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Frameworks for assessing policy research and ACIAR's investment in policy-oriented projects in Indonesia

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Frameworks for assessing policy research and ACIAR's investment in policy-oriented projects in Indonesia

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Foreword

For more than 20 years, the Australian Centre for International Agricultural Research (ACIAR) has invested in the work of Indonesian and Australian social scientists and policymakers as they sought to improve economic policy for primary industries in both countries. The scope of the economic policy research studies has been wide, encompassing such topics as rice self-sufficiency, rural income and employment, fertiliser subsidies, dairy policy, growth and stabilisation policies, linkages between Indonesia's agricultural production, trade and environment, contract farming for smallholders, microfinance for agricultural producers in West Nusa Tenggara, resource-use efficiency in the coconut industry of North Sulawesi, and social capital and rural development in eastern Indonesia.

While establishing a link between research outputs and policy change may theoretically appear to be fairly straightforward and logical, it is, in practice, a difficult task. This is because there are generally many factors that can influence the policy formulation process. In light of the methodological difficulties, the primary aim of this study was to add to the body of literature on the development of methodological frameworks and tools that could be used to assess the benefits of policy-oriented research.

To achieve this, a thorough review of the literature on methods for measuring the impact of policy-oriented research was undertaken. This included examination of alternative approaches to the assessment of policy-oriented research in instances where there is little or no evidence of uptake of project outputs and where there are insurmountable attribution problems.

Lessons learnt from a review of the International Food Policy Research Institute's Impact Assessment Discussion Paper Series, the ACIAR Impact Assessment Series reports and recent studies by Consultative Group on International Agricultural Research Centers on the assessment of policy-oriented research are presented. The conceptual and practical problems that arise when assessing the impact of a policy-oriented research activity within a deterministic or a Bayesian framework are highlighted.

Finally, in addition to examining methodological issues, the study investigated the extent to which policy outputs were achieved in 10 case studies of Indonesian projects. The range and diversity of outputs from the projects are described. While it was concluded that undertaking in-depth impact assessment of ACIAR's investment in policy research in Indonesia would require substantial resources, the report noted that impressive and potentially valuable outputs were produced from all the projects.

Nick Austin
Chief Executive Officer, ACIAR

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Abbreviations

ACIAR	Australian Centre for International Agricultural Research
CGE	computable general equilibrium (model)
CGIAR	Consultative Group on International Agricultural Research
CIFOR	Center for International Forestry Research
EWM	economy-wide modelling
ICARDA	International Center for Agricultural Research in the Dry Areas
ICLARM	International Center for Living Aquatic Resources Management (now The WorldFish Center)
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
IPGRI	International Plant Genetic Resources Institute
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
IWMI	International Water Management Institute
POR	policy-oriented research
PORIA	policy-oriented-research impact assessment
R&D	research and development
WNT	West Nusa Tenggara

Executive summary

For more than 20 years, the Australian Centre for International Agricultural Research (ACIAR) has funded collaborative projects between Australian and Indonesian social scientists and policymakers with the aim of improving economic policy in both countries. The scope of this economic policy research has been wide, including agricultural subsidies and food self-sufficiency, income and employment of rural households, dairy policy, trade, growth and stabilisation policies, contract farming, microfinance and social capital, and resource-use efficiency in the coconut industry of North Sulawesi.

This report describes the findings of a study to review the literature on the impact assessment of policy-oriented research (POR), to scope out likely uptake of outputs and possible benefits from the abovementioned projects, and to investigate the feasibility of applying alternative frameworks for impact assessment of these Indonesian policy projects. The focus in this report is on economic research that might influence policy decisions by governments. The pivotal output of policy research is information that is an input to a policymaking process.

The review of literature on policy-oriented-research impact assessment (PORIA) relied heavily on conceptual and empirical impact assessment studies by the International Food Policy Research Institute (IFPRI), ACIAR and the Consultative Group on International Agricultural Research (CGIAR) Science Council. This literature includes a set of papers from a seminal seminar organised by IFPRI on 'Measuring the benefits from policy-oriented social science research', and some 45 empirical studies that traced the dissemination, influence and/or impact of POR studies.

Pardey and Smith (2004) list problems of attribution, circularity, implementation difficulties, valuation and 'poisoned-well' research as some of the key conceptual and practical challenges to evaluating policy research. Most empirical ex-post impact assessment studies of POR focus on three sequential steps along the impact pathway, namely dissemination of outputs, their influence on the policy process and consequential economic impacts from identified policy changes (CGIAR 2006). One of the main reasons why attribution issues were found to be particularly challenging is that research policy outputs are merely one of a number of intermediate inputs into the policymaking process, which is intrinsically complex and opaque.

Another challenge in mapping the impact pathway is the fact that the essence of POR outputs is the information content of research results, while the focus in many studies has typically been on the channels by which research outputs are disseminated. Hence, it is not surprising that conventional measures of output from the 2007 CGIAR PORIAs, such as lists of publications, and seminar and conference presentations, did not correlate well with either influence or impact (CGIAR 2008, p. 85). Conversely, the emphasis in some of these studies, such as the International Rice Research Institute (IRRI) PORIA on policy recommendations as the main output of the POR, enabled a highly credible counterfactual scenario to be constructed that attributed subsequent policy changes to POR outputs.

A demand-led orientation has been a common approach in assessing POR. This involves starting with a policy that is known to have changed, and leaving it to interviews with policymakers to ascertain the extent to which the policy change was influenced by POR outputs. Attribution of estimated benefits between outputs from POR, and other inputs to the policymaking process, is often cited as the most intractable problem in ex-post impact assessment of POR. In theory, this problem could be circumvented by taking the observed policy choice as the outcome for the

consequential scenario, and eliciting a counterfactual scenario about how the policy choice would have differed if findings from the POR had not been available. As far as could be ascertained, this straightforward question was not asked in any of the studies reviewed, although whether it would succeed or not seems far from clear. Another shortcoming with the demand-led orientation common to most PORIA was that it tended to exclude converse cases where policymakers had intended to change the status-quo policy, but were influenced by POR outputs to reverse such a decision. Such cases are most unlikely to be chosen for PORIA studies because of the practical difficulty of identifying instances where the prior intention of policymakers was to change a policy, but eventually they did not do so.

The widely used conventional approach to impact assessment is basically deterministic, in the sense that it does not explicitly incorporate decision-making under uncertainty. In this framework, the criterion for influence is a change to an intended policy decision. If there is no such change, there will be no difference in policy outcomes between the counterfactual and consequential scenarios. Hence, the POR will be judged to have had no impact on social welfare. One such set of cases, where policymakers fail to take 'good' advice, has been dubbed the 'Cassandra' problem by Pardey and Smith (2004). However, cases where POR outputs reinforce policymakers' prior intentions to maintain status-quo policies are almost certainly more common. Intuitively, such research provides reassurance that is valued by policymakers.

From a Bayesian perspective in which there is uncertainty about key state variables, the influence of new information is established by a change in subjective beliefs about 'pay-offs', which also will change the expected regret, or cost of uncertainty of any given policy. Hence, information from POR might, or might not, change a prior intended policy choice, but intuitively it will have some value as it reduces the expected regret of making a wrong decision. By the same token, if POR outputs do influence a policymaker to change a prior intended policy choice, the consequential benefits in the Bayesian framework are likely to be less than in the conventional framework because the policy change does not eliminate the cost of uncertainty.

Another advantage of a Bayesian approach is that it provides a conceptual framework to analyse the properties of information in different types of policy outputs, such as perceived veracity, bias, reliability or informativeness. However, there is at least one significant problem with this framework for ex-post impact assessment. For at least some outputs from POR, there is the possibility that the posterior cost of uncertainty of the chosen policy will be greater than that for the prior optimal policy. In other words, the ex-post impact of POR on economic surplus may, under some circumstances, be negative rather than positive, because learning from a specific POR output may increase rather than decrease the cost of uncertainty.

Despite a number of attractive theoretical properties, a mere handful of studies have applied a Bayesian decision theoretic framework to PORIA, and the complexity and many practical difficulties of doing so have convinced most analysts to eschew this approach. Nevertheless, to explore a different way to scope out the feasibility and desirability of carrying out a full ex-post impact assessment of 10 Indonesian POR projects, the Bayesian framework was treated as a conceptual analogue for the policymaking process where decision-makers learn from information from POR and elsewhere to update prior beliefs about the impacts under uncertainty of choices between alternative policies.

Specific criteria used to appraise a few selected economically important attributes of POR outputs from Indonesian POR projects were focus, number of potentially susceptible policy choices, readiness, probability of influence, number of highly susceptible policy choices, and geographic and economy sectoral scale. Prior subjective appraisal of these characteristics was based on project documents, interviews with project leaders, anecdotal evidence and personal perceptions of the policymaking process.

The only possible candidate from the Indonesian policy projects for further assessment of ex-post impacts would be the economy-wide modelling (EWM) group of policy projects. The poor prospect of establishing credible evidence of actual influence, coming up with a convincing case for the share attributed to POR outputs vis-à-vis other policymaking inputs, and deriving believable estimates of quantitative impacts of overall influence on policymaking, mean that all the other projects are totally unsuitable.

However, even for the highly successful EWM projects, the challenges of undertaking a formal ex-post impact assessment under either the conventional 'deterministic' framework or the Bayesian decision theoretic framework would be formidable. Moreover, the sheer scale of a comprehensive assessment that attempted to estimate most significant impacts logistically would be extremely difficult, if not impossible, but certainly prohibitively expensive. For a thorough study, a selection of outputs that was representative both of those believed to have influenced policymakers to alter a prior intended policy choice, as well as those that reinforced policymakers' prior beliefs to retain the existing policy, would need to be chosen. While this would permit a trial of the Bayesian framework as an alternative to the conventional framework for ex-post impact assessment of POR projects, the prospects of achieving the aims of such a project would be not be high, due to conceptual and practical problems, such as eliciting policymakers' prior and subsequent beliefs. Hence, the very substantial resources required could not be justified given the considerable risks involved.

Introduction

For more than 20 years, the Australian Centre for International Agricultural Research (ACIAR) has funded collaborative projects between Australian and Indonesian social scientists and policymakers with the aim of improving economic policy for primary industries in both countries.

These economic policy research studies have covered:

- rice self-sufficiency
- rural income and employment
- fertiliser subsidies
- dairy policy
- growth and stabilisation policies
- linkages between Indonesia's agricultural production, trade and environment
- contract farming for smallholders
- microfinance for agricultural producers in West Nusa Tenggara
- resource-use efficiency in the coconut industry of North Sulawesi
- social capital and rural development in eastern Indonesia.

Aims of this study

It was the intent of ACIAR's Impact Assessment Program to conduct a thematic evaluation of the economic impacts of the Centre's total investment in Indonesian policy projects. As a precursor to such an evaluation, this study was initiated with the following aims:

- First, review the literature on the impact assessment of policy-oriented research (POR) and, in particular, examine the applicability of conventional impact analysis involving a linear pathway from inputs to outputs to outcomes to impacts.
- Second, attempt to identify alternative approaches for the assessment of POR where there is little or no evidence of uptake of project outputs, and/or insurmountable attribution problems.
- Third, for selected Indonesian policy projects, scope out the extent to which policy outputs were achieved.
- Fourth, investigate the feasibility of applying identified frameworks for policy-oriented-research impact assessment (PORIA) to these Indonesian policy projects.
- Finally, outline a cost-effective plan for a thematic impact assessment of ACIAR's total investment in Indonesian policy projects.

Potential policy outputs from selected Indonesian policy projects were appraised by consulting the project documentation available and by interviewing the project leaders, who also were asked about the extent to which anticipated uptake of outputs had been realised. Furthermore, how such a diverse range of policy outputs might be used in the policymaking process was considered, together with the possibility of consequential outcomes and impacts.

Report outline

In the next section of this report, the literature on impact assessment of POR is reviewed, with a particular emphasis on some of the special problems in measuring benefits from social science research. This forms the basis for an examination of the applicability of the conventional impact pathway analysis that is widely used for impact assessment of scientific research and development (R&D). Where there is little or no evidence of uptake of project outputs, and/or where there are insurmountable attribution problems, the potential value of insights to be gained from evaluating POR from a Bayesian decision-making perspective is considered as part of an attempt to identify alternative approaches for PORIA in the third section.

The subsequent (fourth) section provides summary information on 10 selected Indonesian policy projects, and describes the diverse range of outputs produced by these projects. Given that, in many cases, evidence of uptake of project outputs either does not exist, or at least cannot be detected, and/or there is no evidential basis for attributing any outcomes to uptake of outputs from these ACIAR projects, the problems of applying identified frameworks for PORIA to these Indonesian policy projects are discussed.

In the concluding section, lessons learnt from this study are outlined, and the prospect of a more formal and in-depth cost–benefit analysis of some of these projects is appraised.

Review of policy-oriented-research impact assessment

Policy-oriented research

While most POR is social science research, not all social science research need be policy oriented. Nonetheless, the output of most social science research is information, the potential value of which depends on its capacity to influence one or more decisions, and on the likelihood of it doing so. For instance, at least some decisions made by households,[1] or by firms,[2] might be influenced by knowledge from social science research. However, the focus in this report is on social science research and, more particularly, economic research that might influence policy decisions by governments, either in the form of new institutions and policy instruments, or changes in the use of existing policies and policy instruments.[3] It is such research that is referred to as POR.

This is a somewhat narrower definition of POR than that used in CGIAR (2006) which, in addition to social science research, also encompasses biophysical/scientific research undertaken to inform government decision-making including, in particular, decisions about natural resource management. While accepting that some scientific research can be policy oriented, such research is nevertheless the exception rather than the rule. As none of the specific policy projects being scoped in this study had a scientific research component, the focus in this report is on social science research and, in particular, on economic research that is policy oriented.

Gardner (2008) states that POR is defined by its intended purpose. In other words, the principal aim of POR is to contribute to, and possibly influence, decisions by governments or other institutions that are embodied in laws, regulations or other instruments. In his view, the output of policy research is an intermediate product in the sense that it is an input into a political process that might change actions by policymakers in government, or actions of private citizens lobbying to influence government decisions that can impact on the welfare of people presided over by those governments or institutions (Gardner 1999).

Policy research most often relates to national or provincial government policies or to those of a regulatory authority but, according to Davis et al. (2008), it also can be applied to community-level collective decisions, or within an industry or firm where there is agreement to follow a set of rules governing behaviour. The types of policies that might be the object of research could include macro-economic stabilisation policies, tariffs, trade agreements and other trade policies, economic growth/development policies, natural resource management policies and regulations, competition policies and redistribution policies.[4]

1 Decisions about nutrition and health, for example.

2 For instance, decisions based on forecasts about future prices or other aspects of the economic environment.

3 Smith and Pardey (1997, p. 1531) note that economic research also may affect total factor productivity within government agencies themselves. Such research is not POR as defined in this report.

4 The Economic Research Service web site of the United States Department of Agriculture provides a longer list of examples of policy topics in the areas of: commodities, conservation and environment, farm income, food and nutrition assistance, food safety, labeling and information, R&D, risk management, rural issues, tax, trade and World Trade Organization (WTO).

The overall objective of ACIAR's investment in research is to improve the productivity and sustainability of agriculture in developing countries and Australia. According to Pearce (2005), the foundation for the potential to achieve this objective depends largely on a strong technical component in ACIAR's investment, but whether these opportunities are realised will depend on the policy framework in place. Hence, the case for the research investment portfolio to include a component of POR depends on various considerations. While the most obvious is the possibility of influencing policymakers to adopt, or stay with, policies that enhance community welfare and/or reduce poverty, another reason for investing in POR is the importance of the regulatory and operating environment to the adoption of technical R&D outputs, and the complementarity of policy and technical outputs.

By 2005, ACIAR had invested cumulative expenditure of about $21 million in real terms (2004 Australian dollars) over the previous 10–12 years to fund some 47 policy-related projects. Pearce (2005) estimated that this sum was probably equivalent to slightly less than 5% of ACIAR's total research investment over the 10 years. About 25% of total expenditure on POR went to funding projects in China, with Indonesian projects accounting for the next largest share of a little less than 20%.

Internationally, most agricultural development–related POR is carried out within the Consultative Group on International Agricultural Research (CGIAR) system, with the ultimate goals of poverty alleviation, enhancement of food security and sustainability of natural resources for the poor in developing countries (CGIAR 2006). If POR is defined to include the management of collectively owned resources regulated by policy regimes, then the centres that specialise in POR are the International Food Policy Research Institute (IFPRI), the International Water Management Institute (IWMI), the International Livestock Research Institute (ILRI), the Center for International Forestry Research (CIFOR) and the International Plant Genetic Resources Institute (IPGRI), plus the International Service for National Agricultural Research (ISNAR) until it was closed in 2003. Almost half of the 2003 CGIAR portfolio could be considered POR if all research projects that list policymakers, governments or development agencies as 'users' are placed in the 'policy' category (CGIAR 2006). Using a narrower definition based on classification of project outputs, POR expenditure in the CGIAR had increased from 9% of research in 1995 to about 18% by 2008 (CGIAR 2008, p. v). Note that the CGIAR regards 'policy research' as a broad and comprehensive term that encompasses everything from basic descriptive research to applied activities that might have policy implications and, as mentioned above, the term 'policy' does not define the discipline of research, but rather the intended primary pathway to impact.

Some of the key indicators of the products of POR in the CGIAR context are listed in Table 1, and are denotive of key stages in the impact pathway for POR.

Outcomes from policy research might include:

- policy change, such as trade related (external, domestic), macro-economic and entry or exit related
- more effective implementation of, and/or greater compliance with, existing policies and regulations
- institutional change, such as market arrangements, property rights, management structures or governance arrangements
- management change in marketing, quality assurance, management approach or production systems
- preventing implementation of bad policies that reduce net social welfare.

Ex post, the value of policy research derives from the extent to which it changes, or reinforces, intended decisions by policymakers or lobbyists, and the economic and social value of the consequences thereof (Gardner 1999). Potential benefits of policy changes include risk reduction, greater competition, enhanced property rights that enable the retention of the proceeds of effort, and stimulation of investment and innovation (Davis et al. 2008).

However, the aim of POR is not always so virtuous, and it is not uncommon for policy analyses and policy research projects to be motivated by rent-seeking. Especially when rent-seeking interest groups fund policy analyses, the intent is to achieve or subvert the redistribution of income to one group at the expense of other groups via the political process. However, regardless of whether POR is funded from public or private sources, there is the potential for the consequence to be a reduction in allocative efficiency and economic welfare for society as a whole (Smith and Pardey 1997).

Table 1. Some indicators of the products of policy-oriented research in the context of the Consultative Group on International Agricultural Research

Outputs	**Dissemination (*nee diffusion/uptake*)**	**Outcomes/influences/ policy responses**	**Impacts**
Publications • number and type • refereed/non-refereed	Publications • citations, use in curricula, circulation numbers, sales, requests, web hits	• Changes in policies attributable to policy research • Reinforcement of existing policies • Implementation of policy changes • Changes in institutions	• Reduced poverty • Improved food and nutrition security • Sustained livelihoods of the poor • Enhanced natural environment
Methodologies • description • value-added	Methodologies • use of new methodologies		
Training • number of trainees • extent of training • duration of training • number and type of manuals	Training • trainee promotions • number of others trained by trainees		
Seminars/symposia/conferences • number • type • number of participants	Seminars/symposia/conferences • number of policymakers present and influence on policy • invitations to centre staff to present keynote and other papers at other meetings—number, organisations and whether expenses are paid		
Press releases • number • type	Press releases • number of press releases published and in what fora; letters to editors spawned as a result		
Press conferences • number • type	Press conferences • number of press articles that resulted and in what forums		
Capacity-strengthening of partner institutions	Capacity strengthening • invitations to centre staff and management to be on committees adjudicating policy changes in partner organisations and countries • refereeing assignments of centre staff, requests for additional research in response to earlier outputs • degree of success in acquiring additional resources for policy research to partner institutions		

Source: CGIAR (2006, p. 10)

General guidelines for ex-post impact assessment

The principle that research benefits should be measured by the consequential changes in the economic welfare of all parties affected by the uptake of research outputs is now widely accepted (Alston et al. 1998). The aim of impact assessment studies is to identify, measure and value changes, intended and unintended, that result from uptake of outputs from research, development and extension (Davis et al. 2008).

