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Aceh soils

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Foreword

On 26 December 2004, an estimated 130,000 people in Aceh Province, Indonesia died as a result of the Indian Ocean tsunami. Seawater intrusion destroyed swathes of urban and rural land, causing significant salinity issues for the smallholder farmers who depend on the affected soils for their livelihoods.

The Australian Centre for International Agricultural Research (ACIAR) is mandated under the *Australian Centre for International Agricultural Research Act 1982* to work with partners across the Indo-Pacific region to generate the knowledge and technologies that underpin improvements in agricultural productivity, sustainability and food systems resilience. We do this by funding, brokering and managing research partnerships for the benefit of partner countries and Australia.

In the aftermath of the tsunami, ACIAR funded a series of soil-related projects in Aceh Province that sought to help farmers recover from the tsunami and to develop diversified, resilient and more profitable farm-based livelihoods. This book presents the findings of an ex-post evaluation of 4 of these post-tsunami projects.

The full impact of research-for-development work in agriculture, forestry and fisheries is realised over decades and cannot be properly evaluated when the research first takes place. For more than 30 years, ACIAR has systematically undertaken independent impact assessment studies of its portfolio of research activities. These evaluations have consistently found high returns on investments, reflecting the quality of Australian agricultural science and our partnership model, which ensures a high level of engagement with in-country partners, and a high level of adoption of research results.

This impact assessment found both direct and immediate benefits for both farmers and partner agencies, as well as ongoing impacts in the 10 years following the projects' completion. In addition to the intended impacts of the projects, such as improved income and living standards among smallholder farmers and reduced or optimised input use, this assessment also found that the influence of the projects had spread much more widely than anticipated.

Techniques that were introduced, tested and proven effective through the ACIAR projects were taken up as provincial policy, promoted throughout Aceh Province and adopted by a large segment of farmers. The assessment suggests that the projects, through their collaborative approaches and the interaction with existing national policies, created an initial impetus and triggered improvements that have been adopted and built on across the province. It also highlights the strong contribution that the ACIAR projects make to community resiliency and capacity building for individuals and organisations during a politically and environmentally disruptive period in Aceh Province.



Professor Wendy Umberger
Chief Executive Officer, ACIAR

Contents

Acknowledgements	vi
Shortened terms	vii
Summary	viii
Conceptual frameworks	viii
Methodology	ix
Observations and findings	1
KEQ1: Partner agency capacity development	1
KEQ2: Partner agency use of knowledge and skills.....	1
KEQ3: Impacts on farmers and production.....	2
KEQ4: Factors influencing achievement.....	3
KEQ5: Lessons on organisational capacity building.....	4
KEQ6: Practicality and value-add of methodology	5
Introduction	7
Conceptual frameworks	13
Methodology	17
KEQ1 Partner agency capacity development	19
KEQ2 Partner agency use of knowledge and skills	25
KEQ3 Impacts on farmers and production	31
KEQ4 Factors influencing achievement	43
KEQ5 Lessons on organisational capacity building	49
KEQ6 Practicality and value-add of methodology	55
Appendices	61
Appendix 1: Project overviews	61
Appendix 2: Key features of sustainable livelihoods framework and total economic value	68
Appendix 3: Indicative theories of change	69
Appendix 4: Framework for capacity development and its operationalisation.....	71
Appendix 5: Key project documents	76
Appendix 6: Consultation lists	77
Appendix 7: Project costs and benefits.....	79
Appendix 8: Publications resulting from the projects	86
References	94

List of tables

Table 1	ACIAR-funded projects in post-tsunami Aceh	8
Table 2	Stated aims and objectives of the Aceh projects.....	9
Table 3	Two-part capacity development impact pathway	15
Table 4	Applying TEV concepts to human and social capital developed in partner agencies	23
Table 5	Results claimed in project reporting.....	32
Table 6	Expected project impacts and actual outcomes	37
Table 7	Contributions to project funding.....	38
Table 8	Combined project benefit–cost assessments	39
Table A1.1	ACIAR-funded projects in post-tsunami Aceh	61
Table A1.2	Actual project pathways and activity phases	64
Table A4.1	Knowledge management process and organisational actions.....	74
Table A7.1	Summary of project costs by funding source (AUD).....	79
Table A7.2	Comparison between yield and income of ICM trials and farmer practice	80
Table A7.3	Average yield increase, cost reduction, gross margin increase and total economic contribution per rice crop for farmers at long-term project sites and in surrounding villages	81
Table A7.4	Comparison of average yield and gross margin data for farmer practice and trial results on rainfed sites in SMCN/2007/040 trials in Bireuen and Aceh Besar, 2010.....	81
Table A7.5	Soybean harvest area, production and yield, Aceh, 2007–2011	81
Table A7.6	Average monthly gross margin for women farmers’ groups, Aceh Besar	81
Table A7.7	Area of vegetable production, Aceh, 2015–2019	83
Table A7.8	Non-rice food crop productivity, Aceh, 2011–2015	83
Table A7.9	Rice area and productivity, Aceh, 2000–2021	84
Table A7.10	Estimates of returns to rice production post-ICM introduction.....	85
Table A7.11	Project costs and estimated direct and (conservative) attributable benefits	85

List of figures

Figure 1	Conceptual frameworks underpinning proposed integrated approach	14
Figure 2	Average rice yield, 1993–2021	34
Figure 3	Aceh poverty rates, 2000–2016.....	35
Figure 4	Current ACIAR capacity building theory of change.....	50
Figure 5	Proposed alternative ACIAR capacity building theory of change.....	50
Figure 6	Problem-driven iterative adaptation	53
Figure 7	Expected vs actual impact pathways.....	56
Figure A1.1	Location of 8 long-term SMCN/2007/040 research sites in Aceh.....	61
Figure A2.1	Summary of sustainable livelihoods framework components that influence household pursuit of livelihoods.....	68
Figure A2.2	Summary of total economic value components (as applied to ecosystem services)	68
Figure A3.1	Indicative/broad impact pathways.....	70
Figure A4.1	Trade-offs identified in ACIAR institutional strengthening review	72
Figure A4.2	SECI model of knowledge dimensions.....	73
Figure A4.3	Magnier-Watanabe and Senoo model	73

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In Aceh, numerous individuals previously involved in the projects engaged patiently with the evaluation team during often-lengthy interviews. Pak Ferizal, head of the Institute for Assessment of Agricultural Technology during the fieldwork period, was especially helpful in reaching out to his extensive networks of researchers and extension agents across the province to secure their collaboration. They, in turn, not only provided their own insights but also connected the team with many farmers in communities impacted by ACIAR projects. Women's and men's farming groups welcomed us into their communities, homes and farm lands, sharing hospitality, experiences and opinions on a wide range of relevant topics. The consultation list in

Appendix 6 captures the breadth of engagement across Aceh Province.

Finally, the Alinea International team would also like to acknowledge the invaluable assistance provided by our Aceh-based research assistants, Maksalmina (Mex) and Cut Izzah Kemala, who efficiently organised the program of consultations, accompanied and guided us during fieldwork around the province, and shared their contextual knowledge and understanding to keep the analysis grounded in the local realities.

The Alinea International team has endeavoured to reflect accurately the wealth of information obtained from project documentation, online consultations and Aceh fieldwork, but we take full responsibility for remaining errors and omissions.

Shortened terms

AUD	Australian dollar
ACIAR	Australian Centre for International Agricultural Research
BPP	Balai Penyuluhan Pertanian (District Agricultural Extension Offices)
BPS	Badan Pusat Statistik (Provincial Statistics Office)
BPTP	Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology)
BRIN	Badan Riset dan Inovasi Nasional (National Research and Innovation Agency)
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
demplot	demonstration site
DFAT	Department of Foreign Affairs and Trade (Australia)
DP	Dinas Pertanian (Department of Agriculture)
FCAS	Food Crops Agricultural Service
ICM	integrated crop management
ICRR	Indonesian Centre for Rice Research
IDR	Indonesian rupiah
ISRI	Indonesian Soil Research Institute
IVEGRI	Indonesian Vegetables Research Institute
KEQ	key evaluation question
KWT	<i>kelompok wanita tani</i> (women's farming group(s))
NAD	Nanggroe Aceh Darussalam Province (Aceh Province)
NGO	non-government organisation
NSW DPI	New South Wales Department of Primary Industries
PDIA	problem-driven iterative adaptation
PPL	<i>penyuluh pertanian lapangan</i> (agricultural extension officer(s))
SECI	socialisation, externalisation, combination and internalisation
SLF	sustainable livelihoods framework
TBIE	theory-based impact evaluation
TEV	total economic value
ToC	theory/theories of change
ToT	training of trainers
USD	United States dollar
WorldVeg	World Vegetable Center

Summary

In the aftermath of the 2004 Indian Ocean tsunami, the Australian Centre for International Agricultural Research (ACIAR) funded a series of soil-related projects in Aceh Province, Indonesia. These projects initially sought to help farmers recover from the tsunami, and then to develop diversified, resilient and more profitable farm-based livelihoods. Each project worked closely with local agricultural research and extension services and sought to build technical and organisational capacity within those agencies.

ACIAR contracted Alinea International to undertake an ex-post evaluation of 4 Aceh projects spanning the period 2005 to 2012. In addition to identifying project impacts and impact pathways, the evaluation was intended to test the practicalities and value-add of applying a new, more comprehensive conceptual model to the assessment of ACIAR agricultural research-for-development investments. Six key evaluation questions were formulated to guide the process: 4 focused on pathways from activities to impacts, and 2 focused on lessons for future ACIAR evaluations. These are discussed in more detail throughout this report.

Four projects are included in this evaluation:

- 'Management of soil fertility for restoring cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province' (SMCN/2005/004)
- 'Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/118)
- 'Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/075)
- 'Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales' (SMCN/2007/040)

The New South Wales Department of Primary Industries (NSW DPI) led the first, second and fourth projects and was also involved in the third, which was led by the World Vegetable Center (WorldVeg). Several local partners were involved, notably Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology) (BPTP) and the extension services of Dinas Pertanian (Department of Agriculture) (DP).

A subsequent project to improve productivity in dryland farming systems of Aceh, which ran from 2014 to 2019, is not included in this evaluation.

Conceptual frameworks

The ACIAR standard impact assessment guidelines (Davis methodology) (Davis et al. 2008) are based on benefit-cost analysis supported by partial equilibrium and/or computable general equilibrium modelling, along with non-market valuation through stated preference and/or revealed preference methods. ACIAR is interested in developing a broader set of tools and methodologies that better reflect and capture the complexity of change and enable more comprehensive reporting on the diversity of outcomes and impacts that project activities might generate. To this end, ACIAR collaborated with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) during 2020 and 2021 to develop a conceptual approach that integrates elements of the sustainable livelihoods framework (SLF) and total economic value (TEV) concepts into a theory-based impact evaluation (TBIE) approach (Randall 1987; Scoones 1998; White 2009). This also built on earlier CSIRO engagement with Philippines-based organisations to integrate economic, social and environmental considerations into impact assessment methodology for agricultural research for development within complex systems (Williams et al. 2021b).

TBIE is structured around theories of change (ToC) and impact pathways, based on key principles aimed at understanding not only what has transpired, but why and how certain outcomes took place. The SLF examines and provides an overview of the multiple strategies people employ to increase their wellbeing, in the context of the system (rules, norms, enablers, constraints) within which they operate. In particular, it describes the ways in which people combine their capabilities, assets and activities (which together are taken to constitute a 'livelihood') to maximise utility. TEV was originally developed to identify and categorise the value of environmental assets beyond their immediate (and often extractive) use. It distinguishes the various ways in which an asset offers utility to people and systems that interact with it.

For this Aceh evaluation, TBIE provided the starting point to guide the development, validation and assessment of impacts. In the absence of explicit ToC in the project proposal documents (or subsequent project reporting), the CSIRO team worked with ACIAR and former project personnel to develop an overall ToC. This was refined at evaluation planning stage to reflect the decision that this evaluation should focus primarily on the 'institutional capacity-building pathway'.

Given this capacity-development focus, SLF and TEV were used to explore the various types of 'capital' built (including at individual, organisational and broader institutional or enabling environment levels), as well as the types of 'value' (or utility) that various stakeholder and beneficiary groups have derived from the changes that have taken place.

Approaches to gender and social inclusion are not predetermined in these frameworks, but need to be incorporated. Gender-responsive lines of inquiry were included throughout, to examine the degree to which:

- programs and activities responded to the (possibly) different priorities of men and women
- men and women were able to participate in capacity-development programs and activities (at both institutional and farm/community level)
- men and women derived benefit (and value) from the capacity development they received.

Other issues of social inclusion and exclusion, such as land ownership, were also explored.

Methodology

Following a planning phase in late 2021 and early 2022, the evaluation centred on 2 separate in-country data-collection exercises, covering a wide range of stakeholders.

- **Phase I: Impacts for ACIAR project partners** involved a desktop review of project documents, initial contacts with Australian project leads, and consultations with project partner organisations in Aceh (in-person) and elsewhere in Indonesia (remotely) over 2 weeks in May–June 2022.
- **Phase II: Impacts for farmers and communities** involved semi-structured interviews or focus group discussions with district-level agricultural extension agents, women and men farmers, and other selected key informants across Aceh over 2 weeks in July–August 2022. Former project team members from NSW DPI and WorldVeg were also interviewed in depth, and project reports and provincial/national statistics were re-examined.

Interview and focus group discussion guides were formulated to elicit information not only on 'standard' types of impact, such as improved yields and income (quantified where feasible), but also on the multiple strands of 'capital' recognised in the SLF and the utility (or TEV 'value') that stakeholders attach to the changes that have occurred. Consultations generally took place in Acehnese and/or Indonesian, facilitated through 2 team members recruited locally (one male, one female). Most conversations were recorded (with permission), then transcribed and translated. Since the data were primarily qualitative and volumes were manageable, notes were organised into matrix format (in Excel) and progressively summarised to extract key points from each category of respondent.



Women farmers in a KWT demonstration plot.
Credit: Patrick Cape

Observations and findings

KEQ1: Partner agency capacity development

The projects initially worked primarily with BPTP, and then with extension officers – known locally as *penyuluh pertanian lapangan* (PPL) – under Dinas Pertanian (Department of Agriculture) (DP). Other local partners included the Indonesian Soil Research Institute (ISRI), Indonesian Centre for Rice Research (ICRR), University Syiah Kuala, the Indonesian Vegetables Research Institute (IVEGRI), Food Crops Agricultural Service (FCAS) Aceh and the non-government organisations (NGOs) Yayasan KEUMANG (an Aceh-based NGO) and AUSTCARE (Australians Caring for Refugees).

Respondents from partner organisations confirmed that the 4 projects did an excellent job of building the capacity of individuals within those local organisations. The training of partner staff had a lasting effect, imparting knowledge and skills that are still remembered and used in their daily work. The projects also attracted suitable and capable experts from national research institutes who supported the Aceh-based agencies in what was described as a win-win collaboration. Interactions with ACIAR project leads were viewed positively and many professional relationships have been maintained.

Despite the challenging post-crisis environment, the evaluated projects also achieved some gains in developing capacity at the organisational level. This included demonstrations of new ways of working, introducing systems to generate new knowledge, strengthening systems to capture that new knowledge and standardising operating procedures, specifically for the BPTP soil laboratory. The projects introduced a learning-cycle approach, including assessment of the situation, problem identification, testing of solutions, sharing of solutions and dissemination to farmers. The learning culture was further strengthened through training on data analysis, statistics and writing of scientific papers.

Influencing the enabling environment (or institutional level) is difficult through short-term projects, although targeted interventions can make a difference. Several techniques introduced, tested and proven effective through the ACIAR projects were taken up as provincial policy, promoted throughout Aceh Province and adopted by a large segment of farmers. This is a huge success, albeit not a planned result.

While the achievement of the ACIAR projects in Aceh is impressive, there might have been opportunities that the projects did not pursue. Understanding of the projects' capacity-development objectives differed somewhat across interviewees and in written material. Implications are considered further under KEQ5.

KEQ2: Partner agency use of knowledge and skills

The primary channels for continued use of project-related knowledge and skills are BPTP and DP, particularly the *kecamatan* (subdistrict) level extension services (Balai Penyuluhan Pertanian (BPP) offices) that come under the DP structure.

The ACIAR projects had an important influence on BPTP staff and their way of working. Laboratory capability has continued to improve. The project laboratory technician is now in charge of the laboratory and his expertise is transferred to the team. The laboratory management system is still being applied and the equipment provided is still used or has been replaced with more up-to-date equipment. Further strengthening is planned through the next BPTP budget cycle.

The projects also influenced research designs, in particular the way farmers are engaged and the way research and demonstration sites (demplots) are used. Some continuation of research areas was identified, particularly in drainage and irrigation. Finally, the development of generic research skills, such as data analysis and scientific writing, had important impacts.

Within DP's extension services, there is strong evidence that the PPL involved in the ACIAR projects are continuing to apply the knowledge and skills they gained. Those PPL have been spreading their influence by training and mentoring their colleagues and/or by rotating to new locations. The projects helped PPL develop valuable ongoing professional networks and personal friendships, including with BPTP and national agricultural institutions. The project methodology of working with and through the extension services reportedly resulted in improved status and recognition both for individual high-performing PPL and for the PPL role more broadly. Farmers saw that PPL had valuable advice based on identified needs, which led to increased farmer trust.

The ACIAR projects were widely acknowledged as having introduced a more consultative ('soft and subtle') approach to extension work. While some PPL continue to use and promote this approach, it has not been systematically institutionalised. In a similar vein, although the use of demplots remains standard practice for PPL, this appears to be primarily an extension tool to encourage adoption rather than a research tool for scientific testing of alternatives.

While both BPTP and DP reported continued regular soil testing, the availability of functional portable test kits for PPL to use is patchy. The PPL interviewed demonstrated a good understanding of soil improvement options, but also a pragmatic acknowledgement of farmers' perspectives and preferences. Current PPL approaches appear broadly consistent with those introduced through the projects, including the emphasis on exploring and promoting alternatives to chemicals. A handful of key individuals have had an especially significant influence – such as a former PPL who produces, markets and promotes biochar.

The *legowo* (skip-row) method of planting *padi* (rice) continues to be promoted through both the DP extension system and BPTP. Variants on the projects' 2:1 approach (e.g. 3:1 and 4:1) are considered acceptable and pragmatic options. The Indonesian Government regularly introduces and promotes new varieties of rice, so the specific varieties introduced during the projects have been superseded.

The attention (and funding) given in the third and fourth projects to vegetable growing and *kelompok wanita tani* (women's farming group(s)) (KWT) have contributed to recognition of the economic and social value of women's groups and the continued focus on supporting them through PPL knowledge and skills.

Since 2020, the routine activities of provincial-level agencies such as BPTP and DP have been constrained by COVID-19-related restrictions and budget cuts. This has undoubtedly disrupted the ability of partner agencies to continue applying the skills and experience developed through the ACIAR projects. The retirement of some key individuals at all levels, from PPL through to agency leaders, is a further obvious risk factor, particularly given the projects' primary focus on individual-level capacity development. Current Indonesian Government restructuring – whereby all scientific research functions are being brought together under a single national agency – creates further uncertainties, because agricultural research in Aceh will no longer sit with BPTP.

KEQ3: Impacts on farmers and production

The most significant changes introduced through the projects were *legowo* planting methods for *padi*, reduced or better tailored input use (e.g. seeds, fertilisers and pesticides) and greater production of vegetables for sale and/or home consumption, including through KWT. Overall, these approaches have been widely adopted across Aceh. Respondents' suggestions on factors affecting adoption included personal characteristics, gender, age, education, location and the relative costs and ease or convenience of different options.

Project reporting and fieldwork responses provide strong evidence that tangible and long-term productivity gains resulted both from the projects and from subsequent technological advances. While these impressive results cannot be attributed solely to the ACIAR projects, the projects certainly created an initial impetus and triggered improvements that have subsequently been built on.

All respondents agreed that family incomes and living standards have improved significantly in the 18 years since the tsunami. The cessation of the long-running independence insurgency in 2005 and the international response to the tsunami both helped create the conditions for recovery and subsequent development. KWT members reported that their food security and nutrition had improved, due in part to an increase in household vegetable consumption resulting from availability of home-produced crops. Again, only a relatively small proportion of these improvements can be attributed to the ACIAR projects, but they undoubtedly achieved important changes in the immediate project locations, which, over time, influenced other locations across the province.

A more direct impact was the additional motivation and self-esteem participants gained as a result of receiving ACIAR project support. This was particularly notable in former 'red zone' (conflict) areas, where the projects helped change the image of participating villages.

Informants generally struggled to identify any negative aspects of the projects. The main recurring critique was the focus on single project sites per location, which created a degree of envy and might have slowed wider uptake. In addition, while the projects worked directly with farmers, key tasks related to the new techniques – particularly planting – are often delegated to labourers.

