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Guidelines for assessing the impacts of ACIAR's research activities

ACIAR IMPACT ASSESSMENT SERIES

58

Research that works for developing countries and Australia

Guidelines for assessing the impacts of ACIAR's research activities

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**Centre for International Economics



ACIAR

Research that works for developing
countries and Australia

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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 been systematically undertaking independent impact assessment studies of its portfolio of research activities for more than 20 years. More recently, for the last 5 years, we have added adoption studies to this program.

Three years ago ACIAR commissioned two reviews of the impact assessment studies. These summarised the overall return of ACIAR's research and development (R&D) investments and also assessed the consistency of the studies. Since a range of independent consultants are commissioned to undertake these assessments, and because these studies are complex and diverse, it was not surprising that the reviewers found that there was variability in the detail, rigour and presentation of the results.

To facilitate building on the substantial effort that ACIAR has placed in this area and also the review findings, we decided to develop a set of guidelines for all independent consultants to use as a basis for future assessments. The aim of the guidelines is to ensure consistency in the methodological approaches used, the treatment of information collected and presentation of the results. We have also developed a database to systematically record the results of all impact assessment and adoption studies, which complements these guidelines.

The guidelines also provide the basis for ensuring consistency between the impact assessment studies and adoption studies.

A draft of the guidelines was developed in 2006–07 and used by all consultants undertaking impact assessment studies and adoption studies during 2007–08. A workshop was held for the impact assessment group in August 2008, and feedback and comments on the practical use of the guidelines have been incorporated in this version.

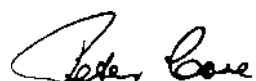
At the same time, the Special Panel on Impact Assessment of the Consultative Group on International Agricultural Research (CGIAR) Science Council was also interested in developing guidelines for its impact assessment activities. While both organisations collaborated closely in the activity, each has developed specific, separate documents.

The CGIAR system is made up of a diverse range of independent international 'research provider' institutions, so it required a more strategic set of guidelines. ACIAR, a small research-funding institution, has a specific, well-established impact assessment system that has been developed over 20 years. It needed guidelines to link the different components and ensure consistency, which is crucial to feed into the database it has developed for storing and interrogating its impact assessment studies. Despite the development of separate documents, I believe the collaboration has significantly enhanced the effectiveness of both.

ACIAR's guidelines will be used as the basis for all future studies in this area but will continue to be reviewed and updated.

I believe this is a very important development for ACIAR and further enhances the quality of this area of ACIAR's monitoring and evaluation program.

I would like to thank the Centre for International Economics, ACIAR staff and workshop participants for the considerable effort that has gone into the development of these guidelines.



Peter Core
Chief Executive Officer
ACIAR

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Abbreviations

ACIAR	Australian Centre for International Agricultural Research	NBIR	net benefit:investment ratio
ADIA	ACIAR Database of Impact Assessments	NPV	net present value
BCA	benefit–cost analysis	PIAS	Project Impact Assessment Summary (ACIAR)
BCR	benefit:cost ratio	PS	producer surplus
CS	consumer surplus	R&D	research and development
IA(s)	impact assessment(s)	RD&E	research, development and extension
IAS	Impact Assessment Series (ACIAR)	WTP	willingness to pay
IRR	internal rate of return	WTA	willingness to accept

Acknowledgments

This report has benefited from input from the independent consultants who undertook impact assessments and the project leaders who undertook adoption studies for ACIAR between 2006 and 2008. We greatly appreciate the comments and feedback we have received from these groups about aspects of these guidelines.

All of those who had undertaken impact assessment studies, or used the draft guidelines to undertake these studies, participated in a workshop in Canberra in August 2008. The workshop allowed detailed discussion of many aspects of the guidelines and of completed impact studies, significantly enhancing these final guidelines. Thanks go in particular to Vincent Fernandes (Grains Research and Development Corporation), Bob Lindner (Economic Research Associates), Greg Martin (IDA Economics) and John Mullen (New South Wales Department of Primary Industries).

Contributions from Jim Ryan (Special Panel on Impact Assessment, Consultative Group on International Agricultural Research), Cynthia Bantilan (International Crop Research Institute for the Semi-arid Tropics) and Bob Warner and Michael Monck (Centre for International Economics) are also gratefully acknowledged.

Executive summary

This report sets out guidelines for undertaking impact assessments (IAs) for the Australian Centre for International Agricultural Research (ACIAR). It provides a common approach for making three types of assessments of the impact of ACIAR investments:

- desktop reviews undertaken by ACIAR staff and others to make a quick assessment of expected impact
- adoption studies undertaken by the principal researchers to inform ACIAR of the success of a research activity in terms of progress in adoption, and observed and anticipated impacts 3 years after the projects finish
- full impact assessments (designed to be published in ACIAR's Impact Assessment Series (IAS)) undertaken by independent consultants to quantify the impacts of the ACIAR-funded research and document returns to the investment in that research.

Impact assessments set out to measure the changes, both intended and unintended, that result from research, development and extension. This report brings together the various methodologies that have been utilised by ACIAR and consultants undertaking impact assessments, with the aim of providing a consistent set of guidelines for future work.

The approach utilises a benefit–cost and results-mapping framework that traces progress:

- from the R&D and extension inputs to outputs that are adopted by the next users
- through to final users to result in outcomes—that is, changes in practice, products and policies.

Taken in aggregate these outcomes lead to impacts setting off a series of reactions before the final impacts are observed. The benefits are measures of the welfare changes that result from the impacts over time. These terms are defined to promote a common use and understanding by ACIAR staff, researchers and others involved in evaluation of ACIAR R&D investments.

The guidelines stress the importance of setting out the causal links between outputs, outcomes and impacts. At the desktop review level, the guidelines provide a checklist of questions to help the user make a qualitative assessment of the expected impact of the investment under consideration. At the adoption study level, summary tools are also provided to support a comparative analysis, and to encourage quantification of evidence where possible. At the impact assessment level, methods for quantification and the agreed approach for estimating summary statistics for return on investment for ACIAR impact assessments are set out in detail.

Appendixes to the report include a checklist that should be completed by staff undertaking a desktop assessment, researchers undertaking an adoption study and consultants undertaking an impact assessment. The electronic version of the checklist is constructed so that the information can be read into the ACIAR Database for Impact Assessments (ADIA). The ADIA can be interrogated to provide portfolio information on investments and the historical rates of return. These guidelines also provide a summary of the uses that can be made of the ADIA.

The guidelines are designed to enhance consistency rather than be prescriptive. They aim to encourage creative approaches to the collection of data and analysis of outcomes, impacts and benefits. A first draft of the guidelines was tested by practitioners and further

revision followed a workshop in August 2008. They were also shared with other organisations such as the Special Panel on Impact Assessment of the Consultative Group on International Agricultural Research Science Council and the Grains Research and Development Corporation, who were developing similar guidelines. The published guidelines should be regarded as a living document. It is anticipated that benchmarks and rules of thumb can be added that will assist in improving the quality and consistency of ACIAR impact assessments over time.

1 Introduction

1.1 ACIAR's impact assessment in context

1.1.1 A long history of impact assessment

The Australian Centre for International Agricultural Research (ACIAR) has a long history of undertaking impact assessments (IAs) of its research and development (R&D) investments. As at June 2008, over 50 full benefit–cost assessments had been published in ACIAR's Impact Assessment Series, and 49 adoption studies had also been undertaken. These assessments have provided valuable lessons in improving the selection, design and delivery of R&D projects. They have also been useful for demonstrating the value of ACIAR as part of Australia's international development assistance program. The credibility of the ACIAR impact assessments has been enhanced by several meta evaluations and the use of independent consultants to undertake the studies.

1.1.2 The purpose of impact assessment

Within ACIAR, impact assessment aims to identify, provide evidence of and, ultimately, quantify the impacts of its R&D investments. ACIAR's impact assessment activities provide an 'after the event' perspective within the comprehensive monitoring and evaluation (M&E) process ACIAR has in place. They provide accountability to stakeholders, as well as a clear measure of the returns to the funds ACIAR invests. Increasingly also, impact assessments provide a basis for improving the research selection process by acting on lessons learned from past projects.

Impact assessments are a valuable learning tool for project participants and project managers. The approach used can be applied at all stages of a project, from its conception and design, through to well after

completion. Impact assessment of completed projects provides lessons on what works, what does not, and why. Understanding what creates value is critical for maximising the returns to ACIAR investments.

1.1.3 Collaboration in developing these guidelines

Development of these guidelines took place over a period of more than 2 years, during which time there were important interactions between ACIAR and other organisations with similar interests. In particular, during the early stages, close discussions were held with the Special Panel on Impact Assessment of the Consultative Group on International Agricultural Research (CGIAR) Science Council. It was initially felt that framing a joint set of guidelines that suited both ACIAR and CGIAR could be an efficient way to proceed. As the activities progressed, however, it became clear that the requirements of the two agencies were quite different. The CGIAR is a complex organisation of diverse and independent research-providing institutions, while ACIAR is a small research-funding agency with relatively clear impact assessment requirements and established systems developed over 20 years. It was therefore concluded that a single document would need to be relatively general and would add little to the large, established body of methodological knowledge. The discussions and sharing of drafts during the development of the ACIAR and CGIAR guidelines have nevertheless significantly enhanced their respective effectiveness.

In addition, during the pilot-testing phase of the ACIAR guidelines, other organisations, including the Grains Research and Development Corporation, showed interest in and were provided with copies of the draft guidelines. They used these, adapting them to suit their own circumstances. This final document has greatly benefited from the interactions between and feedback provided by the various organisations involved.

1.1.4 Ongoing improvement

The meta evaluations identified varying quality in the evaluations in terms of the scope of impacts assessed and robustness of assumptions made (the evidence base). While some of these problems are inevitable, due to the cost of collecting the required evidence, some can be avoided. Common approaches to inputs such as time periods of analysis and discount rates have been implemented. The development of the DREAM (Dynamic Research EvaluAtion for Managers) software improved the consistency of the analytical approach as it required market adjustments to be taken into account, but introduced new challenges when the impacts differed from those the software could easily handle. Nevertheless, differences in approaches remain, such as in the scope of impacts considered, development of counterfactuals (baselines) and benchmarks used to assess validity of assumptions.

1.2 These guidelines

1.2.1 Objectives

To improve consistency in undertaking and using impact assessments, ACIAR has developed these guidelines for use by consultants, project proponents in developing-country partners, researchers and ACIAR staff. They were trialled for over a year before being finalised and published in the Impact Assessment Series (IAS). They focus on assessments—qualitative and quantitative—of completed projects. They can be applied to:

- desktop reviews designed for quick assessment of expected impacts
- adoption studies undertaken by the principal researchers to inform ACIAR about the progress in adoption, and observed and anticipated impacts 3 years after the projects finish
- full impact assessments (designed to be published in ACIAR's Impact Assessment Series (IAS)) undertaken by independent consultants to quantify the impacts of the ACIAR-funded research and document returns to the investment in that research.

The guidelines have five main objectives:

- to set out the basic formats and requirements of results for consistency between assessments
- to set out minimum standards for the welfare analysis applied within the impact assessment, emphasising, for example, the use of economic surplus measures
- to raise a range of issues that needs to be considered in the analysis, without necessarily solving them in general
- to provide pointers to solutions to these issues that have worked in the past
- to indirectly provide a means to help with training and the transfer of knowledge.

This report should be regarded as a document to be updated and improved as ACIAR experience with assessments continues to evolve over time. Updates will be regularly posted on ACIAR's website to complement this published report.