Outputs are the deliverables from R&D projects. The implications for impact assessment of POR of how technology outputs differ from both capacity-building outputs and policy outputs, as well as differences in the way that they are used and adopted, are discussed in this section.

Although Walker et al. (2008) use the generic term 'research interventions' to include outputs from all types of research that might lead to a desired outcome, the immediate output of virtually all successful research projects is almost always new knowledge of one form or other. Such knowledge can be used in a variety of ways that are recognised in ACIAR's guidelines for assessing the impacts of research investments, where outputs are classified into one of the following three broad categories:[5]

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

In this framework, outputs from scientific R&D projects are typically categorised as either technical or capacity building. Typically, in the first category is new knowledge from scientific R&D that is embodied in improved products, or in new or improved inputs or processes that may be embodied or disembodied, but nevertheless are more or less 'adoption ready'. However, although some research outputs might be ready for immediate adoption, technology outputs often require several more transformations, or need to be commercialised, before they can be adopted.

For technology outputs, the pathway from investing in R&D to changes in economic welfare involves a number of tangible, intermediate steps that are often amenable to elucidation. Hence, impact assessment involves mapping progress from the R&D and extension inputs to research outputs that are then adopted by next users and subsequently by final users. Normally, the uptake of agricultural innovations (improved products or processes) leads to productivity gains that, in turn, generate commodity supply shifts with consequential changes in the economic welfare of producers and/or consumers. The welfare changes of these impacts are usually valued utilising a cost–benefit framework.

More commonly, however, new knowledge from research contributes to the intellectual foundations for further research and/or is incorporated into other capacity-building outputs that often are inputs into further R&D. Although capacity-building outputs[6] might eventually be used to produce adoption-ready technology outputs, they are, by definition, not 'adoption ready'.

Capacity-building outputs almost always include intellectual capital development (i.e. new knowledge), but other common examples include human capital development, such as the acquisition of specific technical skills and/or generic skills, and physical capital development, such as scientific equipment, laboratories, experimental trial sites or other physical research infrastructure. As such, they enhance the capability to carry out further research, so their value stems from their potential use as inputs into further research or other intellectual endeavour. Provided that there is further investment, capacity-building outputs may have the potential to contribute to future creation of adoption-ready technology outputs. Hence, while uptake of technical outputs by end users can have outcomes that have quantifiable near-term economic impacts, the pathway to eventual economic impacts from uptake of capacity-building outputs is normally

5 On the other hand, Walker et al. (2008, p. 8) distinguish only between technology outputs, where the knowledge is embedded in material products and practices, and policy outputs in the form of an enhanced body of knowledge that leads to improved understanding of the implications of alternative policies, and guides policy decisions.

6 Sometimes referred to as institutional-strengthening outputs.

much less direct, and tracing through the capacity and knowledge outputs to ultimate adoption-ready outputs can be a challenge (Pearce 2005).

Similarly, there is a broad consensus that the immediate output of most social science research, including virtually all POR, is predominantly new knowledge or information. It may be disseminated by way of publications, presentations at seminars and conferences, or via training programs. It also may be encapsulated in an economic model and/or in policy recommendations and briefs. For instance, Anderson (2003) noted that outputs from IFPRI's basic research on economy-wide modelling (EWM) included publications and the research methodologies presented therein, while applied research included data and models, and policy analyses using them, as well as training programs to strengthen capacity for policy analysis in developing countries.

Some similarities between policy-analysis and capacity-building projects have been noted by Davis et al. (2008) among others.[7] For instance, policy outputs are rarely totally adoption ready, and the impact pathway for outputs from POR is typically less direct than the pathway for technology outputs from scientific R&D, although sometimes it is rather more direct than that for capacity-building outputs. On balance, however, the outputs of POR have more in common with capacity-building outputs from scientific R&D than with technology outputs.

Survey of policy-oriented-research impact assessment

Notwithstanding some similarities between the impact pathways for capacity-building outputs from scientific R&D and those for policy outputs, there also are a number of significant differences. In particular, while capacity-building outputs find their main value as inputs into further research, the principal purpose of POR is to influence government's prior intended decisions about policies, regulations and institutions. Sometimes the outcome will be to alter prior intended decisions, while in other cases such decisions will be reinforced. Either way, the potential value of policy outputs derives from their possible use as inputs to the policymaking process. Furthermore, unless policy outputs result in outcomes in the policymaking process, such as a change in one or more policy decisions relative to the counterfactual scenario, or reinforcement of a prior intended decision that reduces expected regret, then it is difficult to envisage how POR can have any impact, beneficial or otherwise.

Hence, there is general agreement that, in contrast to impact assessment of scientific research, there is a lack of robust methods for carrying out ex-post impact assessment studies on POR (Walker et al. 2008). Some of the more notable ex-post impact assessment studies of POR that have been conducted to date are surveyed below before discussing a number of special challenges in carrying out such studies.

ACIAR published its first impact assessment study of POR in 1998, less than 1 year after IFPRI published the first study in its Impact Assessment Discussion Paper (IADP) series. IFPRI, in keeping with its global mission is to provide economic policy solutions that reduce poverty and end hunger and malnutrition, pioneered many of the early PORIA studies.[8] In 1997, IFPRI organised and hosted a symposium on the topic 'Measuring the benefits from policy-oriented social science research'. This was the first attempt to undertake a comprehensive exploration of the issues in impact assessment of POR. Papers from the symposium were subsequently published in Pardey and Smith (2004). Subsequent IFPRI activities aimed at assessing the impact of its policy research included workshops in 2001 (Ryan 2002; Anderson et al. 2005). Some of the lessons learned by IFPRI in the conduct of PORIA are detailed in Ryan and Garrett (2003) and Raitzer and Ryan (2008). At the time of writing, IFPRI had published about 30 papers in the IADP series.

7 Davis et al. (2008, p. 73) also note that:

> Capacity built can influence organisational effectiveness within the policy environment by enhancing reputation/position to advise government/push agenda; interactions with other agencies; champions/influence; ability to interpret policy.
>
> Uptake of outputs can lead to changes in operating environment (policy, supply chain) and hence influence market access; transaction costs; permissible practice; and input access.

8 For instance, see Islam and Garrett (1997), Ryan (1999a, b), Zilberman and Heiman (1999), Babu (2000), Anderson (2003) and Anderson et al. (2005).

Table 2. ACIAR ex-post impact assessment studies of policy-oriented research

Study	IAS[a]	Author(s) (year published)	Region	Sector
Wool production and marketing in China	IAS 4	Watson (1998)	China	Livestock
Mama Lus Frut scheme	IAS 20	Warner and Bauer (2002)	Papua New Guinea	Fruit
Grain-market reform in China	IAS 26	Mullen (2004)	China	Grain
Beef and wool industry policy cluster	IAS 31	Pearce (2005)	China	Livestock
Policy modelling methods cluster	IAS 31	Pearce (2005)	Indonesia	Agriculture
Trade reform cluster	IAS 31	Pearce (2005)	India	Trade
Water management in public irrigation schemes in Vietnam	IAS 43	Harris (2006)	Vietnam	Agriculture
Improved trade in mangoes	IAS 50	Monck and Pearce (2007)	Philippines/ Thailand	Fruit
Reform of domestic grain markets in China—a reassessment	IAS 64	Mullen (2010)	China	Grain
The biology, socioeconomics and management of the barramundi fishery in Papua New Guinea's Western Province	IAS 67	Fisher (2010)	Papua New Guinea	Fishery

Source: ACIAR Impact Assessment Study Reports

[a] ACIAR Impact Assessment Series report number

ACIAR also continued to make significant contributions to the literature on, and development of, PORIA methods.[9] Key features of ex-post impact assessment studies of POR commissioned and published by ACIAR are summarised in Table 2.

Recently, the Science Council of the CGIAR initiated a system-wide assessment of the impacts from CGIAR investments in POR. A scoping study (CGIAR 2006) preceded the selection of case studies to assess the impact of POR at seven International Agricultural Research Centres (IARCs). The principal findings of the study are reported in CGIAR (2008).

In reviewing indicators of the influence and impact of POR, CGIAR (2006) noted that most ex-post studies of POR focus on one or more of three sequential steps along the impact pathway:

1. Diffusion (dissemination)
   - Studies of dissemination seek evidence, such as citations, of transmission of policy outputs and awareness of research outputs among potential users in the policymaking process.[10]
2. Influence or policy response
   - Studies of influence seek to ascertain, typically by interviewing policymakers, the degree to which use of policy outputs alters the perceptions or conceptions of policymakers, and/or changes outcomes from the policymaking process.

[9] See Watson (1998), Warner and Bauer (2002), Mullen (2004, 2010), Pearce (2005), Harris (2006), Monck and Pearce (2007), Davis et al. (2008) and Fisher (2010).

[10] While the CGIAR (2006) study referred to the first indicator as 'diffusion', such terminology is inconsistent with the use of this term in much of the literature on technological change, where diffusion describes the aggregate spread of individual decisions by initial adopters to use a technology resulting from research, as opposed to simply becoming aware of the availability of such R&D outputs. In this report, the term 'dissemination' is preferred to describe cases where it is only possible to demonstrate readership and relevance to audience interests, but not usage in the policymaking process.

3. Impact
   - Studies of impact seek to quantify the consequential economic impacts on producers and consumers from identified policy changes.

The challenges of evaluating these key steps in the impact pathway are discussed in some detail below.

A catalogue of ex-post impact assessment studies of POR conducted in the IARCs was compiled for the scoping study. This inventory identified the 24 studies listed in Table 3 that trace the dissemination, and/or influence and/or impact of CGIAR POR activities. Attribution of quantitative estimates of benefits from policy interventions to specific national policy research projects was possible for only three of these studies, all from IFPRI, and all oriented to policy analysis. Of the remaining studies, 10 were able to identify the influence of the POR, while the other 11 studies went only as far as assessing the extent of dissemination of the POR outputs.

As part of the scoping study, CGIAR (2006) also devised the following taxonomy to classify the CGIAR's POR projects into one of the following four research categories:

- Process oriented
  - This is research that is primarily descriptive, and oriented towards identifying and analysing theories, problems and relationships, or providing insights and/or data for use in applied policy analysis and advice, albeit often indirectly.
- Method oriented
  - This is research that assembles, synthesises and embeds existing understanding in specific tools that can inform and support applied policy analysis and advice.
- Policy analysis
  - This is research oriented to providing recommendations to policymakers for specific policy changes by comparing the projected outcomes of a number of policy options.
- Management oriented
  - This is research oriented towards providing recommendations for improved institutional practices, such as research management and management of natural resources.

This taxonomy is useful in differentiating between the first two types of POR, outputs from which are similar to capacity-building outputs from scientific R&D in the sense that their primary use is likely to be as inputs to other POR, while outputs from either policy-analysis or management-oriented POR are, if not fully adoption ready, then at least closer to it.

In addition, the range of policies that might be influenced by outputs from process-oriented research, and to a lesser degree from method-oriented research, is likely to be broader than for the other types of POR. On the other hand, the likelihood of influencing any given policy will tend to be greater for outputs from policy-analysis or management-oriented POR, simply because they are closer to being adoption ready.

CGIAR (2006) concluded that inadequate justification for the attribution of influence to specific POR studies, and the lack of an explicit counterfactual scenario by which to assess the value-added by the specific POR being evaluated, were the two major limitations of the studies reviewed. Furthermore, unresolved methodological issues discussed at length in Pardey and Smith (2004), plus other challenges, also need to be overcome if the impact assessment of POR is to make progress.

Following consideration of the scoping study report, the Science Council's Standing Panel on Impact Assessment concluded that additional case studies were needed to augment the evidence on impact of POR, and to further develop methodologies for PORIA (CGIAR 2008). Abridged versions of the seven case studies are summarised in CGIAR (2008), and the scope of the seven commissioned studies is summarised in Table 4. All seven succeeded in the positive documentation of uptake by key policymakers and influence on policy change, which are critical precursors for attribution, but only five were able to estimate economic impact.

To a considerable degree, almost all of the impact assessments had a demand-led orientation that started with a known or perceived policy change, and worked backwards from this to investigate the pathways by which this change had occurred (CGIAR 2008). However, known outputs of a centre's research that arguably could have contributed to the policy change had also been identified before commencement of the impact assessments so, in a sense, they also had elements of a supply-led orientation. Either way, having identified research outputs that were linked to observed policy changes, at least in the minds

Table 3. Studies of the diffusion, influence and impact of CGIAR-sponsored policy-oriented research

Abridged title	Centre[a]	Region	Sector	Type of research[b]	Policy scale	Indicators assessed	Method of attribution[c]
Sustainability of forest management	CIFOR	Global	Forestry	Me/Mg	All	Influence	C/I
Evaluation of CIFOR research	CIFOR	Global	Forestry	Pr/Me/Po/Mg	Global	Diffusion	C
Citation analysis of CIFOR publications	CIFOR	Global	Forestry	Pr/Me/Po/Mg	All	Diffusion	C
Water demand management in Syria	ICARDA	Syria	Water	Pr	National	Influence	I
Bibliographic impact of ICLARM	ICLARM	Global	Fisheries	Pr/Me/Po/Mg	All	Diffusion	C
Asian fisheries social science research	ICLARM	Asia	Fisheries	Pr	All	Diffusion	I
Impact of rural finance policies	IFPRI	Global	Economics	Po	Global	Influence	I
Economy-wide modelling	IFPRI	Global	Economics	Me	National	Diffusion	C
Food security in Bangladesh	IFPRI	Bangladesh	Economics	Po	National	Impact	S/I
Wheat flour ration shops in Pakistan	IFPRI	Pakistan	Economics	Po	National	Influence	I
Strengthening food policy	IFPRI	Global	Economics	Pr	All	Diffusion	I
IFPRI's '2020 Vision'	IFPRI	Global	Economics	Po	All	Influence	I
Diffusion of policy knowledge	IFPRI	Global	Economics	Po	All	Diffusion	C
Agricultural projection modelling	IFPRI	Global	Economics	Me/Po	All	Diffusion	C
Policy research in Malawi	IFPRI	Malawi	Economics	Po	National	Influence	I
Rice policy in Vietnam	IFPRI	Vietnam	Economics	Po	National	Impact	I
Food for education program	IFPRI	Bangladesh	Economics	Po	National	Impact	S/I
Property rights research	IFPRI	Nth Africa	Economics	Po	National	Influence	I
IPGRI's influence on ITPGRFA[d]	IPGRI	Global	Agriculture	Po	Global	Influence	C/I
Impact of IPGRI's publications	IPGRI	Global	Agriculture	Me/Mg	All	Diffusion	S/I
ISNAR's institutional impact	ISNAR	Africa	Agriculture	Me/Po/Mg	National	Influence	I
Impact of ISNAR: 1997–2001	ISNAR	Global	Agriculture	Me/Po/Mg	National	Influence	C/S/I
Irrigation management transfer	IWMI	Global	Water	Mg	All	Diffusion	C/I
Alternatives to slash and burn	CGIAR	Global	Agriculture	Pr	All	Diffusion	C/S/I

Source: CGIAR (2006, pp. 37–39)

[a] CIFOR = Center for International Forestry Research; ICARDA = International Center for Agricultural Research in the Dry Areas; ICLARM = International Center for Living Aquatic Resources Management (now WorldFish Center); IFPRI = International Food Policy Research Institute; IPGRI = International Plant Genetic Resources Institute; ISNAR = International Service for National Agricultural Research; IWMI = International Water Management Institute; CGIAR = Consultative Group on International Agricultural Research

[b] Pr = process; Me = methods; Po = policy analysis; Mg = management

[c] C = citations; I = interviews; S = survey

[d] ITPGRFA = International Treaty on Plant Genetic Resources for Food and Agriculture

Table 4. Summary information on the scope of the seven CGIAR policy-oriented-research impact assessment case studies

Centre[a]/ author(s)	Region	Constraint/problem identified	Research (related) output	New policy/practice adopted
Bioversity International/ Gotor and Caracciolo (2010)	Global	Exercising national sovereignty over crop germplasm, potentially restricting gene flows	'Trusteeship' model for gene banks; facilitation and honest brokering role; advocacy	In-trust Agreement reached and signed
CIFOR/ Raitzer (2008)	Indonesia	Environmental costs high due to corrupt policies encouraging forest clearing	Exposed links between fibre-sourcing practices and natural forest clearance in the pulp and paper sector	Ministerial Decree adopted requiring mills to source all wood from plantations by 2009
ICARDA/ Shideed et al. (2008)	Syria	Policies restricting fertiliser use (allocation) on barley in arid zones	Showed benefits of fertiliser in arid zone; recommended fertiliser rates in each zone; policy dialogue; advocacy	New fertiliser policy (with credit extended to Zone 2) adopted in 1989
IFPRI/ Behrman (2007)	Mexico	Risk of dropping a cash-transfer program deemed effective at keeping children in school longer	Evaluation of PROGRESA[b] program of conditional cash transfers for efficacy and impact	Mexican Government continued with PROGRESA program in basically the same form
ILRI/Kaitibie et al. (2010)	Kenya	Colonial dairy policy protected large-scale dairy producers; criminalised activities of small-scale milk vendors (SSMV)	Small Dairy Project produced evidence supporting policy and institutional reform, e.g. vast numbers of SSMV depending on dairying for livelihood	Revised Kenyan dairy policy adopted in 2004; training and licensing of SSMVs
IRRI/ Templeton and Jamora (2008)	Philippines	Indiscriminate use of pesticides on rice with harmful effects on health and ecology	Research evidence on the economic health costs from pesticide use in rice	1992–1996 policies regulating highly toxic insecticides in rice; training of health officers
WorldFish Centre/Pemsl et al. (2008)	Bangladesh	Current policy of leasing water bodies to highest bidder results in over-exploitation and exclusion of poor fishers	Research derived improved inland fisheries management policies and practices tested and extended to 116 water bodies	Awareness of, and attitudes towards, community-based fisheries management spreading among key stakeholders

Source: Adapted from CGIAR (2008, p. 3)

[a] CIFOR = Center for International Forestry Research; ICARDA = International Center for Agricultural Research in the Dry Areas; IFPRI = International Food Policy Research Institute; ILRI = International Livestock Research Institute; IRRI = International Rice Research Institute; CGIAR = Consultative Group on International Agricultural Research.

b PROGRESA = Programa de Educación, Salud y Alimentación

of the investigators, meant that the impact pathway was both simpler in structure and easier to map than cases where either the research outputs that contributed to an observed policy change were unknown and needed to be identified, or vice versa. For this reason, it might have been thought that most of the case study impact pathways would be quite simple and straightforward. In fact, a number of the elicited impact pathways were notable for their complexity, multiple linkages, non linearity and convoluted trails. Documenting the dissemination and influence of all relevant research policy outputs along such pathways proved to be a formidable task requiring significantly more resources that might often be available, or warranted, for routine PORIA.

In all the studies, authors spent much time and effort interviewing key informants to evaluate the degree to which the policy change of interest could be attributed to the centre's research or research-related output. In many cases, primary and secondary data and reports were also canvassed to validate and support information gleaned from interviews. Notwithstanding the large amount of resources devoted to documenting influence, the results suggested that methods to do so are neither simple nor readily codifiable. A key conclusion to come out of this exercise was that attribution is particularly problematic, and why this might be so is discussed in the next section.