Gender roles have apparently not changed significantly over time. Women reported 'equal' input into decisions, but would ultimately defer to men. Female labourers continue to be paid less than males, despite being considered more efficient. In general, men have a greater role in *padi* production and women lead on vegetable farming, but precise roles vary somewhat across the province and flexibility is evident, depending on family and local circumstances. Overall, the ACIAR projects focused on *padi* would have benefited men more directly, and benefited women indirectly through higher returns – although the *legowo* method involves greater effort for whoever does the planting. Project support for vegetable production had a clear positive impact on women, with indirect benefits to their households.

PPL are required to work with both male and female farmers in their assigned villages. It is notable that a majority of PPL are female (estimated 65% overall).

The projects provided most direct benefits to land-owning 'lead farmers' and selected members of their farming groups. Landless labourers were only incidentally included but are sometimes required to follow their employer's preferred new, more labour-intensive, methods. Expending greater effort for a given area of land would disadvantage labourers if they were paid a flat rate on completion, but generally labourers are paid a daily rate so slower work is a cost to the employer.

Many of the impacts identified above can be articulated as increases in some form of capital, in accordance with the SLF. For example, natural capital increased through improved soil health and reduced chemical use; financial capital accumulated as a result of higher net income; knowledge transfer helped build human capital; and social capital is evident in the form of community cohesiveness, networks and relationships (including between farmers and extension workers). Over time, these capital changes have generated a range of direct and indirect use and non-use values, as per the TEV framework. These are mostly discussed in qualitative terms in the report.

While data limitations and attribution challenges preclude a definitive assessment of the quantitative benefits resulting from the projects, some indicative estimates are provided. These show that even accounting only for short-term gains by immediate project beneficiaries, economic benefits were only slightly below the ACIAR outlay for the 4 projects (benefit:cost ratio of 0.96). Under more realistic, but still conservative, assumptions on wider attributable benefits, the ratio of benefits to ACIAR expenditure is estimated at around 6:1.

KEQ4: Factors influencing achievement

Positive factors that were within the control of each project included the promotion of techniques that already were national policy (e.g. the *legowo* method), enabling provincial-level policy support and roll-out. These technologies were known to be well-suited to local conditions and were tested before being widely promoted. Some limitations on reach inevitably arose given the small number of project sites and the different soil and climatic conditions across the province.

Project methods and partnerships were critical to their success. Project staff used collaborative rather than didactic approaches and involved extension workers and farmers in all phases from planning to testing to dissemination. This ensured a deeper understanding and created a sense of ownership that is still evident today. In particular, the projects motivated PPL and continue to influence their work ethos. PPL greatly appreciated the many learning opportunities and their contributions were recognised and rewarded. The projects used effective, science-based training and dissemination methods based on test sites and demplots, so farmers could see results for themselves. Farmer and PPL meetings and exchange visits supported replication.

The projects built on and strengthened existing systems and types of activity such as rice-farming groups and KWT. The support provided was appropriate to the needs of the groups and the emphasis from the start was on supporting farmers' own decision-making. Financial incentives were kept to a minimum, which avoided distorting participants' motivations.

The projects built social as well as financial capital, supporting partner agency and farmer recovery from the psycho-social trauma of the long-running insurgency and catastrophic tsunami. The projects provided valuable motivation for all involved – partner agency staff, extension workers and farmers – and built personal self-esteem and community pride, which contributed to the sustainability and reach of impacts.

As discussed elsewhere in the report, a clearer articulation of capacity-development objectives and impact pathways could have further strengthened long-term impacts. Greater recognition of the important role of agricultural labourers could have led to explicit strategies to target this cohort. Ensuring partner agencies (and others) had ready access to all reports, publications and data would also have been helpful.

A range of factors beyond the control of the projects also influenced impact, including how individuals respond to opportunities and new knowledge; some elements of adoption decisions; and aspects of the policy, institutional and socioeconomic environment during and since project implementation. Enablers included the vital contributions of BPTP and DP extension services, and the dedication and determination of many individual PPL during and since the projects. As noted above, the post-conflict, post-disaster socioeconomic environment brought a return to stability and more sustained development.

Constraints to project impact have included environmental and climate variability, shortages of land and labour, and a top-down approach to the setting of policies and priorities. PPL are stretched, being required to implement directives across growing numbers of villages as well as meeting administrative obligations. They have few incentives to perform highly, since increasing experience, competence or workload are generally not matched by pay and conditions. Agricultural research and extension budgets are severely constrained, which affects staff training, renewal of critical equipment (e.g. soil-test kits), and further innovation and local testing of technological advances. COVID-19 has significantly disrupted recent progress, with both BPTP on-farm research and DP support and training programs in hiatus. With ongoing budget restrictions, there is a risk that gains from the ACIAR projects will further dissipate.

KEQ5: Lessons on organisational capacity building

ACIAR has made important advances in its approaches to capacity development since these Aceh projects were designed and implemented. The projects would have profited from this improved guidance if it had been available at the time.

ACIAR currently defines capacity development across 3 levels – individual, organisational and enabling environment – as ‘a process of strengthening the abilities of individuals, organisations and systems to undertake agricultural research and to continue to advance development outcomes effectively, efficiently and sustainably’ (ACIAR website). This is a strong and clear definition, and strategic documents

from ACIAR provide further useful direction. ACIAR research partnerships are explicitly intended to build capacity of individuals and organisations involved in agricultural research. The enabling environment and major scaling of research results will generally only be tackled in collaboration with other larger partners and/or funders, except where Australia has a strong interest and comparative advantage (e.g. biosecurity).

The designers and implementers of these Aceh projects focused primarily on training individuals, and most interviewees continue to define capacity development in those terms. Many of the people trained still apply and share the knowledge and skills they learned, but there are relatively few examples of BPTP and DP developing the organisational capacity to replicate the approach, knowledge and skills to new staff or in other research projects. The broader institutional environment also remains challenging.

The Aceh projects progressively shifted their capacity-development focus in terms of substance (from salination to integrated crop management (ICM)), target audience (from BPTP researchers to extension workers and farmers) and methods (from more traditional training to farmer-to-farmer knowledge sharing). The observed shifts were logical progressions from one project to the next based on the barriers to development impact identified by the project implementation teams. In the Aceh context, it would have been difficult and counterproductive to set boundaries between research capacity and the capacity to scale research results or influence policy. In the post-disaster context, needs were urgent and coordination was difficult. It was not feasible to negotiate partnerships before the start of the projects, or to bring in partners who could work with ACIAR to deliver capacity training on scaling or influencing policy. It was logical that the ACIAR projects delivered this wide range of capacity development interventions.

The evolution of the 4 Aceh projects reviewed here resembles to some extent a problem-driven iterative adaptation (PDIA) approach. PDIA advocates for starting at the impact level and working back to develop a solution, and then trying to continually improve and broaden the solution. The Aceh projects were not designed to apply a PDIA approach, but the short funding cycles forced the designers into a PDIA mode. The first 3 projects were of short duration and a new proposal was required for each, which allowed prior lessons to be integrated and built on. In the process, those projects moved beyond research capacity to the capacity to roll out research findings, and from single-issue research to seeking multifaceted solutions to the complex problems of the ultimate beneficiaries. The consultative and collaborative approach of project personnel that was so appreciated and effective in Aceh was also consistent with a PDIA approach.

It could be worth exploring whether longer-term projects that deliberately apply a PDIA approach from the outset are more effective than a series of adaptive (Aceh-style) projects with similar total length. Further experimentation with explicit PDIA approaches might then be considered.

Applying PDIA approaches in future project designs would have interesting implications. Capacity development might then be defined in terms of the ability to apply an iterative problem-solving approach, as opposed to knowing a solution. Improving the capacity of individuals and organisations would focus on supporting their ability to try, learn and iterate – in the course of which, specific agricultural research challenges would come to the surface and the capacity to overcome these challenges would be developed.

KEQ6: Practicality and value-add of methodology

As noted above, in addition to assessing the impacts of ACIAR post-tsunami projects in Aceh, this evaluation tested a conceptual approach that integrated SLF and TEV concepts into the more common TBIE approach, which centres on expected impact pathways in a ToC. The projects themselves did not have explicit ToC, so an overall ToC was developed ex post, focused primarily on an institutional capacity-building pathway.

For this evaluation, the most useful insights arose from testing the hypothesised ToC. For practical application, the integrated framework proved too complex and demanding to use in a rigorous, explicit way with respondents. While the information obtained may have contributed somewhat to the richness of the assessment, the overall sense is that the additional insights from applying SLF and TEV were considered interesting but did not add significant extra value. On the other hand, TBIE provided a logical structure for exploring not only the nature and extent of outcomes (which were significant) but also the way in which those outcomes were achieved. In the process, it helped highlight discrepancies between the actual and anticipated impact pathways, leading to insights on approaches to capacity development in the Aceh projects and more broadly in ACIAR (as discussed above).

Requiring project proponents to articulate their ToC or program logic (including assumptions) at proposal stage – and then revisiting this in project reporting – would ensure that subsequent evaluations can be based on a sound understanding of what the project was aiming to achieve and how, and what assumptions might need to be re-examined.

Having a clear ToC is particularly pertinent for ACIAR, to avoid misunderstandings of how far a research-for-development project can go in achieving development outcomes. While the Aceh projects clearly did contribute to improved livelihoods in farming communities, importantly they also helped build the knowledge base need to underpin higher-level development objectives.

For many ACIAR research projects the primary evaluation focus will appropriately be on capacity-development processes and outcomes. Further developing the framework and approaches to capacity development would support researchers and research organisations to implement high-quality research.

In short, the chosen evaluation methodology needs to match the evaluation purpose. The degree to which a particular conceptual framework may or may not be useful for a given impact assessment will depend on the key goals and impacts of interest, their relevant causal mechanisms and the degree to which these are measurable. In some circumstances, gross margin calculations and benefit-cost analysis of a research intervention will provide the required information. Incorporating TEV concepts would ensure that different forms of value (beyond direct use) are taken into account, potentially providing greater depth to that type of analysis. In other circumstances, where the project intends (within its lifetime) to generate outcomes for farming households, understanding the broader system is essential. Whether this is most appropriately tackled through the SLF or some other systems-based approach will depend on the nature of the project and the answers being sought.

In most cases, TBIE with a tailored mix of quantitative and qualitative assessment tools should be adequate to meet the needs of ACIAR as a learning organisation. In cases where the outcomes relevant to beneficiaries' livelihoods also need to be assessed, the corresponding impact pathways and assumptions in the ToC will provide a firm foundation onto which other conceptual tools (such as TEV) and systems-wide perspectives (such as SLF) can be added as appropriate.



A garden plot belonging to the Harapan Maju KWT.
Credit: ACIAR



Introduction

Background

Since 1982, ACIAR has brokered and funded research partnerships between Australian scientists and their counterparts in developing countries. As Australia's specialist international agricultural research for development agency, its mission is 'to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia, through international agricultural research partnerships' (2018a). ACIAR receives a direct funding appropriation from the official development assistance budget, as well as contributions for specific initiatives from external sources, including the Department of Foreign Affairs and Trade (DFAT).

The Indian Ocean tsunami on 26 December 2004 killed an estimated 130,000 people in Aceh and devastated large swathes of urban and rural land. Seawater intrusion ruined crops and farmland, causing significant salinity issues. From 2005 to 2012, ACIAR funded a series of soil-related projects to support a return to farming and develop diversified, resilient and more profitable farm-based livelihoods.¹ Each project worked closely with local agricultural research and extension services and sought to build technical and organisational capacity within those agencies (further details are outlined under Scope below).

ACIAR-funded agricultural research-for-development projects and programs routinely undergo ex-post evaluations to assess performance and impact. The standard approach for these evaluations is based on economic measures such as benefit-cost analysis (Davis et al. 2008). ACIAR is interested in developing a broader set of tools and methodologies that better reflect and capture the complexity of change, and enable more comprehensive reporting on the diversity of outcomes and impacts that project activities might generate. In particular, there is scope to draw and integrate approaches from both economic and social sciences, in ways that will yield richer insights to inform future programming and policy directions.

A new conceptual approach to impact assessment was developed through a collaborative effort between ACIAR and CSIRO during 2020–21. This built on earlier CSIRO engagement with Philippines-based organisations to integrate economic, social and environmental considerations into impact assessment methodology for agricultural research for development within complex systems (Williams et al. 2021b). This approach applies elements of the SLF and TEV concepts to add further rigour and depth to a TBIE approach centred on expected impact pathways (Randall 1987; Scoones 1998; White 2009). ACIAR identified its Aceh soils projects as suitable for piloting this conceptual model, and contracted Alinea International to undertake the evaluation.

Purpose and audience

This evaluation serves 2 purposes:

1. It assesses the impacts of ACIAR post-tsunami soils projects in Aceh, particularly with a view to identifying lessons on capacity development as a pathway to agricultural research-for-development impact.
2. It tests the practicalities and value-add of applying the integrated conceptual approach 'on the ground' to evaluate ACIAR agricultural research-for-development projects.

This approach might help ACIAR report outcomes against all relevant strategic objectives, rather than focusing narrowly on quantifiable benefit:cost ratios. Ultimately, there is scope to modify approaches at the project design stage to ensure a wider range of key indicators relevant to ACIAR objectives are tracked throughout implementation.

The immediate audience for this evaluation is ACIAR staff, such as research program managers, whose current and/or potential future projects include capacity development as a key pathway to impact. Beyond this, the evaluation should be of interest to a range of stakeholders, including partner agencies in Australia and Indonesia, those involved

¹ A 2014–2019 project to improve productivity in dryland farming systems of Aceh has been determined as out of scope for this evaluation.

in developing the conceptual framework and related methodologies, and the broader agricultural research-for-development and evaluation community.

Scope

Projects included in evaluation

The 4 projects included in this evaluation are summarised in Table 1. NSW DPI led the first, second and fourth projects and was also involved in the third, which was led by WorldVeg. Several local partners were involved, with BPTP Aceh and ISRI providing continuity between the projects.

The first 2 projects focused on the immediate priority of enabling farmers to resume rice production. BPTP Aceh and ISRI were trained in measuring soil salinity, and carried out extensive soil testing to determine where immediate cropping would still be feasible. Salt-tolerant crop varieties and management techniques to improve soil quality were introduced in these areas, initially through demplots and field trials.

The third project sought to improve vegetable production in the tsunami-affected areas through an integrated approach to soil and plant nutrition. The project increased the intensity and range of interactions with farmers, including through farmer field schools. WorldVeg led this project but collaborated closely with NSW DPI activities.

By the time the fourth project began in 2009, the objectives had moved on from immediate tsunami recovery to maximising farmer income and strengthening longer-term livelihood resilience. This project built on the previous ones and promoted integrated management of rice and vegetables. The project proposal also included some small-scale activities to support vegetable growing groups for women. However, this project went further than its predecessors in its conceptual framing and research approaches, extending well beyond soils to include market linkage considerations and other constraints, opportunities and policy drivers that influence farmers' options. These insights informed the capacity-development and applied extension activities.

Table 1 ACIAR-funded projects in post-tsunami Aceh

	ACIAR project	Duration	Partners
1	'Management of soil fertility for restoring cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province' (SMCN/2005/004)	2005–2007	NSW DPI (lead) BPTP Aceh BPTP North Sumatra ISRI
2	'Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/118)	2006–2008	NSW DPI (lead) BPTP Aceh BPTP North Sumatra DP ICRR ISRI
3	'Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/075)	2007–2010	WorldVeg (lead) Austcare BPTP Aceh DP FCAS Aceh IVEGRI KEUMANG NSW DPI
4	'Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales' (SMCN/2007/040)	2009–2013	NSW DPI (lead) BPTP Aceh ICRR ISRI University Syiah Kuala

Notes:

BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology); DP – Dinas Pertanian (Department of Agriculture); FCAS – Food Crops Agricultural Service; ICRR – Indonesian Centre for Rice Research; ISRI – Indonesian Soil Research Institute; IVEGRI – Indonesian Vegetables Research Institute; NSW DPI – New South Wales Department of Primary Industries; WorldVeg – World Vegetable Center

Source: Williams L, Capon T, Fleming-Munoz D, van Wensveen M and Williams R (2021) 'Impact assessment approach: ACIAR-funded soil restoration projects in post-tsunami Aceh' (unpublished draft): 13–14 (Table 4).

Table 2 Stated aims and objectives of the Aceh projects

ACIAR project	Stated aim	Stated objectives
'Management of soil fertility for restoring cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province' (SMCN/2005/004)	To assist short term re-establishment of crop production and hence make a contribution to the restoration of livelihoods in eastern NAD	<ol style="list-style-type: none"> 1. Restore agricultural technical capacity in NAD 2. Assess constraints to re-establishment of crop production 3. Action research for re-establishment of cropping
'Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/118)	To restore livelihoods through the re-establishment of annual cropping, and to reduce the reliance on food aid in tsunami-affected areas of NAD	<ol style="list-style-type: none"> 1. Strengthen and rebuild the technical capacity of extension services at provincial (NAD BPTP), district (<i>kabupaten</i>) and subdistrict (<i>kecamatan</i>) levels to manage tsunami-affected soils to restore crop production 2. Develop and demonstrate soil management practices to restore the productivity of annual crops in tsunami-affected production areas 3. Develop and implement a communication strategy to facilitate information exchange between government, non-government and community interest groups working on restoring agriculture to tsunami-affected land
'Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/075)	To restore and enhance food security, nutrition and livelihoods through rehabilitation of vegetable production	<ol style="list-style-type: none"> 1. Identify constraints to re-establishing vegetable production on tsunami-affected soils, and discover sustainable methods for overcoming those constraints 2. Build technical capacity among researchers, extensionists and farmers in integrated soil and crop management of vegetables 3. Monitor and evaluate the above activities
'Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales' (SMCN/2007/040)	To guide the establishment of more profitable and resilient farming systems in the low land areas of NAD	<ol style="list-style-type: none"> 1. Assess the lowland farming systems in Aceh to identify constraints and opportunities to increase incomes 2. Evaluate technologies and farming system changes that make farms more profitable and resilient 3. Evaluate strategies to increase the resilience of farming systems by better soil management 4. Build the capacity of farmers and district extension services in NAD 5. Facilitate communication between stakeholders

Note: NAD – Nanggroe Aceh Darussalam Province; BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology)

The aims and objectives of each project are summarised in Table 2. Further project details are in Appendix 1.

Impact areas and pathways

The CSIRO team identified 3 broad impact areas that the evaluation could focus on (Williams et al. 2021a:17):

- **social capital**, with a focus on women's groups (while not excluding exploration of social and human capital in the community more broadly)
- **food and income security** of households in tsunami-affected areas
- **institutional capacity** of BPTP and Indonesian research institutes at provincial, district and subdistrict levels, to support recovery and farm production.

Following a workshop in May 2021 involving CSIRO, ACIAR and project implementation leads, it was agreed that the most pragmatic and fruitful avenue would be to focus this evaluation on **knowledge development** and **institutional capacity**. This reflected the fact that all 4 Aceh projects had a strong emphasis on developing knowledge and capacity within key research and extension services, and facilitating communication and coordination across relevant local actors. It was noted that capacity development pathway would require assessing the extent of direct capacity development – including networks and relationships, new knowledge, individual skills and organisational capacity – as well as how that capacity was used and its value, and whether and how it contributed to higher-level impacts (at farm level). The workshop also highlighted some specific lines of enquiry (Box 1).

These workshop deliberations informed development of the key evaluation questions set out in the next section.

Box 1: Lines of enquiry discussed in project workshop (May 2021)

Partnerships and networks

The partner institutions were in a state of devastation when the project started; there were no previous relationships that were being built on or leveraged. Partnerships, and networks were fostered between different levels of agricultural extension (e.g. BPTP and DP) and national research institutes. How were the relationships built and have they been sustained? How did they contribute to the project outcomes and impacts, and other benefits since?

If/how knowledge and skills to support agricultural recovery from tsunamis have been used since

Locally, the project provided EM38 machines to measure salinity levels, as well as providing simple soil testing kits. Are these utilised within Indonesia either by provincial partners or the national research institutes? For the broader international community, knowledge and findings from the project were packaged into a guidebook and journal papers. Have these been utilised?

If/how key partners/champions have passed on knowledge

The project is believed to have effectively built the capacity of individuals in key areas relating to soil management and extension. There are interesting questions regarding if/how individuals have derived value from this change in capacity, as well as if/how it has been used/transferred to build organisational capacity.

Note: A fourth area identified was 'Exploration of co-benefits to Australia'. This was not reflected in the key evaluation questions or the terms of reference, but it is addressed to some extent in the evaluation.

Source: Williams LJ, McMillan L, van Wensveen M, Butler JRA, Camacho Jr JDV, Lapitan A, Datoon R, Gapas J, Pinca E, Macavinta-Gabunada F, Serino MNV, Nunez L, Recto AL, Ruales JH, Enerlan WC, Cagasan EG, Ani PAB and Aranas MB (2021) *An integrated approach to ex-post impact assessment*, ACIAR Impact Assessment Series Report 102, ACIAR, Canberra.

