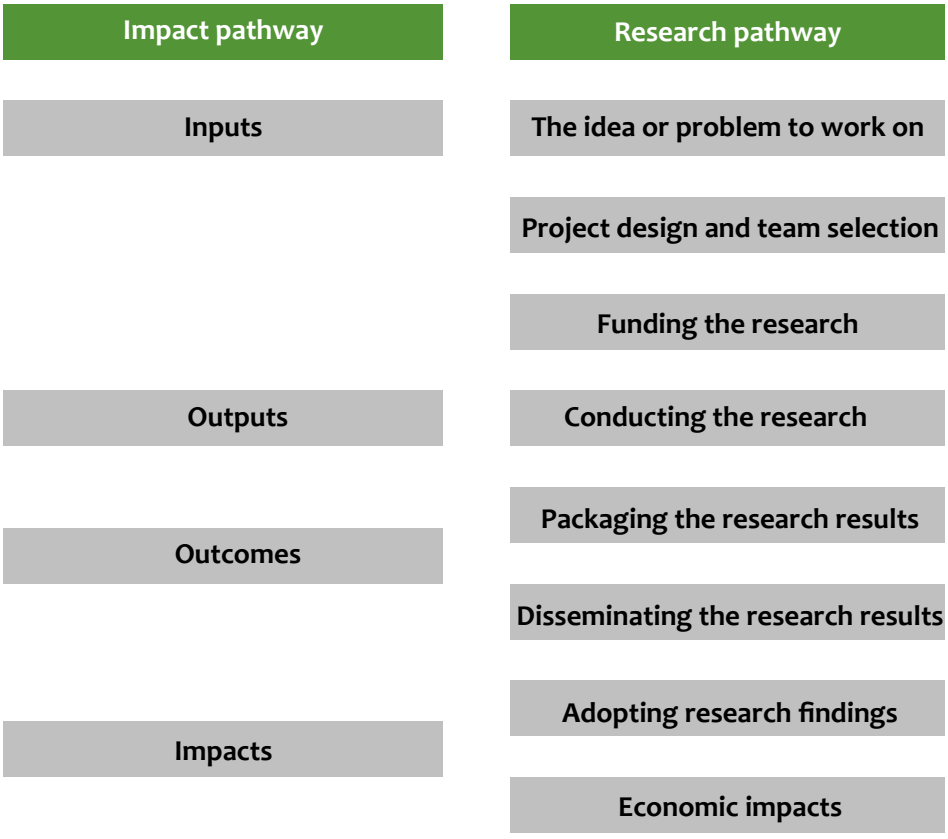
Improving productivity of research

The most important channel through which private sector engagement could increase impacts is through an improvement in the underlying productivity of research. Here, productivity is understood broadly as the relationship between research impacts and the total resources devoted to the research.

How this may come about can be seen by considering the key elements of both the research project and impact pathways (Figure 2.4). From the initial idea of the project to work on, through to the adoption of research outcomes, the private sector has potential to contribute to improvements at the margin in each of the key steps.

To the extent that private sector organisations are actively involved in a number of markets and deal regularly with problems in those markets, the private sector may have important insights into the types of research questions that are both useful and amenable to further research. It is likely that these questions will have a practical focus, and will not necessarily be driven by purely academic concerns.

To the extent that engagement with the private sector allows access to a broader range of expertise than otherwise, it may be that private sector engagement could improve the conduct of the



Source: Centre for International Economics

Figure 2.4 Research and impact pathways

research and thus improve the likelihood of research success.

Importantly, private sector involvement may have a major effect on the adoption of research findings. The private sector partner may have access to a wider variety of potential users (e.g. their suppliers or customers) than is typically the case with some agricultural research projects.

The private sector and identified factors for project success

Another way of looking at this is to consider the ways in which the private sector could contribute to the known factors that determine project success. Table 2.4 provides a summary of how the private sector could contribute to success factors recently identified in ACIAR research (Pearce 2010).

Table 2.4 Private sector contribution to identified success factors

Success factor	Potential contribution of private sector
Clearly defined objectives and research questions	Private sector organisations have a strong incentive to understand the markets within which they operate, and therefore to understand the constraints and opportunities amenable to research and development. They create a very strong potential for better defined projects
Strong communication leading to good collaboration	Once committed, private sector organisations have a strong incentive for success. Large multinational private sector organisations may also have existing, effective protocols for international communication and collaboration
Trust, complementarity and alignment of interests	There is no guarantee of this in principle, so it needs to be established in the course of the project
Good project leadership and management support	This very much depends on the partners involved, as well as the structure of the overall research projects. Some private sector organisations have well-established leadership techniques
Strong, capable research team with skills, incentives and commitment	This is probably outside the control of the private sector and depends very much on the overall structure of the project. Private sector organisations may have established relations with effective research teams in a variety of countries and contexts
Institutional support	Engagement with large private sector organisations creates the possibility for a range of institutional support mechanisms
Involvement of industry partners and the local community	There is a clear role for the private sector. Involvement in the private sector has already been identified as a key success factor for ACIAR research project success
Clear adoption plans	The private sector has a strong incentive for adoption of research outcomes, as it is the final adoption that generates benefits

ACIAR = Australian Centre for International Agricultural Research
Source: Centre for International Economics analysis, Pearce (2010)

The private sector and adoption

The Adoption and Diffusion Outcome Prediction Tool (ADOPT) developed by the Commonwealth Scientific and Industrial Research Organisation identifies a number of factors that determine adoption of a new technology or farming technique. Not all of these factors are directly relevant to private sector involvement, but a number are. Table 2.5 identifies those components that are relevant to private sector involvement, and the type of effect that the private sector may have.