Across the seven studies, there did not seem to be any association between the characteristics of research on a strategic versus applied versus adaptive continuum and its influence or impact. Also, no positive linkage was found between the duration of the research and its success, although this finding may be somewhat illusory because arguably the impact assessments did not account for all of the upstream research inputs.

Finally, the five case studies that estimated the welfare effects of policy change all used the staple methodology of cost–benefit analysis to estimate ultimate economic impact, but several authors found some areas challenging, in particular the construction of an appropriate counterfactual scenario. Where empirical results from earlier policy research were not available for potential use in the analysis, impact assessment was more onerous because impact assessments had to be carried out 'de novo'.

Key challenges in policy-oriented-research impact assessment

A number of key conceptual and methodological challenges that are specific to the careful evaluation of the impacts of policy research, and beyond those faced in impact assessment studies of scientific R&D, have been identified in the literature. The following summary of these special POR-related issues draws heavily on Pardey and Smith (2004) and CGIAR (2006, 2008).

Attribution and counterfactual issues

For ex-post impact assessment of all types of research, attribution is one of the most difficult problems to be confronted. For ex-post impact assessment of POR, establishing the degree to which a newly adopted policy can be attributed to specific well-defined research is an especially challenging task.

CGIAR (2006) describes mapping of the following stages as the additional steps, beyond generation of research outputs, required in an impact assessment of POR:

- communication of a policy tool or information output to policymakers or influencers; the influence, if any, on policy considerations
- the consequential influence on policy change as enshrined in law, regulations or guidelines
- implementation and compliance with changes in laws and regulations
- a response by producers and/or consumers.

Two approaches to mapping the pathway are possible. In a supply-led orientation, mapping the impact pathway starts with the POR and works along the pathway to policy change and impacts. Alternatively, a demand-led orientation starts with a known policy change and attempts to work back to the causes for such a change. If the former approach is taken, it is extremely unlikely that any particular policy-related research activity will have identifiable effects, because policies that are so narrowly tailored are rarely enacted. Conversely, if a demand-led orientation is taken, it is just as unlikely that any particular policy change will have been driven mainly by POR outputs, let alone by a set of closely related policy research projects[11] (CGIAR 2008).

Either way, the critical step is attributing changes in policies to selected policy research. Invariably, the output of POR is but one input to the policy development process, so separating its contribution from that of other inputs is much more of a challenge than for ex-post impact assessment of embodied technological change. Specifying the right counterfactual scenario is critical too, as the direct effects of the POR over and above that of other research

[11] There may be rare exceptions where POR is explicitly commissioned as part of the policy process to resolve a key policy issue.

and information must be considered together with many other factors that can influence policymakers.

Sometimes, even for the first step of the impact pathway, attribution of particular outputs to specific inputs can be difficult, because research projects are often conducted in collaboration with other research institutions, so any output is a joint product. However, of the components in the impact pathway comprising inputs, outputs, dissemination (or uptake), influence and impact, it is the last two steps, namely influence and impact, that raise the most difficult problems of evaluation of POR (CGIAR 2008). Although attributing particular outcomes to specific outputs, and attributing particular impacts to specific outcomes, give rise to the most difficult attribution problems for all ex-post impact assessments, such problems are exacerbated for ex-post studies of the benefits from investments in POR.

Apart from the fact that they are rarely, if ever, adoption ready, outputs from policy research are difficult to specify and quantify in any meaningful way. Davis et al. (2008) list outputs as comprising publications, analytical methods, training, conferences, press releases and capacity strengthening. Sometimes each category is broken down into different kinds of output. For instance, publications might range from peer-reviewed professional journal articles to policy briefs intended for a lay audience. However, Gardner (2008) asserts that no serious impact analysis can go far with this approach alone.

Once POR outputs have been identified, the next questions to investigate are whether policymakers know of and pay attention to these outputs and, secondly, whether such awareness influences their views, and possibly their decisions. CGIAR (2006) notes that effective dissemination through conferences, policy briefs and other activities aimed at informing policymakers is crucial, because in order to influence policymakers, POR outputs must not only reach them, but gain their attention in such a way that they take them up.

A common approach to measuring uptake or dissemination is to look at citations and other measures of academic utilisation of research output. Gardner (2008) notes while these metrics may demonstrate readership and relevance to academic audiences, in isolation such measures offer few insights about influence on non-academic target groups. Another approach to measuring uptake, that to some extent overcomes this concern, is to conduct surveys of possible users, with the aim of assessing the degree to which there is transmission and awareness of research findings among different audiences.

However, evidence of dissemination of policy outputs offers few insights into the value of policy outputs to the policymaking process. The most complex and challenging part of tracing the impact pathway of POR is the step between uptake of the research output by immediate 'clients' as well as awareness among a broader set of users, and influence on eventual decisions by legislators and regulators to articulate, approve and implement policies. Relative to the counterfactual course of events without the information, policy formulation and/or implementation must be influenced and altered by outputs from POR for it to have impact.[12] Hence, one of the most difficult tasks for ex-post impact assessment of POR is to identify and define a plausible and credible counterfactual scenario of how policy might, or might not, change in the absence of POR outputs.

Indeed, the focus on the channels by which research outputs are disseminated, such as the number of publications etc., rather than on the information that they convey, which is the essence of POR outputs, has contributed to the problem of attribution in previous empirical studies. It is not surprising that conventional measures of output from the 2007 CGIAR PORIAs, such as lists of publications, and seminar and conference presentations, did not correlate well with either influence or impact (CGIAR 2008, p. 85). Conversely, the emphasis in some of these studies, such as the International Rice Research Institute (IRRI) PORIA, on policy recommendations as the main output of the POR, enabled a highly credible counterfactual scenario to be constructed that attributed subsequent policy changes to POR outputs.

Gardner (2008) likens dissemination as the supply side of the policymaking process, and uptake as the user's attention to it. In other words, dissemination is necessary for policy influence, but not sufficient. Research output then has to enter the policymaker's frame of mind or 'beliefs'. While specifying research

[12] Walker et al. (2008) make the point that it is much more difficult to link an institutional change to policy research than it is to link a change in yield to plant-breeding research.

outputs by the form in which they are delivered might be a satisfactory way to quantify dissemination, it is the content of the information therein that will determine influence. Given that neither dissemination nor uptake, as defined by Gardner, is sufficient for policy influence, it is questionable whether past efforts to document evidence of dissemination were misplaced.[13]

Pearce (2005, p. 34) argues that outcomes from POR are rarely tangible, but consist mainly of sets of more or less complex ideas in the minds of policy researchers, analysts, policymakers and politicians involved in the formation and maintenance of a society's institutions. As a result, there is usually no objective indicator of innovation source for particular policy outcomes, nor any factual basis for assessing the extent to which a particular piece of research caused (or prevented) policy changes, so attribution of influence is extremely difficult.

However, the fundamental reason for the quandary of attribution in impact assessment of POR is that policy research outputs are merely intermediate inputs into the policymaking process, which is intrinsically complex and opaque due to its political, multi-actor, multi-interest and often multi-period nature. Hence, elucidating the segment of the impact pathway from dissemination of outputs to influence on policy is arguably the most difficult of all.

CGIAR (2006) sought to comprehend how the underlying political processes might influence policymaking to understand how information from POR can influence policy outcomes, and to clarify the maze through the policy process. The relevant literature that aims to understand political action is huge, and a wide cross-section of this literature was reviewed during the CGIAR studies. CGIAR (2008) highlighted a study by Weiss (1979), who drew attention to the complexity of the impact pathways, and who argued that most POR studies fail to leave a discernible mark on the direction or substance of policy, because (Weiss 1979, p. 428):

> … it takes an extraordinary concatenation of circumstances for research to influence policy decisions directly: a well-defined decision situation, a set of policy actors who have responsibility for making the decision, an issue whose resolution depends at least to some extent on information, identification of the requested informational need, research that provides the information in terms that match the circumstances within which choices will be made, research findings that are clear cut, unambiguous, firmly supported and powerful, that reach decision-makers at the time they are wrestling with the issues, that are comprehensible and understood and that do not run counter to strong political interests.

Despite finding elements of considerable interest and some insight in the body of knowledge on political action, the review did not uncover any findings that were particularly helpful for practical impact studies of POR. In particular, no clear practical guidelines to resolve the conundrum of attribution were found.

Given that policy can be shaped by many other forces besides POR outputs, the lack of transparency of the policymaking process poses a particular challenge for PORIA studies. Gardner (2008) describes policymaking as a serendipitous process in which decision-makers are often driven by individual expectations of political support rather than by a desire to implement socially optimal policies. Usually, there are many simultaneous sources of information, influence and advocacy behind policy formulation, so decision-makers are flooded with information and may have limited capacity and willingness to consider external analyses. Moreover, while some sources of influence and advocacy might be complementary to research outputs, others could be competitive. Weiss (1979) spells out the complexity of the various ways in which outputs from POR might be used, and ultimately influence policy decisions.

Hence, evidence for attribution, or a claim of causality from research to policy change, has to rely largely on the statements of policymakers for verification (Norton and Alwang 2004). Surveys and interviews with policymakers and their staff, and reports from advisers or others involved in the policymaking process, are the techniques typically used in attempts to ascertain the degree to which policymakers have changed their perceptions in response to specific pieces of information, together with other competing claims of influences on policy change. Eliciting convincing evidence on these matters is by no means a trivial exercise, and will depend upon the subjective recall of those concerned. This puts a great deal of importance on policymakers knowing in some detail what they did and

[13] One caveat to this conjecture is that an institutionalised process of establishing dissemination (and possibly influence) might enhance internal learning from past research and improve the effectiveness of future POR.

why they did it. The reliability of this information will depend on, among other things, how far in the past were the events in question, because often individual recall of prior events may be limited. These techniques also make the substantial assumption that policymakers will answer frankly, even if they have changed their position in the meantime. Hence, such recollections may over- or under-attribute the actual role of the information source concerned.

To some extent then, the problem of attribution is due in part to practical issues of elicitation, such as reliably capturing the subtleties and nuances of the complex phenomena under inquiry, given time constraints for interviews, plus the fact that some key informants were closer to the action than others and/or played a more central role in policymaking, and some had better memories. According to CGIAR (2006), it is often the advisers to policymakers who read POR outputs and decide how to use them to influence policy decisions. After a review of IFPRI's policy research based on EWM, Anderson (2003) concluded that his surveys of decision-makers did not provide convincing evidence that policy changes were a direct consequence of the research being assessed. While surveys and narratives can play a role in studies of influence on policy, they do not establish what the benefits are relative to a counterfactual scenario of policy conceived in the absence of the research.

Moreover, due to political influence and compromise, it is often the case that policy recommendations are only partially adopted, or are adapted and modified over time and, where government institutions are weak, formally agreed policies may not be fully implemented or enforced. Elicitation of the causal pathway from policy influence to ultimate impact also needs to take account of the fact that, even if new regulations and programs are well implemented, realisation of economic benefits and poverty-reducing impacts also depends on farmers and/or resource managers responding to the new sets of incentives established by the policy reform.

Furthermore, specifying the counterfactual scenario is especially problematic (Walker et al. 2008). By definition, the counterfactual can never be observed, and that controlled experiments cannot be conducted in the policy sciences further complicates the assessment of the impacts of policy research. A greater problem arises where policy research simply reinforces the case for current policies, thereby helping to avert losses from a change to an inferior policy. Attributing the benefit of no change in policy to confirmatory research is especially difficult to discern, document and assess (Anderson 2003).

Also noteworthy is the fact that none of the case studies reported in CGIAR (2008) used Bayesian analysis to more rigorously probe the dimensions of information uptake that precedes influence. As the authors of the synthesis report comment, Bayesian decision theory provides a framework for valuing information, and arguably could have been especially insightful in exploring the element of surprise in the POR outputs that loomed large in the case-study accounts (CGIAR 2008). They also comment that, with hindsight, the failure to do so reinforces Lindner's evaluation that the Bayesian approach is difficult to implement (Lindner 2004). Further discussion of the alternative Bayesian approach for future PORIA is deferred until later in this report.

Having reviewed many of the above issues, CGIAR (2006) concluded that the attribution problem may turn out to be fundamentally insoluble, always requiring a subjective estimate of the contribution of policy research to a particular policy change.

The 'poisoned-well' problem

Ex post, most scientific research projects are viewed as being dry or shallow wells that yield few if any benefits, while a few are gushers that yield large, positive benefits. Conversely, several economists have pointed out that a significant number of social science research projects have resulted in negative benefits. Such outcomes have been dubbed 'poisoned wells' by Pardey and Smith (2004). One cause of poisoned wells is poor economic research based on faulty logic. For instance, Krueger (1997) has documented a case from the mid 20th century when many developmental economists advocated import-restricting trade policies that relied heavily on import substitution and which resulted in the implementation of ill-advised, welfare-reducing measures.

However, it is arguably misleading to portray the only outcomes of scientific research as being dry or shallow wells, or gushers. The history of science contains many instances of good intentions and, supposedly, good science gone wrong, and consequential release and

uptake of 'rogue' technologies. Nevertheless, there seems to be tacit agreement in the literature that poisoned wells are a more serious issue for the impact assessments of policy research than for scientific research that generates adoption-ready technology outputs, such as process and product innovations.

An interesting question to explore is the reasons why poisoned wells might be a more common outcome of POR than of technology-oriented research. One explanation why poisoned wells are not a common problem for the latter type of research is that the self-interest of potential adopters of technology outputs, who at least initially are also the primary beneficiaries of uptake, is often aligned with overall social welfare, although the converse is by no means uncommon. Notable exceptions where there is a misalignment between private and public interests include cases where the adoption of technology outputs results in adverse environmental and/or social impacts. However, in the absence of such externalities, if potential adopters of a process innovation will benefit from adopting it, then uptake of the technology output will result in a downward shift of the supply curve, with consequential increases in social welfare. Therefore, for technology-oriented research, there is an inbuilt mechanism that tends to ensure that, most of the time, only good technology gets adopted, and bad technology is left to languish on the shelf.

The primary exceptions to this virtuous selection process, such as cases where adoption of technology outputs has negative economic, environmental or social consequences,[14] are widely recognised. Consequently, often there are other policies in place to ensure a greater alignment between private and public interest. As a result, the impacts on social welfare of most technology outputs that are permanently adopted[15] are overwhelmingly positive, and contrary cases tend to be the exception rather than the rule. Moreover, because such cases have been extensively documented, the established methodology for impact assessment of technology-oriented research specifically incorporates processes to at least identify, and sometimes to quantify, both positive and negative impacts associated with such externalities. For instance, in the guidelines for impact assessment of ACIAR research investments, a triple bottom line approach of identifying and, if possible, quantifying, economic, environmental and social impacts is advocated (Davis et al. 2008).

By contrast, there are no comparable safety mechanisms for selecting POR that help to moderate the poisoned-well problem. It is noteworthy that the self-interest of policymakers, who are the potential adopters of policy outputs, often might not align with the broader community welfare.[16] The public choice literature is based on the premise that potential adopters of policy outputs may have private agendas that do not coincide with the public interest, and hence will not have the same self-interest in adopting only welfare-enhancing policies. Thus, it is unlikely that the competitive political process will play an equivalent role to competitive market forces in minimising the poisoned-well problem.

Arguably, a problem of much greater significance for the impact assessment of POR are rent-seeking activities by interest groups who fund biased and distorted POR in attempts to influence policy outcomes, and thereby gain benefits for themselves that are not only to the detriment of other groups in society, but also reduce overall welfare (Krueger 1997). Such deliberate provision of misinformation, as opposed to failure to provide complete information, is comparatively rare for technology outputs from scientific research projects, but endemic to POR. Depending on how effective such misinformation is in influencing policy outcomes, ongoing 'public good' POR might have value in offsetting such biased activity, in a similar way that crop protection scientific research can offset what otherwise would be declining crop productivity.

Lastly, as Pardey and Smith (2004) note, the poisoned-well problem also has important implications for PORIA, because any evaluation of economics research cannot simply focus on the upside of the research and ignore its downside. Effectively, this is what happens with a cherry-picking approach that assesses

14 One such case is documented in the classic paper by Hightower (1972).

15 As opposed to temporarily trialling an innovation, and then discarding it when it becomes clear that continued uptake will not deliver the expected benefits.

16 In democracies, it could be argued that the necessity to face the voters at periodic intervals provides a similar intrinsic mechanism to align the self-interest of policymakers with community welfare, but it is widely accepted that instances where this has failed to happen are too numerous to document.

the benefits from gusher wells only, and compares them to total outlays for all research, on the ground that this will provide a lower-bound estimate of the return to the overall research program. Clearly, if some of the projects ignored in the cherry-picking approach have large negative benefits, then such an approach may overestimate the return to the overall research program.[17] However, there are several other implications for ex-post impact assessment of individual POR projects that do not seem to have been widely recognised in the literature. They are discussed below.

The 'Cassandra' problem

Smith and Pardey (1997) have dubbed the question of what value, if any, to ascribe to good advice not taken as the 'Cassandra' problem. To date, the challenge of trying to provide a persuasive answer to the Cassandra problem does not seem to have been taken up in the literature, and this question too will be explored in more detail below.

Valuation problems

Timmer (2004) asserts that there are some fundamental problems that make it difficult to evaluate the benefits from POR. One is how to value goods and services where there is a difference between their market value and their true social value, or where the good is not traded in a market. Second, the difficulty of making interpersonal comparisons when a policy is not Pareto-improving bedevils any evaluation of impact on net social welfare.

Both of these problems are not unique to impact assessment of POR, and can arise in any cost–benefit analysis. They have been discussed at considerable length in the welfare economics literature. At least to some extent, they are being covered by non-market valuation methodologies. Furthermore, the problem where feasible redistributions are not actually implemented for potential Pareto-improving policies are no different than for any other change that might increase, or decrease, social welfare.

A more troubling problem is the circularity involved in using the product of policy research to measure the benefits of policy research. Pardey and Smith (1997) refer to this as the 'fox in the henhouse' problem.

Summary

Some of the problems listed above, including in particular the measurement problems, are features of much of the terrain of economics, and are unlikely to be resolved soon, if ever.

For particular POR projects, it has been shown that attribution and counterfactual issues can be addressed by diligent investigation, although whether the end result justifies the effort involved is open to question (Anderson 2003; Templeton and Jamora 2008). For most POR, however, attribution problems seem insurmountable. Usually, the early part of the impact pathway can be traced fairly easily, and the latter path of the impact pathway from policy outcomes to economic impacts, while not without challenges, is amenable to analysis. However, in the middle there is a large lake, into one side of which are tipped the outputs from POR, together with numerous other snippets of information. On the other side of the lake, policymakers selectively sample appealing bits of information before making decisions whether or not to change particular policies. What happens to POR outputs on the journey across the lake is far from transparent.

Another characteristic of POR noted by a number of commentators is the potential, for reasons other than externalities associated with innovation uptake, for some research projects to reduce rather than increase welfare. In particular, POR lends itself to rent-seeking activities by special-interest groups in ways that rarely, if ever, apply to technology-oriented research. Furthermore, while the self-interest of potential primary adopters of technology outputs is usually closely aligned with broad community welfare, it can be argued that this is often not the case for POR.

These poisoned-well and Cassandra problems are considered further, following an exploration of the insights that a Bayesian approach to PORIA might yield.

[17] When ACIAR moved to a random selection process for impact assessments of both technology and policy projects in response to this issue, it found that even those projects that had meagre economic benefits often had significant benefits in terms of capacity building or strengthening.

Policy-oriented-research impact assessment from a Bayesian perspective

Policymaking under uncertainty

The conventional approach to impact assessment followed in most of the studies discussed above is basically deterministic, in the sense that it does not explicitly incorporate decision-making under uncertainty. In such a deterministic framework, POR outputs might, or might not, influence policymakers to change a prior intended policy decision that would have been instigated under the counterfactual scenario.