Key evaluation questions

The key evaluation questions (KEQs) guiding this evaluation are as follows:

- KEQ1: To what extent have ACIAR investments in Aceh's post-tsunami recovery produced sustained improvements in the capacity of ACIAR local partner agencies?
- KEQ2: To what extent have ACIAR local partner agencies used knowledge and skills developed through ACIAR investments in their agricultural research and extension activities? How else have these projects impacted on the local partner agencies?
- KEQ3: What impacts (positive or negative) have any improvements in ACIAR local partner agency capacity had on farmers and agricultural production in Aceh? How equitable was the distribution of impacts within targeted communities?
- KEQ4: What factors influenced whether impacts from organisational capacity building were achieved as intended?
- KEQ5: What lessons can be drawn from this assessment about ACIAR approach to organisational capacity building?
- KEQ6: What lessons can be drawn regarding the practical applicability and value-add of the integrated impact assessment methodology trialled in this evaluation?

Following a description of the conceptual framework and methodology, the evaluation team's observations and findings are presented in relation to each KEQ. Findings that are relevant to several KEQs are discussed under the most appropriate heading.

Contextual issues

Any evaluation needs to take account of local context. In the case of the locations targeted for the ACIAR soils projects, and the potential wider areas of subsequent influence and impact, several relevant issues were identified by the CSIRO planning team (Williams et al. 2021a:22) (subsequently confirmed through fieldwork):

- Pre-tsunami conflict had resulted in restrictions on movements and gatherings, reduced the provision of government services and support, and hindered development progress. *'It is reasonable to expect that this will have had an influence on how the teams and activities of the project were viewed.'* (CSIRO)
- Conflict and insurgency also resulted in significant geographic disparities. Government staff generally avoided inland areas, which were considered more dangerous. Consequently, before the tsunami, government services were concentrated in coastal areas. These same areas, being most affected by the tsunami, then became the main focus for international aid. *'Any consideration of the extent to which ACIAR projects have scaled out, or had impact more broadly in the province, should be tempered by these disparities.'* (CSIRO)
- *'The influence of existing social divisions/tensions on the distribution of benefits from the project (e.g. access to resources, participation in field activities etc.) needs to be kept in mind.'* (CSIRO)
- More recently, COVID-19, climate change and government policy settings were likely to have influenced key indicators such as rice cultivation area, the marketing and consumption of output, and the functioning of community groups, including the women's groups supported under the fourth ACIAR project.

A note on terminology

The phrase **capacity development** is generally used in this document in preference to 'capacity building', since the latter implies the step-by-step erection of a new structure, based on a preconceived design. Experience suggests that capacity is not successfully enhanced in this way. However, in some research questions or references the phrase 'capacity building' was used; those cases have been left unchanged and used with the same meaning as 'capacity development'.

The ACIAR 3-level definition of 'capacity building' (ACIAR 2022a, based on OECD DAC 2006) is applied here: individual, organisational and the enabling environment (or institutional). However, the earlier CSIRO-ACIAR collaboration that laid the groundwork for this evaluation used the term **institutional capacity building** to refer to all 3 levels, and this terminology was originally used in the KEQs. While the KEQs were subsequently amended to reflect the ACIAR definition, some references to the earlier usage remain.



KWT members planting out a new garden in Aceh.
Credit: ACIAR

Conceptual frameworks

The integrated and holistic conceptual framework underpinning this evaluation was designed to be broad and flexible enough to provide a potential model for future ACIAR impact assessments, and to guide the specific assessment of capacity-development activities and impacts under the Aceh soils projects.

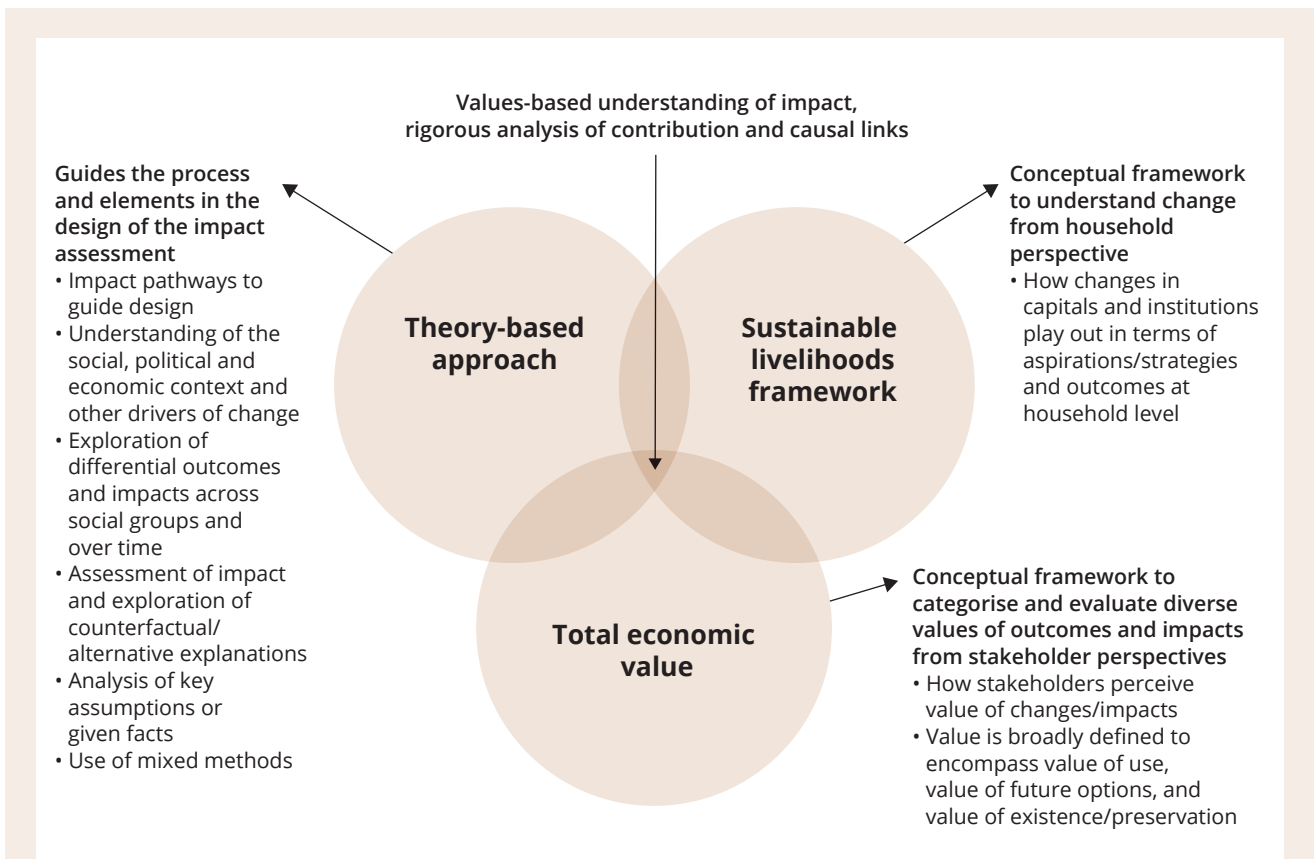
Defining an integrated approach

The ACIAR standard impact assessment guidelines (Davis methodology) (Davis et al. 2008), are based on benefit–cost analysis supported by partial equilibrium and/or computable general equilibrium modelling, along with non-market valuation through stated preference and/or revealed preference methods. However, the assumptions underlying these approaches may diverge significantly from the actual conditions in the project area, and the data and other resources available to an ex-post evaluation team are unlikely to be sufficient for a rigorous application of the Davis methodology. Moreover, the approach does not readily allow for integration of qualitative information, which tends instead to be presented separately.

The broader conceptual approach proposed by the CSIRO team ‘aims to integrate theory, concepts and methods from economics and social sciences to enable a more comprehensive and practical assessment of project impacts’ (Williams et al. 2021a). The proposed unified framework incorporates both qualitative and quantitative assessments and allows for a more coherent, accurate and comprehensive view of the detail and diversity of project activities, outputs and outcomes – capturing not only what was achieved, but also ‘how it was achieved, and its importance to stakeholders (both positive and unintended or negative)’ (Williams et al. 2021a).

The integrated approach (Figure 1) is values-based, meaning that impacts are understood in the context of the values, objectives, aspirations and preferences of stakeholders. It draws from elements of the following frameworks:

- **Theory-based impact evaluation:** The TBIE approach is structured around ToC and impact pathways, based on key principles aimed at understanding not only what has transpired, but why and how certain outcomes took place. Its use of both factual analysis and mixed-methods approaches enables assessment of more detailed and diverse change processes than more traditional planning and evaluation methodologies do (White 2009).
- **Sustainable livelihoods framework:** The SLF approach examines and provides an overview of the multiple strategies people employ to increase their wellbeing (Appendix 2, Figure A2.1). In particular, it describes the ways in which people combine their capabilities, assets and activities (which together are taken to constitute a ‘livelihood’) to maximise utility. Scoones (1998) considers a livelihood to be sustainable when it proves resilient to exogenous shocks and stressors, can maintain or enhance its assets, and does not damage the natural (and rural) resource base on which it depends. The SLF takes a broad approach to traditional economic concepts of capital, acknowledging that livelihoods are supported by more than just economic or financial capital, but also natural, human and social capital, which can support a sustainable livelihood only when combined with one another.
- **Total economic value:** Originally developed to identify and categorise the value of environmental assets beyond their immediate (and often extractive) use, the TEV approach distinguishes the various ways in which an asset offers utility to people and systems that interact with it. These are broadly defined as use value (direct and indirect), option value and non-use value (existence and bequest) (Appendix 2, Figure A2.2). TEV goes beyond traditional cost–benefit analyses to offer a comparatively comprehensive valuation of (tangible or intangible) assets under review. TEV also provides guidance on how these (monetary and non-monetary) assets should be costed to reflect their diverse value offerings (Randall 1987).



Source: Williams LJ, McMillan L, van Wensveen M, Butler JRA, Camacho Jr JDV, Lapitan A, Datoon R, Gapas J, Pinca E, Macavinta-Gabunada F, Serino MNV, Nunez L, Recto AL, Ruales JH, Enerlan WC, Cagasan EG, Ani PAB and Aranas MB (2021) *An integrated approach to ex-post impact assessment*, ACIAR Impact Assessment Series Report 102, ACIAR, Canberra.

Figure 1 Conceptual frameworks underpinning proposed integrated approach

For this Aceh evaluation, TBIE provided the starting point to guide development, validation and assessment of impacts as articulated in ToC (see below).

However given the particular focus here on capacity development, the SLF and TEV approaches also focused attention on the various types of capital built (including at individual, organisational and broader institutional or enabling environment levels), as well as the types of value (or utility) that various stakeholder and beneficiary groups have derived from the changes that have taken place. The CSIRO team articulated the roles of each element of the integrated approach (Box 2).

Box 2: CSIRO guidance

The TBIE approach provides the basis for interrogating how and why changes have occurred as a result of an intervention. The SLF provides an analytical framework for data collection, guiding an exploration of household capitals, and how they have changed. Capitals themselves in the SLF do not have value, rather they are translated into value over time either through use (supporting livelihoods) or through other non-use values ascribed by people, communities and societies. The TEV provides a way of understanding how value is created from capitals, and how they are used, change and grow over time.

Source: Williams L, Capon T, Fleming-Munoz D, van Wensveen M and Williams R (2021) 'Impact assessment approach: ACIAR-funded soil restoration projects in post-tsunami Aceh' (unpublished draft).

Gender and social inclusion

Approaches to gender and social inclusion are not predetermined in the TBIE, SLF or TEV approaches, but should constitute an essential feature of all impact assessments and evaluations. This is because all activities and interactions produce direct and indirect gendered and other social impacts, which in turn define the circumstances in which future activities take place. Any conceptual framework for evaluation must also consider the diverse effects of activities on men and women across project life cycles and 'downstream' at the individual, household and community level.

This approach is consistent with the ACIAR commitment to mainstream gender perspectives across all research investments, as reflected in the *ACIAR Gender Equity Policy and Strategy* and the *ACIAR Gender Guidelines for Project Proposals*, which guide how gender is treated in its research and projects.

In the context of this Aceh evaluation, with its focus on capacity development, gender is a key element of human and social capital that influences high-level livelihood outcomes. As such, gender-responsive lines of inquiry were included to examine the degree to which:

- programs and activities responded to the (possibly) different priorities of men and women
- men and women were able to participate in capacity-development programs and activities (at both institutional and farm or community level)
- men and women derived benefit (and value) from the capacity development they received.

Other issues of social inclusion and exclusion, such as land ownership, were also explored.

Impact pathways and theories of change

The primary impact pathways of all 4 Aceh projects – through which their objectives of restoring and enhancing livelihoods were to be pursued – involved developing knowledge and capacity within BPTP and other local partner agencies, building farmer capacity to adopt new approaches, and facilitating communication and coordination across relevant actors, including government, NGOs, development agencies and community groups. The CSIRO team developed a detailed map of indicative causal pathways (Appendix 3).

Table 3 Two-part capacity development impact pathway

Impact Pathway Part I: From project leads to local partner agencies			
If...	then...	it will cause...	assuming...
<ul style="list-style-type: none"> • training is provided on soil salinity analysis, and soil and crop management practices • partners are provided with tools and equipment to assist with soil salinity measurement • capacity-development activities support partners, government, and NGOs to engage with one another 	<ul style="list-style-type: none"> • partners will have improved capacity to measure, assess and manage soil salinity • partners will have greater capability to advise farmers on good soil and cropping practices 	<ul style="list-style-type: none"> • partners to work with farmers to increase their capacity to manage soil quality and improve productivity 	<ul style="list-style-type: none"> • the projects' capacity development activities promote autonomy, equality and trust among and between partners and project leads
Impact Pathway Part II: From local partner agencies to farmers and their communities			
If...	then...	it will cause...	assuming...
<ul style="list-style-type: none"> • partners work with farmers to increase their capacity to manage soil quality and improve productivity 	<ul style="list-style-type: none"> • farmers will gain relevant new knowledge and skills • access to and supply of crops will be increased 	<ul style="list-style-type: none"> • food security and nutrition to increase across the community • reliance on food aid to diminish 	<ul style="list-style-type: none"> • farmers have the capital to return to crop production • farmers apply the new skills and knowledge disseminated by partners • farmers don't plant where soil is too saline

A simplified two-part capacity-development impact pathway derived from the CSIRO diagram is shown in Table 3, with a corresponding two-part ToC also presented in Appendix 3. (Note that TEV and SLF concepts are explored at all stages.)

This evaluation was designed to assess both the interim capacity-development outcomes and sustained-livelihood impacts of the 4 Aceh projects. In line with the standard TBIE approach, an in-depth exploration of the impacts and impact pathways hypothesised in the ToC was a key element of the document review, consultations and analysis. Assumptions and credible alternative explanations were also considered.

Capacity development

This evaluation uses the current ACIAR definition of capacity development: 'a process of strengthening the abilities of individuals, organisations and systems to undertake agricultural research and to continue to advance development outcomes effectively, efficiently and sustainably' (ACIAR 2022a). This definition distinguishes 3 levels of capacity development:

- individual
- organisational
- institutional or enabling environment.

Capacity development at the individual level focuses on training of staff, attracting experts in relevant fields, hiring staff who are driven by learning and encouraging a culture of learning.

Capacity development at the organisational level is probably the most important, as organisations have limited means to force their employees to use the knowledge available. The organisation therefore needs to capture knowledge management and capacity development in its governance systems and organisational culture. Human resource policies relating to recruitment and staff training are part of the picture, but it may also require changes to organisational structures, relationships and operating procedures to facilitate knowledge acquisition, storage, diffusion and application (or use) (Magnier-Watanabe and Senoo 2008) and/or changes to organisational strategies to focus on innovation.

The enabling environment or institutional level includes policies, regulations and governance that influence and perhaps constrain the ability of individuals and organisations to apply their knowledge and skills. Policymakers are crucial in the knowledge dissemination process as they control the resources to upscale research outcomes to local or national policy. Researchers often shy away from policy engagement, but targeted interventions can help an organisation use its research findings as a compelling evidence base to influence policy directions.

Further exploration of capacity development frameworks and operationalisation is in Appendix 4.

Methodology

Evaluation principles

To maximise the use and ownership of findings by ACIAR and its partners and key stakeholders, the evaluation was underpinned by the following principles:

- **Utilisation-focused:** Keeping a line of sight to the key users of the evaluation and their knowledge needs to ensure the evaluation serves its original purposes.
- **Strengths-based:** Identifying what worked well and why, and focusing on how to build on these strengths to overcome challenges and improve outcomes in the future.
- **Participatory:** Involving key ACIAR personnel and consulting with them throughout the evaluation.
- **Inclusive:** Giving consideration to how projects sought to address, and their impact on, gender equity and social inclusion. A range of stakeholders was consulted to provide a diversity of perspectives.
- **Learning-orientated:** Seeking to identify why particular outcomes were achieved (or not), and what can be learned from experiences to inform future programming.

Process

The evaluation drew primarily on qualitative evidence and data, particularly information from program documentation and stakeholder interviews in-country and with other key project informants. Where available and relevant, quantitative data are used to complement qualitative sources, particularly with reference to outcomes such as crop yield and income. The evaluation recognises the distinct nature of research projects (as opposed to development programs) but does not seek to assess the scientific quality of research carried out under these projects.

Following a planning phase in late 2021/early 2022, the evaluation centred on 2 separate in-country data collection exercises, covering a wide range of stakeholders:

- **Phase I: Impacts for ACIAR project partners** involved a desktop review of project documents, initial contacts with Australian project leads, and consultations with project partner organisations in Banda Aceh and Aceh Besar (in-person) and elsewhere in Indonesia (remote) over 2 weeks in May–June 2022.²
- **Phase II: Impacts for farmers and communities** involved semi-structured interviews or focus group discussions with district-level agricultural extension agents, female and male farmers, and selected other key informants across Aceh³ over 2 weeks in July–August 2022. Former project team members from NSW DPI and WorldVeg were also interviewed in depth, and project reports and provincial/national statistics were re-examined.

See Appendix 5 for a list of key project documents, and Appendix 6 for a full list of those consulted.

Interview and focus group discussion guides for stakeholder consultations were formulated to elicit information not only on 'standard' types of impact, such as improved yields and income, but also on the multiple strands of 'capital' recognised in the SLF and the utility (or TEV 'value') that stakeholders attach to the changes that have occurred. Most interviews took place in Acehnese and/or Indonesian, facilitated through 2 evaluation team members engaged locally (one male, one female). With the authorisation of interviewees, most conversations were recorded and later transcribed and translated. Since the data were primarily qualitative and volumes were manageable, all notes were organised into matrix format (in Excel) and progressively summarised to extract key points on the various topics from each category of respondent.

² Described in detail in a progress update report submitted to ACIAR in June 2022.

³ Banda Aceh *kabupaten* where project activities were located: Aceh Barat, Bireuen, Pidie and Aceh Besar.

Ethical considerations

The evaluation was planned and conducted in accordance with the *DFAT Monitoring and Evaluation Standards* (2017) and (as relevant) Alinea International's Child Protection Policies. This included giving appropriate consideration to issues of consent and confidentiality.

- **Informed consent:** All participants in consultations were provided with a verbal overview of why they were being consulted, how the information would be used and the voluntary nature of their participation. Consultations were only undertaken once verbal consent had been obtained.
- **Privacy and confidentiality:** The identity of any program beneficiaries involved in the evaluation has been protected. Key informants in professional roles are referred to by their position title in the report where explicit consent has been obtained; otherwise they are referred to as a representative of the organisation they work with.

Limitations of the evaluation

This is a complex evaluation, encompassing several discrete but linked projects spanning 7 years. It has been undertaken by an evaluation team based in various locations in Australia, Belgium and Indonesia, and within set timeframes and budget. As a result, there have inevitably been limitations.

- **Documentary sources:** The evaluation team has relied in part on the available documentation on each project. These documents are of varying quality and may not necessarily provide full and objective coverage on both the positive aspects of the projects as well as the issues and challenges. Moreover, the historical trajectory of the various projects, and the elapsed time since their completion, has meant a degree of variability in the extent and quality of reporting available.
- **Consultations with stakeholders:** Given several years have passed since projects were implemented, the consultation list depended heavily on being able to track down key individuals with knowledge and/or memories of the projects. While every endeavour was made to consult a range of key stakeholders and triangulate data sources, there may nonetheless have been gaps and/or biases in the information collected.
- **Contribution vs attribution:** The extent to which particular findings can be *attributed* specifically to the ACIAR projects is discussed further in the sections that follow. The assessment mostly relates to the *contribution* the projects have made, with no implication that the projects alone can be credited with these results.

To what extent have ACIAR investments in Aceh's post-tsunami recovery produced sustained improvements in the capacity of ACIAR local partner agencies?

The projects worked primarily with BPTP in the first instance, and then with PPL within DP. Other local partners included ISRI, ICRR, University Syiah Kuala, IVEGRI, FCAS Aceh and the NGOs KEUMANG and Austcare.