Table 2.5 Private sector involvement and the relationship with adoption factors

Adoption factor	Potential influence of the private sector
Learnability of population factors	
Proportion of farmer population participating in farmer groups	In some cases (e.g. in cocoa research), the private sector provides field school and other facilities so that farmers can engage with each other
Proportion of farmer population using paid advisers	Paid advisers are clearly part of the private sector
Proportion of farmers aware of the use or trialling of the innovation	In many cases (e.g. in cocoa research), the private sector provides trial facilities or supports trial farmers
Learnability of innovation factors	
How easily can the innovation be trialled	The private sector is likely to provide additional incentive for packaging innovations in a way that is suitable for a trial
To what extent would the innovation be observable to other farmers	This depends on a wide variety of factors, but could be influenced through private sector support of farmer field schools etc.
Relative advantage of population factors	
What proportion of the population has a long-term management horizon	This could substantially be influenced through private sector contracts and certification schemes (although, as noted in the cocoa case studies in this report, there are mixed views on this)
What proportion of the population is seeking profit as a motivation	There is likely to be an important 'selection' effect here. For the crops that the private sector is most likely to be interested in (e.g. cash crops for export), a profit motive will play a large role for smallholder producers
Advantage of innovation factors	
What initial investment is required to adopt	The private sector may have the ability to assist smallholders in financing initial investments that may be required to adopt some innovations
To what extent is the innovation likely to affect profitability	There is likely to be a selection effect here as well, where the private sector is able to identify technologies that are most likely to affect profitability and engage with these

Source: Centre for International Economics analysis, Kuehne et al. (2013)

3 Overview of the literature

Summary

- In 2008, the private sector contributed 36.5% of global investment into agricultural research and development (R&D). Developing countries received only 5% of that investment.
- Private enterprise could contribute further to technological advancement if given appropriate incentives, such as:
  - well-targeted policy and regulation changes
  - increased markets for outputs of R&D.
- Limited available evidence suggests that the effectiveness of public–private R&D partnerships will improve if parties gain a greater understanding of the costs and risks associated with such arrangements.
- The private sector undertakes smallholder capacity building to ensure the security of its supply, and to meet consumer expectations of environmental and social standards.
- Private sector investment in R&D and on-farm capacity building in developing tropical countries are concentrated on internationally traded commodities. Smallholders producing cocoa, coffee, palm oil, cotton and sugar can benefit from this investment.
- Public–private partnerships that aim to improve on-farm management practices exist where private and social interests coincide, but the research shows that smallholder interests are not always paramount in these arrangements.

Private sector investment in agricultural research and development

Private enterprise has a large and growing presence in agricultural R&D globally. Between 2000 and 2008, private investment in agricultural R&D grew from US$14.4 billion to US$18.2 billion (Beintema et al. 2012). Private enterprise contributed 36.5% of total investment in agricultural R&D (Beintema et al. 2012). The share of private sector involvement in R&D varies substantially depending on a number of factors, including:

- the point of the agricultural supply chain that is being researched
- whether the R&D is undertaken in a developed or developing country
- the R&D's applicability to smallholders in tropical climates.

Agricultural R&D encompasses improving agricultural inputs—seeds, fertilisers, on-farm management practices and food processing. Historically, private enterprise R&D activities have been concentrated in the processing sectors. In 2008, 54.3% of global private sector investment targeted processing (Bientema et al. 2012). Growth in R&D investment has been uneven across industries. The most rapid increases occurred in crop breeding and biotechnology, and significant growth in R&D spending also occurred in farm machinery and food processing. R&D declined in real terms in other parts of the industry (Fuglie et al. 2011).

Private sector investment in agricultural R&D is heavily concentrated in developed countries. Pardey (2009) estimates that 95% of global private expenditure occurs in developed countries. Statistics compiled by Naseem et al. (2006) show that the ratio of private to public funding of agricultural R&D is very low in many developing countries. For example, only 7% of agricultural R&D in Indonesia was privately funded in 1995.

The literature shows that private sector investment in R&D is growing in larger developing countries. Hu et al. (2011) describe the rapid expansion of private investment in agricultural R&D in China between 2000 and 2006 arising from the privatisation of agribusinesses during the 1990s. The rapid growth in the private Chinese agribusiness sector supported the growth in R&D investment.

One of the consequences of the concentration of R&D in a small number of countries located in the Northern Hemisphere is that the research targets temperate agricultural systems in terms of the climatic and soil conditions, the type of crops grown and low-technology production systems (Kramer and Zwane 2005). Therefore, investment in research targeted at tropical regions is limited and concentrated on internationally traded crops ahead of domestically consumed commodities.

The role of the private sector in technology transfer

Technological advancement arises not only from the development of new technologies, but also from the transfer of technologies between countries (Gisselquist and Grether 2000).

Private R&D is concentrated in four to eight large companies in each of the agriculture input sectors. Generally, these companies operate at a global scale, with research done in multiple regions. This globalisation and concentration of food and agricultural R&D may accelerate the rate of international technology transfer, reducing productivity differences across nations and regions (Fuglie et al. 2011). Agricultural industries in smaller developed economies, such as Australia and Canada, and developing countries often rely on technology transfer through multinational companies to acquire new technologies.

Drivers of private sector investment

A range of studies, including Fuglie et al. (2011), show that private sector investment in agricultural R&D will be high when:

- the market for the research outputs is large
- firms can appropriate the benefits of their investment
- the capital and labour needed to undertake research are available at a relatively low cost
- the capacity exists to disseminate and test the new technologies.

Barriers to private sector investment in developing countries

This review highlights the barriers affecting developing countries, with a particular focus on the difficulties of engaging with smallholder producers.

Naseem et al. (2006), among many others, acknowledge the link between strong intellectual property rights (IPRs) and private sector investment in R&D. The paper describes some of the progress made in strengthening IPRs across the world, including new laws to protect new plant varieties supported by the World Trade Organization. However, the authors also

acknowledge the ongoing need for enforcement of these laws in countries with weaker institutions.

To date, developing countries have not liberalised trade in agricultural inputs and technologies to the extent seen in developed countries (Gisselquist and Grether 2000). Given that R&D is concentrated in developed countries, any barriers to technology transfer are likely to be costly.