If the prior intent was to continue with a current policy, information from POR that persuades a policymaker to change the current policy will create value if the change is from a 'bad' policy to a 'good' policy, but equally will destroy social welfare if the change is from a 'good' policy to a 'bad' policy. Similarly, POR outputs will be welfare enhancing if they dissuade policymakers from a prior intent to substitute a 'bad' policy for a 'good' policy, and instead to persist with the current 'good' policy. However, if policymakers are persuaded by POR to continue a 'bad' policy when the prior intent was to change it for a 'good' policy, then social welfare will be diminished by the POR.

Furthermore, sometimes POR outputs will affect the timing of policy decisions rather than the eventual outcome, so POR can have value if policymakers are influenced by research outputs to take 'good' decisions sooner, or to postpone 'bad' policy decisions for longer. In some conventional PORIA studies, the value from changing the timing of a welfare-enhancing policy has been used to derive a conservative estimate of the economic value of the POR information.[18]

Nevertheless, it is conceivable that a particular policy might never change in response to POR outputs because information from it merely reinforced beliefs that the prior intended decision was in fact the 'best' choice. Likewise, conflicting POR outputs might never lead to any change to the prior intended decision because policymakers' beliefs were not sufficiently influenced to cause them to change their assessment about the 'best' policy choice. In conventional impact assessment, for such cases there is no apparent basis for ascribing value ex post to the policy outputs because influence is demonstrated only by a change to a prior intended policy decision at some point in time.

This is despite it being widely accepted that the value of POR outputs derives from their potential use as inputs to policymaking, a process that inevitably involves decision-making under uncertainty. Intuitively, any information from POR will have some value to policymakers when there is uncertainty about the value of key state variables that co-determine the optimal policy decision, because, ex ante, such information reduces the expected regret of making a wrong decision.

Hence, one problem with the conventional approach is the critical issue of how to judge influence. New information from POR might be influential, in the sense that it causes policymakers to revise their prior beliefs about the desirability of alternative policies. However, even after assimilating this information so that their posterior beliefs differ from their prior

[18] For instance, see Ryan (1999a).

beliefs, they may, or may not, actually change their prior intended policy decision.

Clearly then, a prime determinant of POR value will be the content of the information in the POR outputs. While some conventional PORIA studies have recognised this point, and policymakers have been interviewed to explore what information was most significant in making decisions, other studies have merely measured the form of delivery of POR outputs, which has, at best, a tenuous influence on value.

Also, if prior intended policy decisions are changed, the difficult problem of attribution for such a change arises because findings from POR are just one input to the policymaking process. For this reason, as well as for others to be discussed below, the consequential benefits of POR having some influence in a decision to change a prior intended policy choice are quite likely to be overestimated with the conventional approach. Last, there is no known logical conceptual framework for adjusting such estimates on the basis of perceived veracity, bias, reliability or informativeness of different types of policy outputs. Ex ante, while both outcomes can be probability weighted, the fundamental valuation problem remains.

A Bayesian approach to policy-oriented-research impact assessment

A somewhat different way to conceive policymaking is as a decision-making process under conditions of uncertainty about key states of nature that, together with policy choices, will co-determine economic impacts. A few authors[19] have suggested that evaluating POR within a Bayesian decision theoretic framework might be insightful, but even fewer have sought to demonstrate how the conceptual framework of Bayesian decision theory could be applied to PORIA.

Of those that have done so, Gardner (1999) provides a simple, stylised example of the application of Bayesian decision theory to a hypothetical two-action, two-state policy decision to illustrate how such an approach works analytically. The two policy actions are an acreage control program and a production subsidy program. POR provides imperfect information that might be incorporated into policymakers' prior beliefs about whether export demand for a commodity is either price elastic or inelastic, and thereby possibly influence the choice between the two alternative policies. Gardner had no evidence on the relevant policymakers' beliefs, but concludes from this simple model that three elements determine the ex-ante value of the research: first, the value of acting upon the information the research provides if the information is correct; second, prior knowledge about the subject of the research; and third, the quality of the research, as measured by the likelihood that research findings are correct. More insights are likely to flow from a richer model.

Norton and Alwang (2004) discuss the application of Bayesian decision theory to PORIA, but do not literally apply it to subsequent examples of the evaluation of policy research on deforestation in Brazilian Amazonia, and the effect of tax and exchange-rate policies on pesticide prices in the Philippines. While not explicitly Bayesian, their approach to these two illustrative examples is quasi decision theoretic, albeit one that is highly simplified, as key parameters were obtained from fewer sources than desirable. They also note the difficulty of defining the states of nature about which policymakers are uncertain, and that eliciting policymakers' subjective beliefs for the various states of nature, both before and after new information is received, is a significant impediment to using Bayesian decision theory in PORIA.

Schimmelpfennig and Norton (2003) are the only economists to have developed a formal theoretical framework to evaluate the ex-ante returns to POR within a Bayesian decision theoretic framework.[20] They also demonstrated that it is feasible to apply such a framework in a reasonably realistic, albeit simplified way, to evaluate use of outputs from three United States Department of Agriculture POR programs. One was the risk-management research program of the Economic Research Service that provided policy advice about setting premium rates for revenue insurance. The second was research that developed Hazard Analysis and Critical Control Points plans to strengthen the meat

[19] Lindner (1987, 2004), Gardner (1999, 2008), Schimmelpfennig and Norton (2003) and Norton and Alwang (2004).

[20] For more details of this framework, see Appendix 1.

and poultry inspection system that seeks to monitor and control food safety. Third was POR on the Uruguay Round of multilateral trade negotiations that increased awareness of the nature and size of the trade distortions and their economic costs, and objectively analysed the benefits to the economy of specific negotiating outcomes. These case studies illustrated the difficulty of eliciting highly subjective belief distributions, particularly if there are multiple decision-makers. Also highlighted was a general problem that arises if the pay-off from one policy/state pay-off is sufficiently dominant, so that economic research is likely to have little or no measurable benefit because any changes in probabilities do not reduce the uncertainty enough to reverse intended policy choices. Consequently, results can easily be influenced by the number of states and actions included in the evaluation.

Despite these studies, and despite the fact that it is now several decades since such an approach was first advocated, there has been little positive response by most practitioners of impact assessment to these suggestions. The fact that advocates of this approach also have highlighted the complexity and many practical difficulties of doing so has convinced most analysts to eschew this approach. In addition to those enumerated above, Lindner (2004) has discussed other tenets of Bayesian decision theory that are more controversial in the context of valuing information from social science research.[21]

Notwithstanding the above difficulties, there is one compelling reason to keep coming back to the concept, namely that there is no other logical and rigorous conceptual framework (known to the author) for putting a monetary value on information that potentially might influence a decision, be it a decision by consumers about consumption, by producers about production or by government about policy. This is not to imply that policymakers actually use Bayesian decision theory to make policy decisions nor, given the cost and complexity of doing so, to suggest that they should use it for ex-ante impact assessment of POR.

Rather, the aim in this section is to explore how a Bayesian perspective might be used in advance to make a subjective, broad-brush estimate of prospective benefits in an ex-post impact assessment of selected POR projects. For this purpose, the policymaking process is viewed as one in which Bayesian decision-makers learn from information from POR, as well as other policy inputs. Conceptually, such learning causes prior beliefs about the impacts under uncertainty of alternative policy choices to be updated. As a result, prior intended policy choices potentially might change, although they might not. This portrayal of policymaking is best regarded as a conceptual analogue for a real-world process that is far less rational and much more chaotic.

Key elements of a Bayesian approach

For any given policy choice, the following are the key propositions of such an analogue:[22]

- The essence of policymaking is the choice of a preferred policy, otherwise referred to as a preferred act, from a number of mutually exclusive alternatives.
- The impacts of each policy choice are co-determined by uncertain events, otherwise referred to as uncertain 'states of nature'.
- Decision-makers' subjective beliefs about uncertain events can be summarised by probability distributions over all possible states, and the analogue for the policymakers' level of prior uncertainty is the variance of prior belief distribution.
- Ex post, there is the possibility of regret (i.e. a loss or opportunity cost from a 'wrong' choice of policy for some states). Ex ante, the analogue for the cost of uncertainty for any given act is the probability-weighted expected regret.
- Policymakers may learn more about the likelihood of uncertain events from POR outputs, and incorporate this information into their posterior beliefs about the consequential impacts of alternative policies.

[21] For more details, see Appendix 1, and Lindner (2004).

[22] For a slightly more discursive exposition of the basics of Bayesian decision theory, and the foundations of an economic theory of valuing information, see Appendix 1.

- Inter alia, policymakers' updated posterior beliefs will depend on the extent to which their prior beliefs are uncertain, and on the perceived content and veracity of the information, as well as on its perceived informativeness.
- The analogue for the content of the information in POR outputs is the expected value of the likelihood function[23] adjusted for any perceived bias in the information.
- The analogue for perceived informativeness of POR outputs is the inverse of the variance of the likelihood function, which can incorporate uncertainty about the intrinsic reliability of research results, uncertainty about the extent to which results might be deliberately biased and uncertainty about possible distortions in communication channels relied on by policymakers.

Before any policy research, the preferred policy choice within this Bayesian framework is the one that minimises expected regret based on prior beliefs, which is the dual of maximising expected pay-offs. After completion of the POR, the preferred policy choice will be the one that minimises expected regret based on the policymakers' posterior beliefs that incorporate learning from POR outputs. Because posterior beliefs are formed by incorporating knowledge gained from POR into prior beliefs, this policy choice will be conditional on the information content of POR outputs. Note, however, that the posterior perception of the optimal policy may not differ from the prior intended policy choice, even though posterior beliefs differ from prior beliefs.

The value of information in policy-oriented research outputs

Since it is the content of information contained in the various forms of policy output that potentially might influence policymakers' decisions, such content ideally needs to be characterised by:

- the extent to which the policy outputs are ready[24] for direct use by policymakers
- the number and types of policy choices that are susceptible to policy outputs
- uncertain 'events' that co-determine policy outcomes, but might become less uncertain due to POR outputs.

The classification of POR in CGIAR (2006) as process oriented, and/or method oriented, and/or management oriented and/or policy analysis is helpful with regard to the first point. Such a schema focuses on the extent to which information from POR is adoption ready for direct use as an input into the policymaking process. As already noted, outputs that are less adoption ready, such as those from process-oriented research and, to a lesser degree, from method-oriented research, potentially might influence a more numerous and diverse range of policies, although this breadth of influence is likely to be offset by a lower likelihood of influencing any given policy.

Second, the type of the POR and, in particular, the nature of the prospective findings, will determine the number and types of policy choices that are susceptible to policy outputs. Some types of policy decisions will have very large potential levels of regret for some act/event combinations. For instance, macro-economic policies have nationwide and economy-wide scope, as do general trade policies. Other policies, such as national food policy, also have nationwide scope, but the economic consequences are limited to a subsector of the economy, while decisions by provincial governments typically have only local, and often also industry specific, consequences. Possible levels of regret for the latter type of policies that affect only a small geographical subregion and/or only one industry subsector of the national economy will be smaller by orders of magnitude.

Finally, expected regret will also depend critically on key events about which policymakers are very uncertain, while the characteristics of information produced by POR will determine the potential for it to reduce such uncertainty. For each susceptible policy, the domain of possible states of nature for each crucial uncertain event for policymakers' prior and posterior beliefs need to be defined. While there are likely to be many such uncertain

[23] If a probability distribution of observations depends on alternative parameter values, the likelihood function is the probability distribution of parameter values for given outcomes.

[24] This is the equivalent of the extent to which technology outputs are adoption ready.

events and many possible values for each event, the need for analytical tractability dictates that only one event, or at most a very small number of events, be considered, and that only a few, and preferably only two, possible states are specified for each event.

In theory, if both prior and posterior beliefs can be elicited directly,[25] then the influence of POR can be measured directly by the degree of difference between these two belief distributions.[26] Thus, the value of POR can be still measured in the Bayesian decision theoretic framework by the extent to which it reduces the cost of uncertainty, as measured by expected regret, even if there is no change to the prior intended policy choice, as is often the case when results from POR reinforce prior beliefs.

This might explain some, although probably not all, apparent instances of the Cassandra problem. Another possible explanation is that policy outputs have very little influence in the sense that posterior beliefs differ little from prior beliefs. Intuitive explanations for such an outcome within a Bayesian decision theoretic framework could include that the POR was perceived to be unreliable in terms of determining the true state of nature, and/or was perceived to be biased to an unknown extend, and/or that communication channels that relay information from POR to policymakers were perceived to distort the message to an unknown extent.

In practice, eliciting policymakers' subjective probability distributions to represent their beliefs about uncertain events poses further challenges. Before beliefs can be elicited, the key policymaker(s) for each susceptible policy choice needs be identified. If, as often is the case, there is more than one influential decision-maker, which one(s) to interview to elicit subjective probability distributions needs to be determined, as well as how to resolve differences in elicited belief distributions.

The fact that posterior beliefs can be influenced simultaneously by outputs from POR and other inputs to the policymaking process poses a bigger problem. Even if it were feasible to do so, eliciting beliefs before the POR started, then after sufficient time had elapsed for it to have influenced policymakers' beliefs, would create a problem of how much of any measured change in beliefs to attribute to the influence of policy outputs, and how much to attribute to the influence of other policy inputs. Furthermore, given that it often would not be feasible to elicit prior beliefs before the POR was commenced, it could be argued that a superior approach would be to retrospectively elicit subjective belief distributions for both the counterfactual scenario and the consequential scenario. Eliciting posterior beliefs for the consequential scenario should be relatively straightforward, since policymakers will in fact have been exposed to not only outputs from the POR, but also to other influential information. However, in the counterfactual scenario, the policymaker is assumed to have been exposed only to other information that might influence the policy choice, so interview questions to effectively elicit prior beliefs would have to be designed very carefully.

Ex-ante versus ex-post value of information

Much of the early discussion about the application of Bayesian decision theory to PORIA was in the context of ex-ante impact assessment to assist policymakers to allocate scarce resources between alternative proposals for future research (Gardner 1999). Ex ante, the potential value of the information from POR that is relevant to a particular decision is the reduction in expected regret from the prior preferred policy that can be attributed to the policymaker 'learning' from the POR outputs.[27] As Gardner (1999) notes, this ex-ante value of the information must be non-negative.

In this report, the context is a 'supply-driven' approach to ex-post evaluation of the impact of completed POR. In contrast to ex-ante studies, the ex-post value of the research is conditional on one particular set of research results from among the many possible sets ex ante.

25 The alternative used by Schimmelpfennig and Norton (2003) was to elicit prior beliefs and likelihood functions, and then calculate posterior beliefs.

26 This is in contrast to being inferred from any observed change in policy relative to the prior intended policy choice, which is taken as evidence of influence in the conventional approach.

27 Note that even if the posterior preferred policy based on policymakers' updated beliefs is unchanged from the prior preferred policy, the expected regret of the former will be less than that of the latter, provided that the information is perceived to 'truthful', informative and reliable.

Hence, the consequential posterior belief distribution, and optimal posterior policy, also will be conditional on this particular set of policy outputs.

For many possible policy outputs, the posterior expected regret of the ex-post optimal policy choice will be less than the prior expected regret of the ex-ante optimal policy choice. In particular, it will often be the case that the POR results will reinforce rather than contradict prior beliefs, in which case there will be no change in policy from the prior optimal policy choice, but there will be a positive benefit because the cost of uncertainty will have been reduced.

However, as is demonstrated by a simple example in Appendix 1, for at least one output from POR there is a possibility that, ex post, the posterior cost of uncertainty of the chosen policy will be greater than that for the prior optimal policy. In other words, the ex-post impact of POR on economic surplus may, under some circumstances, be negative rather than positive, because learning from a specific POR output may increase rather than decrease the cost of uncertainty.

A more definitive investigation into how likely such an outcome might be, and under what circumstances it might arise, is beyond the scope of this report, as is any resolution of this issue. Intuitively though, it would seem to be more likely to arise when the policy outputs not only contradict prior beliefs, but also come as a considerable surprise. Policymakers' subjective beliefs are likely to change radically as a result, and more than likely will also cause a change to the optimal policy choice.[28] If this conjecture is correct, then the bigger the surprise element in policy outputs, the more likely it will be that they increase rather than decrease the ex-post cost of uncertainty.

Criteria for ex-post impact assessment of POR

Notwithstanding this unresolved issue regarding ex-post impact assessment of POR, the focus in a Bayesian framework on the information content of policy outputs that might influence the policymaking process is helpful in identifying criteria for a preliminary scoping study of Indonesian POR projects. Since further empirical investigation is not possible, the criteria need to be based on selected economically significant attributes of policy outputs about which a-priori qualitative judgments can be made. The following criteria will be used in the next part of this report to appraise the feasibility and desirability of carrying out a full ex-post impact assessment of selected Indonesian POR:

- *Focus*, referring to pertinent areas of uncertainty addressed by POR.
- *Susceptibility*, referring to the number and type of highly susceptible policy choices that might be influenced by outputs of POR.
- *Scale*, referring to potential levels of regret of highly susceptible policy choices.[29]
- *Readiness*, referring to how relevant and directly usable policy outputs are to policymakers' direct application to susceptible policy choices.

The above criteria are a small subset of the information that would be required for a full ex-post impact assessment of POR within a Bayesian framework. Further extensive investigation would be needed to, among other things:

(a) elicit the level of uncertainty of policymakers' prior knowledge about crucial states

(b) appraise the overall quality of policy outputs, including the extent to which they are likely to be informative, reliable, relevant and influential in changing beliefs and susceptible policies[30]

(c) elicit posterior belief distributions for counterfactual and consequential scenarios

(d) quantify the scale of potential levels of regret for susceptible policy choices.

28 In a number of PORIAs, Ryan asked policymakers a series of questions about whether any of the POR results surprised them and, if so, the extent to which this influenced their decisions (J. Ryan, pers. comm.).

29 As already discussed, the potential value of a change to a policy decision will depend, inter alia, on the magnitude of the economic consequences of the changed decision. Determinants of the possible size of such consequences include the geographic scope of the susceptible policy choices.

In addition, Ryan suggests that the scale criteria often may be correlated with the extent to which the POR outputs are more of an international public good in nature (e.g. methods, processes) (J. Ryan, pers. comm.).

30 Either implicitly or explicitly, this will involve measuring the likelihood that research findings are correct.

The Indonesian policy projects

Overview of projects

ACIAR has funded a diverse range of collaborative projects between Australian and Indonesian social scientists with the aim of improving economic policy in both countries. In this section, achieved outputs from the selected Indonesian policy projects listed below are reviewed. Possible outcomes and potential impacts are considered, to scope out the prospects for a thematic evaluation of the economic impacts of ACIAR's investment in Indonesian POR. The 10 projects selected (with abbreviated title used hereinafter) are:

- **EFS/1983/062** Economic evaluation of policies for rice self-sufficiency in Indonesia (Food crop policies for rice self-sufficiency)
- **EFS/1988/022** Rural income and employment in Indonesia (Rural income and employment)
- **ANRE1/1990/038** Analysis of policies affecting the Indonesian agricultural sector: a multiple modelling approach and application to fertiliser policies (Fertiliser and other agricultural policies)
- **ANRE1/1993/023** Dairy policy in Indonesia (Dairy policy)
- **ANRE1/1993/705** Analysis of growth and stabilisation policies in Indonesia— a linked modelling approach (Growth and stabilisation policies)
- **ADP/1994/049** Policy analysis of linkages between Indonesia's agricultural production, trade and environment (Agricultural, trade and environment policies)
- **AGB/2000/072** Improving resource-use efficiency in the coconut industry of North Sulawesi and its national implications (Coconut industry resource efficiency)
- **ADP/2000/100** Contract farming, smallholders and rural development in East Java, Bali and Lombok (Contract farming)
- **ADP/2000/126** Microfinance for agricultural producers in West Nusa Tenggara: issues and opportunities for a sustainable financial intermediary system (Microfinance in WNT)
- **AGB/2004/028** Social capital and rural development in eastern Indonesia (Social capital).