1.2.2 Overview and structure

The guidelines are structured as follows. The remainder of this chapter discusses some very broad principles and approaches for impact assessment. These are further developed in subsequent chapters. In particular, Chapter 2 provides a general checklist for all types of assessments. The principles of good impact assessment are evident in each of these steps.

Chapter 3 looks at adoption studies in more detail, setting out the general process of identifying the ways in which adoption may take place. Chapter 4 looks at impact assessment studies in detail, considering a number of important issues that must be dealt with in every study. Chapter 5 looks at some special topics in impact assessment, including capacity-building impacts and the assessment of environmental effects.

Chapter 6 describes how ACIAR is placing the results of all impact assessments into a single database, thereby facilitating their use in supporting decision-making and demonstrating accountability.

1.3 Skill and judgment in impact assessment

1.3.1 Professional judgment

Impact assessment is inevitably a complex process requiring high skills. Understanding the results that emerge from complex R&D problems, and tracing through welfare linkages in developing countries where data are limited or non-existent requires patience, persistence and a methodical approach.

The tools of applied welfare analysis, in particular benefit–cost analysis, outlined below provide a framework within which to undertake the assessment. While these guidelines aim to provide a number of pointers for the analysis, ultimately there is no rigid formula for impact assessment. Those undertaking the task must be creative and flexible and will, in many instances, be called on to exercise considerable professional judgment.

1.3.2 Attitudes and approaches

While there is no formula, there are attitudes and broad approaches that make a big difference to the credibility of any assessment. Here are some broad pointers to keep in mind.

- Engage in conversation with researchers. Try to understand the science behind their work and listen carefully to what they say. Be a ‘friendly sceptic’, exploring their claims of impacts without being negative or threatening. Scientists will prove to be a goldmine of information. Many of them will have spent long periods in-country and will, of course, be experts in their field. Information from wide-ranging conversations, coupled with skills in welfare analysis, will allow you to discover many more impacts.
- Understand the context of the research under examination. What came before it? What is planned next? What other organisations are working in the same field? What other experts can provide context for the research?

- Understand the background and institutions of the partner countries. These will be important in helping understand the welfare effects of the research. If it is your first trip to a particular country, spend some time familiarising yourself with the basics of how it works.
- Prepare carefully for field visits. Send data requests in advance and adopt strategies for data collection that are consistent with the institutions and data capabilities of the partner country.
- Cast the net broadly, communicating with as many interested parties as possible. The impacts of research are not necessarily linear, and some impacts might initially appear peripheral.

1.4 Assessing the impacts: broad principles

1.4.1 The task of impact assessment

The fundamental task of impact assessment is to trace the way in which the research leads to changes in the world. The challenge is to identify what exactly changed (compared with what would otherwise have been the case) as a consequence of the research, what the further impacts of this change were (or will be) and how these changes are to be valued, so that the value of the research can be compared with its costs.

The process of tracing through the causal links between the research and the ultimate impacts is sometimes referred to as ‘results mapping’ or ‘pathway analysis’. A results map or pathway is a description of how an output comes to deliver benefits, including through unexpected consequences. One project (or a group of projects working together) delivers outputs either ready for use, or needing transition to use, or that are inputs into further research. Outcomes are the changes in practices, products or policies that follow the adoption of an output by users. Aggregating outcomes across the final users gives the initial impact—changes in market, environmental or social conditions. This initial impact may trigger responses that can magnify or dampen the initial impact and flow through to other markets, natural systems and communities. The benefits are the positive changes in the welfare of producers and consumers in the affected markets, and the welfare of the individuals

in the communities who value environmental and social impacts. Costs are the negative changes in the welfare of producers or consumers that may result from indirect market interactions.

With these impact pathways identified, impact assessment then takes place within a benefit–cost framework that explicitly uses the broad theories of applied welfare economics (through the concept of economic surplus) to value inputs and outcomes. The benefit–cost discipline ensures that all inputs into delivering the benefits are recognised, including the up-front implementation costs, operational costs and the opportunity cost of unpriced inputs. A benefit–cost framework also recognises all impacts, whether intended or not, and all beneficiaries and losers. It also recognises time and the effect this has on welfare, as consumption today is preferred to consumption tomorrow. Finally, it considers the outcomes and impacts relative to a ‘without R&D’ situation—the ‘counterfactual’ or baseline.

Box 1 summarises some of the basic terminology used when undertaking impact assessment, while the basic steps of impact assessment within ACIAR are set out in Figure 1.

1.4.2 Eight principles for impact assessment

There are eight overarching principles for good impact assessment, regardless of whether it is quantifying impacts or making a qualitative assessment. These are introduced in Box 2 and elaborated in Chapter 2.

Box 1. Some definitions

Monitoring—recording observations of measures or indicators of results.

Evaluation—drawing conclusions as to the relevance, efficiency, effectiveness and impact of the investment:

- **relevance**—whether the objectives or targets of the investment are those desired by the investor
- **efficiency**—whether there is a lower cost way of achieving the target outcomes
- **effectiveness**—whether the outputs and outcomes achieved are the target outputs and outcomes
- **impact**—the comprehensive actual (intended and unintended) consequences of the investment. Impact can also consider the impacts on different groups.

Results frame or pathway analysis—the description of the causal links between inputs, outputs, outcomes and impacts:

- **inputs**—the cash and in-kind expenditures on R&D and extension to deliver outputs to the initial (and sometimes final) user
- **outputs**—results of the R&D that can be adopted or are inputs into further R&D; these may be intended or unintended and can be a by-product of the process of undertaking R&D
- **outcomes**—changes in practices, products or policy that result from adoption of the outputs by initial, next and final users—final outcomes are the changes experienced by the final users as a result of their adoption of the output
- **initial impacts**—changes in demand, supply, environmental and social pressures and exposure to risk at the community level due to the sum of outcomes at the individual level, or for common resources at the community level
- **impacts**—changes in markets (prices, input and output costs, quantities) and in the state of common resources (ecosystem health and biodiversity) and communities (livelihood opportunities, health, security, equity)
- **benefits**—value of changes in producer and consumer wellbeing and the wellbeing of the individuals in the affected communities.

The results frame is based on analytical and conceptual modelling to explore and test the underlying logic of investment in a project or program.

Community value—the sum of the values individuals in a community place on non-market outcomes. These arise from:

- **use values**—willingness to pay (WTP) (or accept compensation for loss) for the use of the resource or experience of the impact
- **non-use values**—WTP for the existence of the resources or impact, or for the option to use in the future.

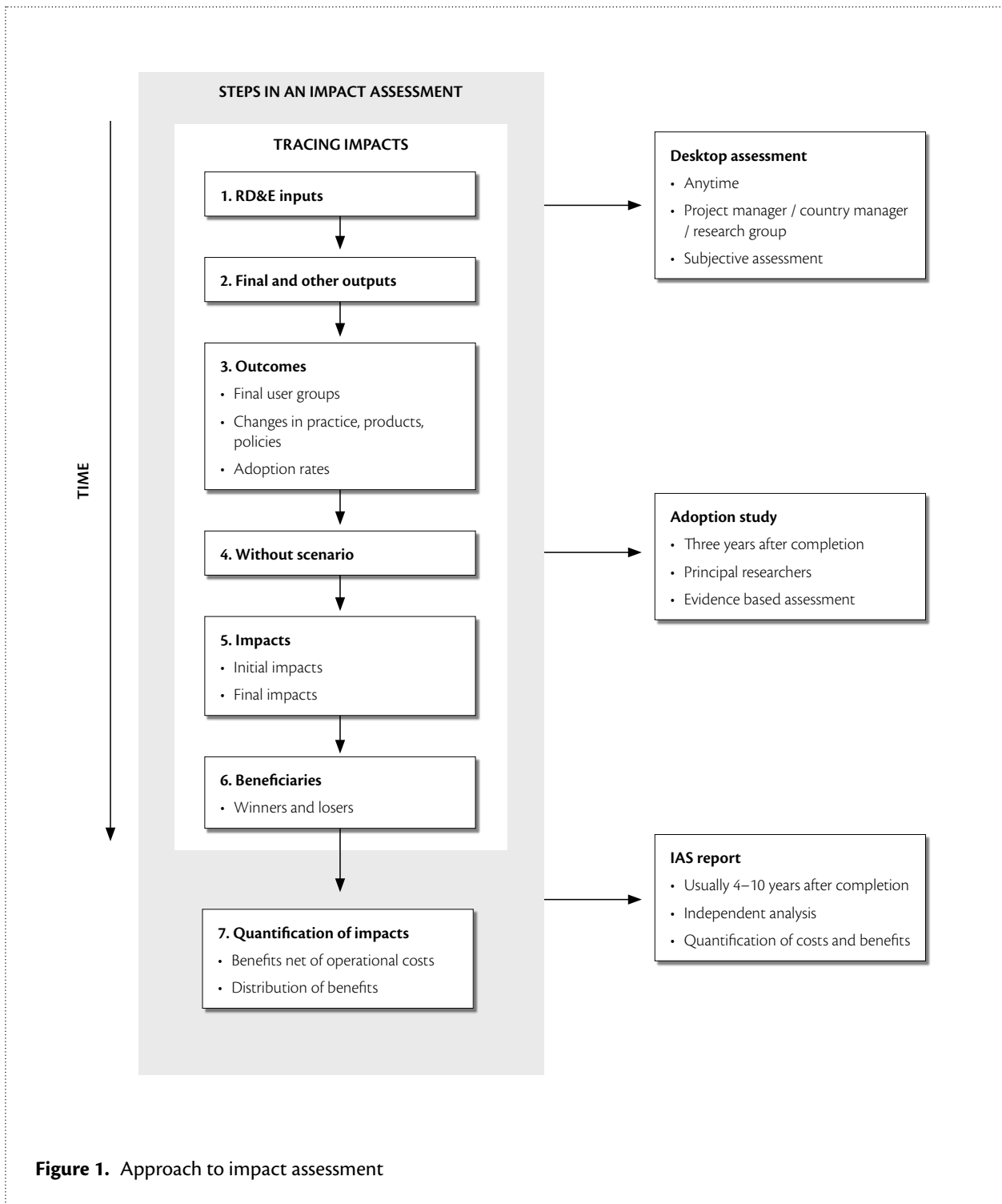


Figure 1. Approach to impact assessment

Box 2. Overarching principles for impact assessment

1. Clearly identify causal links between levels of results.
2. All outputs, intended and unintended should be identified.
3. Identify the preconditions and complementary investments required for the results to be realised.
4. Always measure change from a baseline (counterfactual) and make this counterfactual explicit.
5. Make sure opportunity costs are included in assessing impacts.
6. Final users are not always the only beneficiaries.
7. Attribution, in the absence of any other information indicating otherwise, is based on research, development and extension cost shares.
8. Validate estimates of results and report on the degree of uncertainty in the assessment of impact and benefits.

2 A checklist for all impact assessments

2.1 Using the checklist

The checklist summarised in Figure 2 sets out the steps in undertaking IAs. These steps are the same for a desktop assessment, an adoption study or an analysis for inclusion in the impact assessment, but there are differences in the level of evidence compiled and quantification. The checklist aims to help assessors to ask the right questions. It provides categorisations that may be useful in tracing the causal links between outputs, outcomes and impacts. While these categorisations are based on those often found for ACIAR investments, they are meant only as a guide to assist in the results mapping and in analysing ACIAR's overall investment portfolio. There may be additional or different links so the user should not feel bound to find a perfect fit. Where this is the case, add to the categorisations.