Naseem et al. (2010) describe the ways in which inefficient regulation can be a barrier to private sector investment. Regulation plays an important role in improving consumer confidence in the safety of agricultural inputs and food products, and can manage environmental impacts (Gisselquist and Grether 2000; Naseem et al. 2010). However, overly stringent regulations, particularly regarding the required characteristics of new products, can substantially increase research costs and may discourage research (Gisselquist et al. 2010; Naseem et al. 2010).

The scope and level of publicly funded R&D affect the level of private sector investment positively or negatively. Publicly funded basic research, such as developing germplasm for breeding firms, is known to promote private investment. However, other evidence shows that more commercially oriented publicly funded research can have a 'crowding out' effect on private sector investment (Naseem et al. 2010).

Issues specific to smallholders

Kramer and Zwane (2005) note that smallholders are generally low-technology users—they are less likely to be irrigated than large commercial farms, and fertiliser is often derived from livestock waste as a by-product—and therefore new technologies may not be suitable. Naseem et al. (2010) highlight the lack of purchasing power of smallholders, making them less attractive to private enterprise. The authors also discuss the need for capacity building and learning to ensure that smallholders can effectively use technologies.

Optimising private enterprise investment

The literature is consistent in stating that there is scope for increasing private sector investment in agricultural R&D appropriate for developing countries (Kramer and Zwane 2005; Naseem et al. 2006). Based on the available limited evidence, Naseem et al. (2010) detail options that are likely to increase private enterprise investment in pro-poor technology R&D:

- Tax credits for firms that engage in R&D have been effective in the Organisation for Economic Co-operation and Development since the 1980s, but are not used in many developing countries.
- Research parks and zones help overcome major entry barriers by providing land and infrastructure.
- Technology commercialisation programs improve links between public and private researchers. The cooperative research and development agreements used in the United States of America are an example of a successful program (Fuglie and O'Toole 2014).
- Strengthening innovative capacity within developing countries will improve coordination with private enterprise.
- Increasing the size of the final product market will create larger demand for the final product and, all other things being equal, create greater incentives for research. When thinking about private sector research, the nature of the product market is clearly a key consideration.

For the benefits to smallholders of improving IPRs, regulatory reform, reducing trade barriers, and public–private research partnerships, Naseem et al. (2010) consider the evidence to be inconclusive.

As discussed above, improving IPRs will increase the returns to private enterprise from R&D. Kramer and Zwane (2005) and Naseem et al. (2010) detail the institutional arrangements that need to be addressed to ensure that IPRs are more

effective in promoting pro-poor agricultural R&D. Practices such as allowing the resale of protected seeds—although delivering benefits to farmers in the short term—reduce the returns to private enterprise.

Authors have provided examples where regulations can be reformed to target health and environmental concerns while minimising the costs to developers. As an example, Gisselquist and Grether (2000) suggest that the mandatory in-country efficacy testing of pesticides be replaced with a list of allowed products, and that countries allow no- or low-risk products to enter the market without testing.

Similarly, although Naseem et al. (2010) consider that evidence that technology transfer to smallholders can liberalise trade is inconclusive, Gisselquist and Grether (2000) demonstrate benefits of trade liberalisation and other regulatory reform to farmers in Turkey.

The effectiveness of public–private partnerships in improving R&D outcomes is dependent on each participant's ability to manage the costs and risks associated with the exchange of knowledge and technologies (Naseem et al. 2006)—that is, how the IPRs are distributed. Spielman and von Grebmer (2004), using a methodology similar to that used in this paper, reviewed a number of public–private partnerships between the Consultative Group for International Agricultural Research and private sector partners. The authors tentatively concluded that the partners did not sufficiently account for the costs and risks associated with collaboration, and did not have sufficient understanding of the potential partnership models.

Naseem et al. (2006) concluded that a number of well-designed policy mechanisms could stimulate private sector investment in agriculture R&D targeted at developing countries. However, the authors concede that further work is needed to determine the most effective measures.

The private sector and promoting sustainable on-farm management practices

The preceding sections consider the development and transfer of frontier technologies. This section reviews the role of the private sector and public–private partnerships in facilitating farmer training in on-farm management practices. The development of on-farm management practices has not attracted a large share of R&D funding (Fuglie et al. 2011).

Two major drivers of private sector engagement in improving on-farm practices are to (Bitzer et al. 2012):

- ensure security of supply of products that are inputs to further processing activities
- help achieve environmental, health and social standards (including reducing child labour and improving rural incomes) in response to changes in regulation or consumer preferences.

The cocoa industry has seen a proliferation of public–private partnerships, as industry interest in securing global supply coincided with non-government organisation (NGO) concern for biodiversity, and government concern for improving rural livelihoods and reducing child labour (Shapiro and Rosenquist 2004; Bitzer et al. 2012). Farmer training is only one issue addressed in these partnerships, albeit an important one. Of the 55 cocoa industry partnerships described in the Bitzer et al. (2012) review, 49 address the issue of farmer training.

Consumer preferences for sustainably produced goods have drawn private enterprise into partnerships with NGOs to create private governance arrangements (Schouten and Glasbergen 2011). These arrangements link processing companies to NGOs in roundtable arrangements to help develop sustainable practices

across the supply chain. Examples of these types of arrangements exist for:

- palm oil—to address deforestation
- soy—to address environmental sustainability
- cotton—to address environmental and social sustainability
- sugarcane—to address environmental and social sustainability
- biofuels—to address environmental, social and economic sustainability.

Roundtables directly address capacity building for farmers (Better Cotton Initiative 2015).

Issues specific to smallholders

Bitzer et al. (2008), using the coffee supply chain as an example, show the extent to which intersectoral partnerships can benefit smallholders. The authors contend that, where the interests of the smallholder coincide with those of the processor, sustainability will improve. However, this does not ensure that all aspects of smallholder sustainability improve. For example, these partnerships can improve market access of smallholders, thus increasing their incomes, but do not encourage diversification that would reduce the smallholders' exposure to international price volatility and therefore also improve sustainability.