As outlined above, capacity development was the primary impact pathway for the ACIAR projects. This was successfully achieved. The knowledge transferred through the projects had a significant and lasting impact on the capacity of their local partner organisations and their staff. Even though capacity development was mainly focused on BPTP and DP, the respondents from organisations at both national level and in Australia all confirmed that the projects were also valuable learning opportunities for them.

This is particularly impressive as the projects were implemented in a post-disaster and post-conflict environment. Under these challenging circumstances, it is often difficult to deliver effective capacity building in line with the principles of contextualisation, long-term engagement and sustainability.

The discussion of impact that follows has been structured across 3 levels – individual, organisational and institutional – in line with the definition of capacity building used by ACIAR.

Individual level

The first level of capacity development focuses on the capacity of individuals from local project partners and includes formal or informal activities that strengthen the abilities and agency of individual staff. The projects that are part of this review did an excellent job in strengthening the capacity of individuals from local partners, not only through training but also through inviting the right experts to work on the projects and by creating a culture of learning.

Training of partner staff had a lasting effect. The projects invested considerable time in training counterparts, and coaching and mentoring experts who have continued to work on the topics introduced through the projects. All BPTP staff interviewed remembered the training they received and could easily repeat the key messages that were introduced. In particular, the training of laboratory staff restored the long-term soil and plant analysis capacity in Aceh. The current laboratory coordinator received extensive training in Indonesia and Australia through the projects.

The training of academics at Syiah Kuala University in Banda Aceh also had a long-term impact. Several researchers have continued to specialise on topics started through the projects (e.g. biochar). Beyond the particular subject matter, the projects introduced methods to carve up a larger research question into smaller studies that could be executed by students. This approach was new and it is still being applied today.

In addition to training individual staff, individual capacity can be strengthened by attracting the right experts to work with those individuals. The knowledge and methods from the experts are transferred 'on the job' to the institution's staff. All the evaluated projects managed to attract suitable and capable experts from national research institutes who assisted with the identification of challenges and solutions for farmers. Their contributions to the projects matched their fields of expertise and were therefore respected and perceived as useful.

Many informants commented favourably that the national experts selected to work on the projects not only had the requisite specialist knowledge, but also a collaborative learning attitude. Rather than imposing preconceived solutions, they were willing and interested to work with the local stakeholders to understand the circumstances, define the problem and solve it together. In addition, both national researchers who were interviewed have used the ACIAR projects to further their academic work. Even though their role was to bring in expertise and they did not receive formal training from the ACIAR projects, these interviewees each said their involvement in the projects was a learning experience. BPTP and DP staff also perceived the work with national research institutes as a win-win collaboration.

ACIAR also selected appropriate international personnel to run the projects in Aceh. All interviewees were positive about the interactions with the ACIAR project leads, their affinity with Indonesia and (as with the national experts) their collaborative approach. Contacts between some project leads and staff from local partner agencies have continued long after the end of the last project.

Organisational level

Capacity development at the organisational level focuses on strengthening the ability of the partner organisation to achieve its objectives and fulfil its role in the national agricultural innovation system. The organisational level is the most important, as it is most likely a lasting change that will continue to provide a supporting environment for individual researchers. It is also difficult, as it requires the organisation to change its rules, structure, operations and/or strategy to facilitate knowledge sharing and capacity development.

The projects had fewer successes at this level, which is understandable given the challenging circumstances. However, some gains were observed, including demonstration of new ways of working, introducing systems to generate new knowledge, strengthening systems to capture that new knowledge and ultimately changing organisational rules. Examples are provided below.

The ACIAR projects supported a culture of learning. The project lead organisations had a systematic approach to learning and they introduced this approach to the key counterpart organisations by involving staff (and, progressively, farmers) in each phase of the project cycle. Each project used a learning cycle moving from assessment to problem identification to combining knowledge, testing solutions and finally dissemination. The learning cycle was adopted by counterpart staff through observation, imitation and practice.

The knowledge gained through these processes is often lasting, as can be observed from the detailed knowledge interviewees still have about the ACIAR projects. Some staff are still using specific skills they acquired, such as participatory rural appraisal. Knowledge is also passed on between staff members and fieldworkers. Mostly this takes place through informal coaching or in exchanges between staff both in BPTP and DP, including training sessions among PPL at *kabupaten* (district) or *kecamatan* (subdistrict) level (pre-COVID-19). The impact could have been increased by not only demonstrating a culture of learning in the Aceh projects, but making that information explicit and trying to integrate it into the regular procedures of BPTP and/or PPL.

New knowledge was generated by the projects by assessing the particular problems in Aceh and combining international and national research with local knowledge and specificities of the circumstances in Aceh. BPTP and DP staff were involved in these processes and this exposure broadened their insight into project design and test methods.

The learning culture was also fostered through training focused on data analysis, statistics and writing of scientific papers. Knowledge was captured and made explicit mainly through publications in scientific journals. These articles are a trusted basis from which project knowledge has successfully generated new knowledge. Academics involved in the projects have used these articles for additional research and scientific publications (e.g. on biochar or salinity in Java).

The projects managed to bring about some changes to 'rules' at the organisational level. A good example is the development of standard operating procedures for the BPTP soil laboratory.

The projects also helped strengthen organisational capacity by engaging and supporting partner agency staff with the right expertise or with a strong drive for learning. For example, an existing BPTP staff member with a strong commitment to learning was trained as a laboratory technician. Project staff also invested time, working through partner organisation networks, to identify committed PPL to support on-farm trials and dissemination.

'My knowledge and skill improved. I was also involved with ACIAR when I was doing research, so I could use some of the data for my research as well.' [PPL]

On other occasions, the projects could have better targeted the selection of staff involved in the projects. For example, the BPTP staff selected to participate in fieldwork included not only the regular field staff and the relevant researchers, but also a range of other staff, such as the director of the institute, the laboratory staff and researchers who normally focus on completely different subjects. These staff received training on how to conduct fieldwork even though they were unlikely to work in the field again after the ACIAR project. This might be perceived as a waste of training resources by the projects, although sending the director or the laboratory technician to the field probably had a positive impact on their regular work.

Enabling environment

The final level of capacity development is the enabling environment (or institutional level). The broader system – such as policies, regulations and governance – within which the ACIAR projects operated, supported or obstructed the adoption and replication of the innovations introduced by the evaluated projects. These issues are difficult to address through short-term projects, but targeted interventions can have tremendous impacts.

Several techniques introduced by the ACIAR projects were adopted as provincial policy because BPTP used its fact-based learning approach to demonstrate their advantages. As a result, the techniques have been promoted throughout Aceh Province and adopted by a large segment of the farmers. This is a huge success, albeit not a planned result.

The projects engaged DP's extension services in every aspect of the implementation. As a result, the PPL changed their way of working and adopted the learning approach. Changing the way extension services are governed was beyond the scope of the evaluated projects, so the learning approach remains an informal way of working. Still, several committed PPL are passing on this way of working through training sessions to their colleagues.

Commentary

Capacity development is a key goal of international development cooperation. But while most people agree that development will not succeed without strengthening capacity, the effectiveness of capacity development efforts is often questioned.

The ACIAR-funded projects succeeded in developing capacity even though capacity building is hard and has failed in the best of circumstances. The successes listed above are even more impressive when the operational environment in Aceh at the time of the projects is taken into account.

The projects managed to deliver lasting capacity improvements in a post-conflict and post-disaster environment. These circumstances are considered far more challenging for capacity development than stable conditions. The principles for capacity development (ownership, partnership, contextualisation, flexibility, learning, accountability, longevity and sustainability) are very hard to apply when operating in a complex, dynamic and uncertain operating context.

The projects managed to develop capacity within a timeframe and budget generally considered insufficient for capacity development. Capacity development normally takes time and is resource intensive. It is complex and often requires a try-fail-improve learning approach. It is not a simple transfer mechanism of know-how, but a process that involves partnerships, trial and error, adjustment to context and adoption of unplanned results. Short timeframes with limited resources are generally considered detrimental for capacity development projects, but these projects did very well.

Room for improvement

While the achievement of the ACIAR projects in Aceh is impressive, there might have been opportunities that the projects did not pursue. A few observations are raised below that could start a discussion in ACIAR on its approach to capacity development.

The primary objective of the Aceh projects shifted over time. The interviewees involved at the design stage understand the first 2 Aceh soils projects as relief projects that aimed to re-establish food production after the tsunami. The later projects were more 'livelihood enhancement'. The emergency context evidently encouraged a focus on delivering development results as opposed to developing the capacity of the local partners to deliver these results. This may have influenced the transition from working mainly with BPTP staff to working directly with farmers (albeit shoulder to shoulder with BPTP staff and PPL).

Capacity development at all 3 levels is essential even in a post-disaster situation. The preparatory (ACIAR/CSIRO) work for this evaluation indicates that the projects aimed to deliver institutional capacity building. As noted above, the Aceh projects did well in training the individual staff involved in implementation. More attention to the organisational and institutional level of capacity development could have rendered the capacity more sustainable.

A narrow or unclear definition of capacity development may have resulted in some opportunities being overlooked. The evaluation team noted that ACIAR managers, project managers, project designers and project staff used a range of definitions. These ranged from training counterpart staff to creating an institutional environment where counterpart organisations identify and meet their own capacity needs. Most commonly, respondents associated capacity building with professional development and training. The organisational and enabling environment levels of capacity development were mentioned less often. For the Aceh projects, adopting a common definition and explicitly targeting 'higher' levels of capacity development might have resulted in:

- greater focus on training by and for BPTP staff (e.g. training specifically for new staff or annual refresher training on research methods or writing skills)
- storage of knowledge (e.g. research design frameworks, fieldwork planning guidelines, regular evaluation write-ups, consistent use of the BPTP library as a repository for all reports, use of one computer or intranet site to store all project data and reports)
- institutionalising knowledge (e.g. introducing standard operating procedures, guidelines, weekly recurring information sessions, standard planning tools, compulsory process evaluations, development of best practice guidelines)
- creating communities of practice (e.g. including experts from outside the organisation, introducing weekly presentations by staff for staff, co-locating staff working on one subject).

Implementing a series of short projects created opportunities for learning, but may have reduced the focus on longer-term capacity development interventions. The first project implementation period was only one year, the second 2 years, the third 3 years and the fourth project lasted 4 years. The short implementation cycles allowed the projects to integrate the lessons learned from the previous project into the approach of the next project. This allowed for an iterative, adaptive approach to maximising development impact. On the other hand, project designers had to fit their ambitions to the project timelines and hence were more likely to opt for quicker individual capacity development, rather than longer-term 'higher' level options. A more comprehensive approach might have been achievable if it had been clear from the beginning that the ACIAR engagement in Aceh would continue over a long period.

Some of these observations will be used to discuss lessons on capacity development under KEQ5.

Observations on integrated conceptual framework

The interview guides were developed in part to explore concepts from the SLF and TEV frameworks as well as the validity of hypothesised (TBIE) pathways. As noted above, an assumed impact pathway via 'institutional capacity building' is problematic since most of the capacity development took place at individual level. However, to the extent that individuals within the organisations had their capacity strengthened, this can be understood in SLF terms as **human capital** formation, while the operational environment roughly corresponds to the SLF **social capital** concept. Organisational capacity is a resource or capital that can be transformed into organisational performance. Significant **physical capital** formation also took place, for instance, through the provision of equipment to the BPTP laboratory.

It is clear that the individuals involved in the projects accrued considerable value (or utility) from their participation. Some examples using the TEV framework are captured in Table 4. Other aspects of capital formation and value are considered in relation to the evaluation questions that follow.

Table 4 Applying TEV concepts to human and social capital developed in partner agencies

Type of value	Examples from partner personnel	Interview quotes
Direct use	<ul style="list-style-type: none"> • Personal satisfaction, enjoyment and recognition from project involvement • Increased knowledge and skills, leading to greater confidence in their own abilities • Application of new knowledge and skills in their work roles 	<p>'It increased my knowledge, my passion to learn more, and passion to put all the knowledge into application.' [KII, former PPL]</p> <p>'I had already worked 20 years before ACIAR came. But I still learned lots, for example, management, observing the land, learning about other countries in Asia.' [PPL]</p> <p>'Personally, I am more confident.' [PPL]</p> <p>'There are 2 PPL involved in ACIAR who are still working in this BPP, so the knowledge, skills and resources are still retained. They both continuously train other PPL and farmers.' [PPL]</p>
Indirect use	<ul style="list-style-type: none"> • Those not directly involved have colleagues with valuable skills and knowledge that can be harnessed as needed or through mentoring, training, etc. 	<p>'I want her to transfer her knowledge to other PPL, train them. She tells them how to operate in the field.' [DP district office head, referring to one of his staff, a former project PPL]</p>
Option	<ul style="list-style-type: none"> • Professional networks and career opportunities have expanded 	<p>'We have a closer relationship with BPTP; more network with Agriculture Institution in Java.' [PPL]</p> <p>'ACIAR was a stepping stone for me.' [former PPL]</p> <p>'I became the head of the BPP.' [former PPL]</p>
Existence	<ul style="list-style-type: none"> • DP and other government officials at all levels had greater confidence in the capabilities of BPTP and extension services to support agricultural development in Aceh (and beyond) 	<p>'I am also more trusted and popular within Dinas Pertanian.' [PPL]</p> <p>'One of the PPL got a President's Award – a big achievement.' [former Project lead]</p> <p>'I went all round Indonesia afterwards to train PPL elsewhere.' [former PPL]</p>
Bequest	<ul style="list-style-type: none"> • Staff trained through the projects have played an ongoing role in training newer recruits (i.e. knowledge has been passed through generations) 	<p>'I am invited to other districts to become a speaker and train other PPL.' [PPL]</p> <p>'If there's a budget for training, we use similar training materials, and ToT.' [BPTP]</p>

Notes: BPP – Balai Penyuluhan Pertanian (District Agricultural Extension Offices); BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology); DP – Dinas Pertanian (Department of Agriculture); KII – key informant interview; PPL – *penyuluh pertanian lapangan* (agricultural extension officer(s)); ToT – training of trainers



A member of the Harapan Maju group harvesting vegetables.

To what extent have ACIAR local partner agencies used knowledge and skills developed through ACIAR investments in their agricultural research and extension activities? How else have these projects impacted on the local partner agencies?

Most of the knowledge and skills developed through ACIAR projects continue to be applied in the daily activities of the partner organisations. Project techniques are also used by people who were not involved in the projects. This is a very impressive achievement.

The agricultural techniques have been widely used and copied. Methodologies were copied to some extent, although, as explained in the previous section, capacity development focused on the individual more than on the organisation. Adoption of methodologies was thus more dependent on motivation of the BPTP staff and PPL. A more structured focus of capacity development at organisational level could have integrated these methodologies into BPTP's and DP's standard ways of working.

This evaluation has reviewed the knowledge and skills acquired by BPTP and DP as well as the individual officers working for these organisations. These are the primary channels for continued use of project-related knowledge and skills – particularly the *kecamatan*-level extension services (BPP offices and their PPL) that come under the DP structure.

The knowledge and skills transferred in the course of the projects covered every aspect of the regular project cycle: problem assessment, identification of the solution and dissemination of the solution among farmers.

For BPTP (and ACIAR), scaling the research results to farmers is not part of their regular mandate. The role of BPTP (at least before the current/imminent reorganisation⁴) is to implement agricultural research and demonstrate the research conclusions at farm level. BPTP works with DP extension workers in the demonstration locations. Scaling of

research results to all farmers is the task of the DP at provincial level.

The successive Aceh projects shifted from research into salination solutions, with the goal of disseminating an integrated package of known techniques to as many farmers as possible. This was considered the most effective way to improve development outcomes in the post-disaster, post-conflict situation in Aceh. As a result, the knowledge and skills transfer shifted gradually from a focus on BPTP's core mandate to DP's core mandate.

Below an overview is provided of the knowledge and skills that are still being used by BPTP and the extension workers in DP.

Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology)

The ACIAR-funded projects had an important influence on the staff of BPTP and their way of working. A very obvious capacity improvement is related to the soil laboratory, but ACIAR also influenced research designs, in particular how farmers are engaged and demplots are used. Some continuation of research areas was identified (drainage and irrigation). Finally, the development of some non-agriculture-specific skills had important impacts (e.g. writing scientific papers).

Laboratory capability has continued to improve since the ACIAR interventions. The laboratory technician (who received training including at the National Soil Research Institute and in Australia) is now in charge of the laboratory and his expertise is transferred to the team. The laboratory management system is still being applied and is an excellent

⁴ See 'Recent changes' on p. 29.

example of a standard operating procedure that can become organisational knowledge in addition to personal capacity. The laboratory equipment is still used or has been replaced with more up-to-date equipment. The laboratory has been extended with additional equipment from the Asian Development Bank. It continues to do about 300 analyses per year, although this declined significantly during the COVID-19 pandemic and it is not currently running at full capacity. Most of these tests are related to chemical and biological soil factors and plant analyses. Few salinity analyses are done because salinity is no longer an issue in Aceh. The tests that are done are requested mostly by the local university, where research on soils is continuing. Soil quality is still being tested. More advanced equipment has been received from the Indonesian Government and other donors because the laboratory technicians are capable and the management of the laboratory is professional. This virtuous cycle of good skills and management is resulting in opportunities for further improvement – as also evidenced by the prioritisation of further strengthening of the laboratory for the 2023 BPTP budget cycle.

BPTP staff indicated that they are involving farmers more in their research, in line with the approach introduced by the ACIAR projects. The projects introduced a deep learning approach by communicating with the farmers to understand their challenges and actively including their existing knowledge and practices to the research. This is a shift from BPTP's traditional way of working. Respondents indicated that, before the projects, farmer involvement focused more on testing whether the research technique worked. The socioeconomic assessments introduced through ACIAR are still used, albeit less frequently. One (retired) respondent indicated she continued to use the participatory rural appraisal but she did not provide details. BPTP staff said that, as a result of the ACIAR projects, they pay more attention to the way farmers are currently working before proposing (testing) new techniques.

Prior to the COVID-19 disruptions, BPTP's research program used demplots on farmers' land, with BPTP providing guidance materials, and monitoring and reporting. PPL continue to use demplots (with or without BPTP involvement), both on farmers' land and within the BPP office compounds. The long-term demplots introduced in the fourth project could not be continued due to the project-focused annual work cycle of BPTP. Changing BPTP's annual work cycle was beyond the scope of the Aceh projects as it would require BPTP to adopt a long-term research strategy and obtain multi-year budgets. It would also require a change in the way that BPTP research projects are selected (i.e. through an assessment of farmers' needs or potential development gains).

Research into drainage continues, following the work started by ACIAR. The drainage and leaching introduced by the first ACIAR project was effective, even though in many cases rain leached the fields in a natural way. ACIAR research indicated that yields can be improved by draining the fields rather than continuing the regular practice in Aceh of inundating rice fields. Additional research and field tests have proven this positive effect and as a result the drainage of fields is also promoted in non-tsunami areas. Many interviewees indicated that irrigation and drainage is an important challenge that can only be resolved through a coordinated approach. Some BPTP researchers hoped they could obtain funds to continue this research.

Some training was focused on non-agriculture specific topics, including planning research and writing scientific papers. Publishing is an important performance indicator for BPTP staff, so they were keen to learn how to write and collaborate on scientific papers for international journals. The experience of the early publications led to scientific writing courses and training on statistical analysis in later projects. This training is regularly mentioned by BPTP staff as extremely useful, and it continues to help them to get their work published. It is unfortunate that this training could not be institutionalised (e.g. repeated regularly by one of the BPTP staff to other staff).

Extension services (BPP/PPL)

There is strong evidence that PPL involved directly or indirectly in the ACIAR projects continue to apply the knowledge and skills they gained. 'Everything we learned, we're still adopting because it's still relevant,' said one. Those PPL have also been spreading their influence by training and informally mentoring their colleagues, and/or rotating to new locations.

'He is still implementing what he learned from ACIAR in other villages he's [now] responsible for.' [PPL]

Working with farmers

The ACIAR projects were widely acknowledged as having introduced a more consultative ('soft and subtle') approach to extension work. The PPL involved learned from this experience and several indicated they continue to use and promote an approach that builds on, rather than criticises, farmers' existing practices, listens to their concerns and preferences, and attempts to persuade them through visual evidence rather than insisting on change. Experienced PPL find this approach more effective in gaining farmer trust and achieving adoption of new technologies or approaches.

'With other programs, people are offered funding and are taught new methods but it feels 'forced' [if they didn't adhere, the project or support would stop], and they then revert after completion. With ACIAR, they approached farmers differently and the farmers realised these ways were better, and kept using them. It was more subtle. Farmers were asked what they do now, and then ACIAR showed them alternatives, using demplots. Whereas with other programs, it's "use this pesticide, this method", and there's no room for negotiation.' [PPL]

However, the collaborative extension methods have not been systematically institutionalised. While dedicated PPL support their colleagues to use this approach, it is not routinely covered in PPL training. Several PPL interviewed expressed frustration at the top-down processes for determining their work priorities (e.g. rolling out approved new varieties or cultivation techniques) that they are required to follow without question. With recent COVID-19 disruptions and budget constraints, activities to build PPL capacity have declined significantly and many current PPL are said to lack confidence in interacting with farmers.