The checklist also aims to support a preliminary assessment of the significance of the different causal relationships and hence the possible magnitude of the resulting benefits. It is important to focus on the impacts that make a difference and not get entangled in numerous links that are never going to make a difference to the final scale of benefits.

The first six steps consider the links between inputs, outputs and outcomes. This phase is the core of good impact assessment and cannot be over-emphasised. The final three steps are about providing an overall impact assessment, including information on the degree of confidence in the assessment, and hence how much reliance can be placed on the results.

2.2 Step 1: Identify all the R&D and extension inputs

ACIAR projects may provide stand-alone R&D investments with outputs ready for adoption, or they may be part of a larger set of investments in R&D and extension that together deliver outputs ready for adoption. The first step of any impact assessment is to identify all the significant inputs that contribute to the identified outputs. This is sometimes called 'ring fencing'.

Both the overall magnitude of investment and the relative shares are important. Recognising the relative shares of investment provides a perspective on the return to ACIAR funding (see section 2.8.2).

When identifying inputs, consider:

- ACIAR projects that are causally related— which ones preceded and which followed on, and why
- ACIAR funding and funding contributed to ACIAR projects by research agencies and others
- other non-ACIAR investments in R&D and extension, often made by partner country research organisations and extension services, the Crawford Fund, the CGIARs, AusAID, and other donor agencies.

STEP 1 IN SUMMARY: Clearly identify all causal links between levels of results

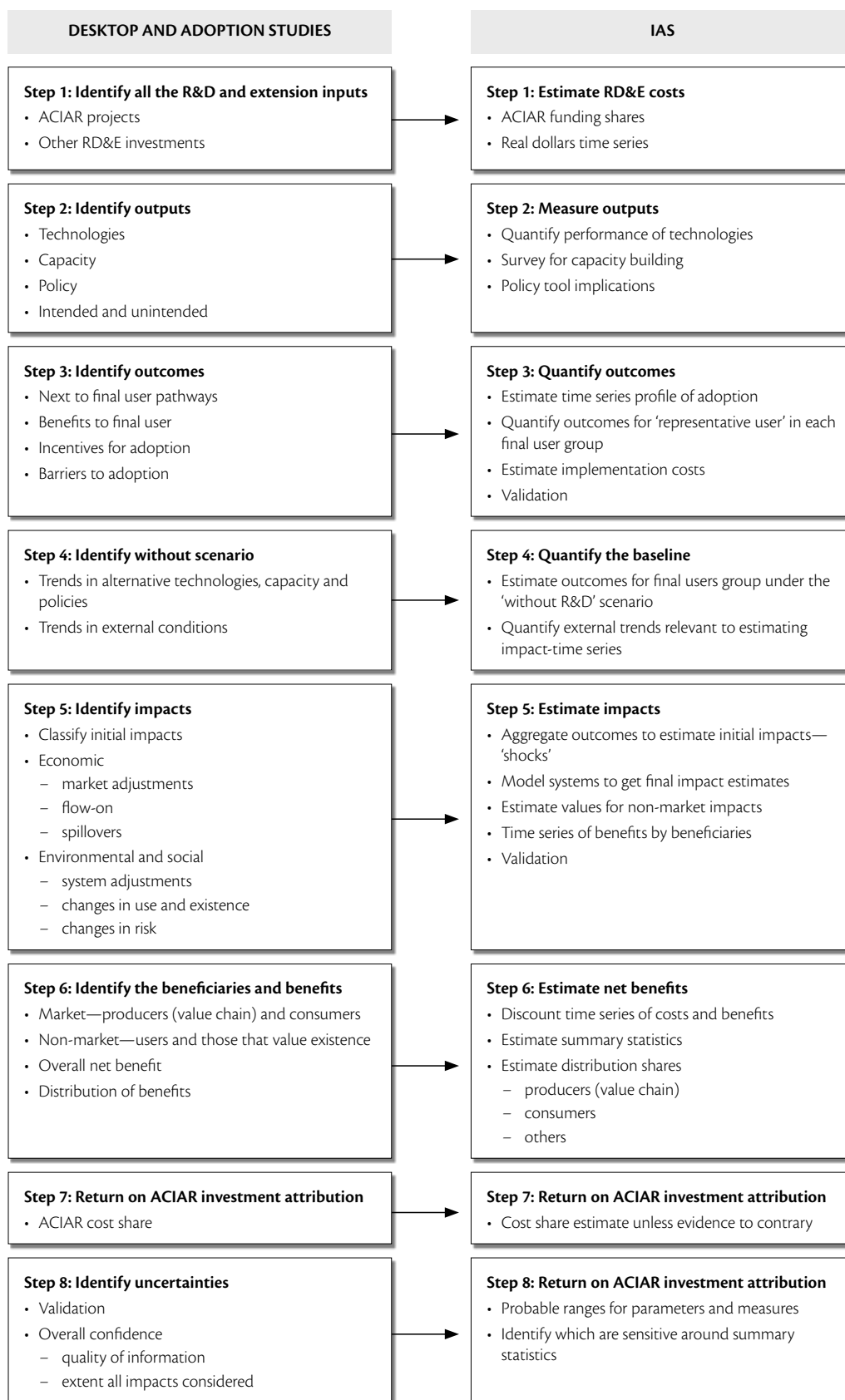


Figure 2. Steps in an impact assessment

2.3 Step 2: Identify outputs

Outputs are the deliverables from the R&D project. ACIAR outputs have three broad categories:

- technologies—new and better products, processes and approaches
- capacity—scientific knowledge, understanding (pure or basic science) and skills at the organisation and individual level.
- policy—knowledge, models and frameworks to aid policy and decision-making.

Some outputs are ready for adoption, others need to be commercialised, and yet others are inputs into further processes involving more R&D. Even technologies that are adoption-ready can often require several more transformations before they can be adopted. Moreover, tracing through the capacity and knowledge outputs to adoption-ready outputs can be a challenge. A guide to tracing capacity and policy outputs through to impacts is provided in Chapter 5.

In identifying outputs consider:

- the categories into which the outputs fall—technologies, capacity and/or policy
- whether the outputs are adoption-ready, require further transformation or are inputs and, if the last, whether there are identifiable outputs already achieved
- who are the next and final users for the outputs.

STEP 2 IN SUMMARY: All outputs, intended and unintended, should be identified.

2.4 Step 3: Identify the outcomes

2.4.1 Intermediate and final outcomes

The outcomes are the changes in practice, products or policy that result from the adoption of the outputs.

Intermediate outcomes require additional investment to generate changes in practice, products or policy that have community outcomes. They are important measures of progress toward achieving final outcomes and consequently impact, but in themselves do not generate impacts. An example is the stock of knowledge. There may be a threshold level of knowledge, skills and capabilities needed in a research organisation before it can generate information or products that are applicable to local farmers. The intermediate outcome is the increase in the stock of knowledge; the output of the application of this knowledge might be a new variety of crop that has a higher yield or improved resistance to disease. Adoption of this output then leads to a final outcome.

2.4.2 Adoption

Adoption is an action—outcomes are the result of adoption. Adoption happens when individuals or firms have an incentive to adopt—the pay-off from the change more than compensates them for the cost of making the change. The exception is where adoption is by coercion by, for example, changes in regulations. Tracing adoption of outputs from next to final users is an essential step in undertaking an impact assessment. Final users are usually at the community level, and it is here that the outcomes are likely to have the greatest impact. While final use of project outputs may be by other researchers, leading to savings in research costs, until they deliver new technology or information that changes policy, the impacts are small. Similarly, capacity built (an output) has to be utilised (an intermediate outcome) before it generates an output that has a use at the community level.

2.4.3 Final outcomes and variation between final user groups

For an impact assessment to be undertaken, it must be possible to track the research, development and extension (RD&E) investments to final outcomes. If final outcomes cannot be identified, no claim of impact is possible, beyond small impacts arising from cost

savings due to research capacity outcomes, or rises in personal income due to human capacity built. Final outcomes have two components—the adoption rate and the change in practice, product or policy resulting from adoption. Both may vary between different groups of final users. Where different groups of potential users face different outcomes it is important to separately identify these groups or populations of final users. Outcomes vary between locations because of differences in characteristics such as climate and soil, enterprise or farming system (such as cropping mix), access to technologies and other inputs, and availability of other livelihood or resource-use opportunities.

2.4.4 Implementation costs

The costs of implementing policies, changing practices and introducing new or improved products need to be considered in assessing likely adoption by each next user and the final user groups. There are investment costs, such as the costs of commercialising a new variety of rice or investing in new processing machinery, that can pose hurdles to adoption. These costs are additional to the RD&E investment, but critical in adoption decisions. The costs need to be seen in the context of access to finance for the final user. In a developing country, difficulty in getting finance can be a major constraint on adoption.

Higher ongoing operational costs need to be fully offset by a higher financial return from the change in practice before final users will make such a change, unless they are required to do so by regulation. Any change in operational costs should form part of the assessment of *incentive* for adoption.

Figure 3 summarises the steps to this point. It shows the feedback loops that have to be considered as the exploration of adoption raises issues of other investments.

While implementation costs, or the perception of implementation costs, may influence the decision to adopt particular technologies, when undertaking the benefit–cost analysis of the overall research it is important to distinguish between implementation costs that arise in particular markets, and implementation costs that are public good in nature.

Implementation costs that arise in markets—for example, the cost of machinery that is part of a new technology—should be explicitly included in the

economic surplus analysis. If the R&D leads to an on-farm productivity improvement that requires, for example, a new machine, then the annualised capital cost of that machine should be included as part of the estimated shift in the supply curve.

If, however, the implementation costs are public good (publicly funded extension services, for example) then these costs need to be explicitly included alongside the R&D costs in the cost stream in the benefit–cost analysis.

When identifying outcomes consider:

- whether outcomes are intermediate or final and, if intermediate, whether there is a clear set of links through to outputs that have final users and outcomes
- final user groups and differences between them in terms of outcomes from adoption
- incentives for adoption for each final user group—whether the outcomes for the final user would justify their adoption, given any implementation costs and changes in operational costs
- the time profile of adoption and changes in practice, products and policies.

STEP 3 IN SUMMARY: Identify the preconditions and complementary investments required for the results to be realised.

2.5 Step 4: Establish the ‘without R&D’ scenario

Determining the impact of any R&D activity requires an understanding of what would have happened in the absence of the R&D outputs that are attributed to the R&D funding under examination. This ‘without R&D’ scenario (sometimes called the ‘counterfactual’) cannot, of course, be observed, so it must be inferred from measured market conditions.