Key problems that remain for smallholders are often a general lack of skills and training, the high costs of coordination among smallholders and imperfections in market information. This means that there is likely to be an asymmetric relationship between smallholders and large private sector companies.

The United Nations Development Programme's Growing Sustainable Business initiative developed public–private partnerships with an underlying understanding that the private sector can act as a development agent by virtue of contributing to economic growth, as distinct from corporate philanthropy (Gregoratti 2009). Following an analysis of a public–private partnership in Kenya, the author found that the intended beneficiaries of the program—the smallholders—did not benefit greatly because they did not participate in decision-making and the economic imperatives of the partnership.

4 Cocoa case study

In the past, the Australian Centre for International Agricultural Research (ACIAR) has engaged directly with private sector partners in undertaking cocoa research, as seen in the following ACIAR-funded projects:

- Managing cocoa pod borer in Papua New Guinea through improved risk incursion management capabilities, IPM strategies and stakeholder participatory training (ACIAR project ID PC/2006/114)
- Commercial sector/smallholder partnerships for improving incomes in the oil palm and cocoa industries in Papua New Guinea (PNG; ACIAR project ID ASEM/2006/127)
- Improving cocoa production through farmer involvement in demonstration trials of potentially superior and pest/disease resistant genotypes and integrated management practices (ACIAR project ID SMAR/2005/074)
- Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment (ACIAR project ID HORT/2010/011).

Based on these ACIAR-funded cocoa projects, this report:

- puts the ACIAR private sector collaborations into context
- reports on a qualitative survey of research participants as to the impact of the private sector organisation on the research
- uses impact assessment data to assess the potential importance of private sector collaboration for project impacts.

The impact of this cocoa research has been analysed in a separate impact assessment study (Pearce 2016).

Cocoa collaborations

The ACIAR cocoa collaborations need to be understood in the context of the recent emergence of a wide variety of collaborations within the cocoa sector. This sector has a long history of collaboration, particularly between private and public organisations. Indeed, in recent years, the majority of publicly funded research projects in the cocoa sector (both Australian and international) have involved private sector collaboration.

Figure 4.1 summarises the numerical growth in collaborations in the cocoa sector. The first panel shows the cumulative number of collaborations over time (anywhere in the world) and separates out the subset of those collaborations that Mars is involved with.

The second panel illustrates that the rapid growth in collaborations started after it became clear that global cocoa yields were starting to decline (as compared with strong yield growth previously). The collaborations were a clear response to a slowly growing 'crisis' in cocoa production, which was a

clear commercial concern to many of the private sector organisations involved.

The third panel summarises the number of collaborations that various organisations have been involved in. Mars is the second-most frequent collaborator across the cocoa chain.

Table 4.1 summarises some recent international projects in Indonesia, all of which involved private sector collaboration and overlapped with ACIAR projects in that country.

Qualitative survey findings

As part of an impact assessment of recent ACIAR-funded cocoa studies, the Centre for International Economics surveyed researchers to understand their views of the importance and impact of private sector engagement. The qualitative questions (set out in Table 4.2) were asked formally of project researchers and informally of a range of stakeholders in the course of interviews undertaken during field visits (particularly in Indonesia). The responses to these questions are also in Table 4.2 and in the 'Discussion' section.

Discussion

This section details some of the longer responses to questions referred to in Table 4.2.

The responses indicate that the overwhelming view was positive, reflecting an enthusiastic response to private sector engagement in the research projects. The same positive attitude was also evident during more general interviews with stakeholders in the course of field visits for the evaluation of ACIAR-funded cocoa projects in Indonesia and PNG.

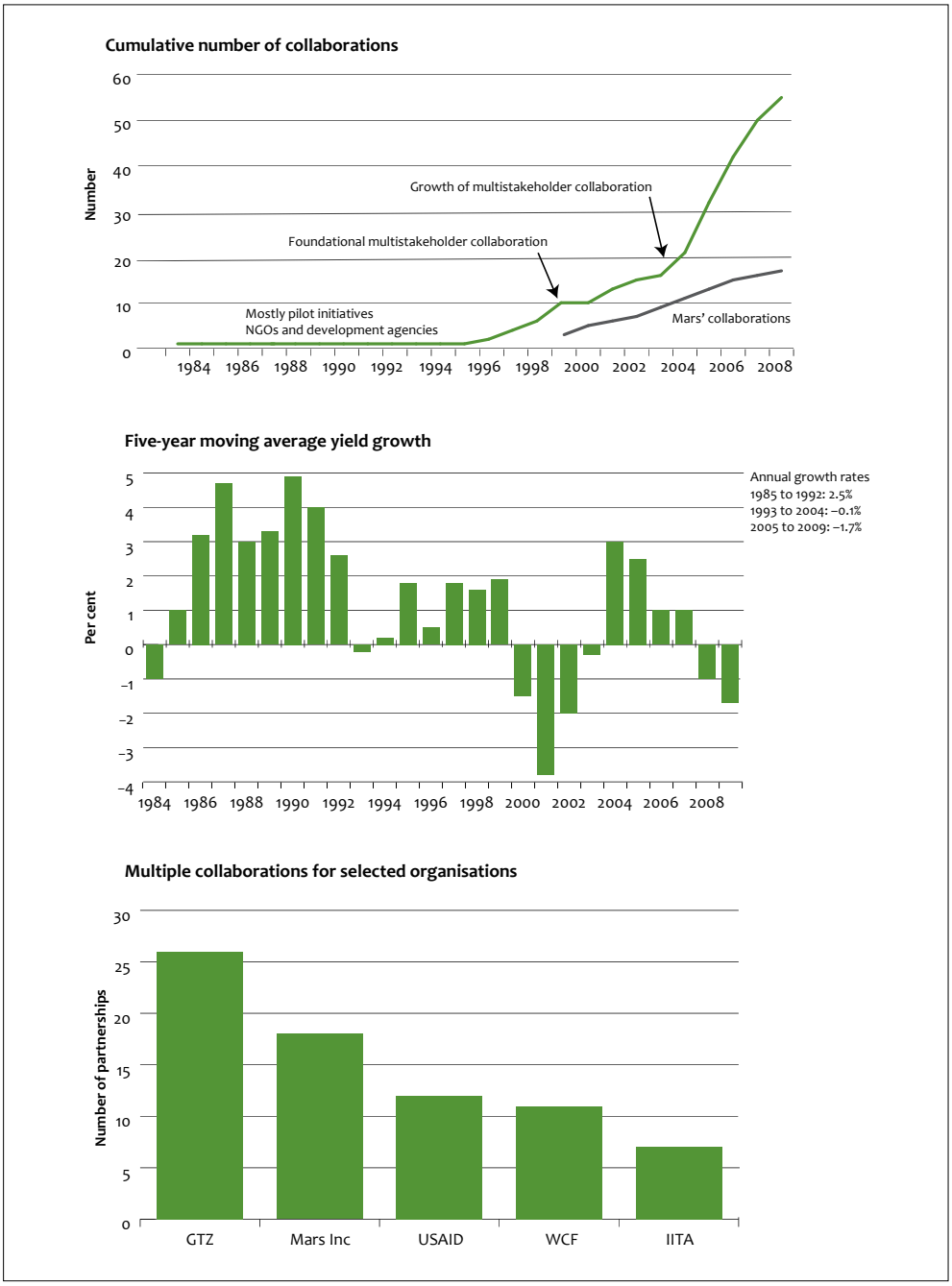
Were there specific benefits to smallholders that can be attributed to private sector engagement?