Demonstration sites

The use of demplots on farmers' land and/or at BPP offices is now standard practice for PPL. However, in contrast to project usage, these appear to be primarily extension tools to encourage adoption of the latest DP-mandated technologies or varieties, rather than research tools for scientific testing of alternatives. The exception has been BPTP-managed on-farm trials, but these are currently on hold. Private agribusinesses also use demplots to promote farm inputs, such as new varieties of fertiliser.

Demplots are part of a wider approach to dissemination introduced by ACIAR. Extension workers and BPTP staff indicated that they select each demplot site carefully to maximise farmer reach. Every village has a farmers' group led by an influential farmer. Running a demonstration on the field of the head of the farmers' group will influence the whole village. Inviting other villages to the demplot can widen the reach even further. Farmer-to-farmer replication has probably been the most common route of technology transmission for ACIAR techniques. Training farmers to effectively communicate the new techniques is therefore important. The latter depends in part on the extension workers' ability to combine demplots with simple explanations about why the techniques are increasing yields.

New varieties

Some rice varieties introduced during the projects (e.g. varieties that are more pest-resistant or better suited to soil type) have been superseded over the years, since the Indonesian Government regularly introduces and promotes new varieties. As noted above, varieties developed at national level may be promoted through demplots, but are not generally subjected to rigorous testing at the local level. Adoption is mandated to an extent, both through directives to the PPL and through the government's controls over seed availability. (Varieties are colour-coded to indicate those that can be marketed and those that can be retained for further use or shared between farmers at no cost.)

Integrated crop management

The fourth project (SMCN/2007/040) developed an integrated approach to improve rice yields. It combined all the techniques that had been tested and approved at national level and that were not commonly practised in Aceh. These techniques were introduced as a single package:

- timing of seedling transplanting
- timing of fertiliser application
- *legowo* planting method
- 3 plants; 1 hole
- integrated pest control
- intermittent irrigation
- timely harvest
- organic fertiliser use/chemical fertiliser reduction
- crop rotation
- use of biochar and other soil organic amendments.

Most of these techniques continue to be promoted by the DP extension workers. The *legowo* method continues to be promoted as provincial policy by all DP extension workers. Variants on the ACIAR 2:1 approach (3:1 or 4:1) are acknowledged as acceptable and pragmatic options, addressing to some extent farmer concerns over 'wasted' space or greater effort (see further under KEQ3). The promotion of the remaining techniques depends on the local extension workers' experience and training. Biochar and intermittent irrigation turned out to be less practicable and hence less promoted. But even for these techniques, a handful of key individuals have had an especially significant influence. For example, one former PPL had her own biochar cooker constructed based on the model demonstrated during the project. She continues to produce and market biochar as well as home-made organic compost and promotes their use through training and field visits for PPL and university agriculture students.

Another PPL interviewed in a *kabupaten* some distance away learned about biochar through these activities and is now demonstrating how to make and use it.

Integrated vegetable management

The third project (SMCN/2005/075) introduced a similar package of techniques to improve vegetable farming (as well as a special package for chilli growing), which included:

- natural enemies/biopesticides
- seed production
- soil assessment
- methods of making compost/soil fertility
- how to use straw mulching
- irrigation (drip)
- starter solutions
- crop rotation.

PPL continue to promote most of the integrated practices for vegetable crop management. Some techniques were too onerous (e.g. straw mulching and drip irrigation) and were not widely adopted. The integrated approach is reported to have had an important impact on yields and on farmers' income (as discussed in more detail in KEQ3).

Soil testing

The head of one DP office at *kabupaten*-level reported continued soil testing, with samples sent to BPTP once a year. He also said that each *kecamatan*-level BPP office has its own portable soil test kit so PPL can test farmers' soils before planting season. However, the actual level of use of these tests is patchy. Some BPP offices visited during fieldwork only have one type of kit – for instance, a dryland kit, which cannot be used on *padi* land, or vice versa. In one case, the chemicals had expired and no budget was available to replace them. In another, the kits were only used during the project, 'because the land is fertile'. Where functional soil test kits are not available, some PPL rely primarily on a leaf colour chart, which provides a guide to soil nutrient content.

Soil management/improvement

PPL interviewed demonstrated a good understanding of soil improvement options, but also a pragmatic acknowledgement of farmers' perspectives and preferences (discussed further in KEQ3). BPP demplots frequently focus on comparing different types of chemical and organic fertiliser, including home-made (e.g. compost or biochar) and commercially manufactured products.

To improve their soils, PPL advise farmers to grow crops such as corn between rice plantings where conditions are suitable, and not to plant the same type of vegetable continuously on the same plot. They also advise on the appropriate fertiliser regime for specific crops and soil conditions, and encourage farmers to minimise their use of chemical fertiliser and pesticide, particularly for vegetable crops. This approach has become provincial policy and, as a result, most farmers across Aceh adjust the quantity of chemical fertilisers they use to suit the particular conditions of their soil. This is a major shift compared to before the tsunami, improving soils and increasing farmers' income at the same time. Current approaches appear broadly consistent with those introduced through the ACIAR projects, including the emphasis on exploring and promoting alternatives to chemicals.

Women's groups

Some women's farming groups (KWT) existed prior to the tsunami, but revitalising and expanding these to new areas became a major focus, particularly during the fourth project. The general expectation or norm now is that each village will have a KWT that grows vegetables, as well as one or more men's or mixed groups focusing on rice (although, as discussed in KEQ3, KWT can face a variety of challenges and not all are active). While both male and female PPL work with both types of group in the villages they are responsible for, female PPL were said to give particular priority to the KWT. The converse is also plausible, though not confirmed (i.e. some KWT in villages serviced by male PPL may be relatively neglected). However, it is clear that the attention (and funding) given in the third and fourth projects to vegetable growing and KWT have contributed to recognition of the economic and social value of women's groups and the continued focus on supporting them through PPL knowledge and skills.

Other impacts on extension services

PPL status

At least in project areas, the project methodology of working with and through the extension services reportedly resulted in improved status and recognition both for individual high-performing PPL and the role of the PPL more broadly. Farmers saw that PPL had valuable advice and a collaborative approach, and this led to increased farmer trust in PPL. During field consultations, the continued warmth and strong regard many farmers have for their experienced, knowledgeable and dedicated PPL was evident. However, these observations cannot be extrapolated beyond the sites visited, and at institutional level PPL get little reward for their effort.

PPL networks

PPL had opportunities during the projects to train together and travel to each other's districts, resulting in ongoing professional networks and personal friendships. Broader networks also resulted. Some PPL informants noted that they had little awareness of or interaction with BPTP before the projects, but this changed as a result of working together during project implementation, and these personal connections have been maintained. Some were also able to establish valuable networks with national agricultural institutions, which they have subsequently drawn on to further their careers.

Recent changes

While the discussion above points to many lasting legacies from the ACIAR projects, there is cause for concern that these legacies will increasingly dissipate. As noted, over the past 2 years the routine activities of provincial-level agencies (BPTP and DP) have been constrained by COVID-19-related restrictions and budget cuts. This has undoubtedly disrupted the ability of partner agencies to continue applying the skills and experience developed through the ACIAR projects. The retirement of some key individuals at all levels (PPL through to agency heads) is a further obvious risk factor, particularly given the projects' primary focus on individual-level capacity development.

Furthermore, the Indonesian Government has recently embarked on a major restructuring of its scientific research institutions, with the creation of the Badan Riset dan Inovasi Nasional (National Research and Innovation Agency) (BRIN) in 2021. By early 2022, BRIN had absorbed 33 research agencies from diverse fields, including archaeology, astronomy, botany and meteorology. All key agricultural research agencies are also being consolidated within BRIN. In Aceh, BPTP's agricultural research functions will move to BRIN Aceh, while other services, such as its soils testing laboratory and standard-setting activities, will remain. While the government has committed to strengthen the agricultural innovation and delivery system through BRIN, there have been criticisms from scientists and academics, and many uncertainties remain (Robet 2021; ACIAR 2022b; Rochmyaningsih 2022).

Observations on integrated conceptual framework

As noted under KEQ1, the TBIE pathway from the ACIAR projects via 'institutional capacity building' of local research and extension partners to on-farm impacts is misleading. There was little focus at institutional level and limited impact at organisational level. However, the project did build individual capacities with partners and farmers, and these capacities have been applied as outlined above. Female and male farmers interviewed confirmed that the motivation provided through project participation, the way project support was provided ('subtle', through consultation and demonstration) and the clear evidence of economic and social benefits all contributed to achieving impacts consistent with the hypothesised ToC. These impacts and contributing factors are discussed further in KEQ3 and KEQ4.

The KEQ1 discussion highlighted the important role of the projects in building human, social and physical capital (as per the SLF) in partner agencies, particularly BPTP but also DP's extension services, Syiah Kuala University and selected NGOs. The way in which knowledge and skills were imparted and adopted at farm level has resulted in an increase in capital development, contributing to more sustainable farm-household livelihoods. These farm-level effects, and the types of total economic value associated with them, are discussed in KEQ3 below.

Some forms of capital creation and value (or utility) accrued to partner agency staff through the dissemination activities outlined in this section. For example, human capital was further developed through the experience PPL gained as they continue to train farmers and help them resolve challenges. Social capital has been an important factor in motivating PPL to keep working, despite the somewhat unsupportive institutional environment. As noted above, PPL status and networks improved as a direct result of the projects, and this has been reinforced to an extent through their continued engagement with farmers and with each other. Similarly, the credibility of BPTP increased.

As well as creating direct use value for the agriculture sector, the social capital created has indirect use value (status and credibility among the wider population), existence value (capable institutions are essential to identify future challenges and solutions to increase the resilience of the community) and bequest value (capable institutions pass on knowledge and skills and continue to improve the knowledge and share it with those who can apply it).



Women inspect their crop grown as part of an ACIAR funded project in Aceh.
Credit: Patrick Cape

What impacts (positive or negative) have any improvements in ACIAR local partner agency capacity had on farmers and agricultural production in Aceh? How equitable was the distribution of impacts within targeted communities?

Initial results

In the immediate aftermath of the tsunami, the first project focused primarily on restoring affected land to production. Through salinity testing, attention to drainage issues and trials of salt-tolerant varieties, those areas which could rapidly resume cropping were enabled to do so. As salinity gradually subsided naturally through rainfall leaching, soil testing techniques and equipment helped identify when it had reached manageable levels. Follow-up projects focused increasingly on testing, and demonstrating improved varieties and cropping techniques. Integrated crop management (ICM) and participatory assessment methods were a significant feature of the vegetable production project (SMCN/2005/075), and this emphasis continued during the final project (SMCN/2007/040), which not only addressed rice production but also developed a significant component to strengthen and expand KWT.

Immediate outreach and impacts (including dollar values where available) recorded during the project lifetimes are summarised in Table 5. Further details are provided in Appendix 7.

The longer-term production impacts depend on continued promotion of those varieties and techniques through the research and extension system (see KEQ2), the extent of (continued) adoption by farmers and the productivity effects of those innovations.

Adoption

The most significant changes introduced through the projects were the *legowo* planting method for *padi*, reduced or tailored input use (i.e. seeds, fertilisers, pesticides) and greater production of vegetables, including through KWT. These approaches have been widely adopted across Aceh.

Views on the factors affecting adoption varied somewhat. Many said that it depended on 'individual characteristics', but some indicated that women tend to be more interested in trying new things, whereas men might agree when talking to their PPL but then fail to implement. Others suggested 'elderly farmers' were less likely to change compared to younger and more educated individuals. On the other hand, intergenerational knowledge transfer also takes place. One PPL said, 'The farmer group here was not directly involved with ACIAR, but their fathers maybe were, so they would have learned techniques from them.' Conversely, a male farmer said, 'My son is not farming, so the knowledge will be lost.'

'We work with the willing. The younger and more educated tend to be open to change. We do technology trials with them but also encourage entrepreneurship. Younger folk actively research themselves (YouTube, Google). If they find obstacles, they'll modify the approaches and feed that back to us.'

[BPTP]

Land ownership and off-farm work are also factors. Rural landowners who work their own fields full-time are more likely to adopt new methods than urban (part-time/absentee) landowners who hire labourers. The labourers themselves are less likely to have received direct training, and tend to prefer the simple, quick and familiar method (unless their employer is present and explicitly instructs otherwise). Remote areas were also thought to be more resistant, especially if the new

Table 5 Results claimed in project reporting

ACIAR project	Reported benefits and values
'Management of soil fertility for restoring cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province' (SMCN/2005/004)	<ul style="list-style-type: none"> • 20 assessment sites (primary focus on restoration and demonstrating potential) • Development of a general strategy for reducing crop losses on tsunami-affected land
'Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/118)	<ul style="list-style-type: none"> • Farmers convinced to return to farming • Yields increased due to improved technologies • Other cash crops introduced, improving income and food security (benefits not quantified)
'Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/075)	<ul style="list-style-type: none"> • Baseline survey estimated relative returns to chilli, tomato, cucumber and rice • Net returns to chilli: USD3,500/ha (investment of USD3,700/ha) • Farmer field schools on chilli production for 1,648 farmers; improved knowledge and skills • Generation of employment opportunities (800 labour days for 5-month chilli season – 3 times that of rice)
'Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales' (SMCN/2007/040)	<p>Rice (ICM)</p> <ul style="list-style-type: none"> • 8 long-term sites directly involving 103 farmers • Numerous PPL and farmer-training workshops and demonstrations • 8 exchange visits involving 75 farmers and 117 PPL • Adoption of ICM by 43–84% of farmers • Farmers whose gross margins increased: >90% • Farmers whose gross margins increased >20%: 45% • Increase in rice production in Aceh: 221,880 tonnes (14.25% from 2009 to 2012)[†] • Production increase in districts where the long-term sites were located: 26.6% • Average yield increases at project sites: 1.44 t/ha (AUD480/ha economic benefit; average AUD84/crop for each participating farmer) • Yields and returns replicated in surrounding villages • Total economic contribution of >AUD50,000 per season across 112 ha of project sites and surrounding villages (618 farmers) • Yield increases: peanut 89%; soybean 31% • Gross margins: AUD331/ha to AUD518/ha <hr/> <p>Vegetables (KWT)</p> <ul style="list-style-type: none"> • 35 KWT formed, 750 members, 45 PPL involved • Technical training for 245 women and PPL, including 25 women and 20 PPL from nearby villages • Total economic benefit to participants: AUD297,000/year • Total economic benefit can be extended to a further 750 women if KWT growth continues • Profit/month/member (not including home consumption): wet season AUD26 to AUD74; dry season AUD5 to AUD28 • Total net income (from crop sales and not purchasing vegetables for family consumption): IDR300,000 (AUD33)/month per family • Income for the average 25m² family backyard in Bireuen (using family labour): AUD23/month

Notes: † This statement does not accord with official statistics, which show an increase of around 6.5%.

ICM – integrated crop management; KWT – *kelompok wanita tani* (women's farming group(s)); PPL – *penyuluh pertanian lapangan* (agricultural extension officer(s)); t/ha – tonne per hectare; USD – US dollars

Source: Projects' final reports

technique seemed expensive or harder work (as is often the case with the *legowo* method, for instance). In addition, information transfer can simply be less effective if not regularly reinforced. One KWT reported: 'PPL taught us a lot, but sometimes we forgot what they taught us.'

While individual characteristics clearly play a role, there is also evidence of variability across districts. Having direct experience of the ACIAR projects may be a factor. One PPL said, 'The villages directly involved are more accepting of new technologies'. The fourth project (2007/040) reported that ICM had been adopted by 43% to 84% of farmers by the end of the project. Now, in one former project village, 'almost 100% use *legowo*', and estimates in other districts range from 50% to 80%. Land type or soil structure could also be a factor, with the *legowo* method considered unsuitable on 'deep' (peat) lands. While the potential productivity gains of the *legowo* method appear to be quite widely recognised, not everyone is prepared to put in the additional effort required. There is widespread acknowledgement in BPTP and the extension services that some farmers remain unconvinced because it appears land is 'wasted' in the vacant spaces between rows. For one farmer group, an evident benefit when the *legowo* method was first introduced – easier manual clearing of snail pests – became less important when they reverted to chemical pesticide use.

The projects carried out trials of organic fertiliser, and PPL currently encourage farmers to minimise chemical use. As with the *legowo* method, speed and simplicity are also an evident factor affecting choice of fertiliser type, at least for rice production.

'We have an abundance of natural resources for making organic fertilisers, but most of the farmers want things as simple and efficient as possible.'
[male group]

However, many farmers noted that the projects and/or subsequent PPL advice had given them a much better appreciation of when and how to use fertilisers, including adjusting their inputs based on soil fertility.

'We use less chemical fertilisers; we're trying to reduce chemical substances.' [KWT]

Recent spikes in fertiliser cost (due, in part, to reduced government subsidies) are prompting farmers to look for alternatives. Manufactured organic fertilisers are now commercially available at relatively low cost, and some extension offices are conducting or planning demplots to test their effectiveness compared to the more commonly used inorganic applications.

For vegetables, messaging from the projects on the human health risks of chemicals – since reinforced by PPL – have clearly contributed to KWT adoption of organic alternatives.

'KWT vegetable crops uses natural fertiliser and pesticides, because the harvest is also for family consumption, and the KWT are more aware of the dangers of chemical substances.' [PPL]

All KWT visited during fieldwork had received training on making and using natural fertilisers from some combination of organic waste (e.g. *padi* husks, home waste and other vegetation), animal manure and (in some cases) biochar, and were continuing to do so. Similarly, at least some groups were using various non-chemical options to control pests – although pesticides continue to play a role.

'We use organic fertilisers, and a combination of natural and chemical pesticides.' [KWT]

Crop rotation advice has had mixed take-up. For rice, where irrigation allows 2 or more crops per year farmers are less likely to forego that opportunity. Soil 'depth' is also a factor. For vegetables, market opportunities may override rotational advice:

'We harvest twice a year, so it's not possible to work on other crops.' [KWT]

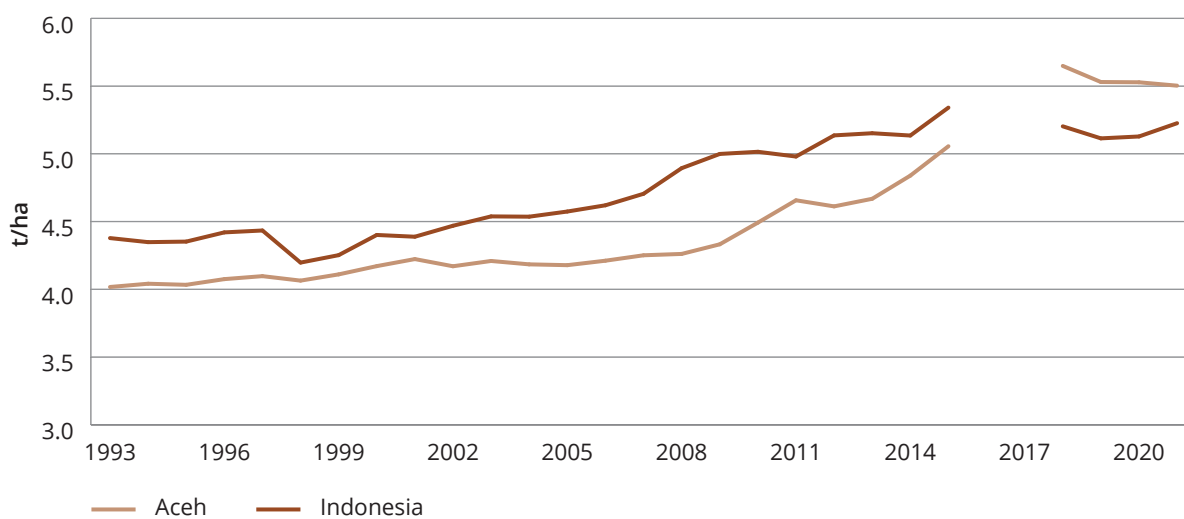
'We only plant padi because our padi fields are a bit deep for other crops.' [KWT]

'Farmers want to fulfill the market demand continuously, not grow rotational or intermittent crops.' [KWT]

Production and productivity

Project reporting and fieldwork responses provide strong evidence that tangible and long-term production and productivity gains resulted from the projects and subsequent technological advances. In the first instance, cropped areas increased as people began to use lands left vacant or abandoned after the tsunami. Many PPL and farmers pointed to:

- improved yields and returns from *padi* production following adoption of the *legowo* method
- faster-growing and more pest-resistant varieties suited to local soil conditions
- more efficient input use.



Note: Data not available for 2016 or 2017. Source: Badan Pusat Statistik (www.bps.go.id)

Figure 2 Average rice yield, 1993–2021

In the Bireuen area, PPL reported that yields had been increasing continuously each year, reaching 8 t/ha or more (up to 12 t/ha) in some districts before a recent landslide damaged the irrigation system. Farmer groups in Bireuen and Aceh Besar confirmed their yields had increased from around 4–5 t/ha pre-tsunami to 6–7 t/ha. While official statistics show a less-dramatic picture (Figure 2), it is clear that average yields across Aceh Province have increased steadily since the tsunami (4.184 t/ha in 2004; 5.503 t/ha in 2021) – catching up with, and recently exceeding the national average (5.226 t/ha in 2021) after lagging well behind for many years.