Table 5 provides summary information on project timing, duration and cost. More detailed information is provided in Appendix 2.

Three of the projects, namely ANRE1/1990/038, ANRE1/1993/705 and ADP/1994/049, have been reviewed previously by Pearce (2005) to draw lessons for the overall portfolio of POR. Pearce (2005, p. 65) noted that these three projects 'were linked, and their development and transition tracked a process of experimentation and evolution in approaches to modelling issues facing the Indonesian agricultural sector'. For this reason, these three studies will be treated in this report as being, in effect, a single project, even although there were changes to key researchers leading the projects, and there also were noteworthy differences in the objectives and methods used.

Table 5. Overview of Indonesian policy-oriented research projects

Project	Short title	Start	End	Budget (A$)
EFS/1983/062	Food crop policies for rice self-sufficiency	11 December 1983	31 March 1989	191,268
EFS/1988/022	Rural income and employment	1 January 1989	30 June 1992	68,579
ANRE1/1990/038	Fertiliser and other agricultural policies	1 January 1992	31 December 1994	641,671
ANRE1/1993/023	Dairy policy	1 July 1994	31 December 1996	285,917
ANRE1/1993/705	Growth and stabilisation policies	1 May1993	30 August 1995	130,000
ADP/1994/049	Agricultural, trade and environment policies	1 January 1996	31 December 2002	1,003,472
AGB/2000/072	Coconut industry resource efficiency	1 January 2004	31 December 2006	396,158
ADP/2000/100	Contract farming	1 January 2001	31 December 2005	439,491
ADP/2000/126	Microfinance in WNT	1 July 2001	31 March 2004	243,477
AGB/2004/028	Social capital	15 June 2006	31 August 2007	149,334

Scoping achieved outputs

The main reason for reviewing achieved outputs from these Indonesian policy projects was to explore the feasibility and desirability of applying identified frameworks for PORIA to a complete ex-post impact assessment of one or more of these policy projects. This was mainly a desktop study based on a consideration of project documents and publications, although most of the Australian project leaders were interviewed to identify achieved outputs. No meaningful attempt was made to map the impact pathway from outputs to influence or beyond, although the challenges of doing so will be discussed.

Impressive and potentially valuable outputs, including useful information of one form or another, were produced from all projects. Some of this information was policy specific, such as evaluation of rice self-sufficiency policies, but other information was broader and more general, such as primary data on rural household incomes and employment. Other information consisted of detailed descriptions of marketing institutions, such as contract farming arrangements and beef supply chains in Bali and Lombok.

Capacity building and, in particular, training of Indonesian counterparts, was another important output of all projects. Without exception, project leaders rated this output as the most important achievement of their projects. The fact that such outputs are not discussed further in this report does not diminish their importance, but rather reflects the near impossibility of quantifying the magnitude of the impacts from these outputs, and the huge resources that would be required to do so.

In this review of outputs from the Indonesian POR projects, the focus is on the 'policy outputs' because, as already discussed above, it is the nature of these outputs that provides the most tangible starting point for scoping out whether particular POR projects would make suitable candidates for a full ex-post impact assessment study. Note that there will be no policy impacts unless the policymaking process is influenced in some way by some project outputs, whether they be enhanced capacity of project participants or policy analysis per se. Moreover, such influence needs to be in the not too distant future if it is to be discernible and measurable, so it is pivotal that a project produces at least some adoption ready outputs, such as policy-analysis or management-oriented outputs, as defined in CGIAR (2006). Otherwise, the impact pathway from output to influence will be so drawn out, convoluted and murky as to be virtually untraceable. Certainly, mapping it would require excessive resources.

From the list of 10 Indonesian policy projects selected for this study, none produced any management-oriented outputs, and four projects produced no meaningful policy-analysis outputs.[31] The outputs from these projects were predominantly process oriented, including collection of primary economic data, estimation of elasticities and other economic parameters and relationships, and documentation of the structure of sectors of the economy and/or of marketing institutions and supply chains. In subsequent discussion, these projects are grouped in a 'process-oriented cluster'.

The other six projects did produce some meaningful policy-analysis outputs, and are grouped in a 'policy-analysis–oriented' cluster. This cluster also produced both method-oriented and process-oriented outputs, which often enabled and reinforced their analysis of policy choices.

Within each cluster, the projects are reviewed individually, except that the three projects in the EWM group are reviewed as a single project. Each review commences with a brief project description, including a short outline of the context and a summary of the key project aims. Next, some economically significant attributes of key achieved policy outputs are subjectively appraised from a Bayesian decision theoretic perspective.

The reason for emphasis on a Bayesian framework was in part because the application of this framework to ex-post impact assessment of POR projects has been, as noted earlier, virtually ignored in the literature. Furthermore, the above review of alternative frameworks for PORIA found that the focus in the Bayesian framework on policy outputs as information that might influence the policymaking process provided a richer source of criteria with which to appraise POR outputs in a preliminary scoping study than did the conventional framework. This is important given that the preliminary scoping study was limited primarily to a desktop review, and so was restricted to considering only those attributes of POR outputs about which a-priori qualitative judgments could be made.

The specific criteria used to appraise selected economically important attributes of POR outputs from Indonesian POR projects were: focus; number of potentially susceptible policy choices; readiness; probability of influence; number of highly susceptible policy choices; and geographic and economy sectoral scale. In this preliminary scoping study, a-priori appraisal of these characteristics reflects subjective judgments formed from some combination of reading project documents, plus reviews where available, as well as interviews with project leaders, anecdotal evidence and personal perceptions of the policymaking process.

The research focus, as defined by the questions the research seeks to answer, will determine the areas of state uncertainty that are pertinent to policymakers, and about which they may become less uncertain if they learn from POR outputs.

In turn, the types of uncertainty that might be partly resolved by POR outputs will co-determine which policy choices are susceptible to influence by outputs from POR. Also important in determining susceptibility to influence by POR are the objectives of the research, and how well they are achieved. While only one or a very small number of policy choices might be susceptible to a tightly focused research project, other projects that produce more-generic information potentially might influence a very large number of policy choices. The approximate number of policies that might be influenced by policy outputs was appraised to be either very few, few, many or very many.

However, for various reasons, including those discussed above, many policy choices that might be susceptible to influence are very unlikely to be affected by particular policy outputs. One common reason is that policy outputs typically only provide information about some of the considerations that policymakers think relevant. As a result, they often need to be reworked before being considered. The characteristic of readiness refers to the degree to which policy outputs are directly usable by policymakers and answer all relevant questions without the need for further evaluation or consideration of other factors. Subjective ratings of readiness for the Indonesian policy projects ranged from insignificant for the process-oriented cluster of projects to low to very high for policy-analysis–oriented cluster.

[31] Specifically, none of the outputs from these projects included any formal assessment of the impacts on economic welfare of well-specified policies, although some project reports did contain assorted suggestions about policies that might be changed. However, there was no evaluation of the costs and benefits of the suggested policy options even from a narrow frame of reference, let alone in an economic surplus framework.

While a high degree of readiness is necessary for influence, it is not sufficient. In general, other determinants of influence cannot be appraised a-priori from policy outputs, although in this scoping study limited information germane to the probability that policy outputs will influence policy choices was available from project documents, leader interviews and a previous review by Pearce (2005) for the three EWM projects. With the exception of these three projects, the subjectively appraised measure of probability of influence was insignificant,[32] trivial or small, three measures in ascending order of size.

This measure of probability of influence was subjectively combined with the raw appraisal of the number of potentially susceptible policy choices, to come up with an appraisal of the number of highly susceptible policy choices.

Finally, only two of the numerous determinants of potential levels of regret of these highly susceptible policy choices can be a-priori scaled. If a policy changes, the affected number and type of economic activities will be determined, inter alia, by:

- the scale of the legal jurisdiction of the governing body to which the policy choice applies, be it international, national, provincial or subprovincial
- industries or sectors of the economy where affected economic activities are conducted
- the geographic location where the affected economic activities are conducted.

On the basis of information sources explained above, partly informed qualitative guesses were made about the geographic and economic-sectoral scales of economic activities likely to be affected by highly susceptible policy choices. Of course, there are many other determinants of the magnitude of potential levels of regret from policy choices that could not be ascertained from information available for this scoping study, but which would be pivotal to any full cost–benefit impact assessment of one or more of these Indonesian POR projects.

The above criteria are used below to subjectively appraise selected attributes of policy outputs for the Indonesian policy projects.

[32] Insignificant is defined here to include zero probability of influence.

Review of the cluster of process-oriented projects

The broad objectives for this cluster were to collect, analyse and document information on rural labour and finance markets and supply chains. As already discussed, the outputs from projects in this cluster did not include any formal assessment of the impacts on economic welfare of well-specified policies. While some project reports did contain suggestions for policy changes, the projects did not rigorously evaluate the costs and benefits of the suggested policy options from even a narrow frame of reference, let alone in an economic surplus framework. Consequently, policy readiness of outputs from projects in this cluster was appraised to be insignificant, as was the probability of influencing policy choices without further significant investigation and analysis. Consequently, no policy choices were judged to be 'highly susceptible'.

Rural income and employment project

Description of project EFS/1988/022

The context for this project was a trend for farm households in Indonesia to rely more on non-agricultural sources of income. Very little information about the consequences of this trend on rural employment and household income was available despite the need for a thorough understanding of the effects at the village and household levels to ensure a sound basis for future rural policies.

The general aim of the rural income and employment project was to estimate the impacts of pending agricultural price policy changes and new technology on income and employment levels of rural households in Java. Specific objectives were to:

- develop a summary statistical database of rural labour markets in West Java
- estimate a series of elasticities showing how internal and external factors affect family labour allocation
- test hypotheses about determinants of rural family labour allocation.

Appraisal of policy outputs

The main output of the rural income and employment project was primary data. It did not investigate any

specific policies. Potentially, knowledge from this project could have helped in a small way to inform an almost limitless number of policy choices but, in any particular instance, it would have been only one very minor input among many others into any decision-making.

In the unlikely event of there being some highly susceptible policies, it is likely that such policies could impact on most rural households on Java and, depending on the nature of the policy, just possibly might also affect rural households elsewhere in Indonesia.

Contract farming project

Description of project ADP/2000/100

The context for this project was a growing recognition that contract farming might assist smallholders in Indonesia to overcome market imperfections, minimise transaction costs and gain market access.

The general aim of the project was to document marketing arrangements for contract farming in selected supply chains for rice seed, hybrid maize seed and broiler production in East Java, Bali and Lombok, and to investigate the benefits to smallholders from contract farming. Specific objectives were to:

- determine contract types used and commodities under contract in East Java, Bali and Lombok
- determine benefits of contract farming
- ascertain the potential for smallholders in contract farming, and the potential to improve policy.

Appraisal of policy outputs

Outputs included improved knowledge about contracting in Indonesia, plus a number of suggested policies to encourage the expansion of contract farming in Indonesia. Patrick (2003, p. 69) stated, 'policy makers in Indonesia should view these contractual relationships in a positive light and seek mechanisms to expand these types of interaction between multi-national corporations and smallholders'. A long list of suggested mechanisms followed.

The explicit basis for many of the detailed recommendations was equity and, in particular, a wish to improve access of disadvantaged smallholders to the benefits of contract farming. However, neither the poverty-reduction nor more general welfare impacts of implementing such policies were assessed. It is extremely unlikely that mere suggestions to consider changing an extraordinarily diverse range of policies would have any influence on policy choices by the Government of Indonesia. Hence, it would be implausible to attribute subsequent policy changes, if any, to adoption of policy outputs from the contract farming research project. Furthermore, the possibility that this project might have resulted in poisoned-well impacts would need to be considered if outcomes from uptake of project recommendations could be demonstrated. Consequently, the probability of influence on any potentially susceptible policy was appraised to be insignificant. In addition, if there were any influence on polices, the scale effect would most likely be small, which is larger than insignificant and trivial.

Microfinance in WNT project

Description of project ADP/2000/126

The context for this project was a perception that existing agricultural credit systems were performing poorly in many respects, including in terms of access to credit, credit use, credit repayment and sustainability of credit delivery.

The overall goal of the microfinance project was to create a new, more effective and sustainable innovative microfinance system for agricultural producers in WNT province.

Specific goals were to:

- undertake a critical evaluation of strengths and weakness in existing credit schemes
- identify measures for improvement from earlier evaluation, and develop and evaluate training and pilot system activities
- create a new, more effective and sustainable innovative microfinance system for agricultural producers in WNT province.

Appraisal of policy outputs

New knowledge and capacity building were the principal outputs from this project. By the end of the project, considerable progress had been made toward getting a new microfinance system adopted,

but significant obstacles to uptake remained.[33] These obstacles would need to be overcome before there could be any uptake of this output. However, the project did produce one unplanned policy output in the form of a contribution to draft legislation for the Mataram City government to regulate the operations of LKKs (small financial institutions operating within the city). This draft legislation included provisions for monopoly status for the LKK financial institutions as the 'one gate' for funding from government and private funding programs. It is not known whether this legislation was subsequently enacted, or if other local governments adopted similar legislation.

On the face of it, a 'one gate' financial institution might seem like a highly susceptible policy but, as was pointed out in the review report (Chamala et al. 2004), no formal analysis to estimate overall impacts on economic surplus has been carried out, and the prospects for uptake are not good, given strong opposition from other government agencies. Consequently, the probability of influence was appraised to be insignificant, and any possible scale effects would most likely be very small.

Social capital project

Description of project AGB/2004/028

The context for this project was recognition of the role that social organisations can play in smallholder coordination and empowerment by facilitating their links with agribusiness.

The general aim of the social capital project was to document marketing arrangements in the supply chain for beef cattle in Bali and Lombok, the role of farmer groups in the marketing of cattle and determinants of a group's ability to participate, and to investigate how social capital might benefit smallholders.

Appraisal of policy outputs

The outputs of this project were new knowledge about the potential for social capital to benefit smallholder owners of cattle. There was also capacity building in survey techniques and data analysis. No specific policies were investigated, so no possible policy changes could be identified that might be attributed even in part to this project. In future, knowledge from this project might help inform some policy choices, but almost certainly its influence would be insignificant, as would any possible scale effects.

[33] See review report (Chamala et al. 2004).

Review of the cluster of policy-analysis-oriented projects

Food crop policies for rice self-sufficiency project

Description of project EFS/1983/062

The context for this project was the use of input and output price supports for rice producers, and price support for consumers to achieve, respectively, self-sufficiency in rice and social stability. These were major instruments of Indonesian government agricultural policy from the early 1970s until the early 1980s, when falling international oil prices triggered a balance of payments crisis.

The general objective of the food crops project was to provide an economic evaluation of the output and input price policies that Indonesia implemented to achieve rice self-sufficiency, and to demonstrate the benefits and costs of some alternative policies. The specific aim was to develop an economic model to analyse the budgetary and efficiency costs of current and alternative food policies.

Appraisal of policy outputs

In addition to the process- and method-oriented outputs listed in Appendix 2, the policy-analysis outputs achieved included estimation of the impacts of a number of alternative food crop output and input price policies on net social benefits, level of rice self-sufficiency, foreign exchange costs and government budgetary costs.

Due to the relatively tight focus of this project, it is likely that only a few policy choices would have been susceptible to influence by its POR outputs. Also, the readiness of the outputs was appraised to be high. However, the probability that these outputs would actually influence policymaking was judged to be small, partly because other internationally prestigious agencies also had POR projects in the same area at more or less the same time; and partly because the Australian research team did not have close links with the most powerful government economic policy agencies in Jakarta. Hence, it is unlikely that there were any highly susceptible polices, although both scale effects would have been very large for such policies.

Dairy policy project

Description of project ANRE1/1993/023

The context for this project was concerns that the numerous government regulations and institutional arrangements used to provide very heavy levels of protection to an Indonesian dairy industry based on smallholder farms organised into cooperatives could result in widespread inefficiencies.

The general aim of the project was to analyse the efficiency effects, including impacts on consumer and producer welfare, of restrictions on imports of dairy products. The regulation requiring the Indonesian dairy industry to mix imported milk with domestically produced milk was a particular focus of the study.

Appraisal of policy outputs

In addition to the process- and method-oriented outputs listed in Appendix 2, the principal policy analysis output achieved was the estimation that existing mixing-ratio policies in the dairy industry resulted in production efficiency losses plus consumer deadweight losses that, in total, could be between $0.75 million and $17.49 million annually. The overall conclusion from the project was that the social benefits to poor farmers may offset any such efficiency losses.

As the focus of this project was almost entirely on the so-called mixing regulations, it is likely that this policy was the only potentially susceptible policy choice for POR outputs from this project. Again, the readiness of the outputs was appraised to be high. However, the probability that these outputs would actually influence policymaking was judged to be trivial, so it is unlikely that there were any highly susceptible policies. Moreover, because the Indonesian dairy industry is a very small part of the Indonesian economy, both scale effects also would have been very small for this policy.

Economy-wide modelling group of policy projects

Description of projects ANRE1/1990/038, ANRE1/1993/705 and ADP/1994/049

Initially, the context for this group of related projects was a growing understanding among economists that agricultural output or input price policies typically have impacts in the rest of the economy, and vice versa. Such effects are not captured by the single-sector perspective of the then traditional analysis using partial equilibrium models. Perceived limitations of earlier models resulted in the development of economy-wide models, otherwise known as computable general equilibrium (CGE) models. These models, in addition to identifying direct effects of policies, also captured indirect consequences on prices of substitutes or complements to food in production or consumption, as well as effects of government interventions in currency markets that may have nontrivial distortions to incentives for production or trade. As progress was made with CGE models, the need became apparent to develop expanded and more-detailed sectoral components of these models, and to modify them to take better account of broad trade and environmental issues. In addition, there was growing appreciation in Indonesia of the significance of trade liberalisation and other changes in multilateral trading systems for Indonesian agriculture.

The general aim of these projects was to develop and refine economy-wide CGE models of the Indonesian economy, and to use them to assess the effects of policy settings on Indonesian agricultural production, consumption, food security, trade, income distribution and poverty alleviation, as well as the regional, environmental and efficiency impacts of a wide range of structural and policy changes at home and abroad.

The condensed collective objectives for this cluster were as follows:

- undertake a critical evaluation of strengths and weakness in existing credit schemes
- identify measures for improvement from earlier evaluation, and develop and evaluate training and pilot system activities
- create a new, more effective and sustainable innovative microfinance system for agricultural producers in WNT province.

Appraisal of policy outputs

In addition to the process- and method-oriented outputs listed in Appendix 2, policy-analysis outputs achieved included evaluation of a long list of diverse economic policies, including:

- improving food self-sufficiency with fertiliser subsidies, product pricing policies or investments in R&D

- the efficiency of irrigation development and its impact on the agricultural sector
- policy options for the Indonesian dairy sector
- impact of the Uruguay Round on Indonesia's agricultural sector
- economic growth, trade and policy reforms
- growth and stabilisation policies for the Indonesian livestock sector
- exchange-rate policy and reserve management in Indonesia
- impact of mandatory credit allocations on small businesses' bank loans
- the costs and benefits of trade liberalisation
- Indonesia's policy response to the Asian economic crisis.

In addition to measures of economic surplus, the analyses of some policies also estimated the impacts on food security and other agricultural goals, income distribution and poverty, and on the environment.

It goes without saying that a very large number of policy choices are susceptible to the extraordinary range of policy analysis outputs and, while not all outputs were policy ready, many had a high degree of readiness. Furthermore, the probability of influence was rated to be very high because of the exceptional networks and links to key Indonesian policymakers built by team members.