So far, the jury is still out on whether certification schemes promoted by various companies through certification bodies provide incentives for farmers.

Companies were asked questions about this directly at the 6th Indonesian International Cocoa Conference in Bali (May 2014), but generally avoided providing direct answers. The general feeling is that companies believe that, since their training in, and support of, certification should lead to improved management and production for the farmer, this is the benefit provided rather than an increased premium, which farmers of course seek after increasing investment in their own farms. In addition, a major portion of the premium (if certification is held by the company) is allocated to administration costs, auditing costs and so on, and therefore does not reach the farmer.

The engagement of the private sector through ACIAR projects has had a positive impact on demonstrating methods of increasing production and quality, and making production more sustainable (e.g. through training in composting, provided widely by Mars).

Commercial stakeholders such as Mars have an interest in increasing the quantity and quality of cocoa beans to satisfy their processing requirements. Other private sector stakeholders may be cocoa buyers, or suppliers of inputs such as pruning equipment, fertilisers and so on. They also have a financial interest in sustainably increasing production. Smallholders benefit from improved access to information and inputs, as well as medium- to long-term certainty.



GTZ = German Agency for Technical Cooperation; IITA = International Institute of Tropical Agriculture; NGO = non-government organisation; USAID = United States Agency for International Development; WCF = World Cocoa Foundation

Source: Centre for International Economics analysis, Food and Agriculture Organization of the United Nations, Bitzer et al. (2012)

Figure 4.1 Cocoa collaborations, 1984–2009

Table 4.1 Overview of selected cocoa collaborative projects in Indonesia

Project and key players	Objective	Key outcomes
SUCCESS (including SUCCESS ALLIANCE): Sustainable Cocoa Enterprise Solutions for Smallholder Projects. Funded by the USDA and implemented by ACDI/VOCA. Included collaboration with private sector partners, including Mars	The first project focused on CPB infestation, designed to train Indonesian farmers in CPB control methods, particularly frequent harvesting, pruning, and sanitation of pod husks and litter	Training directly reached more than 100,000 farmers Substantial reported adoption (up to 50%) of key control methods Reported benefits of US$435/ha/year
AMARTA I: USDA-funded Agribusiness Market and Support Activity. Includes links with a wide variety of private sector agencies	Designed to strengthen value chains through improved linkages between smallholders and other stakeholders. Includes training in good agricultural practices (including IPDM). Project drew on material from ACIAR	Cocoa yields increased from 600 kg/ha to 995 kg/ha About 50,000 farmers trained
PEKA: Peningkatan Ekonomi Cacao Aceh, undertaken by Swisscontact and funded through multidonor trust funds. Includes interaction with the private sector, including Mars	Rehabilitation of aged cocoa gardens, intensification of cultivation, training of farmers	12,540 farmers trained Mixed evidence on adoption
AMARTA II: continuation of AMARTA I project funded by the USDA	See AMARTA I	Limited evidence on outcomes
SCPP: Sustainable Cocoa Production Program, operated by Swisscontact with funding from the Swiss and Netherlands governments, and private sector partners, including Cargill, Mars and Nestle	Trains local government extension officers to serve as farmer field school facilitators. Developed training manuals in cultivation practice, post-harvest operations and household nutrition. Target to train 60,000 farmers and to increase their cocoa income by 75%	By the end of 2014, 46,000 farmers trained, with observed yield increases from 422 kg/ha to 688 kg/ha
CIP: Cocoa Innovations Project undertaken by ACDI/VOCA in conjunction with the WCF and specific WCF members, including Mars	Essentially a continuation of activities under AMARTA I and II, including microfinance facilities for farmers	Limited information, but a benefit:cost ratio of around 7:1 claimed in some documentation

ACIAR = Australian Centre for International Agricultural Research; CPB = cocoa pod borer; ha = hectare; IPDM = integrated pest and disease management; kg = kilogram; USDA = United States Department of Agriculture; WCF = World Cocoa Foundation

Source: Pearce (2016)

Table 4.2 Questions and responses to assess the influence of private sector involvement in ACIAR-funded cocoa studies