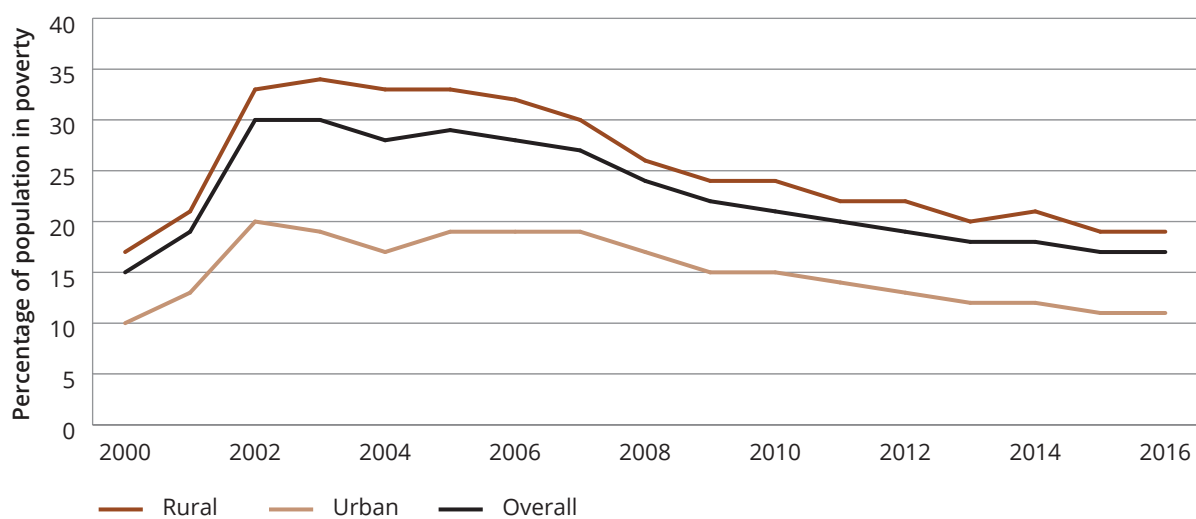
ACIAR work with KWT supported new KWT to form and existing ones to become more productive. Women were introduced to different types of vegetables and shown how to manage soils, pests and diseases. Corn ‘grew bigger’ once they started applying fertilisers. Some PPL helped KWT experiment with post-harvest processing, such as coconut syrup, nutmeg sweets, rosella flour, syrup, jam and spinach chips.

‘Previously we planted without rules or techniques. With new techniques, the results were different.’
[KWT]

‘We made lots of profit when planting peanuts. We also fried the peanuts to get more value and then sold them for a higher price.’ [KWT]

While there can be no suggestion that these impressive results can be attributed solely (or even in large part) to the ACIAR projects, the projects certainly created initial impetus and triggered improvements that have subsequently been built on. At the very least, the projects hastened the introduction and spread of innovations that were already applied elsewhere in Indonesia as national policy, but had not yet been extended into Aceh. Indicative values are provided in the TEV discussion below.

‘The impact of the ACIAR projects was not direct, but as a multiplier. Overall, perhaps 10% of the impact or progress is attributable, indirectly (20% would be an exaggeration). Productivity definitely increased, though total production depends on many factors (e.g. area, climate, policy). If there’s a drought, a smaller area will be grown. In Bireuen, it’s a lower area now because of the damaged dam – but productivity is consistent. After one year, the effect would be small, but there’s been gradual spread.’
[BPTP]



Source: Badan Pusat Statistik, Aceh Province (aceh.bps.go.id)

Figure 3 Aceh poverty rates, 2000–2016

Other impacts on farmers

All respondents agreed that family incomes and living standards have improved significantly in the 18 years since the tsunami. The cessation of conflict and the international response to the tsunami both helped create the conditions for recovery and subsequent development. Poverty rates have declined steadily in Aceh since about 2006, for both urban and rural areas (Figure 3).

KWT members reported that their food security and nutrition had improved, including through an increase in household vegetable consumption resulting from availability of home-produced crops. Again, only a relatively small proportion of these improvements can be attributed to ACIAR projects, but they undoubtedly achieved important changes in the immediate project locations that, over time, spread to other locations across the province.

'If we wait for aid and support from the government, it would be very slow. Without ACIAR, we wouldn't have developed this fast.' [PPL]

A more direct, albeit intangible, impact was the additional motivation and self-esteem participants gained as a result of receiving ACIAR project support. This benefit was confirmed by both PPL and farmers. PPL noted that project activities not only helped restore the soil, but also changed farmers' mindsets and boosted their 'hopes and spirits'. KWT said: 'ACIAR gave encouragement and support so we were motivated to keep working'.

'Project team visits increased the morale of farmers in the area because they indicated that people around the world cared for their welfare and livelihood and were looking at how they could help.'

[SMCN/2005/118 final report]

There was a particularly dramatic change in former 'red zone' (conflict) areas.

'This village had a bad reputation as an "independent movement fighter" area, so was quite dangerous. After ACIAR came, this village could produce 3 harvests per year of different commodities – padi, corn and soybeans. This changed the image of the village and turned it into a positive image, no longer feared or looked down upon by other villages.' [PPL]

Negative or unintended impacts

Informants generally struggled to identify any negative aspects of the projects. The only recurring critique was the limited focus of the projects (i.e. only one village per location). As well as creating envy from villages that were not chosen, it was also suggested that replication cannot be assumed.

'ACIAR's program was good, but it only benefited that one village. [D]ifferent villages have different ways of life that also affect their way of farming.' [BPP head]

The other significant issue was that some important actors were missed. As noted by one PPL, 'Farmers were taught new methods, but if work is done by labourers they may not understand or want to change.' This is discussed further in KEQ4 below.

Equity

Gender

While several informants said that 'men and women work equally', it is common for men to have a greater role in growing *padi* and for women to lead on vegetable farming. However, the division of labour between men and women varies considerably across the province. In some cases, men are said to 'dominate all facets' of rice production. In other cases, men prepare the land, plough and spray pesticides, and women plant and/or harvest. Sometimes women do most of the work (including machine ploughing) and men only help with harvesting.

A degree of flexibility in response to family circumstances is evident, and the last scenario is perhaps related to the extent of men's engagement in off-farm work, such as fishing, construction or salaried roles. KWT members also acknowledged that their male family members assist with heavier tasks, such as ploughing or making fences.

As a broad generalisation, the above suggests that the projects focused on *padi* would have benefited men directly, and women indirectly through higher returns. However, since the *legowo* method is acknowledged as requiring greater effort, this would have negatively affected whoever did the planting. Conversely, the ACIAR projects' support for vegetable production had a clear positive impact on women, particularly those involved in KWT, with indirect benefits flowing to other household members.

There is limited information in project reporting on the gender balance of beneficiaries. In the third project (2005/075), 45% of participants in farmer field days were female, but less than 30% participants in a vegetable ICM and training-of-trainer workshops were female. Figures for farmer field schools (1,648 farmers) are unfortunately not disaggregated. The fourth project (2007/040) focused almost entirely on women in its KWT component (750 women farmers and at least 45 PPL), but it seems likely that mostly men were involved in the rice activities.

When asked about household decision-making, all KWT visited during fieldwork said that this was equal. Further probing through an imaginary scenario showed that discussion and negotiation were commonly used within families, with one KWT saying, 'We should listen to both [viewpoints] and discuss it to find the right way.' However, the final decision usually rested with the men. In particular, if a son had received more education, his view was likely to carry additional weight.

The general consensus across all respondents was that gender roles had not changed significantly over time. It is notable that female labourers continue to be paid

less than males,⁵ even though they are widely viewed as more efficient.

As previously noted, a majority of PPL are female, and all PPL are required to work with both male and female farmers in their assigned villages. Some female PPL noted the challenges of having to meet with farmers out-of-hours, particularly with regard to personal safety, but had developed strategies for handling this, such as only meeting in groups and in public venues.

Land ownership

Given the focus of the ACIAR projects on establishing demplots on farmers' land, the immediate beneficiaries were the lead farmers who were willing and able to offer up land, and selected members of their farmer groups who participated in demplot-related activities. Other activities involved broader groups of farmers (e.g. training and cross-visits). Farm labourers appear to have been only incidentally included if they were hired to work on demplots during peak periods. Implications of this for project reach and impact are discussed in KEQ4. From an equity standpoint, fieldwork respondents noted that labourers may be required to follow their employer's preferred, new, more labour-intensive methods, with little prior instruction or guidance. Expending greater effort for a given area of land would disadvantage labourers if they were paid a flat rate on completion, but generally labourers are paid a daily rate, so slower work is a cost to the employer. However, the picture is complicated somewhat by the blurred distinction between farmers and labourers. Some labourers also own and work farmland, and may themselves hire in others for labour-intensive tasks such as planting and harvesting.

Insights from the conceptual framework

Impact pathways and theory of change

Although the actual project impact pathways centred more on key individuals than organisational or institutional levels (see KEQ1), the activities that built capacity of partner staff have clearly led to the application of that capacity (see KEQ2), and then to significant impacts for the farming communities directly involved as well as many others who are indirectly affected (see KEQ3). While impacts over time cannot be directly attributed to the projects alone, it is evident from the discussion above that they made a significant contribution. Findings on the expected impacts articulated in the (ex-post) project ToC (Appendix 3) are summarised in Table 6.

⁵ In one location, female weeders are paid IDR50,000 for one half-day, while males are paid IDR60,000–70,000.

Table 6 Expected project impacts and actual outcomes

Expected impact (from theory of change)	Outcome	Comments
Farmers return to crop production	Achieved	After 3 years, rice production in Aceh returned to pre-tsunami levels. [†] This outcome was not attributable solely to the ACIAR-funded projects, as fields that were affected by the tsunami were mostly leached clean by rain. However, the projects did play a role in demonstrating the feasibility and potential of resuming cropping, which helped restore farmer confidence.
Soil salinity managed or reduced	Achieved	The capacity to manage soil salinity has been successfully developed. The problem of salinity has been resolved, albeit mainly through natural leaching of the soil. A side outcome is that the capacity to measure and manage salinity has triggered a large salinity research program in Java.
Reduced risk of crop loss	Achieved	As salinity was reduced and technical advice was provided on pest and disease control, the risk of crop loss also reduced. Again, the reduced risk was not only due to the ACIAR projects, and cropping remains highly susceptible to a range of external risks, as demonstrated by the recent irrigation system damage in Bireuen.
Increased price production; alternative cash crops	Achieved	The yields from rice and cash crops (mainly chilli) increased by about 25%. [‡] Since the techniques were widely copied by other farmers, the productivity per hectare for the whole province increased. Most respondents agree that the ACIAR projects were an important contributory factor, but as most innovations were national policy already, they would have been introduced in Aceh eventually. The ACIAR projects significantly increased the speed with which these techniques were adopted.
Increased food security; reduced reliance on food aid	Achieved	The increased rice and vegetable production directly improved food security and field observations suggest this remains strong.
Increased cash income and savings (group and individual)	Achieved	The increased yield resulted in increased cash income, as prices of rice at the farm gate remained stable. The expansion of vegetable growing through KWT has also had a significant income and savings impact, some of which is attributable to project activity (at least initially).
Increased farmer wellbeing	Achieved	Most respondents claim to have observed improved wellbeing as a result of increased income. Observations range from better clothing and household appliances to greater self-esteem and livelihood security.
Increased wellbeing and social capital of women	Achieved	About 35 women's groups were established as part of the ACIAR projects. Most are still operational and actively producing vegetables. The model has also expanded widely across the province. These factors have had significant positive impacts on women's wellbeing and social capital.
Increased access to and supply of vegetables	Achieved	Interviewees confirmed that their access to vegetables has increased. KWT are using home-grown vegetables and selling surplus in the market.
Improved household nutrition	Achieved	Most respondents said their household nutrition and food security have improved, due in part to increased consumption of home-grown and purchased vegetables – the latter enabled by additional income from growing cash crops.
Increased trust and social capital	Achieved	Respondents indicated that social capital and community trust increased as a result of the ACIAR projects. The relations between extension workers and farmers have also improved. In the areas where ACIAR had their demonstration projects, relations were strengthened as a result of the frequent meetings between farmers. In the villages with a women's group, the relations between women strengthened and their confidence increased.
Improved soil quality	Achieved	Soil quality has improved as a result of the projects (i.e. less chemical and more biological fertilisers; less pesticides). In the rest of Aceh Province, soil quality also improved because the government promoted the use of biological fertiliser, the measured use of chemical fertilisers and integrated pest management.
Improved pest management; reduced number of pests	Ongoing	Most respondents indicated that their knowledge of pests has improved and they are able to apply preventative or control measures. However, pests remain an ongoing issue for many.

Notes: [†] Badan Pusat Statistik (Provincial Statistics Office); [‡] Mariyono J (2018) 'Empowering rural livelihoods through farmers' field school on vegetable production in Aceh Province-Indonesia', *Journal of Rural Development*, 37:129; Mariyono J, Luther G, Bhattarai M, Ferizal M, Jaya R and Fitriana N (2013) 'Farmer field schools on chili peppers in Aceh, Indonesia: activities and impacts', *Agroecology and Sustainable Food Systems*, 37.

Indicative benefit–cost assessments

Project reporting provided some data on improvements in yield, gross margins and actual or potential income gain at the project sites (Table 5; Appendix 7). Project proposals (or later updates) included detailed budgets for ACIAR funds and in-kind partner agency contributions. This project information, supplemented by official time-series statistics (where available), has been used to collate estimates of project benefits and costs under a range of assumptions. Details are provided in Appendix 7 and summarised briefly below.

Project costs

ACIAR provided the bulk of the funding for each project but partner agencies also contributed, particularly by allocating staff time. Budgets are summarised in Table 7 (see Table A7.1 for a breakdown by partner). The total contribution by ACIAR across the 4 projects was just over AUD3.3 million.

Table 7 Contributions to project funding

Project	ACIAR (AUD)	Partner agency (AUD)	Total (AUD)
SMCN/2005/004 [†]	412,034	35,334	447,368
SMCN/2005/118	783,515	67,191	850,706
SMCN/2005/075	500,007	297,979	797,986
SMCN/2007/040	1,608,803	60,804	1,669,607
Total	3,304,359	461,308	3,765,667

[†] Breakdown not available, but assumed same ratio as 2005/118.

Direct and immediate project benefits

The first set of calculations assumed that project benefits were limited only to those reported (or reasonably estimated) for farmers directly participating in project activities, for a 3-year period after adoption (i.e. only within the project period or its immediate aftermath). All calculations are based on prices and exchange rates pertaining at the time (i.e. constant 2010 or 2012 values); therefore, no discount rate is applied.

The first and second projects (SMCN/2005/004 and SMCN/2005/0118) discussed economic benefits in general terms in their final reports but did not attempt to quantify these.

The third project (SMCN/2005/075) focused primarily on chilli production, training 1,648 farmers. Estimates of financial returns were not provided in reporting, but if the new farmer knowledge is hypothesised to have led to a reduction of 10% in production costs (through lower input purchases), this would equate to net returns increasing by AUD400 per farmer, or around AUD659,200 across the trained cohort. Extrapolating over a 3-year period gives a benefit of just under AUD2 million.

The fourth project (SMCN/2007/040) worked on both ICM (rice) and vegetables (through KWT). ICM trials involving 103 farmers led to estimated gains of AUD480/ha or AUD84 per farmer per rice crop. Similar benefits were estimated for the surrounding villages, resulting in a total economic contribution of over AUD50,000 per season across a rice area of 112 ha (Table A7.3). Assuming 2 crops per season in these immediate project areas and a similar gain from the new techniques for 3 years, the benefits within the project locations (112 ha) would be around AUD300,000.

For KWT activities, total economic benefits to the 750 participating women were estimated at around AUD400 per person, or AUD297,000 in total, per year. For consistency with other 'beneficiary-only' estimates, it is assumed that 750 women gained AUD297,000 annually for 3 years, giving a total net gain of AUD891,000.

Project benefits with wider (conservative) attribution

Given the evaluation findings on adoption of project-supported technologies beyond the immediate project areas, the direct benefits summarised above are undoubtedly underestimates of total benefit. However, it is difficult to extrapolate confidently from the project data to give robust estimates of overall dollar values resulting from the projects. Limited reliable quantitative data are available on adoption, cropping performance, input and output use, and prices. Statistical coverage on variables such as cropped areas, yields and production across Aceh is also patchy. Further, attribution of benefit also needs to take into account the wide range of external factors that have influenced agriculture in Aceh since the time of the tsunami. Therefore, the estimates here should be regarded as indicative at best, intended only to provide guidance on orders of magnitude.

ICM rice: Provincial and national productivity statistics for rice in Aceh were used to calculate the difference in yield/ha from a pre-project 2009 'base' across subsequent years. Valuing this at 2012 prices and multiplying by the reported *padi* production area gave a total additional value for Aceh Province (Table A7.10). With a relatively conservative attribution of 10% of the increased productivity value over just the first 3 years (and zero thereafter), the financial benefit to farmers across Aceh from the projects' ICM activities would be around AUD13.7 million.

Chilli: Provincial statistics on chilli production area suggest the project directly worked with around 11% of Aceh's chilli producers. Using similar logic and assumptions as for ICM rice, if each of the 1,648 farmers directly trained continued to gain AUD400 as a result of project learnings for a further 3 years, then they would have collectively gained close to AUD2 million. If a further 10% of Aceh's chilli farmers also gained AUD400 annually for 3 years from learning and applying project methods, the total project benefit would be around AUD3.5 million.

KWT vegetables: Again assuming constant costs and prices, replicating the direct project benefit (AUD400 for each of 750 women) over 3 years would give a benefit figure of AUD891,000. The project report suggested it was reasonable to expect similar benefits to accrue to a further 750 KWT members over the course of the following 5 years. (Although KWT now exist in most villages across Aceh, it is difficult to justify attribution beyond this.) If it is assumed that economic gains of a total of 1,500 women are attributable over 3 years, the project's benefit to KWT totalled AUD2.673 million.

Summary of benefits and costs

Based on the cost information and rough benefit estimates above, indicative benefit-cost assessments for the 4 projects combined are provided in Table 8 (for more details, see Table A7.11).

It can be concluded that, even accounting only for short-term gains by immediate project beneficiaries, economic benefits were slightly below the ACIAR outlay for the 4 projects (benefit:cost ratio of 0.96).⁶ However, this can confidently be viewed as an underestimate of project benefits.

More realistic, but still conservative, assumptions on wider attributable benefits give an estimated benefit:cost ratio for ACIAR expenditure of around 6:1.

Table 8 Combined project benefit-cost assessments

	Short-term (AUD)	Long-term (AUD)
ACIAR funds	3,304,359	3,304,359
Benefits		
– Immediate	3,168,600	
– Wide-ranging	–	16,797,436
Net benefits	(135,759)	20,101,795
Benefit:cost ratio	0.96	6.08

Note: Constant 2012 AUD; no discount rate applied
No specific benefits have been calculated for the first 2 projects, but their costs are included as they laid the groundwork for the later projects.

Sustainable livelihoods framework

Many of the impacts identified earlier in this chapter can be articulated as increases in some form of capital: physical, natural, financial, human or social. The SLF can be used to assess how these different types of capital have changed as a result of the project interventions, particularly at 'final beneficiary' (farm-household) level.

Physical capital

Physical capital mainly covers assets such as equipment and machinery. Many respondents noted that the use of machines in Aceh has increased in recent years as they are proving more efficient and cost-effective for some tasks than manual labour. This is particularly the case near urban areas, where alternative employment opportunities result in absentee landowners and agricultural labour shortages. Some lead farmers interviewed had acquired machinery and some were hiring it from other communities. However, it is not possible to establish direct links between project activities and these developments.

Natural capital

Increases in natural capital take the form of improvements in soil health as a result of better practices. For example:

- optimum fertiliser use (reduced and more targeted inorganic fertiliser, more organic fertiliser)
- integrated pest management (less chemical pesticide)
- crop rotation
- better drainage and irrigation.

⁶ While no specific benefits are attributed to the first 2 projects, their costs are included since they effectively laid the groundwork for the later projects.

Where these measures have been adopted, the crops produced can be assumed to be healthier. The reduced use of chemical inputs would also have had a positive impact on water quality and all the ecosystems that are dependent on healthy water. In addition, more animals, pollinators and other insects are able to survive and re-establish a natural balance between pests and their natural enemies. This is good for biodiversity, as these smaller animals are at the lower end of the food chain of the local ecosystem. Improved water management techniques, such as drip irrigation on vegetable crops, were intended to increase water use efficiency. Other actual or potential environmental benefits were highlighted in the reporting of the second project.