It is notable that three of the projects' research team subsequently assumed powerful policymaking positions in the Government of Indonesia. The Indonesian leader of the third project (Mari Pangestu) subsequently became the Minister for Trade. Another project participant later became Indonesia's Ambassador to the World Trade Organization and, yet another, Director-General of the Indonesian Agency for Agricultural Research and Development. Susilo Bambang Yudhiono, now President of Indonesia, was a PhD candidate in agricultural economics at the Faculty of Economics and Management, Institut Pertanian Bogor, during the term of these projects, but it is not clear if he had any involvement in them.

Based on this evidence, it seems reasonable to suppose that several, maybe many, policies were susceptible to influence by project outputs. Moreover, given the economy-wide scope of most of these policies, both scale effects most likely would have been very large.

Coconut industry resource efficiency

Description of project AGB/2000/072

The context for this project was declining farm sizes and productivity of small coconut plantations, and a corresponding decline in smallholder farm incomes. The coconut industry in North Sulawesi contributes more than 85% of total provincial agricultural output, and is the main income source for about 30% of the population. Furthermore, responsibility for many areas of policymaking has been devolved to the provincial government.

The main objective of the project was to investigate investment and policy options for improving the incomes of smallholder coconut producers. Specific aims were to:

- investigate the current problems facing smallholder coconut producers in North Sulawesi
- develop investment models to enable local planners to identify policy options for improving resource-use efficiency in the coconut production sector
- develop and use a provincial economic model to analyse policy options for improving resource-use efficiency in the coconut marketing sector
- use this investigation as a case study to examine broader economic policy options for improving the incomes of very low income Indonesian households.

Appraisal of policy outputs

In addition to the process- and method-oriented outputs listed in Appendix 2, the principal achieved policy-analysis output was estimation of benefits to growers from various investment options to improve productivity and farm incomes. This analysis showed that:

- adoption of alternative enterprises, such as an intercropping of peanuts among ageing coconut plantations, could achieve substantial gains in farmer gross margin income
- replanting coconut palms to raise productivity and farm income would be unprofitable unless copra prices improved.

The contribution of the marketing system's limitations to low farm incomes was estimated also, and possible strategies to redress these limitations were analysed.

It was appraised that, because of the project's narrow focus, only a few potentially susceptible policy choices might be influenced by these outputs. Output readiness also was appraised to be low because of the possible emergence of significant technical problems in implementing identified investment options for growers, and because the North Sulawesi provincial government would need to make decisions about the best mechanisms to facilitate uptake of the these options. For these reasons, as well as the perceived lack of strong links to provincial government policy agencies, the probability that these outputs would actually influence policymaking was judged to be small. Hence, it is unlikely that there were any highly susceptible polices. Any scale effects would be limited mainly to one sector and one province, and thus would be quite small.

Summation

Table 6 summarises the subjective appraisal of selected economically important attributes of POR outputs from Indonesian POR projects. For all the projects, with the possible exception of the EWM group, the amount of time and resources that would need to be devoted to carry out such a study could not be justified by the poor prospects of establishing credible evidence of actual influence, coming up with a convincing case for the share attributed to POR outputs vis-à-vis other inputs into the policymaking process and deriving believable estimates of quantitative impacts of overall influence on policymaking. Furthermore, even for such a highly successful set of POR projects as the EWM group of policy projects, there would be formidable challenges to be faced in undertaking a complete ex-post impact assessment under either the conventional 'deterministic' framework or the Bayesian decision theoretic framework, and very substantial resources would be required that would be difficult to justify given the considerable risks involved.

Under either framework, the first step would be to identify and characterise all relevant policy-analysis outputs that are 'ready' for use in the policymaking process. Clearly, this would be a long list for the EWM group, as would be the corresponding list of policies that are susceptible to influence by the identified POR outputs. The latter list could be culled by making a-priori, subjective appraisals about the probability that the outputs have been influential. Then, the resulting set of highly susceptible policies could be used to identify a potential list of policymakers to interview to ascertain elicited influence for each highly susceptible policy.

At this stage, a decision would need to be made about how many and which policymakers to interview. Often, there is more than one influential decision-maker, so there may be more policymakers than selected susceptible policies. On the other hand, the same policymakers may be involved in making many of the policy choices on the list. While this would tend to reduce the number of policymakers that needed to be interviewed, the people concerned would undoubtedly be very busy, and might not have the time required for each interview. Given that resources for such studies are not unlimited, it will probably be necessary to restrict the scope of the ex-post impact assessment to a subset of the selected susceptible policies, with the result that, ceteris paribus, total impacts of the group of POR projects would tend to be underestimated.

For each selected susceptible policy, the key issues to be investigated in these interviews will depend on whether the conceptual framework employed is the conventional or the Bayesian one.

In most studies to date under the conventional framework, the key issue that has been explored in interviews with policymakers is whether the substance and/or timing of an observed change in policy was influenced by previous dissemination of POR outputs and, if so, to what extent? Among the various issues raised in Pardey and Smith (2004) and discussed above, perhaps the most intractable problem with this approach is how much of any estimated increase in economic welfare resulting from the policy change should be attributed to the influence of outputs from POR and how much to other inputs to the policymaking process?

In theory, this problem can be circumvented by taking the substance and timing of the observed policy choice as the outcome for the consequential scenario,[34] and explicitly asking policymakers about how timing of

[34] Alternatively known as the 'with research' scenario.

Table 6. Summary of subjective ratings of selected attributes of policy outputs from ACIAR policy-oriented research projects

Project no.	Focus of research	No. of susceptible polices	Policy readiness	Probability of influence	No. of highly susceptible polices	Policy scale—region	Policy scale—economy
EFS/1983/062	Food crop policies	Few	High	Small	0	Nationwide	Very large food crops sector
EFS/1988/022	Rural household income	Very many	Insignificant	Insignificant	0	West Java	Economy wide
ANRE1/1993/023	Dairy policy	Very few	High	Trivial	0	Four Java provinces	Very small dairy sector
EWM group[a]	Agriculture and trade policies	Many	Low to very high	Small to very high	Several	Nationwide	Economy wide
ADP/2000/100	Contract farming	Many	Insignificant	Insignificant	0	West Nusa Tenggara (WNT), Bali and East Java	Very small sector
ADP/2000/126	Microfinance	Very few	Insignificant	Insignificant	0	WNT	Very small sector
AGB/2000/072	Coconut industry resource use	Few	Low	Small	0	North Sulawesi	Coconut sector
AGB/2004/028	Social capital	Many	Insignificant	Insignificant	0	Bali and WNT	Small beef sector

[a] Economy-wide modelling group = ANRE1/1990/038, ANRE1/1993705 and ADP/1994/049

changes to chosen policies would have differed under a well-specified counterfactual scenario[35] in which the only thing that differs from the current situation is that the POR would have not been carried out. Despite recognising that 'benefits are relative to a counterfactual scenario of policy conceived in the absence of the research being assessed' (CGIAR 2006, p. 9), most interviews focused on the influence of the POR being assessed on an identified policy change.[36]

Another shortcoming of this approach is that converse cases tend to get overlooked. Such cases, where policymakers had intended to change the existing policy, but were influenced by POR outputs to reverse such a decision, will not be readily apparent to outsiders because prior intentions of policymakers typically will not be known. In principle, this deficiency could be redressed by asking policymakers not only about policies that had changed, but also about policies that might have changed but had not, although the extra interview time needed to do so might stretch their goodwill.

Also, there are the twin problems of whether to value POR and, if so, how, when it can be established that there was no change to the prior intended policy choice. First, if POR findings simply reinforce prior beliefs, a rational policymaker would not change the prior intended policy choice, yet, one would intuitively

35 Alternatively known as the 'without research' scenario.

36 For instance, Templeton and Jamora (2008, p. 2) state that the central question was, 'Did IRRI's research influence the policy change and, if so, how much of the potential benefits from the policy-induced changes in farmers' pesticide practices can be attributed to that research?'

conclude that the reassurance that such research provides is valued by policymakers. Last, there is the Cassandra problem. Where a policy is not changed despite POR indicating that economic welfare would increase if it were changed, or vice versa, should any value be attributed to such POR?

A different set of problems would need to be addressed if an attempt were made to carry out an ex-post impact assessment under a Bayesian framework. The key issue to explore in interviews with policymakers would be whether their beliefs about key areas of uncertainty had been influenced by the dissemination of POR outputs and, if so, to what extent. Ideally, beliefs would be elicited for each event about which policymakers are uncertain. However, the need to limit the duration of the interview, as well as the need for analytical tractability, suggest that the only practicable option would be to elicit subjective probability distributions about pay-offs (i.e. policy impacts on economic welfare). First, however, the policymakers would need to define a discrete domain of two or three possible impacts on economic welfare for each policy choice.

To ensure that the difference between elicited distributions over this domain captures the influence of POR outputs only, both prior and posterior distributions should be elicited at a common point in time, but for counterfactual[37] and consequential[38] scenarios tightly defined in the same way as for the conventional framework discussed above. As already discussed, questions to elicit prior beliefs would have to be designed very carefully.

Last, the issue of how to measure the ex-post impact on economic welfare in the Bayesian framework remains unresolved. While the expected regret for both the prior and posterior optimal policy choices can be estimated from the respective belief distributions and the regret function, there remains the possibility that ex-post, economic welfare might be reduced rather than increased as a result of policymakers being influenced by the outputs of POR.

It is clear from the above review that a full ex-post impact assessment of even a subset of the EWM group of Indonesian policy projects would face daunting challenges. The sheer scale of a comprehensive assessment that attempted to estimate most significant impacts logistically would be very extremely difficult, if not impossible, but certainly prohibitively expensive. Furthermore, how to approach a number of conceptual and methodological problems would need to be decided.

In the recent CGIAR case studies of selected POR projects, analysts found attribution of influence between POR outputs and other inputs to the policymaking process to be one of the most intractable problems. A possible way around this problem has been proposed above, but it is untested, and may well prove to be infeasible irrespective of which conceptual framework is followed. Either way, such a study would require the enthusiastic cooperation, and devotion of considerable amounts of time, from some very senior policymakers in the Government of Indonesia.

Pardey and Smith (2004) also identify the poisoned-well and Cassandra problems. For the particular case of the EWM group of policy projects, there is a real possibility that, in the early days, some bad advice was given and taken. Equally, it is likely that some good advice was not taken. Perhaps these issues could be explored using the Bayesian approach to impact assessment, but it is doubtful whether any good purpose would be served by investigating such a politically sensitive topic.

In addition, as discussed above, there are some unresolved measurement problems with ex-post impact assessment under both the conventional and Bayesian frameworks that do not seem to have been widely canvassed in the literature. Within the conventional framework, prima-facie evidence of influence is a change to the substance and/or timing of the prior intended policy choice. Ex post, there is no value in policy research outputs that simply reinforce prior beliefs about the best policy choice, so that there is absolutely no difference in the substance and timing of policy choices between the counterfactual scenario and the consequential scenario. Under the Bayesian framework, there is the possibility that POR outputs will influence a policymaker's subjective beliefs so as to increase, rather than decrease, the cost of uncertainty. On balance, there does not seem to be a clear-cut answer to the question of which of these two frameworks is the best one within which to conduct an ex-post impact assessment of POR.

[37] Elicited beliefs for the counterfactual scenario would be current beliefs had the POR not taken place.

[38] Elicited beliefs for the consequential scenario would be current beliefs given that the POR did take place.

Lessons

In reviewing the literature on the impact assessment of POR, this study has benefited from the Impact Assessment Discussion Paper series produced by IFPRI, the ACIAR Impact Assessment Series reports and recent studies by the CGIAR Science Council on impact assessment of POR in the CGIAR. In this literature, some 45 empirical studies that traced the dissemination, influence and/or impact of POR studies were identified. Of the 24 studies reviewed in Raitzer and Ryan (2008), only three made quantitative estimates of benefits that were attributable at least in part to POR. The other 21 studies traced only dissemination of policy outputs and/or their influence on policymaking. There were 10 reports in the ACIAR series covering 14 projects. Quantitative estimates of impacts were made for seven projects, while influence was assessed for the rest. More recently, five of the seven case studies in the CGIAR study made quantitative estimates of impacts (CGIAR 2008).

In those empirical studies that estimated impact, a common criterion for selecting which POR to assess was knowledge that a related policy had, in fact, changed. Hence, the impact of the policy change could be estimated as the difference between economic welfare with and without the policy change, leaving it to interviews with policymakers to ascertain the extent to which the policy change was influenced by dissemination of POR outputs.

This issue of allocation of estimated benefits between outputs from POR and other inputs to the policymaking process was often cited as the most intractable problem in ex-post impact assessment studies of POR. In theory, this problem could be circumvented by taking the observed policy choice as the outcome for the consequential scenario, and by asking policymakers somewhat different questions for the counterfactual scenario along the lines of 'if findings from the policy-oriented research had not been available, would the policy choice have been any different?'

As far as could be ascertained, this straightforward question was not asked in any of the studies reviewed,[39] although whether it would succeed or not seems far from clear, given the difficulty that most people have in trying to answer hypothetical questions.

Another shortcoming with the demand-led orientation common to most PORIA was that it tended to exclude converse cases where policymakers had intended to change the status-quo policy, but were influenced by POR outputs to reverse such a decision. Although such cases are not inconsistent with the observation that 'To have impact, decision-making processes related to policy formulation must be influenced and altered relative to the course of events without the information' (CGIAR 2008, p. 17), the practical difficulty of identifying those cases where the prior intention of policymakers was to change a policy, but they eventually did not do so, makes it most unlikely that they will be chosen for a PORIA study. In principle, this deficiency could be overcome by asking policymakers not only about policies that had changed, but also about those that might have changed but had not, although the extra interview time needed might stretch the goodwill of policymakers.

[39] Arguably, Behrman (2007, p. 23) came closest with Question 3—'What was the relation between the IFPRI evaluation and the evolution and sustainability of the PROGRESA/Oportunidades program? Were there dimensions of the program that might have developed differently or with different timing if IFPRI had not been involved?' However, the counterfactual question posed here is not what would have happened if the POR had not happened, but rather what would have happened if an organisation other than IFPRI had carried out the POR. Raitzer (2008) also asked whether the timing of benefits would have been different in the counterfactual scenario.

Arguably, more serious problems arise in cases where outputs from POR do not influence policymakers to change intended policy choices. If the policy choice is the same under both the counterfactual scenario and the consequential scenario, then there is no basis in the methodology of the conventional deterministic approach to value information that does not cause policy choice intentions to change. Therefore, there is no change in social welfare to attribute between POR outputs and other inputs to policymaking. Pardey and Smith (2004) have dubbed one such set of cases, those in which policymakers fail to take 'good' advice, the Cassandra problem. However, cases where POR outputs reinforce policymakers' prior intentions to maintain status-quo policies, are almost certainly more common. Intuitively, such research provides reassurance that is valued by policymakers. If such research outcomes do have value, then any bias against selecting such cases for PORIA will cause aggregate benefits from POR to be underestimated in much the same way that under-representation of poisoned-well projects would cause aggregate benefits from POR to be overestimated.

The Bayesian framework for impact assessment of POR resolves some of these problems, although it does create some new dilemmas. Crucially, influence is established by a change in subjective beliefs about 'pay-offs' for each combination of policy choice and uncertain state, which also will change the expected regret, or cost of uncertainty. Because new information that reinforces prior beliefs will reduce the cost of uncertainty, this approach resolves one the fundamental problems with the conventional framework that relies on a change in intended policy choice as a basis to value POR outputs. However, while the change in expected regret from learning from unbiased information must be non-negative for ex-ante impact assessment, this is not necessarily the case for ex-post impact assessment. Depending on the ex-post actual findings from the POR, there is some possibility that expected regret will increase relative to prior expected regret even if the information is unbiased. Conceptually, this is the biggest challenge to using the Bayesian framework for ex-post impact assessment, although there are also significant practical challenges as well.

Clearly, interviews with policymakers would be essential to determine if their subjective beliefs had been influenced by the dissemination of POR outputs and, if so, to what extent. To ensure that the difference between elicited distributions captures the influence of POR outputs only, both prior and posterior distributions should be elicited at a common point in time, but for counterfactual and consequential scenarios tightly defined in the same way as for the conventional framework discussed above.

In conclusion, ex-post impact assessment of POR within either the conventional or Bayesian decision theoretic framework poses a range of conceptual and practical difficulties that either do not arise in ex-post impact assessment of technology outputs from scientific R&D, or are much more difficult to resolve.

Finally, the only possible candidate from the Indonesian policy projects for further assessment of ex-post impacts would be the EWM group of policy projects. The poor prospect of establishing credible evidence of actual influence, coming up with a convincing case for the share attributed to POR outputs vis-à-vis other policymaking inputs and deriving believable estimates of quantitative impacts of overall influence on policymaking, mean that all the other projects are totally unsuitable. However, even for the highly successful EWM projects, the challenges of undertaking a complete ex-post impact assessment under either the conventional 'deterministic' framework or the Bayesian decision theoretic framework would be formidable. For a thorough study, a selection of outputs would need to be chosen that was representative both of those believed to have influenced policymakers to alter a prior intended policy choice, as well as those that reinforced policymakers prior beliefs to retain the existing policy. While this would permit a trial of the Bayesian framework as an alternative to the conventional framework for ex-post impact assessment of POR projects, due to conceptual and practical problems, such as eliciting policymakers' prior and posterior beliefs, the prospects of achieving the aims of such a project would be not be high. Hence, the very substantial resources required could not be justified given the considerable risks involved.

Appendix 1
The basics of Bayesian decision theory and valuing information

Following Hirshleifer and Riley (1992), the micro-economic theory of information derives from a decision theoretic approach to the economics of uncertainty, in which the decision problem is characterised as the selection of one of a number of alternative and mutually exclusive acts. Decision-makers' beliefs about uncertain events, or states of nature, that influence the outcomes from alternative acts, can be summarised by the decision-makers' subjective probability distributions over all possible states of the world, and the dispersion of such distributions encapsulates the degree of the decision-makers' uncertainty. Given this uncertainty, there will be some possibility that the act chosen on the basis of subjective beliefs will in fact be suboptimal for some states of nature, in which case there is an associated opportunity cost (or loss or regret) relative to that act which is in fact optimal for the true state of nature. The possibility also exists that the chosen act is identical to the (truly) optimal act, in which case there would be zero opportunity loss. A-priori, both possibilities need to be countenanced, and the expected value of this opportunity loss is commonly referred to as the cost of uncertainty.

In addition, the cost of risk is another conceptually distinct cost of uncertainty, the size of which depends both on the perceived level of risk, and on decision-makers' attitudes to risk. The ex-ante value of information derives from its potential to reduce either or both of these costs. Note that if 'perfect' information can eliminate both of these costs, then the sum of the cost of uncertainty and the cost of risk provides an upper bound on the possible value of 'imperfect' information. Of course, information is rarely, if ever, perfect. In practice, the expected value of imperfect information will be some proportion of the potential expected value of perfect information.

The economics of information also has important antecedents in Bayesian statistical decision theory,[40] in which information is not a stock of certain knowledge, but a flow or increment of 'news' or 'messages' of uncertain reliability that may, or may not, change a decision-makers' prior probability distributions (Gardner 2008, p. 7). From this perspective, it is the process of changes in belief distributions that constitutes the essence of information, although information also has value to the extent that it reduces the degree of dispersion of the decision-makers' belief distribution.