Question	Rationale/hypothesis for question	Key responses
How did private sector involvement influence the choice of research targets and priorities (didn't influence, small influence, major influence)?	Would expect a strong incentive for the private sector to help choose research targets and priorities to align with commercial objectives	Major influence, along with other stakeholders, including farmers Major influence for a project concerned with studying the effectiveness of private sector extension Influence went in both directions. Partner institution research also influenced the future direction of ongoing private sector research
How did private sector involvement influence the conduct of the research (didn't influence, small influence, major influence)?	Private sector incentives are less clear here; scientific research is a specialist activity with its own disciplines and requirements, so the private sector is more likely to be interested in outcomes rather than process	Didn't influence or small influence. Methods and research conduct mostly determined by ACIAR project partners. Private sector partner was monitored and approaches were adjusted as necessary
How did private sector involvement influence the resources available for research (didn't influence, small influence, major influence)?	The private sector may have some incentive to provide resources to research, depending on the structure of the project and how well resourced it is relative to private sector objectives	Small to major influence. Responses varied considerably by project. In the case of major influence, the private sector partner provided financial and logistical support, including essential field staff for trials
How did private sector involvement influence interaction with partner country researchers (didn't influence, small influence, major influence)?	Underlying private sector incentives are unclear	Small influence. ACIAR project structures are mostly responsible for influencing these interactions
How did private sector involvement influence access to research material or material protected by IP (didn't influence, small influence, major influence)?	Would expect a strong incentive to maintain control over any IP associated with the project	Major influence (in cases where IP was relevant). Private sector partner tended to hold sensitive material very close and chose to control how it was accessed by other researchers. Some researchers found access to information very difficult

How did private sector involvement influence the dissemination of research findings (didn't influence, small influence, major influence)?	External publication may or may not be a concern for the private sector partner. This may depend on the interests of individual private sector staff. There are a number of scientific papers with private sector staff as authors	Didn't influence. In most cases, report writing was left to the main project researchers and other project partners
How did private sector involvement influence the probability of research success (didn't influence, small influence, major influence)?	Would expect a strong private sector incentive to increase the chances of a project's success. Given that research is by its nature uncertain, it is not clear how the private sector could influence this independently of the total amount of funding	Major influence. Private sector involvement allowed longer trials than typical for an ACIAR project. Private sector was very keen to have research outcomes and to adjust input resources accordingly. Appears to be mostly a resource effect
How did private sector involvement influence adoption of research outputs (didn't influence, small influence, major influence)?	Would expect a strong incentive for the private sector partner to ensure adoption (e.g. by farmers) is as broad as possible; otherwise real gains to the private sector will not be achieved	Major influence. Private sector partners have a permanent engagement with the country, in contrast with ACIAR projects for which the engagement only extends across the life of the project. This has a major impact on adoption. Private sector partner also had very strong incentive for research findings to be adopted (as they directly influence company outcomes)
Were there specific benefits to smallholders that can be attributed to private sector engagement?	Does the private sector specifically influence smallholder outcomes?	See 'Discussion' in main text
Has there been any increase in risk or costs as a result of involving private sector partners?	ACIAR-funded researchers may perceive some risks	No increase in risk or costs
What lessons did you learn from private sector involvement?	Seeking practical experience	See 'Discussion' in main text
Do you have any recommendations for future projects and researchers collaborating with private sector partners?	Advice on future private sector interactions	See 'Discussion' in main text

ACIAR = Australian Centre for International Agricultural Research; IP = intellectual property

Source: Targeted questions and responses compiled by the Centre for International Economics

What lessons did you learn from private sector involvement?

By engaging with the private sector, these projects have ensured a long-term impact, beyond the life of the projects, as research methods and findings have been implemented. The practical support provided by the private sector is often invaluable, and without it the establishment of research would be much more difficult.

The project itself is a medium through which the private sector can work with government bodies on neutral ground. Since these are often poorly resourced and lack research skills, bringing the private and public sectors together can be very productive. For example:

- The Assessment Institute for Agricultural Technology, a Government of Indonesia organisation, has worked with Mars in the ACIAR-funded projects on clone testing, farmer training, and testing compost and fertiliser treatments in marginal soils.
- Genotype material has been exchanged between the Indonesian Coffee and Cocoa Research Institute (ICCRI) and Mars, so that both organisations share some cocoa germplasm for testing in the field and, potentially, dissemination to farmers.
- ICCRI, on behalf of the Government of Indonesia and the district government of North Luwu, has evaluated Mars-selected clones, such as M01, for official release to farmers.

ACIAR-funded projects facilitate such exchange of information and even materials.

Responses to this question also included the following points and recommendations:

- Private sector involvement increases the capacity of government institutions, particularly through improved skills and knowledge.
- Involve the company in the design of the project, so that they feel they are a true partner in the research.
- Keep in regular contact with the private sector partner to inform them of progress on the project, and regularly seek their feedback.
- Do not expect the private sector partner to make large time and labour commitments to the project, because they have their own day-to-day workloads to manage.
- Remember that the private sector partner is a business, and this drives their interest in the project.

Do you have any recommendations for future projects and researchers collaborating with private sector partners?

For social and socioeconomic studies, it is important that an independent and objective methodology is followed that is not influenced by private sector considerations. However, the practical management of field trials and so on can be greatly improved by private sector involvement. It is recommended that partnerships find common goals and work on these, but keep other research as independent as possible.

Responses to this question also included the following points and recommendations:

- Engage private sector stakeholders early in the project design, and maintain the links through regular consultation and review.
- Maintain the scientific integrity of the research and do not merely provide an externally funded research service for the largest or loudest stakeholder.
- Invest a lot of time in the relationships to make them effective.
- Show how the project will be of benefit to the private sector partner. This does not always have to be direct—for example, projects that lead to a more stable social environment create a better environment for smallholder production, such as research that reduces land disputes, which leads to less disruption of production.

Quantitative implications

What does private sector involvement bring in quantitative impact terms? As noted at the beginning of this report, there is no controlled set of results to allow a definitive answer to this question, so the approach must be more indirect. As the previous discussion indicates, there are strong reasons to consider that private sector involvement will lead to greater research impacts, particularly by improving the efficiency with which research is undertaken and by improving adoption outcomes (compared with what would have been the case in the absence of private sector involvement).