'The adoption of organic soil amendments as a result of the project's research and demonstration activities will reduce nutrient leaching (pollution) ... and cost to the environment ... Successful rehabilitation of tsunami affected soil gives incentive to farmers to improve productivity of existing farmland. This will reduce the need to open up forested upland areas for agriculture. Keeping the forest areas intact reduces the possibility for the occurrence of flooding, soil erosion, and landslides.' [SMCN/2005/118 final report]

Financial capital

Indications are that the projects have resulted in higher incomes for farmers (higher yield and lower costs). Project reporting provides some evidence of immediate financial benefits and the basis for indicative benefit-cost estimates, as outlined above. During focus group discussions for this evaluation, several KWT mentioned routinely saving a proportion of their harvest returns. It is reasonable to conclude that the projects helped create savings or stocks that have financial value.

Human capital

Knowledge among farmers who were directly impacted by the projects increased considerably and this continues to be passed on both to the wider farming community and to the next generation (notwithstanding some 'leakage' of youth away from agriculture). The knowledge covers the various techniques introduced by the projects, but also methods for testing new techniques, the importance of exchanging with other farmers, the need to collaborate and discuss with other farmers and the importance of organising themselves in women's or farmers' groups.

Social capital

Relations between farmers and extension workers reportedly improved as a result of the ACIAR projects. In addition, most respondents perceived an increase in social cohesiveness and responsiveness in communities that introduced better farming techniques, even in villages that were not directly involved in the projects but where the techniques were subsequently replicated.

'Farmers are becoming more open and welcoming of new ideas and methods after many years of relative isolation.' [SMCN/2005/118 final report]

Respondents suggested that the following factors could have caused social capital to increase:

- Higher income means that farmers have more reserves and are thus more willing to help when another farmer is in need.
- More meetings, more communication and the exchange of information also allows for sharing of needs and/or sharing of potential solutions to problems.
- More communication also strengthens relationships and creates the necessary trust for transactions between farmers to move from pure information to more economic exchanges (e.g. exchanging equipment, working on each other's fields, lending seeds or money).

Farmers' groups were also strengthened in areas away from ACIAR project sites. The projects used farmers' groups to support the replication of their techniques. When leaders of farmers' groups met to discuss irrigation or planting dates (at *kecamatan* level) they would also exchange information about the new techniques. The leaders from villages where the techniques were not yet used increased their credibility and the value of the farmers' group by sharing the information on their return to their home village (often combined with farmer-to-farmer visits).

KWT set up with project support helped increase participants' social capital. This has had lasting impacts – many of these groups still exist 10 years later and the model has been widely replicated since.

Total economic value

The TEV framework provides a way of understanding how the capital changes identified above have been translated into value over time. Five broad types of value are distinguished: direct-use, indirect-use, existence, bequest and option.

The benefit–cost discussion above can be viewed through the TEV lens as pertaining to direct-use value. The commentary that follows is primarily based on qualitative interview responses. As discussed under KEQ6, it was not feasible to attempt quantification of the other types of value.

Direct-use value

The first 2 projects focused on managing salinity. This worked well, but the long-term impact was limited as rain flushed out the salt in most of the tsunami-affected areas. The direct value created by this component of the early ACIAR projects is therefore negligible. However, the projects also included soil improvement techniques and these have been widely used across Aceh.

The third and fourth projects then introduced ICM for vegetables and rice, respectively, and these techniques have persisted and been replicated elsewhere. Some specific outreach figures and estimates of direct-use value generated by the projects are in Table 5 and Appendix 7 (see also benefit–cost discussion above).

Indirect-use value

The most important indirect-use value is the quality of the soil. The greater use of organic fertiliser and other ‘soil amendments’, such as biochar, can be assumed to have had an impact on replenishing the organic content of the soil. The use of biopesticides and other natural pest control methods, and better knowledge about pests and pollinators and the health risks of chemicals, has reduced the use of chemical pesticides. Crop rotation, better irrigation and some use of mulching may also have contributed to improving soil health.

Publicity surrounding farmers’ return to cropping after the tsunami may also have provided indirect-use value for the broader Acehnese population who were not involved in the projects, or in farming.

Existence value

Many respondents indicated that farmers are more confident since the ACIAR projects. The reasons given for this are the empowerment resulting from successfully implementing new farming techniques, the connections through women’s groups (where applicable), and increased income and savings, which provided a buffer and hence more resilience. Other reasons given include increased networking and access to information, which has been further strengthened over time through mobile phone and other communication technologies.

‘This project demonstrated to local farmers that cropping was feasible after the tsunami and support is available for farmer groups in affected areas.’
[SMCN/2005/118 final report]

Bequest value

As noted above, several dimensions of the projects have demonstrated continued influence and are expected to have a lasting effect. In addition, the new farming techniques will often be passed on to the next generation of farmers. Increased income, better nutrition, greater availability of vegetables and healthier living environments can be expected to result in healthier children. Additional farm income can also improve children’s access to education. Successful KWT provide girls with examples of empowered mothers. In general, children will grow up in an environment where their parents feel more confident, economically secure and empowered.

Option value

As a result of their increased confidence, farmers may be more open to trying new techniques and be better able to judge the risks and opportunities related to new crops, seeds and techniques. The projects introduced or helped encourage farmers to grow other crops in addition to rice. Through the projects, farmers experienced how to test new approaches with limited risk (e.g. small test fields as part of their cropping area). However, the benefits from these factors may be constrained by challenges evident in the current extension system (discussed further in KEQ4 below).

‘Farmers and other members of project-targeted communities have become more aware of the economic importance of, and opportunities provided by, vegetable production.’ [SMCN/2005/118 final report]



A woman farmer from the Harapan Maju KWT.
Credit: ACIAR

What factors influenced whether impacts from organisational capacity building were achieved as intended?

In general terms, factors influencing achievement can be divided into those:

- under project control, which includes the technologies, methods and partnerships promoted and activated during project implementation
- outside project control, which includes specific individual or contextual factors that affected how people (e.g. researchers, extension agents, other government officials and farmers) responded to project activities, and the broader policy, institutional and economic environment.

Factors under project control

Technologies

The projects introduced techniques to Aceh Province that were already national policy. This allowed for faster implementation (less testing required, only adaptation to local circumstances). It also made it easier for BPTP to support these techniques. But most importantly, it facilitated the adoption of the techniques as provincial policy and their roll out through the province via DP's PPL services.

The technologies had good prospects of being well-suited to local conditions (e.g. crops were known to be salt-tolerant) but were tested through on-farm trials before being widely promoted. Good quality varieties were selected.

However, given the different soil and climatic conditions across Aceh, there were inevitable limitations on the scale to which some techniques could be replicated. For example, different soil types require different types of test kit, which are often not available to PPL.

'Some farmers cannot implement the legowo method because the water depth is too high and will push the plant over, or there is too little water, which needs a special variety of padi.' [PPL]

Methods and partnerships

The projects involved farmers, PPL and BPTP staff in all phases from assessment to testing to dissemination of techniques. This involvement not only ensured a deeper understanding of the techniques, it also created a sense of ownership that is still noticeable among everyone who was involved in the project. Care was taken to select individuals to work with (at all levels) who were identified through local networks as being dedicated, hardworking and best able to support achievement of project objectives. Training-of-trainer and other capacity development activities, along with strengthened networks within and beyond Aceh, further supported this core group, many of whom have continued to play a vital role in deepening and extending project impacts.

In particular, the projects motivated PPL and continue to influence their work ethos. The project methodology of working with and through the extension services reportedly resulted in improved status and recognition both for individual, high-performing PPL, and also for the role of the PPL more broadly. PPL appreciated the 'serious' approach, involving regular training, ongoing support and oversight, and robust research methods. They valued the direct exposure to national and international experts and academics, and the learning that ensued. Their contributions and efforts were recognised and rewarded through opportunities to present their work to senior DP and BPTP staff, to travel within Aceh and beyond, and in some instances through formal awards. Farmers saw that PPL had valuable advice based on identified needs, and this led to increased farmer trust of PPL.

'During ACIAR times, PPL trained together with farmers. This allowed us to have the same vision and goals to achieve. Not only that, but we also had experts from the university involved. This joint involvement raised our motivation. We didn't get bored as we got to learn a lot of new things, and we could exchange information.' [PPL]

The projects used effective, science-based training and dissemination methods. At the test and demplots, PPL and farmers were supported continuously throughout the crop cycle. The projects applied robust research methods, with strict monitoring of trials and publication of results. The scientific expertise provided through the projects was a significant contrast with prior NGO projects, which distributed seeds and encouraged planting but had limited success on tsunami-affected land. The demplots helped farmers assess options for themselves and make their own decisions. As one PPL said, 'Farmers trust what they see'. In addition, there were farmer exchange visits and extension worker meetings to support replication. As researchers, the project teams had an inquisitive approach rather than a traditional instructive attitude. These more 'subtle' methods of engaging farmers were very effective (see KEQ3).

The projects built on and strengthened existing systems and types of activity. Male/mixed rice-farming groups and KWT existed prior to the tsunami; they were not new concepts imposed by foreign project personnel. The support provided was appropriate to the needs of the groups and the emphasis from the start was on supporting the farmers' own decision-making. For new or re-established KWT, the project provided a small grant, but funds were managed by the group and allocated to their own priorities (e.g. small infrastructure, equipment, inputs). The projects also provided highly valued training opportunities, field trips, and other guidance and encouragement. With ongoing PPL advice and support, many of these groups quickly proved their viability as a source of income, own-consumption and social benefit, and the model is the norm across Aceh (though not always active in practice, due to constraints such as land access).

Financial incentives were kept to a minimum, which avoided distorting participants' motivations. A small additional stipend was provided to PPL who took on project-specific roles, such as managing demplots, and some had opportunities for domestic or even international travel. However, farmers were not paid to participate in the project. This contrasted with approaches of some NGOs, which may have made it more difficult for PPL to get traction:

'Since farmers got help from NGOs, they always want handouts. They ask "What did you bring today? If you didn't bring us anything, why did you come?" Knowledge is not enough.' [PPL]

The projects built social as well as financial capital. Given the post-conflict and post-disaster circumstances, project personnel sought out opportunities to support partner agencies and farmers to recover from psychosocial trauma. Project staff and other participants greatly valued the ACIAR project presence and support, which reduced their sense of loss and abandonment. Farmers, PPL and BPTP staff all acknowledged the important motivational effects of the projects and the increased personal self-esteem and community pride resulting from project-related achievements. These factors contributed to the sustainability of project impacts.

Project sequencing addressed both immediate humanitarian and longer-term development needs. Respondents commented favourably on the long-term ACIAR commitment, which contrasted with most other post-tsunami interventions. Partnering with local agencies from the outset also differentiated the ACIAR projects from the often chaotic and ill-coordinated disaster relief effort (for example, see IRIN News (2014)).

Areas for improvement

The objectives for capacity development were framed too vaguely. There may have been an assumption that building the technical capacity of individuals would result in (or was perhaps equivalent to) organisational/institutional capacity development. Under the circumstances of a huge humanitarian crisis, the emphasis was understandably on achieving maximum immediate impact for the ultimate beneficiaries (farmers), and the objectives focused (appropriately) on farmers' wellbeing. However, greater attention to developing longer-term organisational and institutional capacity could have further strengthened long-term impacts. The project teams might have invested more resources in building organisational capacity if the institutional change impact pathway had been articulated more clearly up front.

Capacity development targeting did not capture the important role of agricultural labourers. Some labourers probably received incidental training through working on demplots, or from being farmers in their own right as well as labouring for others. However, respondents commented that the exclusive focus on farmer outreach might have reduced the scale of adoption, particularly for planting techniques such as *legowo*. Greater recognition that planting and harvesting rely heavily on hired labour could have led to explicit strategies to target this cohort.

ACIAR did not routinely share final project reports with BPTP, even though the reports were drafted in collaboration with BPTP staff. Proposals and other key documents were likewise not shared. It would have been very valuable to have all reports available in the BPTP library. At the time of fieldwork, only one ACIAR publication about the Aceh projects was available in addition to the regular ACIAR *Partners* magazine. As discussed under KEQ1, a repository of all reports, publications and data would have been very helpful to sustain the impact of capacity development.

Factors outside project control

Partner and beneficiary responses

How individuals respond to opportunities and new knowledge, such as those provided through the ACIAR projects, cannot be fully predetermined or controlled. As noted above, by and large the people selected to collaborate in project implementation appear to have made the most of these opportunities and many have contributed to ongoing impacts. Many PPL interviewed suggested that 'personality' was key to their sense of commitment, enjoyment of their role and personal satisfaction from achieving good results.

'For me, motivation comes from interacting with farmers. I love to work with farmers. Sharing knowledge and finding solutions for farmers is what drive me. And there is another level of satisfaction when I see them produce a good harvest.' [PPL]

A range of individual and contextual factors also affected the extent to which farmers chose to adopt the new approaches promoted through the projects. As discussed in KEQ3, farmer adoption can be influenced by gender, age, land ownership, non-farm activity, local land and soil characteristics, and perceptions of the relative ease, speed, complexity or economic returns from various options.

Enabling environment

Some aspects of the policy, institutional and socioeconomic environment during and since project implementation have helped strengthen impacts.

Government policy

As noted above, key techniques introduced during the projects, such as *legowo* planting methods for *padi*, were already national policy but had not yet been systematically introduced in Aceh. Their subsequent adoption as provincial policy greatly magnified their spread through the province. While this would doubtless have happened in due course without the projects, the testing, practical demonstration and training that took place during the projects is considered to have hastened and strengthened the subsequent roll-out.

BPTP and DP support

BPTP provided very generous support to the ACIAR projects. BPTP has had an annual research agenda with strict deliverables. The ACIAR projects were introduced through the Department of International Cooperation and Evaluation. BPTP staff time was not compensated for by the projects because it was considered a contribution from BPTP to the projects. As such, the work was in addition to the regular workload of the BPTP organisation and staff. Despite this, BPTP made staff available on an almost permanent basis and staff from every level, from the director to the field staff, contributed diligently to the projects.

DP's extension services also provided invaluable support. The continued dedication and determination of individual PPL has been a significant driver of impact. While those directly involved in the projects received a small stipend and other motivating benefits at the time, they have continued to apply and share their knowledge and enthusiasm in the years since, often with minimal institutional support.

Socioeconomic environment

The relatively favourable socioeconomic environment during and after the projects also enabled impacts to be achieved and maintained. The tsunami triggered a major influx of national and international recovery and development funding. The cessation of conflict and restoration of stability made an enormous difference to Aceh's development trajectory. Provincial and village-level infrastructure have improved over the years, as have education levels (including for farmers). Access to information (including on farming) has become much easier as internet and mobile phone coverage has expanded.

Constraining factors

PPL workload and support

PPL operate within a challenging institutional system. Policies and priorities are set at national and provincial level and may not take adequate account of local circumstances. PPL have little or no influence; they are simply expected to implement policy as directed. PPL with ACIAR experience can find this frustrating.

'When working with ACIAR projects, we seemed to pay attention more to the farmer's needs and listen to their opinion. Not merely doing work based on what the people in the office told us to do.' [PPL]

'In Aceh the soil is very good, but the rules, the leaders, are what makes it difficult.' [PPL]

PPL remuneration may hinder recruitment, retention and commitment. Pay structures are based on educational attainment rather than experience or performance. Additional incentives are provided at the *kabupaten* level but vary depending on local finances.⁷ Several PPL commented that no new staff have been recruited into their offices in recent years. In addition, the national government is seeking to limit its pension burden by placing most new civil service recruits onto contracts rather than permanent positions. Contract periods also vary from district to district, impacting job security.⁸ Few PPL are provided with motorbikes (e.g. 2–3 in an office of 10–15) and those using their own transport are not reimbursed.

PPL are also stretched. The number of villages each is responsible for has increased over time – many now serve 5–6 villages, or even up to 8 in some cases. Most villages have at least one male/mixed farmer group (with 20–60 members) and one KWT (20–25 members); some have more. In addition to regularly visiting these groups, PPL are also expected to be available to non-group members. The variety of crops grown across 'their' villages is often wide, including rice, other *padi*-field crops (e.g. soybean or corn), and many different types of vegetables. While the district DP office and some BPP offices have pest experts who can help with specific problems, in general, the PPL is expected to be knowledgeable across all of these crops.

A common theme from PPL interviewed was their enthusiasm for spending time outside, working with farmers. However, their responsibilities also include many administrative tasks, which many find demotivating. Some also struggle with new online information-sharing and reporting requirements]. Very few PPL were able to access IT training, so most have to 'figure it out by themselves' or seek help from colleagues.

'All the information shared by the central government is now available online. It was not like in the past when they sent us books or written guidelines ... We also now need to write reports and input data online. I can handle this, but for older PPL, they are struggling. Some even have a hard time using smartphones.' [PPL]

Budget restraints

Agricultural research and extension budgets are severely constrained. Even before COVID-19, training budgets were very limited and PPL access to training appears to have been somewhat ad hoc. Budgets also constrain the ongoing use of soil-testing equipment and associated knowledge. The portable test kits require regular replenishment of chemicals, and it is evident that few BPP offices have kits appropriate to both dryland and wet rice fields (*sawah*). The current process of absorbing BPTP's research function into BRIN Aceh could have significant implications for continued innovation and local testing of technological advances.

COVID-19

COVID-19 has significantly disrupted recent progress. BPTP on-farm research ceased during the COVID-19 pandemic, as did DP programs, including training for its extension staff. With ongoing budget restrictions there is a risk that some of the gains resulting directly or indirectly from the ACIAR projects will further dissipate.

Natural environment

The natural environment, including climate and soil conditions and terrain, varies across the province and can constrain cropping options. Some areas are more naturally fertile than others, and there are substantial areas of peatland (parts of which are protected forests; other parts are increasingly targeted for oil palm plantations). Farmers describe rainfall as 'enough' in some areas, but 'very dry' in others. Some also blamed climate change as a cause of unusually high temperatures. Irrigation is not universally available and is subject to natural hazards such as the recent Bireuen landslide, which caused major infrastructure damage.

⁷ Bonuses apparently range from IDR200,000 per month in Aceh Besar to IDR800,000 in Banda Aceh.

⁸ Reportedly 5 years in Aceh Utara but just one year in Aceh Besar.

Land and labour shortages

Land and labour shortages are also affecting agriculture. KWT often struggle to secure access to land for group vegetable-growing. Urban areas are increasingly encroaching on farming areas, with rice fields being converted into housing. Already-small land parcels are further subdivided through inheritance to multiple offspring. As is common across Asia (and in Australia), the farming population is ageing as off-farm alternatives prove more attractive and/or lucrative for the younger generation. In parts of Aceh close to urban centres, shortages of local labour are emerging – although it appears these are generally manageable where machines are available for tasks such as planting and harvesting.



Preparing a new garden bed after the 2004 Tsumani.
Credit: Patrick Cape

What lessons can be drawn from this assessment about the ACIAR approach to organisational capacity building?⁹

ACIAR has gone through many positive changes in its approaches to capacity development since the Aceh projects were designed and implemented, so many of the lessons emerging from the Aceh projects have already been actioned. This section begins with an overview of the current ACIAR definition of capacity development and guidance, then summarises relevant findings from the Aceh evaluation that offer insights for other ACIAR projects.

ACIAR capacity development guidance

As noted earlier, ACIAR defines capacity development across 3 levels – individual, organisational and enabling environment – as ‘a process of strengthening the abilities of individuals, organisations and systems to undertake agricultural research and to continue to advance development outcomes effectively, efficiently and sustainably’.

The ACIAR *10-Year Strategy 2018–2027* (ACIAR 2018a) and *Capacity Building Policy* (ACIAR 2018b) provide further direction in relation to capacity development. While ACIAR had previously focused its research partnerships and training programs primarily on building individual scientist capabilities, the *10-Year Strategy* also commits to investing strategically in developing capacity at the level of whole organisations as well as potentially tackling the enabling environment, particularly on issues such as biosecurity, where Australia has a strong interest and comparative advantage.

The *Capacity Building Policy* pre-dates the *10-Year Strategy* but, interestingly, includes an intention to ‘strengthen capacity needs assessment at both the project and program levels’ and link these with ‘fit-for-purpose training and learning’ (ACIAR 2018b:4).

The ACIAR ToC for capacity building (Figure 4) also provides useful guidance, although it remains focused primarily on the training and mentoring portfolio (updates to capture capacity development in research activities are planned). The ToC articulates ACIAR accountability for developing the capacity of researchers (orange blocks) and research organisations (blue blocks), apart from developing its own capacity and networks (green blocks). The success of the capacity development interventions can be observed through the continuation of quality research by researchers and research organisations after ACIAR-funded interventions have been completed.

ACIAR defines its core business as brokering research partnerships, and recognises that taking research outputs to scale will generally require resources far in excess of its own budget. It therefore increasingly seeks co-investment with larger development partners to achieve maximum impact. In this scenario, an equally high-level but more complete capacity development ToC would include contributions from local and development partners. Figure 5 illustrates this alternative ToC, in which the core role of ACIAR is building capacity of researchers and research organisations, while development partners focus on developing capacity for taking research results to scale and lobbying to improve the enabling environment.