Establishing the ‘without R&D’ baseline is fundamental to the impact assessment. In general, the baseline should

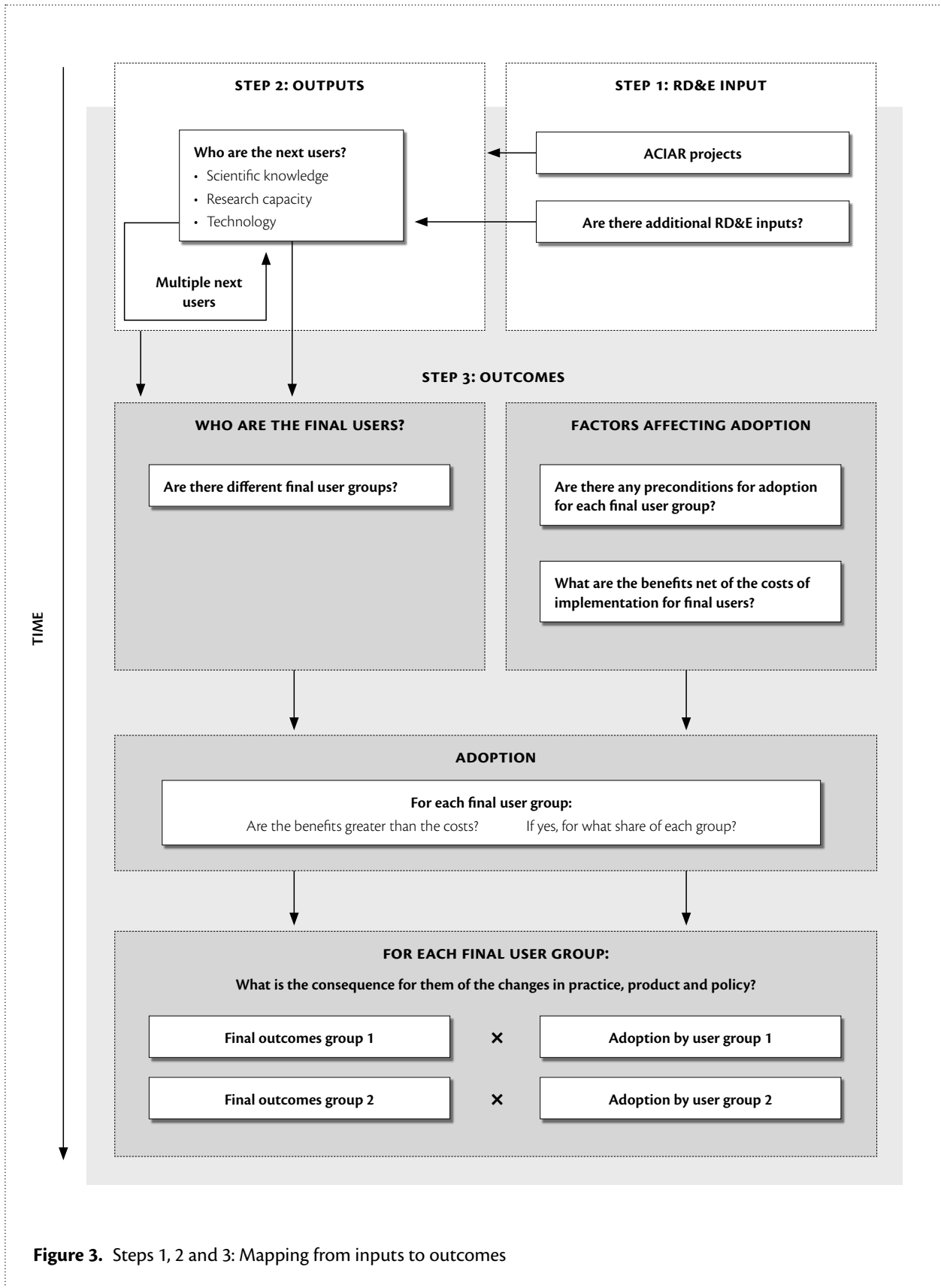


Figure 3. Steps 1, 2 and 3: Mapping from inputs to outcomes

be very carefully thought through and—particularly in full benefit–cost analyses—should be explicitly set out using the tools of applied welfare economics.

When considering productivity improvements, for example, shifts in the supply curve that would have taken place even without the research (shifts in the baseline or business as usual curve) should be explicitly considered along with the shifts in the supply curve that result from the R&D. In general, the gap between the ‘with research’ supply curve and the baseline supply curve will remain indefinitely over time. This should be the default assumption in the impact assessment unless there is an explicit reason to consider that this is not the case.

It is sometimes tempting to construct a baseline scenario that embraces the idea that ‘the research would have happened anyway’ so that the returns from the R&D under examination are only those relating to bringing benefits forward in time. In general, this ‘it would have happened anyway’ idea does not constitute a sound baseline and should be considered only if it can be rigorously demonstrated.

In assessing the ‘without R&D’ scenario consider:

- evolution of existing technologies, input markets and policy reform agendas and the improvements that these might have delivered over the same period
- changes in prices of inputs, product markets, and/or environmental conditions that are external to the adoption of the R&D and might affect the impacts (and adoption).

STEP 4 IN SUMMARY: Always measure change from a baseline (counterfactual) and make this counterfactual explicit.

2.6 Step 5: Identify the impacts

The impacts of the R&D are the aggregate effect of the changes in practice, products and policies by the final user groups relative to the baseline or counterfactual.

Like the outcomes, impacts arise over time, initially in the markets or systems directly affected, and subsequently in other markets and systems as the impacts flow through. The final impact depends on the reactions over time as the directly affected markets and systems adjust and, where flow-on effects are large, as related markets or systems adjust.

2.6.1 Initial impacts (shocks)

Initial impacts result from the aggregation of changes in practice, products or policies across the different final user groups. They can be described as changes in:

- demand—arising from changes in preference for products (due to new products, improvements in flavour or freshness and so on) or through changes in derived demand for products, themselves caused by supply shifts elsewhere in the production chain
- supply—arising from changes in the production function due to improvements in yield, reduced input requirements, lower input costs, joint products and other changes that shift supply. These changes can occur at any point in the value chain, which is the chain of production that starts with the supply of off-farm inputs, through the farming, then tracks the progress from the farm gate, through transport and processing to wholesale and retail to the final consumer. Supply shifts later in the supply chain may appear as the derived demand shifts at the farm level
- environmental pressures—arising from reduction in the use or degradation of natural resources due to protection, restoration or changes in the production process
- social pressures—arising from improvements in nutrition and other minimum basic needs, livelihood opportunities, control over and input into decision-making, improved access to social services, and to community activities and support
- risk—arising from greater certainty about income, lower exposure to harm for workers and consumers, and sources of reduced risk.

Risk is a crosscutting issue that has value in its own right (individuals, communities, governments and firms all prefer certainty) and through changing the probability of an adverse demand, supply, environmental or social outcome.

R&D that shows the way not to go can be of considerable value.

R&D that demonstrates that an approach or technology will not work in a target situation can still deliver value. It does this by avoiding the unproductive use of resources and, in some cases, by avoiding the potential to unintentionally create major new problems. Similarly, strategic R&D to improve the options available is valuable even if the option developed is not in the end utilised as the situation it was developed for did not arise. These kinds of impacts—that arise largely through a reduction in risk—should also be considered when making an assessment.

2.6.2 Final economic impacts—directly affected markets

Economic impacts are those mediated through the market for goods and services. Thus, for example, water efficiency and carbon credits can become economic impacts where there is a market for these products.

Changes in demand and supply for a product (good or service) generally stimulate a price and quantity response. For example, an increase in demand pushes up prices; then, as producers respond to price and supply increases, prices fall back somewhat. The net increase in price depends on the market conditions and how sensitive consumers and producers are to price. These sensitivities are represented as price elasticities of demand and supply. Exporters of products to the rest of the world tend to face fairly elastic or price-sensitive demand unless they are a major producer or have niche-market access. Producers that sell only in the local area may see their prices fall with a significant increase in the quantity of product on the local market. These sorts of transmissions need to be understood to assess not only the distribution of benefits (see section 2.7), but also the magnitude of the total impact and hence benefit.

The markets for inputs into production can also be directly affected if the resulting changes in supply lead to large changes in the demand for inputs. Again, the price sensitivity of demand for, and supply of, inputs will affect the input prices and quantities. In some developing countries, labour is in surplus in rural areas,

so changes that demand more labour can see supply respond with little, if any, rise in wages. Supply of land tends to be more constrained, so land-using innovations may bid up the price of land with implications for other industries, as well as landowners' wealth. These opportunity costs for inputs—their value in the next-best use—must be recognised in assessing impacts.

2.6.3 Flow-on economic impacts and spillovers

Flow-on economic effects arise as changes in relative prices of inputs and other products flow through into changes in costs of production and consumption patterns. In general, the impacts on other industries (producers and consumers) are less than those in the directly affected markets.

There can also be dynamic effects arising from economic spillovers, such as increased skills in the labour force, new technology platforms that can be used by other industries, economies of scale or scope that lower transaction costs (cluster economies), and changes in institutional arrangements that can benefit (or sometime impose costs on) other industries.¹

When identifying economic impacts consider:

- changes in demand (particularly derived demand) and supply for the markets directly affected
- sensitivity to price changes and whether this enhances or dampens impact
- flow-on effects due to competition for inputs or consumers
- spillover effects from upskilling labour, sharing technology platforms, cluster economies or institutional improvements.

¹ The Productivity Commission (2007) report on public support for science and innovation identified spillovers as the major justification for public funding as they are to a large extent public goods (unlike flow-on effects). That is, they are non-rival in consumption and non-excludable, at least to similar groups of users (club goods). They are rarely externalities in that the consumption is voluntary—firms can choose whether or not to avail themselves of the opportunities.

2.6.4 Final environmental impacts

Just as markets adjust to changes in demand and supply, natural systems adjust to changes in the pressures on them. Natural systems may be fragile and hence highly responsive to changes in pressures such as the level and timing of environmental flows to a river, or they may be robust and so experience little change with changing pressures. Robustness need not imply a good result. Severely degraded land may be robust, and so need very large changes in pressures, such as large-scale revegetation, to have a final impact that delivers value. Understanding how responsive systems are to the first round impacts is important for accurately representing benefits. For example, tree planting to reduce salinity has an observed outcome—trees have been planted. The first round impact could be a decrease in salt discharge in the planted area; the system impact depends on whether this area planted was a net recharge or discharge zone.

Environmental impacts often feed back into economic impacts where natural resources are used in production. For example, improvements in environmental services can lower the cost of water treatment. It should also be noted that some environmental outcomes can have negative economic impact, as when industry access to a resource is restricted.

Environmental impacts are often classified as externalities, as they impose or reduce the costs on consumers and producers. Reductions in pollution, revegetation, reduced pressure on soil and vegetation, and improved environmental flows are all initial impacts resulting from environmental outcomes such as changes in regulations, reduced grazing pressure and improvements in water-use efficiency. Final environmental impacts that are valued by individuals in the community (called ‘community values’ for short) fall into two main categories:

- ecosystem health—the sustainable (in a biological sense) functioning of natural ecosystems—terrestrial, riparian and marine
- biodiversity—protection of relatively scarce ecosystems and their flora and fauna and other life forms.

These categories are not mutually exclusive—protecting biodiversity requires sustainable ecosystems, but having sustainable ecosystems does not in itself protect biodiversity. Healthy ecosystems and biodiversity

are valued for both use and non-use purposes. Use purposes include recreation, aesthetics and research, while non-use purposes are existence values and options values (option for later use). Changes in the risks to ecosystem health or biodiversity are also final impacts that are valued by the community.

When identifying environmental impacts consider:

- initial impacts on pollution, greenhouse gas emissions, native vegetation cover, water quality, soil quality and ecosystem disturbance
- changes in use and access to natural capital—non-market uses
- flow-on effects of ecosystem services on
 - inputs into production (economic impacts)
 - pollution and human health (social impacts)
 - climate change and production (economic)
 - dislocation of populations (social)
- spillover effects to ecosystem health and biodiversity
- changes in the risk to ecosystem health or maintaining biodiversity.