In Bayesian statistical decision theory, an unbiased sampling process generates observations from a stochastic distribution centred on the unknown parameter of interest.[41] If the decision-maker uses sample observations to update prior beliefs in a manner consistent with Bayes' theorem, then provided that sufficient observations are taken, ultimately the true value of the parameter of interest will become known with certainty, and the cost of uncertainty will reduce to zero. Furthermore, an established result from statistical sampling theory is that the cost of uncertainty is a

40 For instance, see Degroot (1970).

41 For a biased sampling process, observations are drawn from a stochastic distribution that is centred on the unknown parameter of interest plus or minus a bias term that also may not be known.

monotonically declining function of the amount of information obtained, and that the speed of convergence to certainty will be faster, the more 'informative' is the sampling data (i.e. the smaller the variance of the sampling distribution). Hence, the value of information increases monotonically with extra information, and also is a monotonic non-decreasing function of the accuracy, reliability or precision of the information.

Management economists have adapted Bayesian statistical decision theory to the analysis of business decisions, and there now is an extensive literature on Bayesian business decision theory in which some key foundations of statistical decision theory have been modified somewhat to accommodate a wider range of sources of information.[42] Nevertheless, at the heart of all Bayesian decision theory is the proposition that when choices have to be under uncertainty about key parameters, learning typically takes place by collecting information that potentially might modify the probability distributions with which a decision-maker starts.

The information content of economic research covers a wide spectrum, ranging from primary data through new knowledge or information about current values of economic variables to predictions about future levels of market prices, and to detailed and comprehensive analyses of the economic consequences of specific policy changes. Such information has value to the extent to which it might influence decisions that have economic consequences. The three broad classes of decisions that might be influenced by information from economic research are decisions by households, decisions by firms and decisions by government. The value of information to consumers from searching for data on market prices was first explicitly analysed in the classic paper by Stigler (1961) on the economics of information.

In the subsequent literature, this decision theoretic framework has been extended to many areas of economic behaviour of both consumers and producers. In a path-breaking study to evaluate soybean outlook research, Norton and Schuh (1981) assumed that subjective prior distributions were based on historical probabilities of price movements for the preceding 15 years. Conditional probabilities were determined by comparing past outlook projections with the actual states that occurred. These probabilities were then used to calculate posterior probabilities using Bayes' formula.

However, the possible advantages of further extending the Bayesian decision theoretic framework to policy decisions to explore the implications of viewing economic policy research outputs as bits of information that might influence future decisions by government about regulations and policy settings have only rarely been discussed.[43] Gardner (1999) provides a simple stylised example of how POR that provides imperfect information about the price elasticity of export demand for a commodity might be incorporated into policymakers' prior beliefs, and thereby possibly influence the choice between two policy actions, namely an acreage control program and a production subsidy program.

Norton and Alwang (2004) have employed a quasi decision theoretic approach to measuring benefits from research on policies associated with deforestation of Brazilian Amazonia basin, and to measuring benefits from research on pesticide policies in the Philippines.

Schimmelpfennig and Norton (2003) have demonstrated the practical feasibility of using a Bayesian decision theoretic approach, albeit in a simplified way. Some of the main features of their formal theoretical framework to evaluate the returns to POR are outlined below to illustrate how Bayesian decision theory can be applied to the impact assessment of POR. In their model, the policy decision is characterised as a choice of the value of the policy instrument from a variety of possible values by a policymaking centre that is assumed to be constitutionally authorised to make this choice. Without information contained in policy research outputs, the decision-maker would choose that policy instrument value that maximises the expected utility of the prior probability weighted consequences of different states of nature. However, the decision-maker would learn from any additional information that became available by converting prior probabilities into posterior probabilities and reassessing the available policy actions. Since the chosen value of the policy instrument affects the wellbeing of all decision-makers, those with similar preferences for policy outcomes may organise into

42 For instance, see Anderson et al. (1977) and Winkler (1972).

43 See Lindner (1987), Gardner (1999), Schimmelpfennig and Norton (2003) and Norton and Alwang (2004).

interest groups that can attempt to influence the policy decision by incurring lobbying costs. The preferences of the policymaking centre are influenced by the interest groups, and the solution value of the policy instrument maximises a policy governance function to balance the demands of different interest groups, while the political–economic equilibrium values of the policy instrument variables are determined through a bargaining game between the interest groups.

New information from POR may cause decision-makers to revise their prior probabilities about the consequences of specific policy instruments if they believe there is a positive probability of the research message being true. This may lead to further lobbying and a change in the optimal policy action. The value of the new research information is the difference between the maximum value of the policy governance function with and without the information. This theoretical framework captures the impacts of POR on the subjective beliefs of policymakers about the consequences of policy choices, as measured by their welfare effects, and the political–economic interactions between policymakers and interest groups that underpin policy decisions.

For those authors who have advocated evaluating POR from a Bayesian decision theoretic point of view, such an approach highlights the fact that normally the economic value of information outputs from POR is due primarily to reduced uncertainty about the optimal design of a policy, but also allows for the possibility that some information from POR may be worse than what was available before. Thus, it can readily accommodate the possibility of poisoned-well outputs, and even suggests an answer to the Cassandra conundrum of how good advice not taken could nevertheless have value.

A simple numerical example serves to illustrate the differences in ex-post impact assessment in a Bayesian decision theoretic framework vis-à-vis the more conventional deterministic economic surplus framework. Both cases are based on the same simple, stylised, two-act, two-state policy choice problem adapted from Gardner (1999, pp. 2–4). The uncertain event is whether export demand for a commodity is inelastic (State 1, or S1) or elastic (State 2, or S2). The goal for a POR program is to determine which state exists.

Two policy actions are possible: A1 is an acreage control program; and A2 is a production subsidy program. The value of any policy outcome is measured by $V(i, j)$ where i is the state of the world, j is the chosen policy and V is a weighted sum of benefits to producers and consumer-taxpayers. There are four possible outcomes, as shown in Table 7.

If the acreage control policy (A1) is chosen, the result is \$100 if demand is inelastic, but only \$20 if it is elastic. If the production subsidy policy (A2) is chosen, the result is \$25 if demand is inelastic, and \$70 if it is elastic. The policymaker will regret choosing A1 if demand is elastic, and A2 if demand is inelastic. Prior to the POR, it is not known which of these two states is the true one, but the prior belief of policymakers is that either state is equally likely (i.e. Prob (S1) = Prob (S2) = 0.5). Given these beliefs, the prior optimal policy is acreage controls, since E(V:A1) = \$60.00 is greater than E(V:A2) = \$47.50. Hence, for a counterfactual scenario in which either POR is not carried out, or where any research outputs have no influence, the acreage control program will be chosen under both the Bayesian and the deterministic frameworks.

After the findings from the POR are known, one of three observable outcomes is possible for the consequential scenario. If the research concludes that demand is inelastic, and this finding influences policymakers, then the previously intended decision to choose the acreage control policy (A1) would be reinforced. On the other hand, if policymakers are influenced by research that concludes that demand is elastic, then they may decide to reverse the previously intended decision to choose the acreage control policy (A1), and choose the production subsidy policy (A2) instead.

Table 7. Value of all policy/event outcomes

	S1: demand inelastic	**S2: demand elastic**
A1: acreage control program	\$100	\$20
A2: production subsidy program	\$25	\$70

However, notwithstanding the finding from the POR, they may decide to still choose the previously intended acreage control policy (A1) if the policy outputs are not sufficiently persuasive.

If the impacts of POR are assessed under the deterministic framework, then the ex-post assessed benefit will be zero if there is no change to the previously intended acreage control policy (A1), irrespective of the research findings. Alternatively, if the policymakers are influenced by research findings to opt instead for the production subsidy policy (A2), then implicitly they have been persuaded that demand is in fact elastic (S2), in which case the ex-post benefit will be assessed to be \$50 (i.e. V(A2:S2) – V(A1:S2)).

Now consider the ex-post impact assessment of the benefits of POR under the Bayesian framework. In addition to being able to observe the content of the policy outputs from the research, and whether or not there is a decision to change from the previously intended acreage control policy (A1) to the production subsidy policy (A2), a measure of the degree to which the research outputs had been influential could be ascertained by eliciting the policymakers' prior and posterior beliefs.[44]

In the example from Gardner (1999), if the finding of POR was that demand is inelastic, the posterior belief that demand (S1) is inelastic would be 70%. Hence, even although the previously intended acreage control policy (A1) would not change, ex post there would be a reduction in the cost of uncertainty, or level of expected regret, of \$10 (i.e. from \$25 based on prior probabilities to \$15 based on posterior probabilities). Conversely, if POR found that demand was elastic, the posterior probability of S1 (elastic demand) would be 20%. Given such posterior beliefs, the policymaker would decide to reverse the previous intended policy of acreage control (A1), and instead decide to choose the production subsidy policy (A2). For this case, ex post there would be a reduction of the cost of uncertainty of \$10 (i.e. from a level of expected regret for A1 of \$25 based on prior probabilities, to a level of expected regret for A2 of \$15 based on posterior probabilities).

It is purely coincidental in the example taken from Gardner (1999) that the reduction in the cost of uncertainty was the same (i.e. \$10) irrespective of the assumed findings from the POR. Alternative examples where policymakers found the research result that export demand is elastic either more or less persuasive than assumed by Gardner (1999) can easily be constructed by modifying the assumptions about the likelihood function. For instance, if after learning that the POR found export demand to be elastic, policymakers believed that the posterior probability of it being inelastic (S1) was either 10% or 30%, then they would still be persuaded that the production subsidy policy (A2) would be the superior policy. However, the respective reduction in the cost of uncertainty from choosing A2 would be either \$17.50 (i.e. from \$25 based on prior probabilities to \$7.50 based on posterior probabilities) for the former case (posterior P(S1) = 10%), or only \$2.50 (i.e. from \$25 based on prior probabilities to \$22.50 based on posterior probabilities) for the latter case (posterior P(S1) = 30%). Note, however, that whereas the ex-ante value of information from research is non-negative provided that it is generated by a stochastic process that is unbiased,[45] the same is not necessarily true for the ex-post value of information from research, even if it is unbiased. For instance, in the above example, if given a POR finding that export demand was elastic the posterior probability of SI was 40%, then the expected regret of A2 would be \$30, which is greater, not less, than the prior expected regret of A1 of \$25.

However, there are few examples of attempts to apply Bayesian decision theory to PORIA despite it seeming to be tailored for valuing information. CGIAR (2008) notes that, with hindsight, this is not so surprising, and reinforces the evaluation by several economists that this

[44] It is important that any change in measured subjective belief distributions is attributed solely to policy outputs from the POR, and not to other influences on policy choices. One way to ensure this result is to not only elicit posterior belief distributions ex post, but also to elicit prior belief distributions at the same time, but under an alternative hypothetical scenario under which everything else was the same except that the POR was not undertaken. This may be easier said than done.

[45] As Gardner (1999, p. 4) notes, ex ante, all research, including 'Even uninformative research—research that delivers no news, that leaves the posterior probabilities the same as the prior probabilities—has value no less than zero because it makes no difference in action taken'. However, while Gardner does not spell it out, a caveat to this proposition is that it does not apply to misinformation, which by definition is biased.

approach is difficult to implement. Lindner (2004) has discussed some of the tenets of Bayesian decision theory that are more controversial in the context of valuing information from social science research.

In particular, characterising social science research as a process of objectively sampling at random from the 'true state of nature' strains credulity. Hence, any implicit assumption that all essential aspects of the information-generating process can be summarised by a likelihood function that is objective in the sense that effectively it is based on sampling at random from the 'true state of nature' clearly needs to be modified. It needs to be recognised that POR sometimes, perhaps even often, produces misinformation rather than information, but as a profession we have barely scratched the surface of the economics of misinformation. In theory, veracity or falsity of information could be treated analytically as bias in the information-generating process which, in the sense used in statistical sampling theory, is a knowable, even if unknown, parameter. However, bias in the context of social science research is arguably unknowable in any objective sense, and certainly a much less tractable notion.

To use the logic of decision theory, if an infinite amount of 'unbiased' information will lead to certain knowledge of the 'true state of nature', what are the consequences of an infinite amount of misinformation? If it is not perceived to be misinformation, then presumably decision-makers will reach false conclusions about the 'state of nature', and so increase the probability of bad decisions. This would seem to imply that more misinformation will, ex post, increase the expected value of regret (cost of uncertainty) when the true state of nature is revealed—an intuitively appealing result. On the other hand, if misinformation is perceived as such, then a common reaction is simply to ignore it. In this case, it has no impact on the twin costs of uncertainty and risk, and presumably no value. A more sophisticated response to perceived misinformation would be to draw inferences about the 'true state of nature' from the nature of the misinformation being peddled.

In discussing the application of a decision theoretic approach to evaluation of policy research on deforestation in Brazilian Amazonia, Norton and Alwang (2004) resorted to highly simplified modelling, as key parameters were obtained from fewer sources than one would normally use for such analysis. They also noted the difficulty of defining the states of nature about which policymakers are uncertain, and that eliciting policymakers' subjective beliefs for the various states of nature, both before and after new information is received, is a significant impediment to using Bayesian decision theory in PORIA. Other problems flow from the diversity of types and objectives of agricultural policies, so that any analysis needs to be disaggregated by type of policy.

Schimmelpfennig and Norton (2003) are the only economists to have applied Bayesian decision theory to the impact assessment of realistic examples of POR. From these examples, they concluded that eliciting highly subjective belief distributions is difficult, and particularly so if there are multiple decision-makers. All examples also illustrated the general point that if the pay-off from one policy/state pay-off is dominant enough, then economics research is likely to have little or no measurable benefit because any changes in probabilities do not reduce the uncertainty enough to reverse intended policy choices. Consequently, results can easily be influenced by the number of states and actions included in the evaluation. Last, in the first example of POR on premium rates for revenue insurance, calculating program cost savings due to research on premium insurance rates was difficult because, in some years, additional premium subsidies were provided as a partial substitute for reduced price supports due to changes in farm programs, which demonstrates the complexity of policymaking in the real world.

Appendix 2
Summary details of ACIAR Indonesian policy projects

Economic evaluation of policies for rice self-sufficiency in Indonesia (EFS/1983/062)

Collaborating agencies and lead researchers	• University of New England, Australia; Roley Piggott • Center for Agro-Socioeconomic Research, Indonesia
ACIAR funding	$191,268
Duration	Start: July 1985 Termination: September 1988
Available documentation	• Preliminary proposal (no date) • Budget (no date) • Capacity building impact statement (August 1999)
Context	Input and output price supports for rice producers and consumers have been major instruments of Indonesian government agricultural policy to achieve social stability and self-sufficiency in rice, but little economic appraisal of these policies has been conducted.
Objectives	• Document relationships between the Indonesian rice economy and the secondary food crops sector • Estimate effects of policies to achieve and sustain self-sufficiency in rice on treasury cost, social cost and exchange-rate costs • Outline a model which can be used for future food policy experimentation in Indonesia • Suggest and analyse policy alternatives to achieve self-sufficiency in rice
Method-oriented outputs	• Developed economic models to analyse output and input price policies in the food crops sector
Process-oriented outputs	• Documented the economic structure of the food crops sector and the overall effect of output and input price policies on the Indonesian economy
Policy-analysis outputs	• Estimated impacts on net social benefits, level of rice self-sufficiency, foreign exchange costs and government budgetary costs of a number of alternative food crop output and input price policies

Source: ACIAR project documents

Rural income and employment in Indonesia (EFS/1988/022)

Collaborating agencies and lead researchers	• Department of Economics, University of Wollongong, Australia; Dennis O'Brien • Center for Agro-Socioeconomic Research, Indonesia
ACIAR funding	$68,579
Duration	Start: January 1989 Termination: June 1992
Available documentation	• Project proposal (August 1986) • Program manager analysis (July 1988) • Annual report (August 1990) • Preliminary analysis (no date) • Project review (no date)
Context	Trend to greater reliance on non-agricultural sources of income by farm households. The few micro-level studies of income and employment completed have provided very little information on impacts at the household level, yet an understanding of the effects at the village and household levels is necessary to ensure a sound basis for future programs.
Objectives	• Develop summary statistical database of rural labour markets in West Java • Estimate a series of elasticities showing how internal and external factors affect family labour allocation • Test hypotheses about determinants of rural family labour allocation
Method-oriented outputs	None
Process-oriented outputs	• Documented household characteristics, resource allocations to income-generating activities, income and production levels by agricultural and non-agricultural activities, and household expenditure patterns for 300 households in six villages in the Cimanuk Basin • Estimated elasticities, showing how family composition, technology adoption, crop prices and wage rates affect family labour allocation between farm production and off-farm income activities
Policy-analysis outputs	None

Source: ACIAR project documents

Analysis of policies affecting the Indonesian agricultural sector: a multiple modelling approach and application to fertiliser policies (ANRE1/1990/038)

Collaborating agencies and lead researchers	• Research School of Pacific Studies, Australian National University; Ray Trewin • Center for Agro-Socioeconomic Research, Indonesia
ACIAR funding	$641,670
Duration	Start: February 1992 Termination: February 1996
Available documentation	• Project document (September 1991) • Proposal for extension (April 1994) • Termination report (February 1996)
Context	Perceived limitations of partial equilibrium models built by earlier ACIAR projects and by IFPRI
Objectives	• Estimate production functions for major crops and regions • Analyse Indonesian agricultural policies using an econometric model of the agricultural sector • Examine broader effects of policies through inter-sectoral linkages • Promote spillover applications of research outcomes
Method-oriented outputs	• Developed software to estimate frontier production functions over time • Built and refined INDOGEM general equilibrium economic model
Process-oriented outputs	• Documented the economic structure of agricultural sector of the Indonesian economy
Policy-analysis outputs	• Analysed policies for rice self-sufficiency, fertiliser pricing, irrigation investment, research and extension, stabilisation, diversification, livestock arrangements, consumer demand, open trade and investment, and the 'tariffication' of key sectoral non-tariff barriers

Source: Pearce (2005) and ACIAR project documents

Dairy policy in Indonesia (ANRE1/1993/023)

Collaborating agencies and lead researchers	• Department of Economics, University of Queensland, Australia; Paul Riethmuller and Joseph Chai • Center for Agro-Socioeconomic Research, Indonesia
ACIAR funding	$285,917
Duration	Start: July 1994 Termination: December 1996
Available documentation	• Project proposal (no date) • Review report (December 1996)
Context	Very heavy levels of protection enabled development of an Indonesian dairy industry based on smallholder farms and organised into cooperatives, but numerous government regulations and institutional arrangements have resulted in widespread inefficiencies.
Objectives	• Investigate the use of regulations on mixing of imported with domestically produced milk in the Indonesian dairy industry • Formulate new/revised policy arrangements and estimate the effects of these on the dairy industry and the dairy processing industry, and on consumers and farmers • Assess the implications of the new/revised arrangements for farmers, manufacturers, consumers and exporting countries such as Australia
Method-oriented outputs	• Developed economic model to analyse dairy policies
Process-oriented outputs	• Documented the economic structure of the Indonesian dairy sector
Policy-analysis outputs	• Estimated that total losses to the economy associated with the mixing ratio, including production efficiency loss plus consumer deadweight loss, could be between $0.75 million and $17.49 million annually

Source: ACIAR project documents

Analysis of growth and stabilisation policies in Indonesia—a linked modelling approach (ANRE1/1993/705)

Collaborating agencies and lead researchers	• International Food Policy Research Institute, Washington, DC; Mark Rosegrant • Research School of Pacific Studies, Australian National University (ANU); Ray Trewin • Center for Agro-Socioeconomic Research (CASER), Indonesia
ACIAR funding	Total budget not specified: ACIAR contribution $130,000 (IFPRI provided time of principal researcher)
Duration	Start: May 1993 Termination: August 1995
Available documentation	• Special-purpose grant proposal (undated) • Progress report (April 1994) • Paper by Rosegrant et al. Indonesian agriculture to 2020: source of growth, projections and policy implications (April 1997)
Context	IFPRI brought in to develop sectoral component of project 9038, building on previous work with CASER, so that ANU could focus on building a CGE model named INDOGEM
Objectives	• Extend past IFPRI analysis of food crop sector to: – link with CGE modelling of ANU – develop a user-friendly version of the model
Method-oriented outputs	• Developed sectoral food crop component for the INDOGEM model • Developed user-friendly version of the food crop supply and demand simulation model
Process-oriented outputs	• Updated and extended estimates of elasticities in food crop supply system from 1985 to 1990
Policy-analysis outputs	• Analysed price stabilisation policies

Source: Pearce (2005) and ACIAR project documents.