Here, we consider the importance of three particular elements of a project that have a major influence on quantitative impact measures. In doing so, we draw on an impact evaluation of cocoa projects in Indonesia and PNG.

First, consider the impact of the research on smallholder yields in the commodity (cocoa) supply curve. In impact assessment terms, this is measured as the 'vertical shift'. The extent of this vertical shift essentially determines the economic surplus that arises as a consequence of the research.

Second, consider the maximum adoption rate that is likely to be achieved following the research. The maximum adoption rate clearly has a major influence on the measured impact of the research.

Third, consider the speed of adoption, which can be measured as the time it takes (in years) to get to half of the maximum adoption rate. Given the time value of money (or the opportunity cost of funds devoted to research and development), the speed of adoption has a major influence on measured research impact.

Figure 4.2 illustrates the impact that variations in supply shift, and maximising and timing the adoption have on the measured impact of research. In this case, impact is measured as the present value of the increased economic surplus arising as a consequence of the research. Note that these returns are those attributed to the ACIAR-funded research and should be compared with a combined project cost (in present-value terms) of A$12 million.

Vertical supply shift

The first panel of Figure 4.2 shows the importance of the yield (vertical supply shift) arising from the research. Here, it is assumed that a common vertical shift has occurred in Indonesia and PNG. The horizontal axis is expressed as a proportion of the farm price. From the impact assessment, estimated values are between 20% and 30% of the farm price. The impact of research clearly increases as the vertical supply shift increases. Every additional 10% in impact is worth A$24 million (in Indonesia and PNG combined).

Thus, for example, if private sector involvement increased the research outcomes from a 20% to a 30% supply shift, the incremental value of this would be A$24 million.

Maximum adoption rate

The second panel in Figure 4.2 shows the effect of increases in the maximum adoption rate, this time separately for PNG and Indonesia (which have different expected adoption rates in the impact assessment). Increases in adoption clearly increase benefits. For Indonesia, every 10% of adoption is worth A$6.6 million, and for PNG it is worth A$5.9 million.

So, for example, if private sector involvement were to increase adoption by 10%, it would be worth A$12.5 million.

Speed of adoption

The final panel in Figure 4.2 shows the effect of increases in the time it takes to get to half the full adoption rate, separately for PNG and Indonesia (which have different expected adoption rates in the impact assessment). Each year of quicker adoption is worth A$2.5 million in Indonesia and A$1.9 million in PNG.

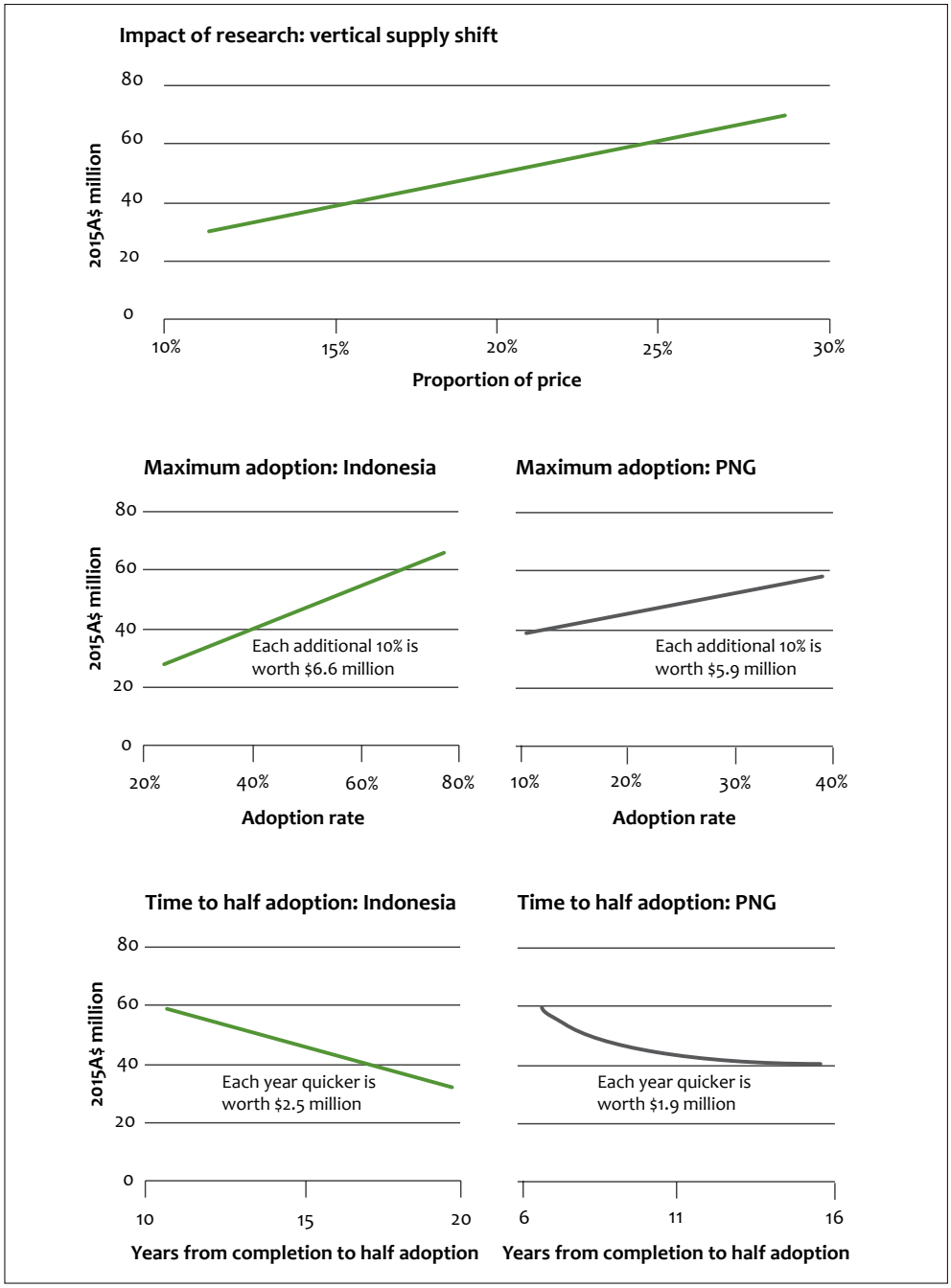
Thus, if private sector involvement were able to induce 1 year more rapid adoption in the two countries, this would be worth A$4.4 million.