2.6.5 Final social impacts

Social impacts are variously defined in the literature, and studies have included impacts from market-mediated impacts where public funding is involved (as with medical costs) to moral and ethical issues such as the value placed on more equitable outcomes. The approach taken here is to include all categories of impact that might not be captured in the economic or environmental impacts. Three broad categories of impacts are identified:

- population health—changes in nutrition levels, prevalence and incidence of diseases, achievement of other minimum basic needs

- economic opportunity—increases in the diversity and/or quantum of employment opportunities for communities
- social opportunities—changes in access to education, health care, transport and other resources for human wellbeing, including the extent of community support and engagement, i.e. social capital.

Population health and social opportunities also flow through to economic impacts by improvements in the supply of labour. Such impacts tend to be long term and require considerable complementary investment. The share that can be attributed to ACIAR is very small, and is usually not considered in the impact assessment.

As with economic and environmental impacts, reductions in the risk of adverse impacts should also be identified. The value placed on an improvement in economic opportunity may arise in part from the lower risk associated with a larger number of options for generating a livelihood. This is in addition to higher incomes that might be generated and which are already included in economic impacts.

2.6.6 Assessing final impacts

Figure 4 summarises the approach to assessing final impacts.

In assessing final impacts consider:

- the significant first round changes—to demand, supply, environmental pressures, social pressures, and risks to any of these
- economic impacts—directly affected markets, flow-on and spillovers
- environmental impacts—initial impact and flow-on to ecosystem health and biodiversity, and links back to economic and social impacts
- social impacts—population health, social opportunity and changes in social exclusion

STEP 5 IN SUMMARY: Make sure opportunity costs are included when assessing impacts.

2.7 Step 6: Identify the benefits and beneficiaries

2.7.1 Identifying the beneficiaries

Project benefit is the sum of the net values of the project impacts to the beneficiaries (those groups of individuals who are positively affected by the project impacts) and to those made worse off as a consequence of the project.

Direct beneficiaries may include:

- final users (why else would they adopt the outputs) and their employees
- others involved in the production value chain from the suppliers of inputs to traders, processors, wholesalers and retailers
- consumers.

Other groups that may be affected include (either as beneficiaries or losers):

- industries competing for resources
- industries competing for consumers
- industries supplying products and services to the workers and owners of resources
- industries benefiting from spillovers
- those in the same industry that do not adopt the new technology.

Environmental and social impacts tend to affect a much wider population. Their benefits derive from:

- use values, which are associated with use by different populations of users. For example, a village next to a river may benefit from multiple uses of the water when its quality improves, while people using the river for transport may make less regular use
- non-use values, which arise where impacts have existence value such that the beneficiaries do not need to have physical access to the environmental or social capital. Even populations in other countries may value the impacts. This is the case with biodiversity protection, where developed-country populations may place a high importance on protection of endangered species found in a developing country. Options value is a non-use value only in the sense

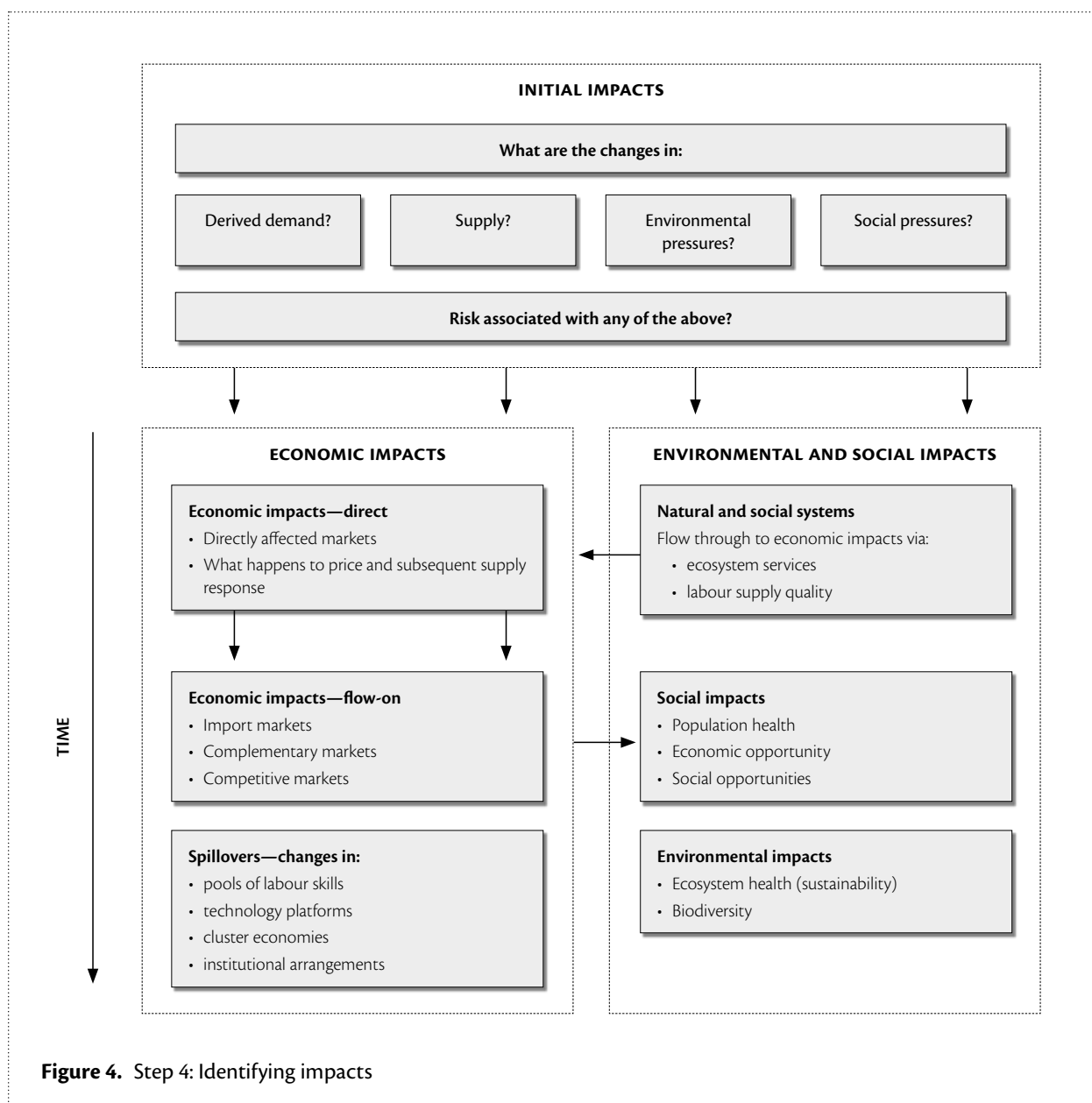


Figure 4. Step 4: Identifying impacts

that it is a future option on use. Consequently, the populations of non-users who value an impact for its existence or option for future use can be large.

2.7.2 Assessing the value of the impacts

Economic impacts are valued at market prices, with estimates made of the changes in total community welfare measured by producer surplus (profits) and consumer surplus (measure of welfare from consumption).

Environmental and social impacts generally do not have market prices. In the absence of direct market estimates, a number of indirect approaches can be taken. Costs

incurred to address the impact (or costs avoided) can be used as an estimate of the value of the impact. Non-market use values can be estimated in a similar manner or by using willingness-to-pay (WTP) methods. Impacts can have both use and non-use (existence) values. For example, the restoration of biodiversity in an area has a use value to hikers and to communities that may use the resource to improve food security (reducing risk). The same impact has a non-use value for people who feel it is important to preserve biodiversity for its own sake, or for future generations (intergenerational equity). The resource has an option value to the community that use

it for food security. It can also have an option value for those who currently do not use it, but could do so in the future.

The values placed on the impacts can vary over time as market conditions change and community values evolve. Non-market use values can vary with user groups (and within groups). Existence values are the sum of the values of the individuals in a community who place a non-zero value on the impact.

2.7.3 Assessing the net benefit of the RD&E investment

The net benefit of an RD&E investment is the sum of the values placed on the impacts by the beneficiaries less the public good cost of the implementation (not already incorporated in the surplus analysis, see section 2.1.3) and project costs (see section 2.1.1). Net benefits tend to be large when:

- a major crop, grazing industry or fishery, or a large area of land or water, is positively affected
- there are high rates of adoption by large groups of final users (this also indicates a good return to the final user)
- economic opportunities were relatively low in the regions affected, and resources were not fully utilised or were used in low productivity enterprises.

2.7.4 Assessing the distribution of benefits

The final users will, in general, benefit the most. For example, the economic impacts arising from improvements in productivity lower costs and raise profits, but the producers' share depends on how much of the gain is passed through to consumers in lower prices. The relative price elasticities of demand and supply in the product market help to understand how the benefits generated are shared between consumers and producers.

In addition, benefits to producers will be shared along the production value chain, again according to relative supply elasticities and market conditions.

Understanding the ways in which market conditions and supply and demand responses potentially influence the distribution of benefits can provide insights into adoption rates.

Benefits will not, of course, be distributed to non-adopters of the new technology. This group will, in general, lose (as market prices decline from the actions of adopters, for example). It is important to identify non-adopters and incorporate their outcomes in the analysis. The relative share of production by these non-adopters is also an important determinant of the distribution of the total benefits. In many cases, this share overrides the importance of the relative supply and demand elasticities.

Environmental and social benefits accrue to the users and wider communities. The distribution of such benefits depends on the degree of use and the values placed on that use, the size of the communities and the average existence values held by the individuals in those communities.

Figure 5 summarises mapping from impacts to benefits and beneficiaries.

In assessing benefits and beneficiaries consider:

- changes in consumer and producer surplus and other appropriate measures of the total welfare change
- losses of producer and consumer surplus in the case of non-adopters or other losers
- sharing of producer and consumer surplus along the value chain
- environmental and social use benefits –
 - scale of use and use values (costs of alternatives and costs avoided)
 - scale of communities affected and their average existence value.

STEP 6 IN SUMMARY: Final users are not always the only beneficiaries.