Policy analysis of linkages between Indonesia's agricultural production, trade and environment (ADP/1994/049)

Collaborating agencies and lead researchers	• Centre for International Economic Studies, University of Adelaide; Kym Anderson • Research School of Pacific and Asian Studies, Australian National University; Ray Trewin • Center for Agro-Socioeconomic Research, Indonesia • Center for Strategic and International Studies, Washington, DC
ACIAR funding	$1,003,472
Duration	Start: July 1996 Termination: December 2002
Available documentation	• Project proposal (undated) • Fourth annual report (2000) • Reviewers' report (June 2000) • Proposal for 1-year extension (undated) • Final report (January 2003)
Context	Perceived need to take better account of broad trade and environmental issues given Uruguay Round agreement and sustainable development focus of recent 5-year plan
Objectives	• Assess efficiency, distributional, environmental and welfare effects of structural and policy changes at home and abroad that may affect Indonesian agriculture • Update INDOGEM model (with regional and income group disaggregation) • Conform INDOGEM to the Global Trade Analysis Project (GTAP), to be able to take advantage of GTAP update processes • Disseminate skills in CGE-based empirical policy analysis among Indonesian researchers
Method-oriented outputs	• Augmented CGE models with environmental and new input and output linkages
Process-oriented outputs	• Assembled new data to document relationships between deforestation, expansion of farm land, international prices for food and forest products, greenhouse gas concentrations, use of farm chemicals and fertilisers, land prices, soil erosion, subsidies and agricultural growth
Policy-analysis outputs	• Examined impacts of pricing policies, investments or subsidies on the goal of food self-sufficiency, and on other social, environmental and agricultural goals • Investigated options to implement commitments made in Uruguay Round of trade negotiations • Provided input into policy debate on Indonesia's response to the Asian crisis

Source: Pearce (2005) and ACIAR project documents.

Improving resource-use efficiency in the coconut industry of North Sulawesi and its national implications (AGB/2000/072)

Collaborating agencies and lead researchers	• Department of Agricultural and Resource Economics, University of Sydney, Australia; Lynn Henry • Sam Ratulangi University, Indonesia • Bogor Agricultural University, Indonesia • Coconut and Palmae Research Institute, Research and Development Board of North Sulawesi, Indonesia
ACIAR funding	$396,158
Duration	Start: January 2004 Termination: December 2006
Available documentation	• Project proposal (undated) • Annual report 05 (undated) • Annual report 06 (undated) • Annual report 07 (May 2007) • Final report (June 2006) • Review report (July 2006)
Context	The coconut industry contributes more than 85% of total agricultural output to the North Sulawesi economy, but the majority of producers are small landholders facing declining incomes. Policymaking responsibility is being devolved to provincial governments.
Objectives	• Investigate the current problems facing the smallholder coconut producers in North Sulawesi • Develop procedures to enable local planners to identify policy options for improving resource-use efficiency in the coconut sector • Use investigation as a case study to examine broader economic policy options for improving the incomes of poor Indonesian households
Method-oriented outputs	• Built a multi-period, multi-crop linear programming model of the North Sulawesi coconut industry to investigate grower investment options • Built an equilibrium displacement model of the coconut industry sector of the North Sulawesi economy to investigate reforms to coconut marketing system • Extended national CGE model to include a North Sulawesi component to quantify economy-wide effects of changes in North Sulawesi coconut industry
Process-oriented outputs	• Documented state of resource use in North Sulawesi coconut industry, including farm size and opportunities for alternative farm enterprises • Quantified relationships between the coconut industry and the broader economy of North Sulawesi and the national economy
Policy-analysis outputs	• Evaluated various investment options for growers to increase farm incomes • Estimated benefits to farmers from various investments to improve productivity in coconut production and in the processing/marketing sectors

Source: ACIAR project documents

Contract farming, smallholders, and rural development in East Java, Bali and Lombok (ADP/2000/100)

Collaborating agencies and lead researchers	• Graduate School of Agricultural and Resource Economics, University of New England, Australia; Phillip Simmons • Assessment Institute for Agricultural Technology, East Java, Indonesia • Bogor Agricultural University, Indonesia • Brawijaya University, Indonesia • Udayana University, Indonesia
ACIAR funding	$439,491
Duration	Start: January 2001 Termination: December 2005
Available documentation	• Project proposal (undated) • Annual report 02 (undated) • Project extension proposal (undated) • Final report 03 (undated) • Completion report for extension 05 (undated) • Review report (August 2004)
Context	There is growing recognition that contract farming has the potential to overcome market imperfections, minimise transaction costs and gain market access for smallholders in Indonesia.
Objectives	• Determine contract types used and commodities under contract in East Java, Bali and Lombok • Determine benefits of contract farming • Ascertain the potential for smallholders in contract farming and the potential to improve policy
Method-oriented outputs	None
Process-oriented outputs	• Documented contract farming systems for seed maize in East Java, seed rice in Bali and broiler chickens in Lombok; and the benefits of these systems for contracted smallholder farmers and contracting agribusiness firms
Policy-analysis outputs	None

Source: ACIAR project documents

Microfinance for agricultural producers in West Nusa Tenggara: Issues and opportunities for a sustainable financial intermediary system (ADP/2000/126)

Collaborating agencies and lead researchers	• Department of Economics, University of Queensland, Australia; Shankariah Chamala • University of Mataram, Indonesia • Private Bank of Nusa Tenggara Barat, Indonesia • Center for Agro-Socioeconomic Research and Development, Indonesia
ACIAR funding	$243,477
Duration	Start: July 2001 Termination: March 2004
Available documentation	• Project proposal (undated) • Research program manager assessment (March 2001) • Annual report 02 (April 2002) • Final report (undated) • Review report (July 2004)
Context	Poor performance of existing agricultural credit systems regarding credit access, credit use, credit repayment and sustainability of credit delivery
Objectives	• Undertake a critical evaluation of strengths and weakness in existing credit schemes • Identify measures for improvement from earlier evaluation, and develop and evaluate training and pilot system activities • Create a new, more effective and sustainable innovative microfinance system for agricultural producers in West Nusa Tenggara province
Method-oriented outputs	• Developed pilot systems and training programs to evaluate the extent to which farmers' credit was meeting their needs • Developed generic 'one-gate' model for credit delivery
Process-oriented outputs	• Documented existing credit schemes and strengths and weakness in credit access, appropriateness, transaction costs, repayments, saving services and institutional arrangements
Policy-analysis outputs	None

Source: ACIAR project documents

Social capital and rural development in eastern Indonesia (AGB/2004/028)

Collaborating agencies and lead researchers	• Graduate School of Agricultural and Resource Economics, University of New England, Australia; Ian Patrick • New South Wales (NSW) Department of Primary Industries, Australia • University of Mataram, Indonesia • Udayana University, Indonesia • Assessment Institute for Agricultural Technology, Indonesia
ACIAR funding	$149,334
Duration	Start: June 2006 Termination: August 2007
Available documentation	• Project proposal (undated) • Annual report (undated) • Final report (undated)
Context	In Indonesia, smallholder empowerment in agribusiness is an agreed priority. Recognition of the role that social organisations can play in facilitating coordination among smallholders to link with agribusiness has grown in recent years.
Objectives	• Define the beef supply chains in Bali, Lombok and NSW, and highlight critical factors that affect the efficient and equitable functioning of these markets • Describe how beef producers are organised in their respective domestic and export markets and how the public and private sectors have facilitated this process of organisation • Examine whether collective action (through community leaders) has contributed to improved market access for cattle smallholders • Define the smallholder organisational structure that can best facilitate successful integration into the cattle market
Method-oriented outputs	None
Process-oriented outputs	• Documented beef supply chains in Bali and Lombok, and the way in which social capital, leadership and other characteristics of cattle groups predisposed members to sell their cattle on-farm rather than at public cattle markets
Policy-analysis outputs	None

Source: ACIAR project documents

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IMPACT ASSESSMENT SERIES

No.	Author(s) and year of publication	Title	ACIAR project numbers
1	Centre for International Economics 1998.	Control of Newcastle disease in village chickens	AS1/1983/034, AS1/1987/017 and AS1/1993/222
2	George P.S. 1998.	Increased efficiency of straw utilisation by cattle and buffalo	AS1/1982/003, AS2/1986/001 and AS2/1988/017
3	Centre for International Economics 1998.	Establishment of a protected area in Vanuatu	ANRE/1990/020
4	Watson A.S. 1998.	Raw wool production and marketing in China	ADP/1988/011
5	Collins D.J. and Collins B.A. 1998.	Fruit fly in Malaysia and Thailand 1985–1993	CS2/1983/043 and CS2/1989/019
6	Ryan J.G. 1998.	Pigeonpea improvement	CS1/1982/001 and CS1/1985/067
7	Centre for International Economics 1998.	Reducing fish losses due to epizootic ulcerative syndrome—an ex ante evaluation	FIS/1991/030
8	McKenney D.W. 1998.	Australian tree species selection in China	FST/1984/057 and FST/1988/048
9	ACIL Consulting 1998.	Sulfur test KCL–40 and growth of the Australian canola industry	PN/1983/028 and PN/1988/004
10	AACM International 1998.	Conservation tillage and controlled traffic	LWR2/1992/009
11	Chudleigh P. 1998.	Postharvest R&D concerning tropical fruits	PHT/1983/056 and PHT/1988/044
12	Waterhouse D., Dillon B. and Vincent D. 1999.	Biological control of the banana skipper in Papua New Guinea	CS2/1988/002-C
13	Chudleigh P. 1999.	Breeding and quality analysis of rapeseed	CS1/1984/069 and CS1/1988/039
14	McLeod R., Isvilanonda S. and Wattanutchariya S. 1999.	Improved drying of high moisture grains	PHT/1983/008, PHT/1986/008 and PHT/1990/008
15	Chudleigh P. 1999.	Use and management of grain protectants in China and Australia	PHT/1990/035
16	McLeod R. 2001.	Control of footrot in small ruminants of Nepal	AS2/1991/017 and AS2/1996/021
17	Tisdell C. and Wilson C. 2001.	Breeding and feeding pigs in Australia and Vietnam	AS2/1994/023
18	Vincent D. and Quirke D. 2002.	Controlling *Phalaris minor* in the Indian rice–wheat belt	CS1/1996/013
19	Pearce D. 2002.	Measuring the poverty impact of ACIAR projects—a broad framework	
20	Warner R. and Bauer M. 2002.	*Mama Lus Frut* scheme: an assessment of poverty reduction	ASEM/1999/084
21	McLeod R. 2003.	Improved methods in diagnosis, epidemiology, and information management of foot-and-mouth disease in Southeast Asia	AS1/1983/067, AS1/1988/035, AS1/1992/004 and AS1/1994/038
22	Bauer M., Pearce D. and Vincent D. 2003.	Saving a staple crop: impact of biological control of the banana skipper on poverty reduction in Papua New Guinea	CS2/1988/002-C
23	McLeod R. 2003.	Improved methods for the diagnosis and control of bluetongue in small ruminants in Asia and the epidemiology and control of bovine ephemeral fever in China	AS1/1984/055, AS2/1990/011 and AS2/1993/001
24	Palis F.G., Sumalde Z.M. and Hossain M. 2004.	Assessment of the rodent control projects in Vietnam funded by ACIAR and AUSAID: adoption and impact	AS1/1998/036

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No.	Author(s) and year of publication	Title	ACIAR project numbers
25	Brennan J.P. and Quade K.J. 2004.	Genetics of and breeding for rust resistance in wheat in India and Pakistan	CS1/1983/037 and CS1/1988/014
26	Mullen J.D. 2004.	Impact assessment of ACIAR-funded projects on grain-market reform in China	ADP/1997/021 and ANRE1/1992/028
27	van Bueren M. 2004.	Acacia hybrids in Vietnam	FST/1986/030
28	Harris D. 2004.	Water and nitrogen management in wheat–maize production on the North China Plain	LWR1/1996/164
29	Lindner R. 2004.	Impact assessment of research on the biology and management of coconut crabs on Vanuatu	FIS/1983/081
30	van Bueren M. 2004.	Eucalypt tree improvement in China	FST/1984/057, FST/1987/036, FST/1988/048, FST/1990/044, FST/1994/025, FST/1996/125 and FST/1997/077
31	Pearce D. 2005.	Review of ACIAR's research on agricultural policy	
32	Tingsong Jiang and Pearce D. 2005.	Shelf-life extension of leafy vegetables—evaluating the impacts	PHT/1994/016
33	Vere D. 2005.	Research into conservation tillage for dryland cropping in Australia and China	LWR2/1992/009 and LWR2/1996/143
34	Pearce D. 2005.	Identifying the sex pheromone of the sugarcane borer moth	CS2/1991/680
35	Raitzer D.A. and Lindner R. 2005.	Review of the returns to ACIAR's bilateral R&D investments	
36	Lindner R. 2005.	Impacts of mud crab hatchery technology in Vietnam	FIS/1992/017 and FIS/1999/076
37	McLeod R. 2005.	Management of fruit flies in the Pacific	CS2/1989/020, CS2/1994/003, CS2/1994/115 and CS2/1996/225
38	ACIAR 2006.	Future directions for ACIAR's animal health research	
39	Pearce D., Monck M., Chadwick K. and Corbishley J. 2006.	Benefits to Australia from ACIAR-funded research	AS2/1990/028, AS2/1994/017, AS2/1994/018, AS2/1999/060, CS1/1990/012, CS1/1994/968, FST/1993/016 and PHT/1990/051
40	Corbishley J. and Pearce D. 2006.	Zero tillage for weed control in India: the contribution to poverty alleviation	CS1/1996/013
41	ACIAR 2006.	ACIAR and public funding of R&D. Submission to Productivity Commission study on public support for science and innovation	
42	Pearce D. and Monck M. 2006.	Benefits to Australia of selected CABI products	
43	Harris D.N. 2006.	Water management in public irrigation schemes in Vietnam	LWR2/1994/004 and LWR1/1998/034
44	Gordon J. and Chadwick K. 2007.	Impact assessment of capacity building and training: assessment framework and two case studies	CS1/1982/001, CS1/1985/067, LWR2/1994/004 and LWR2/1998/034
45	Turnbull J.W. 2007.	Development of sustainable forestry plantations in China: a review	
46	Monck M. and Pearce D. 2007.	Mite pests of honey bees in the Asia–Pacific region	AS2/1990/028, AS2/1994/017, AS2/1994/018 and AS2/1999/060

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No.	Author(s) and year of publication	Title	ACIAR project numbers
47	Fisher H. and Gordon J. 2007.	Improved Australian tree species for Vietnam	FST/1993/118 and FST/1998/096
48	Longmore C., Gordon J. and Bantilan M.C. 2007.	Assessment of capacity building: overcoming production constraints to sorghum in rainfed environments in India and Australia	CS1/1994/968
49	Fisher H. and Gordon J. 2007.	Minimising impacts of fungal disease of eucalypts in South-East Asia	FST/1994/041
50	Monck M. and Pearce D. 2007.	Improved trade in mangoes from the Philippines, Thailand and Australia	CS1/1990/012 and PHT/1990/051
51	Corbishley J. and Pearce D. 2007.	Growing trees on salt-affected land	FST/1993/016
52	Fisher H. and Gordon J. 2008.	Breeding and feeding pigs in Vietnam: assessment of capacity building and an update on impacts	AS2/1994/023
53	Monck M. and Pearce D. 2008.	The impact of increasing efficiency and productivity of ruminants in India by the use of protected-nutrient technology	AH/1997/115
54	Monck M. and Pearce D. 2008.	Impact of improved management of white grubs in peanut-cropping systems	CS2/1994/050
55	Martin G. 2008.	ACIAR fisheries projects in Indonesia: review and impact assessment	FIS/1997/022, FIS/1997/125, FIS/2000/061, FIS/2001/079, FIS/2002/074, FIS/2002/076, FIS/2005/169 and FIS/2006/144
56	Lindner B. and McLeod P. 2008.	A review and impact assessment of ACIAR's fruit-fly research partnerships—1984 to 2007	CP/1997/079, CP/2001/027, CP/2002/086, CP/2007/002, CP/2007/187, CS2/1983/043, CS2/1989/019, CS2/1989/020, CS2/1994/003, CS2/1994/115, CS2/1996/225, CS2/1997/101, CS2/1998/005, CS2/2003/036, PHT/1990/051, PHT/1994/133 and PHT/1993/87
57	Montes N.D., Zapata Jr N.R., Alo A.M.P. and Mullen J.D. 2008.	Management of internal parasites in goats in the Philippines	AS1/1997/133
58	Davis J., Gordon J., Pearce D. and Templeton D. 2008.	Guidelines for assessing the impacts of ACIAR's research activities	
59	Chupungco A., Dumayas E. and Mullen J. 2008.	Two-stage grain drying in the Philippines	PHT/1983/008, PHT/1986/008 and PHT/1990/008
60	Centre for International Economics 2009.	ACIAR Database for Impact Assessments (ADIA): an outline of the database structure and a guide to its operation	
61	Fisher H. and Pearce D. 2009.	Salinity reduction in tannery effluents in India and Australia	AS1/2001/005
62	Francisco S.R., Mangabat M.C., Mataia A.B., Acda M.A., Kagaoan C.V., Laguna J.P., Ramos M., Garabiag K.A., Paguia F.L. and Mullen J.D. 2009.	Integrated management of insect pests of stored grain in the Philippines	PHT/1983/009, PHT/1983/011, PHT/1986/009 and PHT/1990/009
63	Harding M., Tingsong Jiang and Pearce D. 2009.	Analysis of ACIAR's returns on investment: appropriateness, efficiency and effectiveness	
64	Mullen J.D. 2010.	Reform of domestic grain markets in China: a reassessment of the contribution of ACIAR-funded economic policy research	ADP/1997/021 and ANRE1/1992/028

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No.	Author(s) and year of publication	Title	ACIAR project numbers
65	Martin G. 2010.	ACIAR investment in research on forages in Indonesia	AS2/2000/103, AS2/2000/124, AS2/2001/125, LPS/2004/005, SMAR/2006/061 and SMAR/2006/096
66	Harris D.N. 2010.	Extending low-cost fish farming in Thailand: an ACIAR–World Vision collaborative program	PLIA/2000/165
67	Fisher H. 2010.	The biology, socioeconomics and management of the barramundi fishery in Papua New Guinea's Western Province	FIS/1998/024
68	McClintock A. and Griffith G. 2010.	Benefit–cost meta-analysis of investment in the International Agricultural Research Centres	
69	Pearce D. 2010.	Lessons learned from past ACIAR impact assessments, adoption studies and experience	
70	Harris D.N. 2011.	Extending low-chill fruit in northern Thailand: an ACIAR–World Vision collaborative project	PLIA/2000/165
71	Lindner R. 2011.	The economic impact in Indonesia and Australia from ACIAR's investment in plantation forestry research, 1987–2009	FST/1986/013, FST/1990/043, FST/1993/118, FST/1995/110, FST/1995/124, FST/1996/182, FST/1997/035, FST/1998/096, FST/2000/122, FST/2000/123, FST/2003/048 and FST/2004/058
72	Lindner R. 2011.	Frameworks for assessing policy research and ACIAR's investment in policy-oriented projects in Indonesia	ADP/1994/049, ADP/2000/100, ADP/2000/126, AGB/2000/072, AGB/2004/028, ANRE1/1990/038, ANRE1/1993/023, ANRE1/1993/705, EFS/1983/062 and EFS/1988/022

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