Combined effects

The potential increments summarised in the three previous sections total A$33.8 million, one measure of the potential incremental gross impact of private sector involvement. Although not definitive, the indications from the qualitative survey report previously discussed, as well as discussions in the course of field visits, indicate that this order of magnitude of improvement is not unreasonable.

The remaining question is to what extent these incremental benefits were offset by incremental costs arising directly from the private sector involvement—either private sector costs themselves or incremental costs to ACIAR. Full information on private sector costs associated with these projects is not available; however, they are most likely to be less than A$10 million, and possibly considerably less. From ACIAR's perspective, there is no evidence to suggest that private sector involvement per se resulted in incremental costs (compared with typical project costs).

On this basis, we can provisionally conclude that private sector involvement in these cocoa projects has led to an overall increase in the net benefits of the research.



ACIAR = Australian Centre for International Agricultural Research; PNG = Papua New Guinea
Source: Centre for International Economics estimates based on impact model for Pearce (2016)

Figure 4.2 **Potential value of improved outcomes: ACIAR-funded cocoa projects in Indonesia and PNG**

5 Conclusion and recommendations

This report reveals strong qualitative evidence that private sector engagement will increase the impact of the Australian Centre for International Agricultural Research (ACIAR)–funded research. The quantitative analysis around cocoa case studies also suggests benefits of involving private sector partners, although it is hard to attribute quantitative gains to private sector involvement with any certainty without further information.

Replicating the cocoa case

The cocoa case studies, looking particularly at the advantages of the interaction with Mars, suggest a very positive outcome. Surveys and field visits did not identify any downside risks. However, the Mars interaction may have been a special case in that:

- public–private interaction in the cocoa sector has been established for many years and has grown rapidly internationally in recent years
- cocoa (as an exportable cash crop commodity that, in its processed form, is highly differentiable) is a case where there are strong private sector incentives to engage in research, development and extension to the benefit of smallholders
- Mars is one of the most prolific organisations for engaging in collaborations
- Mars commitment will continue, with or without ACIAR involvement.

A key question, then, is whether the cocoa and Mars experience is replicable across the ACIAR research portfolio.

Challenges for ACIAR

To continue to monitor its impacts, particularly in the context of private sector collaborations, ACIAR needs to build up a qualitative and quantitative picture of the ways in which private sector interactions change the impact of ACIAR-funded research. In practice, this will mean:

- fleshing out, in quantitative detail, the framework set out around Figure 2.3 and, in particular, understanding the benefit–cost trade-offs for the private sector partners
- setting bounds around the potential impacts, as set out in the discussion around Figure 4.2.

Broadly, there are two key challenges in pursuing increased private sector engagement. First, private sector engagement must involve genuine additionality and induce additional research that would not have otherwise taken place. This is consistent with the idea of maximising the value of resources devoted to research. Second, the research spillovers that flow to smallholders need to be maximised.

Projects with private sector involvement could also include a formal survey on impacts at the beginning and the end of the projects, to try to establish some controls.

This information will help ensure, among other things, that ACIAR engagement with the private sector in research and development (R&D) does not involve crowding out, but rather leads to an increase in total research effort.

Checklist when considering projects for private sector partnership

In addition to the processes ACIAR currently uses to assess the suitability of a research project (including understanding the country, commodity and institutional context for the research to take place), it will be important to understand:

- the existing incentives for private sector research in the market and country under consideration
- how the collaboration will maximise spillovers to smallholders
- the mechanisms by which the collaboration is expected to improve research outcomes.

Each of these is considered in the following sections.

Existing incentives for the private sector

To determine existing incentives for private sector R&D, key questions to consider include:

- ✓ Is the research concerned with inputs (e.g. seed, fertiliser), farming practices or final product output? Different points in the production chain are likely to have different incentives associated with them.
- ✓ Is the product concerned differentiable in its final market?
- ✓ Are sales mostly for the domestic market or for export?
- ✓ What is the pattern of existing intellectual property associated with the proposed research?
- ✓ What are the broad institutional arrangements that encourage or discourage research in the country under consideration?
- ✓ What is the current state of private sector research into the area under consideration?
- ✓ What other private–public research partnerships are currently in place?
- ✓ Are the project proponents confident that this collaboration will result in additional research activity rather than crowding out or substitution?

Maximising spillovers and benefits to smallholders

When trying to maximise spillovers and benefits to smallholders, key questions to consider include:

- ✓ Does the collaboration include mechanisms to ensure maximum benefits to smallholders?
- ✓ What will be the status of intellectual property generated in the course of the project?
- ✓ What will be the effect of the research outputs on the state of competition in input or product markets?
- ✓ Will the collaboration benefit one particular private sector organisation over others in terms of market competition?

Improving outcomes through the collaboration

When trying to determine how the collaboration is expected to improve outcomes compared with the ACIAR standard, key questions to consider include:

- ✓ Will the collaboration increase resources available for research? How?
- ✓ Will the collaboration change the conduct of the research project? How?
- ✓ Will the collaboration increase the probability of success for the research? Why?
- ✓ Will the collaboration improve the dissemination of research results? How?

- ✓ Will the collaboration increase adoption of the research findings? How?
- ✓ Will the collaboration change the nature or the magnitude of economic impacts?

Research impact evaluation

After completing the research, it would be extremely valuable to include extra data collection in addition to ACIAR's usual process of impact evaluation. In particular, targeted survey questions, such as those set out in Table 4.2, would measure impacts and compare them against original expectations.

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