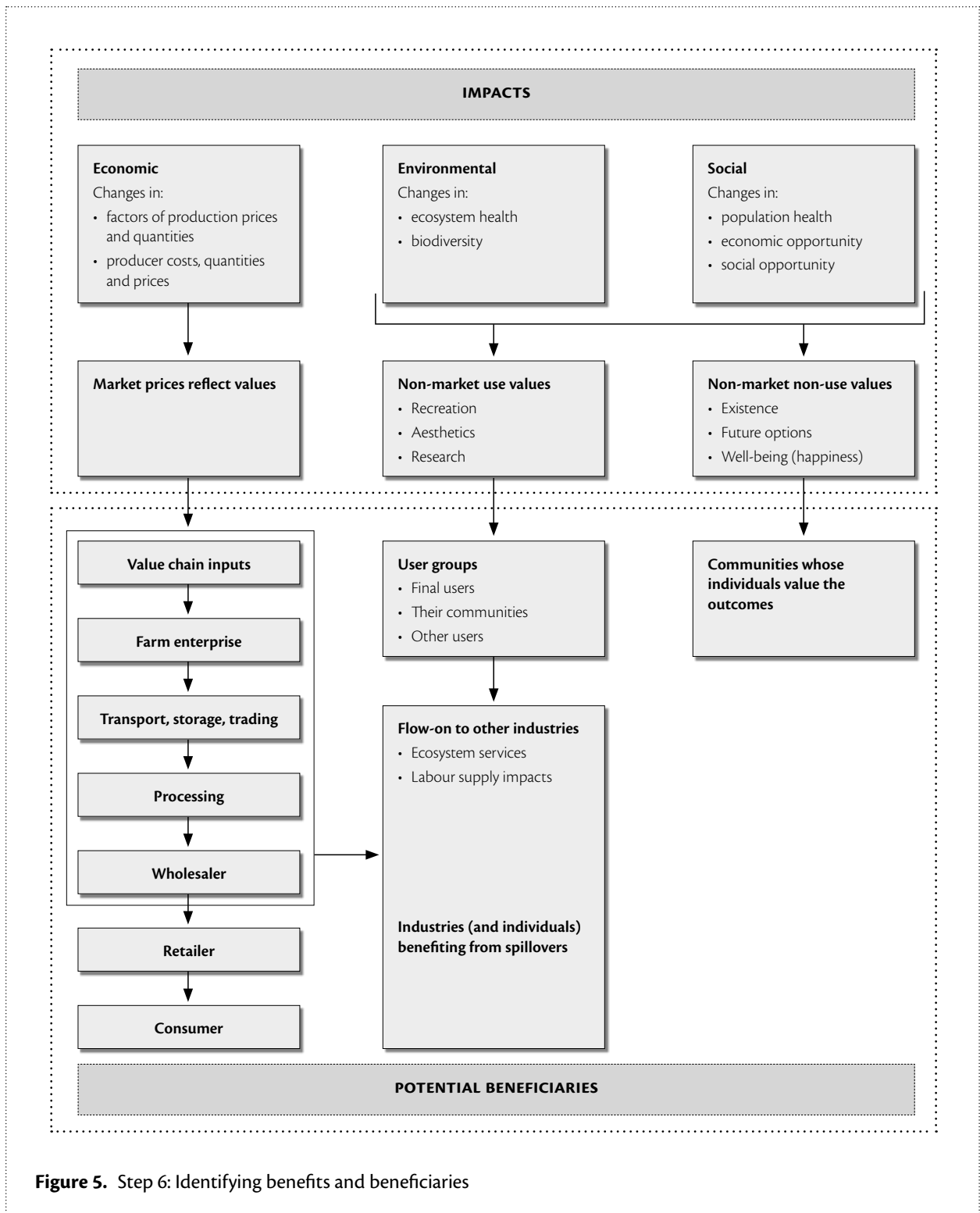


Figure 5. Step 6: Identifying benefits and beneficiaries

2.8 Step 7: Return on investment and attribution

2.8.1 Return on investment

The impact assessment studies quantify the benefits and costs to provide return-on-investment estimates. They report the present value of the flow of RD&E costs and the present value of benefits less implementation and operational costs. The ratio of this benefit estimate to the present value of the RD&E costs is the benefit:cost ratio. The standard discount rate applied by ACIAR is 5%. This means that each dollar earned is worth 5% less for every passing year. Consequently, the time profile of the net benefit flow has an impact on the return on investment. Investments that have benefit flows that accrue earlier will have a higher return on investment than the same benefit profile delayed by, say, 5 years.

The adoption studies and desktop reviews need only to make an overall qualitative assessment of the return on investment. The considerations outlined above, including the time profile of the benefit flow, should help in making this overall assessment.

2.8.2 Attribution to ACIAR

ACIAR is not, of course, the only agency funding R&D. In any impact analysis the question of how to attribute total benefits to ACIAR always arises.

The attribution problem is very closely related to the appropriate definition of the baseline or ‘without research’ scenario. Ideally, this baseline should be a ‘without ACIAR-funded research’ scenario. This scenario will often be difficult to construct because of the inevitably high levels of interaction involved.

In general, unless there is evidence to suggest a different attribution is appropriate, the analysis should work towards constructing a baseline that allows any attribution to ACIAR to be based on a cost share of the total RD&E investment. The cost share approach is based on all the RD&E investments being necessary but none alone sufficient for the outputs and subsequent outcomes to have been achieved.

Attribution can be different if some investments can be shown to have had a marginal (as opposed to average) contribution. For example, if ACIAR funding had

brought forward the R&D investment, advancing the benefits in time, then the return on ACIAR’s investment is the added return from the benefits arising earlier. Another example is where the ACIAR R&D can be shown to have raised the yield of a crop to 10% more than that which the other investments in R&D would have achieved. In this case, the return on ACIAR investment is the benefit arising from the extra 10% yield, regardless of the cost share.

In assessing the return on ACIAR investment consider:

- size and timing of the benefit flows net of implementation costs—all else being equal, earlier flows give higher returns than later flows
- scale and timing of the RD&E costs
- ACIAR’s funding contribution to the projects relative to all other RD&E investments that were needed to deliver the outcomes.

STEP 7 IN SUMMARY: Attribution, in the absence of any other information indicating otherwise, is based on RD&E cost shares.

2.9 Step 8: Uncertainties in the impact assessment

Desktop reviews rely on judgments and on the program and country managers’ knowledge of the project. There is a higher degree of uncertainty in the information in desktop reviews than there is in adoption studies and impact assessments. Therefore, as with all assessments, the level of confidence in the findings or conclusions should be made explicit.

2.9.1 Validation of information and evidence

Where possible, the information and measures of results—qualitative or quantitative—used in the impact assessment should be validated. Assessments often rely on subjective appraisals, and even apparently objective data (such as production figures or sales) can be highly

biased. Validation needs to be applied to the results mapping to test the strength of the linkages, as well as to estimates of the size of the results.

2.9.2 Assessing the confidence in the results

Assessing what degree of confidence can be placed on the results has several elements. Measurement error and modelling mistakes are dealt with to a large extent by validation approaches. In addition, there is often uncertainty in the true parameters used to estimate outcomes, impacts and benefits. These uncertainties may compound or offset each other. Sensitivity analysis is used for quantitative analysis to provide a measure of the confidence that can be placed in the point estimates of benefits. Where the results are not robust to changes in the value of any particular parameter, further effort may be needed to verify its validity, or the argument for choosing it may need strengthening. Sensitivity analysis is essential in impact assessments and recommended in adoption studies, to provide an indication of the range of outcomes that might be possible given the available evidence. Methods are provided in Chapter 4.

Confidence in the impact assessment also depends on:

- time elapsed since the completion of the R&D—ex-ante reviews, undertaken as part of proposal assessment, will inherently be uncertain. Three years after project completion, outcomes are more likely to be observed, too long out, and the outcomes may be difficult to distinguish
- evidence supporting the results map—where the links are well known and clearly established empirically, there is more confidence in the conclusions drawn about impacts, even if many have still to arise. Sound theoretical links are better than none, but evidence should be provided to support the application of theory to the circumstances under assessment
- evidence of outcomes and impacts—objective evidence of major outcomes and impacts such as volumes of production improves confidence, but must be analysed for potential alternative sources of the changes observed for this confidence to be justified

- the extent to which the impacts and benefits can be quantified—whether potentially large impacts have been left out.

In assessing the confidence in the impact assessment consider:

- evidence supporting the results mapping—both direct and from well-accepted linkages
- uncertainty in the estimates of the most significant outcomes and impacts
- the extent to which all potential impacts have been included in the assessment.

STEP 8 IN SUMMARY: Validate the results and report the estimated degree of uncertainty in the assessment of impact and benefits.

2.10 The desktop review

The eight steps just described are common to all classes of impact assessment, qualitative or quantitative. Desktop reviews may be undertaken for project proposals, during project implementation, on project completion and to help select projects for impact assessment. When undertaking an adoption study or an impact assessment, a desktop review is the first step.

2.10.1 The steps in a desktop review

There are eight steps in a desktop review.

Step 1:

- identify related ACIAR projects and, if possible, other RD&E investments
- record the expenditure on the ACIAR project and ACIAR's share of the total.

Step 2:

- identify the countries involved and commodities
- identify the significant outputs and classify them.

Step 3:

- identify the next and final user populations, and whether there are various final user populations. If there are no links to a final user population the impact assessment is 'no impact'
- identify the changes in practice, products or policy required of the next and different final users to adopt the outputs
- assess likely or actual adoption given the benefits and costs to next and final users.

Step 4:

- based on the expected adoption and consequences of the changes in practice, identify the first round impacts relative to the 'without R&D' scenario.

Step 5:

- considering the market characteristics for economic impacts and the systems for environmental and social impacts, assess the final impacts, identifying those that are significant.

Steps 6 and 7:

- for significant impacts, identify the beneficiaries and, considering their values (reflected in market prices, WTP), assess the overall level of benefits as high, medium or low.

Step 8:

- classify the confidence in the impact assessment as high, medium or low.

Given the way that desktop reviews are conducted there will usually be some uncertainty about the assessment of impact. The degree of confidence will vary between desktop reviews, depending on the reviewer's personal knowledge of the project and the extent of their contacts with the researchers and others involved. Consequently, the reviewer should make explicit the level of confidence they have in the assessment, relative to that in other projects they have assessed.

2.10.2 The Project Impact Assessment Summary

Desktop reviewers should complete a Project Impact Assessment Summary (PIAS) form. The PIAS form is provided as Appendix 1 and is available electronically in Microsoft® Word format. The form provides a template for completing the eight steps described above. It also provides a summary for adoption studies and full impact assessments, and so includes some fields that a desktop reviewer may not be able to complete. Where the reviewer lacks the information these fields can be left blank.

The categorisations set out in the steps above are available as drop-down menus in the electronic form. If new categories are needed, they can be added, so the reviewer should not feel constrained to the existing categories. The drop-down menus include the countries and commodities involved in the projects. This information is used in portfolio analysis. The most detailed categorisation should be used where possible; for example, if the project is on bananas this category should be selected rather than 'fruit'. Multiple choices are available for most categories, reflecting that ACIAR investments are complex and often multifaceted.

Completing the PIAS form allows the impact assessment information to be compiled in the ACIAR Database for Impact Assessments (ADIA). The desktop review PIAS also forms a starting point for undertaking adoption studies and full impact assessments.

3 Adoption studies

3.1 The purpose of adoption studies

ACIAR undertakes adoption studies for large projects (over \$400,000), usually 3 years after their completion. The studies are undertaken by the principal researchers involved in the projects. Adoption studies provide a useful follow-up from a research perspective as they renew contact with the developing-country researchers and others involved in the RD&E. They are also used by ACIAR in assessments of the value of follow-up investments, investments in similar areas or investments in other areas with the same research partners. They form an important part of ACIAR's impact assessment program for reporting to stakeholders in the achievements of ACIAR investments.

3.1.1 Adoption studies annual reports

ACIAR publishes annual reports on the findings of its adoption studies. Each report presents the summaries of the adoption studies undertaken during the year and an overview that draws out the main findings of the studies and the lessons for ACIAR, under the following headings:

- Project outputs produced. These are classified into the three categories (technical, scientific knowledge and policy tools), with many projects having outputs in more than one category. They are summarised in a table, with a discussion of whether the projects had achieved the intended outputs and if there were also unintended outputs.
- Research capacity developed by the projects. This is classified as capacity built in terms of partner countries researchers and research infrastructure. There is a description of the ways in which these capacities are being utilised (or not) and why.
- Uptake of the R&D outputs—progress along adoption pathways. This classifies the approaches to adoption taken by the projects in the report, presenting a summary for each of the pathways used. The progress to date in all the projects is tabulated, together with the classification of adoption progress made by the authors of the adoption studies (progress toward significant adoption by next and final users). The overview should identify any patterns that emerge.
- Implications for the impact of ACIAR investments. The author of the overview should draw on the individual studies to make an assessment of the implications for the impact of ACIAR investments. High and early adoption rates tend to imply good returns to the final users. The discussion should identify these projects, as well as those with potentially large final user populations, and assess whether, given the information, the impact is likely to be high, medium or low. The main reasons for the judgment should be provided, together with a table presenting the assessments of the authors of the adoption studies and the overview. Differences in opinion should be discussed.
- Lessons. This should draw out reasons for high or low adoption and impact that provide some guidance for future ACIAR investments. A table presenting the factors contributing to, or inhibiting, uptake should be provided.

3.2 Structure of an adoption study

Adoption studies should follow the impact assessment steps, but the main effort must go into:

- setting out the results mapping and testing the initial premises underpinning the decision to invest in the R&D
- gathering evidence on the adoption of the outputs of the R&D by the next and final users
- analysing the outcomes achieved in practice by the final users—and quantifying them where possible
- analysing the costs and benefits to final users and hence their incentives to make the changes in practice, products and/or policies over time.

3.2.1 The adoption study template

ACIAR provides a template for the adoption studies (see Appendix 2), collecting information under the headings listed below. The template aims to improve consistency between adoption studies, most notably in the interpretation of what are outcomes, impacts and beneficiaries.

- Motivation for the project and what it aimed to achieve:
 - the motivation—the problem or opportunity being tackled and what the project hoped to achieve in doing so (this tends to be at impact level)
 - the objectives of the project (these should be defined at the outcome level)
 - the history of the project—this is a summary of the inputs, including related ACIAR projects and other investments in RD&E and the agencies involved, the partner countries, the commodities or issues, and how the R&D was undertaken.
- Outputs—what did the research produce? Outputs delivered—this should summarise outputs and how they differ from what was previously available under the three headings (where relevant):
 - technical outputs
 - policy outputs

- capacity developed by the project—researcher skills and knowledge, and research infrastructure.

- Adoption—how are the project outputs being used? Outcomes achieved and expected in the future:
 - capacity utilisation
 - adoption to date—presenting evidence on adoption
 - adoption in the future and assessment of time to significant final user adoption
 - factors affecting adoption.
- Impact—what difference has/will the project make?
 - main beneficiaries
 - external factors affecting the impact
 - benefits for Australia
 - overall assessment of impact, including the level of confidence in the assessment.
- Lessons for ACIAR.

3.3 Tracing the results from outputs to outcomes: what has been achieved?

In undertaking an adoption study the authors should follow the eight steps set out in Chapter 2. The following discussion provides some additional tools that can be applied to help guide the analysis and provide some comparable estimates of elements of impact. These tools can also be useful in undertaking an impact assessment, especially where the outcomes have yet to be fully achieved, necessitating an ex-ante assessment of likely outcomes.

3.3.1 Identifying the next and final user groups: mapping the adoption pathway

The adoption pathway describes how the output gets from the R&D project to the final user. There are four broad pathways to adoption: commercialisation, communication, capacity building and regulation. There may be others, and these can be added as identified. The pathways are presented here to assist in identifying the next and final users and in assessing progress along the pathway, as significant impact usually requires adoption

by the final users. Successful projects often embed the pathways to adoption within the project. This might involve farmers participating in the research (action research), working with regulatory authorities that might develop and enforce policy (for example, banning use of a particular class of pesticides), or conducting field days and distributing 'how to' manuals. Adoption pathways should track through the next users (initial and intermediate) and final users, identifying what else needs to happen for adoption to occur. The four broad pathways are summarised in Figure 6. They are not mutually exclusive.

- **Commercialisation.** This pathway engages the market for the distribution of the product or practice. The clearest example is the involvement of a commercial partner in the development, marketing and distribution of a new variety of, say, a crop plant. This need not involve the licensing of intellectual property (IP), which may be provided free to firms willing to market the product. Practices can also be promoted through engagement with agribusinesses, which then offer advice on the practice as part of their packages of products and services.
- **Communication.** This pathway carries information directly or indirectly to the final user, and/or to organisations such as extension services that provide information to final users. Communication pathways include publication in academic journals and trade publications, information targeting extension or other change agents, communication products such as manuals or laminated posters for farmers, demonstration farms and field days.
- **Capacity building.** The transfers of knowledge and skills enables adoption as part of the R&D project. This could directly target final users by including them in the research (action or participatory research). It could work by including policymakers in the R&D, to gain their understanding and promote a supportive environment for adoption. It can also be indirect, through developing and promoting the delivery of training packages.

- **Regulation.** This pathway enforces or encourages adoption through compulsory (usually government) or voluntary (usually industry or cooperative) regulation. It includes adoption necessitated by the existence of monopoly services provided by governments or other organisations as, for example, when irrigation water is supplied by a regional water-management company that requires farmers to adopt certain procedures to gain access to their water allocation. Another example is compulsory vaccination of animals to enhance disease control.

Progress will depend to some extent on the number of users involved before the final user. For example, in terms of policy outcomes, the final users (consumers and producers) are those who change their practice, process or product in response to the change in policy. The penultimate users are the implementers of the policy, after ministerial approval, with next users being departmental staff formulating draft policies and advice, while the initial users may be policy research groups or university academics who provide policy analysis. Table 1 describes some of the pathways from initial users to final users. It should be noted that in some cases there is yet to be a final user as the project outcome was limited to input to other R&D.

In assessing applicable populations consider:

- the relevance of the technology or change to the current production system (for example, systems that require purchased inputs tend to be irrelevant to subsistence farming), and/or the production environment (for example, climate, soils, pests and access to markets)
- the desirability of the outcomes for the final users—for example, while adoption might increase income it might also require additional effort or introduce greater risk, making the change less desirable
- whether there is institutional support for the change.

3.3.2 Assessing the extent of adoption and potential adoption

Adoption studies should assess the extent of adoption at the time of the study and make a judgment about adoption in the future. They should:

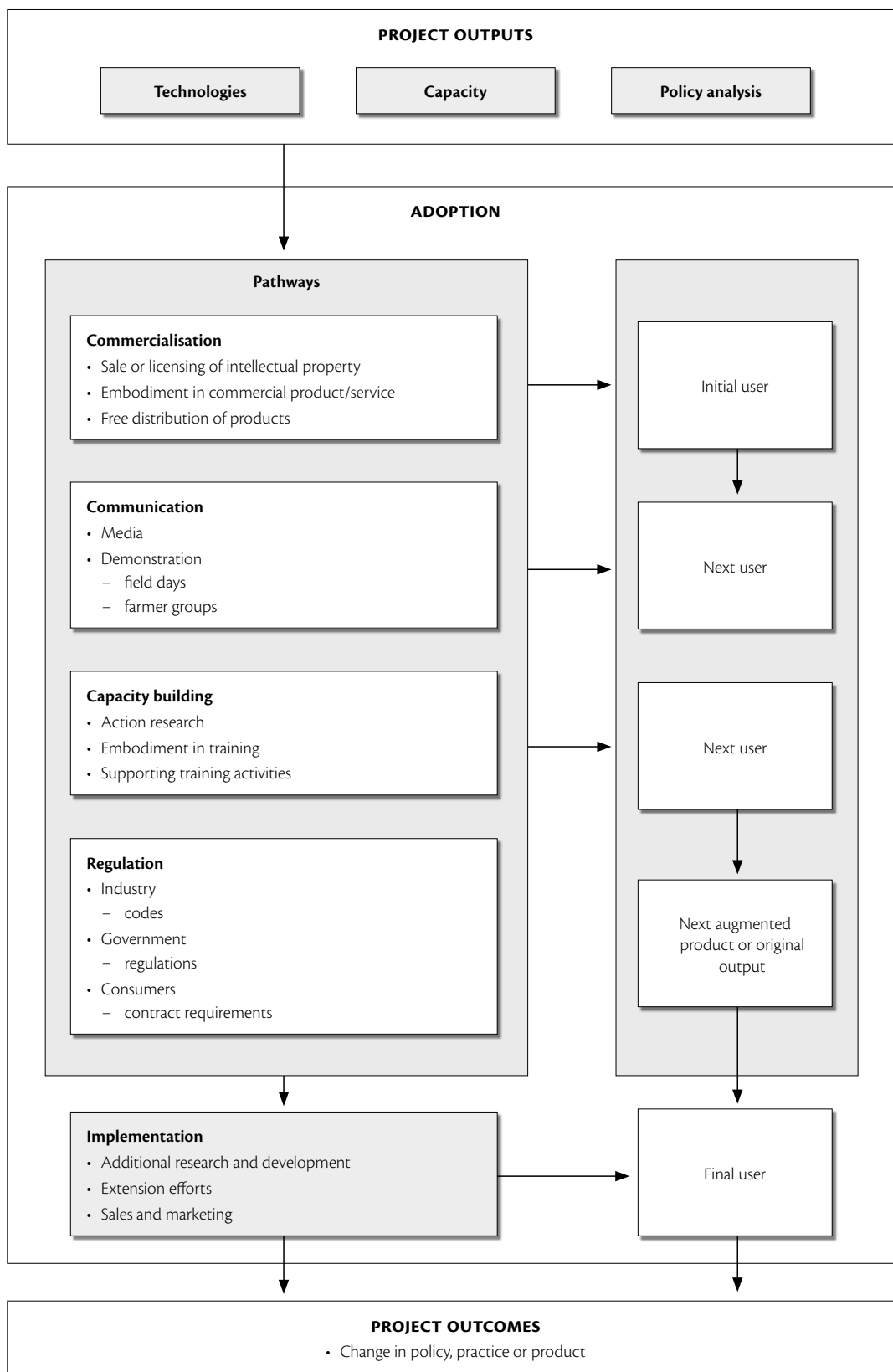


Figure 6. Adoption mapping

- assess who is currently using the project outputs—the initial, intermediate or final users and provide evidence to support this assessment
 - describe the time profile for adoption by final users—if there has yet to be any adoption by final users, assess how long it will be before adoption
 - what full adoption looks like in terms of the share of the potential users in each relevant group that will be using the outputs.
- is likely to start and the time before full adoption will be achieved, providing justification for the assessments

Table 1. Mapping of adoption pathways—next users to end users

Examples	Initial user(s)	Transfer process	Final user
Commercialisation			
Via licensing of intellectual property (with or without a royalty)	Commercial firm	Sales	Individuals/firms
Partnership with commercial firm	Commercial firm	Sales and service package	Individuals/firms
Public release varieties, technologies	Commercial firms, farmers	Sales, growing own seed	Individuals/firms
Communication			
Demonstration farms, field days	Volunteer farmers	Observation	Individuals
Targeted materials distributed directly to final users	Final user	Receipt of materials, acting on information	Individuals
Targeted materials distributed via industry media	Industry media	As above	Individuals
Targeted materials made generally available to extension providers	Extension advisers	Provision of advice that is followed	Individuals
Journal articles	Other researchers	Learning, building stock of knowledge, potential networking	Input into further R&D
Capacity building			
Action research—involvement of next/end user in project	Researchers/final users		Individuals
Demonstration in situ	Final users	Tours for final users	Individuals
Training program	Final users	Enhanced capacity	Individuals
Training packages	Training providers	Provision of courses incorporating content	Individuals
Regulation			
Central/local government policy	Government policy advisers, Lobby groups	Policy change	Organisation
Industry code	Organisation policy development	Publication and socialisation of the code	Individuals complying
Cooperative/firm code	Supplying organisation policy development	Internal processes for disseminating code	Firm/cooperative members
Customer requirement	Purchasing organisation policy development	Communication to suppliers of customer requirements	Supplying firms/ individuals

Adoption pathways suggest progress indicators that can be monitored to provide evidence.

Table 2 provides some examples of evidence of adoption. Only those indicators towards the bottom of Table 2 measure actual adoption; the earlier ones indicate progress towards it. The strength of the relationships between these indicators and actual adoption is important if using the progress indicators to predict adoption rates. If the project outputs are considered highly applicable, and the costs of adoption are low, then progress indicators should perform well. It is where the linkages are less well understood that greater care needs to be taken in drawing conclusions about adoption. For example, studies that have tried to test the links between changes in awareness and attitudes to actual changes in environmental practices have not found a strong relationship.²

3.3.3 Factors influencing adoption

The profitability of the technology (new or improved products or processes) and/or public demand for policy change are the two most significant influences

² See, for example, Curtis and Robertson (2003) and Rhodes et al. (2002)

on adoption rates, with the difference between returns and adoption costs having the greatest effect.³ For this reason it is useful when mapping adoption pathways to identify additional inputs (including the operating environment) required to achieve adoption by the final user. Such information on implementation costs helps in assessing the likely extent and speed of progression along the adoption pathway.

Adoption also requires that the final user be aware of the opportunity—that the pathways described are effective, or adoption is unavoidable. ACIAR adoption studies have identified a number of factors that have influenced the uptake of project outputs. Table 3 categorises these according to the factors described above for adoption of new technology and practical approaches. There are three main categories:

- knowledge of the opportunity
- net benefits to the user
- other incentives/barriers to adoption.

3.3.4 Qualitative measures of adoption

The adoption study must assign a qualitative score that reflects the assessment of progress along the adoption pathway at the time the study is undertaken. This also

Table 2. Indicators of progress toward adoption

Commercialisation	Communication	Capacity building	Regulation
Intellectual property licensed for use (with or without payment)	Publication of information	Number of participants in project	Position paper on policy change produced
Investment levels by commercial partner	Purchase or readership of publication	Survey on learning outcomes achieved	Documented discussions/meetings held
Advertising of product/service	Awareness of information survey	Echo measurement—number of contacts for each person trained	Formal proposal for change made
Market surveys of potential sales	Intention to adopt survey	Intention to adopt survey	Formal adoption of proposal
	Sales of associated products/services	Sales of associated products/services	Policy implemented—requests for/distribution of information
Sales of product—royalty stream as an indicator	Adoption survey	Adoption survey	Policy enforcement

³ There is a considerable literature on factors influencing adoption. See Pannell et al. (2006) and references therein.

Table 3. Factors influencing adoption of new technology and practical approaches

Factors contributing to uptake	Factors inhibiting uptake
Knowledge of the opportunity	
Targeted workshops and communication activities	Ineffective distribution of information to farmers/lack of access to information
Workshops that increase awareness and understanding, especially those involving local 'champions'	Scientist discomfort in simplifying messages and delivering these in an educational/learning framework
Appropriate and extensive training of users and/or promoters of the new approaches	Complex policy and administration environments
Publishing results in appropriate languages and in a way that is accessible	
Long-term involvement of project 'champions'	
Benefits accruing to the adopter	
The development of market infrastructure, including public investment in transport and communications	No existing domestic market and/or poor infrastructure to support industry development
Demand by consumers for the final product	Disruption by political events
	Competition, especially from cheaper alternatives
Culturally relevant	
Compatibility with the socioeconomic context of farmers	Farmer satisfaction with their way of life and seeing no need to change
	Inadequate land tenure and reward system
Factors contributing to uptake	Factors inhibiting uptake
External incentives/barriers to adoption	
<i>Capital cost and ability to raise sufficient funds</i>	
	Shortage of essential facilities and/or equipment and/or the expertise to use it
	Lack of funds to 'scale up' adoption beyond those originally involved in the project
	Limited access by farmers to investment funds
<i>Complexity and capacity to absorb, understand and apply</i>	
Active involvement with the project from the beginning	Lack of time
Trained scientists who can continue the work and help train others	Lack of appropriate partnerships
<i>Compulsion or prohibition</i>	
	Government/agency secrecy about disease outbreaks—need to 'save face'
	Bureaucratic barriers to further development and implementation of project results

Table 3. (continued)

Factors contributing to uptake	Factors inhibiting uptake
<i>Risk and uncertainty</i>	
Government, or commercial enterprises, sharing the risk	Poor record keeping at industry level
Reputation, and credibility, of the scientists	Limited number of field trials and demonstrations to provide visible 'proof' of the effectiveness of a new approach
	Changes in personnel during the life of the project
	Time lag—where the results from implementing a change are not immediately apparent

Source: McWaters and Templeton (2004)

allows for no progress and the circumstance in which the output goes into further R&D and does not, in itself, have a final user in the community. Table 4 sets out the scoring that should be used.

This qualitative assessment has behind it some quantitative notion of what proportion of users is 'considerable'. Unless there is explicit guidance provided, this proportion may vary with who is undertaking the assessment. There can also be significant variation in the estimation of what proportion of any relevant population of potential users the assessment 'considerable' should be applied to. It must be noted that the numbers of initial and next users adopting may have no bearing on adoption by final users.

Project proposals are required to identify the expected number of years to adoption (less than 5, 5–10, more than 10). The adoption study should review these assessments and make a new assessment. Along with

the adoption achievement score, this time to adoption will be collated for presentation in the adoption study overview.

3.3.5 Descriptions of outcomes

As discussed in section 2.5, outcomes are the consequences of adoption of the outputs for the final users. The changes in practice, products or policy may lead to higher yields, lower costs of production, less exposure to disease and hence lower probability of crop loss, or other immediate impacts. Table 5 lists a number of outcomes that arise regularly for ACIAR projects and identifies those that can and hence, ideally, should be measured.

In estimating outcomes be aware that trial and laboratory outcomes are rarely achieved under real conditions.

Table 4. ACIAR categories for adoption studies

Category	Description
NF	Demonstrated and considerable use of the results by the next and final users
Nf	Demonstrated and considerable use of the results by the next user, but only minimal uptake by the final users
NI	Intermediate outputs with considerable use by the next users and has led to further outputs that have a final user
Ni	Intermediate outputs with considerable use by the next users and yet to lead to further outputs that have a final user
N	Some use of the results by the next users but no uptake by the final users
O	No uptake by either next or final users

Table 5. Examples of immediate impact measures

Economic: supply shocks	Environmental	Social
Productivity improvement on-farm • Unit cost reduction/input efficiency • Fixed-cost reduction/efficiency	Pollution pressure Reduced: • chemical run-off • noxious air emissions • waste generation	Health pressures • Disease incidence • Costs of treatment
Productivity improvement off-farm • Margin activities (e.g. transport) unit cost reduction	Greenhouse gas emissions Increased: • energy efficiency • carbon capture and vegetation	Employment opportunities • Job availability • Quality of employment (security, pay and conditions)
Input production efficiency— reduction in input costs	Soil degradation Reduced: • grazing pressure • land clearing	Improved rural capacity • Market access opportunities • Diversity of resource use options • Skills base
Economic: demand shocks	Environmental	Social
Improvements in quality ^a —increased willingness to pay per unit	Water—improved river/marine/estuarine health • Ecosystem services (see economic) • Recreation/amenity use impact • Existence impacts (see biodiversity) • Fisheries (see economic)	Participation and equity
Development of complementary products— increase in associated demand for product	Biodiversity protection/improvement of natural habitat/ecosystems • Threatened species • Ecosystem services • Recreation/amenity use impact	Confidence in the future
Improvements in market access		
Risk	Risk	Risk
Changes in the probability of or exposure to the risk of shifts in factors underpinning demand or supply	Changes in the level of threats to the environment	Changes in level of threat to social conditions

a Quality can be real or perceived; for example, demonstration of health benefits raises the confidence in a product and its perceived quality. Marketing is all about raising the perceived quality of a product relative to similar products.

Replicability describes the extent to which the project outputs perform as expected when adopted by the final user. It is well documented that technologies usually fail to perform as well under a normal operating environment as they do under trial conditions. Similarly, the results of policy changes rarely replicate those predicted by models employed to convince policymakers of the need for the change. For example, one study on the performance of new varieties of grains found that only about half of the yield improvement achieved under trial conditions was gained in practice.⁴ This disparity should be lower now, as trials are more likely to be conducted under real constraints facing farmers. Nevertheless, replicability should be considered in adoption studies. Better information on the likelihood of achieving the ‘best case’ outcomes in reality would assist in improving the estimates of ‘expected outcomes’, and hence the quality of ex-ante (and, in many cases, ex-post) assessments.

3.4 Identifying impacts and beneficiaries

3.4.1 Identifying the impacts

Effort should be made in adoption studies to identify the impacts that have arisen or are considered likely to arise. The main purpose is to test the presumptions on which the R&D proposal was based, to assess whether these are still valid. This is an important source of the lessons to be drawn from the adoption studies. The other feature of an adoption study is that it should consider the benefits to Australia. As discussed in section 2.6, the initial or first round impacts arise from the aggregation of the outcomes across adopters. The final impacts depend on the reactions and responses of markets, natural systems and communities to these impacts. The results mapping from outcomes to impacts can be based on well-accepted relationships and linkages that have been demonstrated in similar situations, or on the evidence available.

To identify the impact of a project requires consideration of the results over the full period when results can be observed. This is more than a time-related issue, it also requires tracing through the adjustments to the project impacts. For example, the introduction of the biological control for the banana skipper pest in Papua New Guinea

(PNG) reduced the impact of the pest on production and improved food security. Bananas are grown mostly as a subsistence crop in PNG, so two flow-on effects were the release of labour for production of cash and other crops, and reduction in the incidence of malnutrition.

3.4.2 Identifying beneficiaries

Beneficiaries are those people or communities affected in a substantive way by the impacts of the R&D. The main groups of beneficiaries are:

- the final users—often the farmers
- other producers along the value chain—for example, input suppliers, traders, processors and transporters
- consumers of the product
- communities of the producers.

Consideration should also be given to those who might lose from the impacts. They may include:

- non-adopting farmers or groups of producers
- users of the resources (labour, capital and materials) whose demand increases as a result of the adoption of the research, leading to increased price or decreased availability (compared with what it would have been without the research).

3.4.3 Sources of benefit for Australia

Consideration should also be given to the benefits to Australia. These may be direct as Australian producers adopt outputs from the research or indirect as Australia benefits from the outcomes in the developing-partner country. Continuing the banana skipper example, Australian banana farmers were also major beneficiaries as the control of the pest in PNG reduced the risk to Australian production. A meta analysis of ACIAR projects identified the following as the main sources of benefits to Australia (Pearce et al. 2006):

- project-derived technology improvements
- protection from pests and diseases by reducing pests and diseases in neighbouring countries and trading partners (lower risk of transport and migration of pests and diseases into Australia)

⁴ See for example, Dillon and Anderson (1990)

- knowledge and capacity built that lead to further innovations of value to Australia
- increased trade—access for Australian consumers, access to inputs for Australian producers.

3.5 Validation of information and evidence

Approaches to validation include the following:

- Triangulation—using information from three sources that are expected to have different viewpoints. These may include, for example, the project manager, researchers, the implementing agency, producers and customers.
- Top-down analysis—adding up the estimated results to ensure that they are consistent with known aggregate figures.
- Comparative analysis or benchmarking—comparing the results measured to those in similar situations and questioning results that are very divergent.
- Peer review—using expert judgment to challenge the approach to estimation and the measures used.