⁹ As discussed in the Introduction, the term ‘capacity development’ is preferred to ‘capacity building’, but the agreed KEQ language is retained here.

Looking back to Aceh

The current capacity development definition, policy guidance and ToC are clear and very useful. Earlier versions might have been available at the time of the Aceh projects, but it was not evident from interviews that key personnel were aware of any such guidance, so it is unlikely to have influenced project approaches.

While the impact of the evaluated projects on capacity development has been impressive, the designers and implementers did not have the benefit of the 3-level definition. Perhaps unsurprisingly, they focused their efforts on training individuals (and most interviewees continue to define capacity development as individual training). This narrow focus had long-term consequences. While the researchers and extension workers trained in the ACIAR projects still apply the knowledge and skills they learned (and many try to pass this on to colleagues), BPTP and DP by and large did not develop the organisational capacity to replicate the approach, knowledge and skills to new staff or in other research projects.

A common understanding and operationalisation of the current capacity development definition and approach among both ACIAR staff and project partner personnel can help ensure that future designs give appropriate attention to developing capacity at the level of the organisation and (where feasible) the enabling environment, as well as at the individual level.

In particular, the Aceh experience suggests that to effectively contribute to developing agricultural research capacity, ACIAR could focus on building the skills and confidence of partner organisations to scale, broker and translate research knowledge into policy and practice.

In addition to definitional clarity, the Aceh projects could have benefited from:

- guidance on addressing the balance between research and capacity development in ACIAR projects
- needs assessment guidelines to identify capacity development priorities (including enabling environment factors such as power, influence and entrenched interests)
- the type of capacity development that can be addressed within the timelines and budgets available
- the type of organisation ACIAR can build capacity in (e.g. only research organisation or also outreach, extension services, etc.)
- the minimal conditions in the operating environment to succeed in capacity development (e.g. what can be done in a post-disaster or a post-conflict environment).

This could have enabled a more planned, deliberative approach with a balanced set of interventions addressing all 3 levels of capacity development.

Evolution of Aceh project approaches

A closer assessment of the sequence of Aceh projects implemented after the tsunami reveals that, from one project to the next, there were shifts in the following areas:

- substantive focus and objectives
- primary targets
- capacity development methods.

Focus and objectives

Project substance and objectives moved from a focus on salination research to solutions for improvement of soil quality to improvements in yields and nutrition.

Interview responses indicated that conclusions from the early projects had an important influence on the design of the following projects. For example, the salination research in the first project not only resulted in effective ways to reduce salination, the soil tests undertaken also brought to light that the organic content of the soil was low and that the use of chemical fertiliser was not optimal for the local soil conditions. The second project then focused on the development of simple and effective ways to improve soil quality, noting this has an important influence on crop yields.

During the second project, soil quality objectives encouraged project designers to venture into other important factors influencing yield, such as crop rotation. While testing and rolling out these soil improvements, the international and national experts observed that Acehnese farmers were not yet applying a range of nationally approved techniques that had been proven to boost yields. The third and fourth projects therefore focused on applying existing and proven techniques (rather than researching new techniques) and adjusting these to the specific conditions in Aceh.

The substantive focus of the projects shifted from research into solutions to reduce salination to the promotion of ICM for various vegetables and rice. This shift was driven by the observations of the project team, who were focused on maximising the development outcomes of their interventions.

Primary targets

The second shift was from BPTP to extension workers (under DP) as the primary target for capacity development. The first project focused on increasing BPTP capacity to measure soil sodicity and chemical and biological soil characteristics in the BPTP laboratory as well as in the field. In addition, BPTP's researchers received training, including in research methods such as on-farm trials and scientific writing.

While the training of laboratory staff continued in the second project, there was a shift towards training field researchers (on topics such as selection of research sites, pot and field trials) as well as a greater emphasis on training of extension workers and farmers. This shift towards PPL and farmers continued during the third and fourth project. Again, this shift was necessary to maximise development outcomes.

The project implementation team observed where the critical capacity needs were across the whole impact pathway from research to yields, and focused on the actors most likely to influence development impacts.

Capacity development activities

The third shift related to capacity development methods. All projects used a range of methods, but there was a shift in emphasis over time from classroom-based training to social dynamics between farmers.

The first project focused mostly on classroom training, formal training for laboratory staff and support for producing scientific publications. While it also included action research with farmers, in each subsequent project there was a considerably increased emphasis on participatory methods, demonstration plots, field schools, farmer field days, farmer-to-farmer visits and women's groups. The emphasis on learning by doing and peer-to-peer techniques was a perfect complement to the other shifts, where existing techniques needed to be introduced to extension workers and farmers to achieve the biggest possible development impact.

While, in principle, other development partners could have supported the ACIAR team to build the capacity of extension workers and farmers, in reality it would have been difficult and counterproductive to set boundaries between capacity development for agricultural research and capacity development for scaling research results. The project implementation teams progressively shifted their activities in a logical search for the most effective interventions to achieve development impact.

Moreover, in a complex post-conflict and post-disaster context, it would have been challenging to find partners that could smoothly implement the capacity development required for scaling research results or influencing policy. The most effective approach was for the ACIAR projects to manage the 3 shifts mentioned above within their own project scope. This ensured coherence between interventions and it connected BPTP researchers, extension workers and farmers within one single approach.

The conclusion is that these observed shifts were logical progressions from one project to the next, based on the barriers to development impact that the project implementation teams identified. In the Aceh post-disaster context, it made little sense to maintain the theoretical distinction between research capacity and capacity to scale or to influence policy. Needs were urgent and coordination was difficult. It was therefore not feasible to negotiate partnerships before the start of the projects, or to bring in partners who could work with ACIAR to deliver capacity training on scale-up or how to influence policy once those needs were identified.

Problem-driven iterative adaptation

The funding cycles for the successive projects required the ACIAR project designers to work in a way very similar to the PDIA approach (Figure 6).

The PDIA approach advocates short implementation cycles starting at the impact level (e.g. rice productivity in Aceh), working back to develop a solution (e.g. solution for soil salination), then trying this solution and evaluating whether it increased the targeted impact (i.e. rice productivity).

Based on the lessons learned from applying the solution (e.g. there is a need for more organic fertiliser and more training of extension workers), the short implementation cycle is improved and repeated. Each iteration introduces various improvements (e.g. in substance, target groups and methods).

The ACIAR projects in Aceh did not set out to apply the PDIA approach but, as outlined in the previous section, the unique circumstances in Aceh at the time forced the project managers to try, learn, iterate and adapt. The requirement for a new proposal for every extension allowed lessons learned from the previous projects to be integrated into the next one. This approach resulted in the allocation of project resources to those capacity development interventions that had the biggest influence on development impacts.

**Local solutions for local problems**

Transitioning from promoting predetermined solutions to allowing the local nomination, articulation and prioritisation of concrete problems to be solved.

**Pushing problem-driven positive deviance**

Creating (and protecting) environments within and across organisations that encourage experimentation and positive deviance.

**Try, learn, iterate, adapt**

Promoting active experiential (and experimental) learning with evidence-driven feedback built into regular management that allows for real-time adaptation.

**Scale through diffusion**

Engaging champions across sectors and organisations who ensure reforms are viable, legitimate and relevant.

Source: Andrews M, Pritchett L, Samji S and Woolcock M (2015) *Building capacity by delivering results: putting problem-driven iterative adaptation (PDIA) principles into practice* [PDF], accessed 13 Sep 2023. www.oecd.org/dac/accountable-effective-institutions/Governance%20Notebook%202.3%20Andrews%20et%20al.pdf

Figure 6 Problem-driven iterative adaptation

Positive feedback provided by many interviewees confirmed the similarities with PDIA in the Aceh project approaches. They said the ACIAR projects were different from other projects they had experienced because the staff did not come with a fixed solution but engaged with all stakeholders to search jointly for a solution that was appropriate for the particular circumstances in Aceh. Interviewees also mentioned that project staff listened to their concerns and preferences, and persuaded them by using visual evidence rather than insisting on change for more abstract or theoretical reasons. Adopting the PDIA ‘try, learn, iterate’ approach in other projects would require international and national project staff also to adopt the consultative and collaborative approach that was so appreciated in Aceh.

It could be worth exploring whether longer-term projects that deliberately apply the PDIA approach from the outset are more effective than a series of adaptive (Aceh-style) projects with similar total length. Further experimentation with explicit PDIA approaches might then be considered.

Applying PDIA in future project designs would have interesting implications. Capacity development might then be defined in terms of ability to apply the iterative problem-solving approach, as opposed to knowing a solution. Improving the capacity of individuals and organisations would focus on supporting their ability to try, learn and iterate – in the course of which, specific agricultural research challenges would come to the surface and capacity to overcome these challenges would be developed.



Sowing seed in a freshly dug field

What lessons can be drawn regarding the practical applicability and value-add of the integrated impact assessment methodology trialled in this evaluation?

In addition to assessing the impacts of ACIAR-funded post-tsunami projects in Aceh, this evaluation is intended to test a new conceptual approach that adds elements of the SLF and TEV concepts to the more common TBIE approach (which centres on expected impact pathways in a ToC).

The rationale for developing this new methodology was driven, in part, by a desire to move beyond assessing crop gross margins and benefit:cost ratios of investing in agricultural research to capturing broader development impacts through mixed-methods enquiry within a robust framework (Box 3).

Interview and discussion guides for the evaluation were designed to cover SLF and TEV concepts as well as exploring TBIE pathways. Commentary on the integrated assessment framework has been provided above for KEQs 1–3, each of which address a step in the impact pathway. Commentary on organisational capacity development (KEQ5) is also relevant to a consideration of the usefulness of this methodology. The experience of applying the framework at these various stages is summarised below, initially for each element of the framework separately before drawing overall conclusions.

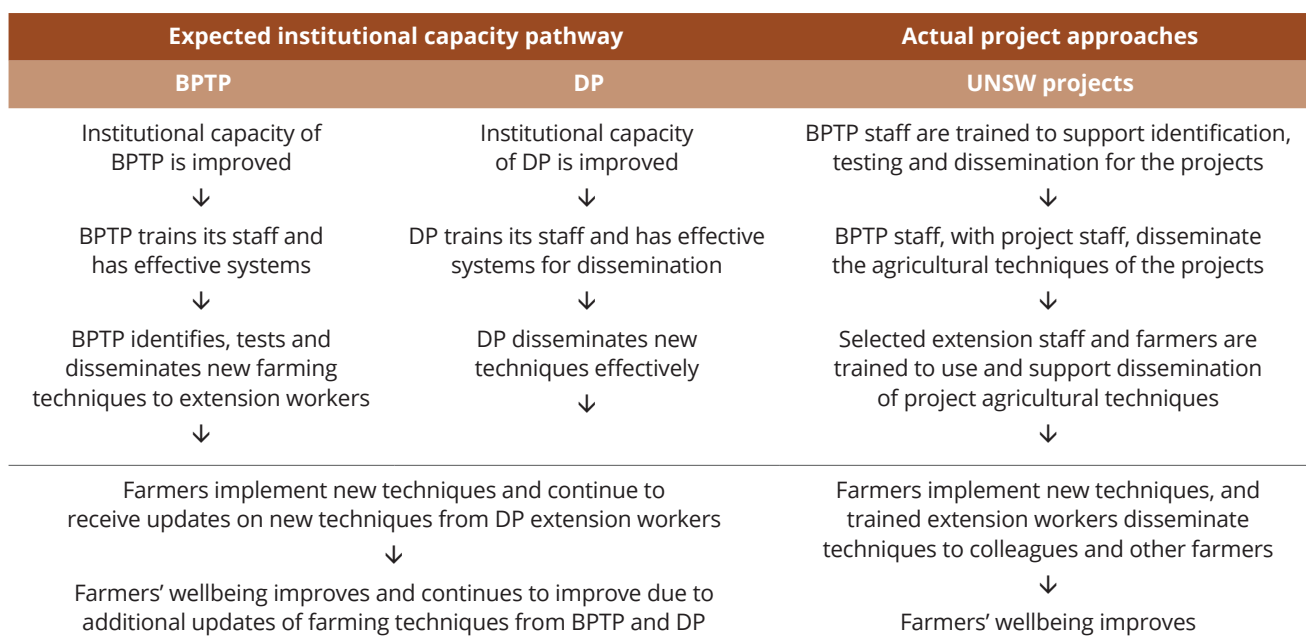
Theory-based impact evaluation

TBIE uses the ToC and impact pathways to understand whether the expected outcomes and impacts were achieved and how and why they were achieved. In the absence of explicit ToC in the project proposal documents (or subsequent project reporting), the CSIRO team worked with ACIAR and former project personnel to develop an overall ToC. It was decided that this evaluation should focus primarily on the institutional capacity building pathway. A two-part ToC was developed during the evaluation planning stage that illustrated the expected pathways from project activities to partner capacity outcomes, to partner activities, to farm-household livelihood outcomes (Appendix 3). Fieldwork was planned in 2 phases to explore each of these pathways in greater detail.

Box 3: Added value of an integrated approach

Combining elements of SLF, TEV and TBIE provides a way of testing relationships between research, changing capitals and values. For example, if an intervention provides new information that influences how people manage their farms, does this change the capitals that they have access to by improving soil quality (physical capital), or perhaps by creating new practices of social cooperation (social capital)? Are these capitals growing over time, or shifting in terms of relative value as household livelihood/enterprise mixes change? TEV captures values like increasing production and farm income, as well as indirect value such as the wellbeing and security that comes from knowing you have productive land and can provide for your family.

Source: Williams L, Capon T, Fleming-Munoz D, van Wensveen M and Williams R (2021) 'Impact assessment approach: ACIAR-funded soil restoration projects in post-tsunami Aceh' (unpublished draft).



Notes: BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology); DP – Dinas Pertanian (Department of Agriculture); UNSW – University of New South Wales

Figure 7 Expected vs actual impact pathways

As discussed earlier in this report, the focus on ‘institutional’ capacity building and its expected impact pathway have proven problematic, since actual project approaches focused primarily on developing individual capacity. Figure 7 illustrates this distinction in broad terms for the UNSW projects.¹⁰

Despite the inconsistency between hypothesised and actual impact pathways, it is nonetheless clear from the discussions in KEQs 1–4 that the project activities did lead to the types of impact intended (and hypothesised in the Appendix 3 ToC). The projects built the capacities of (and helped motivate) partner agency staff and farmers, and these capacities were productively applied. The way project support was provided demonstrated the potential economic and social benefits and stimulated widespread adoption. The impacts have been significant, both for the farming communities directly involved as well as many others indirectly affected during and since the projects. While these impacts cannot be attributed to the projects alone, it is evident that the projects made a significant contribution.

Applying the TBIE methodology has served important purposes for this evaluation. It provided a logical structure for exploring not only the nature and extent of outcomes but also the way in which those outcomes were achieved. In the process, it helped highlight discrepancies between the actual and anticipated impact pathways and ToC, leading to insights on approaches to capacity development in the Aceh projects and more broadly in ACIAR (KEQ5).

Sustainable livelihoods framework

The SLF captures key factors that influence household livelihood outcomes. These include:

- various forms of capital (e.g. natural, economic/ financial, human, social)
- the institutional and organisational processes and structures (including rules and norms) and broader context within which households operate
- strategies adopted by households to make optimum use of their capital in their particular circumstances.

10 The process for the WorldVeg project was somewhat different, beginning with participatory assessment to identify local constraints, followed by collaborative planning and design of research trials and defining technology dissemination strategies, then adapting improved technologies through research trials, and finally disseminating adapted technologies to stakeholders. All steps were carried out collaboratively with BPTP. As with the UNSW projects, project SMCN/2005/075 also included capacity-building elements such as BPTP staff training and farmer field schools.

As a framework for assessing how and why project activities do or do not result in improved livelihoods for intended beneficiaries, SLF can yield some useful insights. Perhaps most importantly, SLF takes a systems view. A project does not exist in isolation – it is one additional factor that can influence livelihoods. Understanding the broader system along with household aspirations and coping mechanisms will help ensure a project is well-targeted to address constraints and enable livelihood improvements.

In the Aceh situation, the first 2 projects were essentially rapid-response humanitarian interventions that made some reasonable assumptions about the benefits of rebuilding capability within key partner agencies, and demonstrated the feasibility of returning to farm production even in tsunami-affected areas. The third (vegetable) and fourth (ICM/KWT) projects built on the relationships and insights developed through the early interventions and had more time to assess farmer needs and preferences, including through participatory methods. This relatively long-term ACIAR engagement (which also included the subsequent dryland project that is not included in this evaluation) allowed lessons to be learned and approaches to be adapted to maximise livelihood outcomes.

For this evaluation, the need to explore project outputs and outcomes through a 'capital' lens and probe farm-household strategies and preferences may have contributed to the richness of the assessment. Within the partner organisations, considerable human and social capital was developed, which played a vital role in the subsequent roll-out of new technologies and approaches. The dissemination activities themselves resulted in further increases in human and social capital, leading to improvements in the ability and motivation of (at least some) extension officers to address farmer needs. Physical capital – BPTP laboratory equipment – was (and continues to be) a valuable enabler.

For farmer beneficiaries and their households, the projects' focus on soil health and ICM (including reduced use of chemical inputs) resulted in improvements to natural capital. Additional economic/financial capital was generated as a result of reduced input costs, expanded cropping areas and increases in yields. Production of a wider range of foods (particularly vegetables) reduced the need to purchase food as well as providing an important income source. Human capital developed both directly, through knowledge acquisition, and indirectly, through health benefits, which are likely to have resulted from dietary diversity and reduced chemical exposure (noting, however, that these assumed benefits are based on subjective, self-reported evidence).

Strong themes also emerged around social capital, with new networks and relationships and greater income and food security contributing to greater credibility, trust, support and cohesiveness within farming groups and in their communities.

Interview questions asked of PPL and farmers on their attitudes to change, current priorities and aspirations, and perceptions of community strengths and challenges provided insights into livelihood strategies and preferences, as well as contextual and institutional factors that may be influencing the wellbeing of farming households. Responses confirmed the importance of self-esteem, reputation, community solidarity and continued self-improvement, as well as more tangible concerns around land access, input prices and natural hazards, such as climate change. These responses suggest that the ACIAR projects were appropriate to the local context and used suitable approaches to progress not only agronomic research objectives but also socioeconomic livelihood objectives.

Total economic value

As with the various forms of capital distinguished in the SLF, the various types of economic value in the TEV framework can be applied to get a sense of the importance – or utility or value – of project contributions for both participants and beneficiaries. Again, interview guides were tailored to probe beyond 'What happened?' to 'How important or valuable was this to you?'

As outlined under KEQ1, partner agency personnel accrued considerable benefits from their participation, which they valued (and continue to value) highly. Their new knowledge and skills had both direct-use value and increased their personal satisfaction and the confidence they had in their roles. The new career opportunities that opened up to them had option value. Knowledge has been made available to others within and outside those agencies (indirect-use value), and passed on to new staffing cohorts (bequest value). The status and credibility of key agencies and individual staff improved, as did their confidence in their capability to identify future challenges and solutions (existence value).

For farmer beneficiaries, project reporting provided some quantitative estimates of direct-use value generated during project lifetimes, based on beneficiary numbers, yield increases and gross margin calculations. For instance, the fourth project estimated that its ICM interventions generated an economic benefit of AUD480/ha for *padi* production (around AUD84 per crop per farmer), resulting in over AUD50,000 additional returns across the 112 ha in project sites and surrounding villages.

KWT activities were estimated to have resulted in economic benefits of just under AUD300,000/year for the 750 women directly involved, and potentially double that if the program itself doubled in size. This and other quantitative project reporting suggested that even limited ongoing benefits to project participants resulted in direct-use values only slightly below the ACIAR project outlays. With reasonably conservative attribution of benefits to additional farmers, an indicative benefit:cost ratio of over 6.0 seems defensible (see KEQ3 and Appendix 7).

Using the TEV framework forces the evaluator to look beyond these direct dollar values to other forms of use and non-use values that might have resulted from the projects' engagement with farmers. As discussed in KEQ3, it is reasonable to conclude that indirect-use value resulted from improved soil and environmental quality, and (for the broader community) the knowledge that farming had resumed. Farmers were empowered and their confidence and resilience improved (existence value). At least some farmers are able to pass their knowledge on to the next generation, and children are growing up with greater economic security than might otherwise have been the case (bequest value). Farmers involved in or heavily influenced by the projects also acquired greater option value, being better prepared to assess risks and opportunities and try new techniques.

Even for the most straightforward component of TEV – direct-use value – extrapolating from available quantitative evidence and statistics at best provides a rough order of magnitude. No attempt has been made in this evaluation to quantify the other components of TEV that the ACIAR projects contributed to. Information on the other types of value has been drawn from qualitative interviews and the ex-post matching of interviewee responses to TEV categories. Given the passage of time and the complex multitude of factors that determine agricultural and livelihood outcomes, quantifying and attributing significant benefits to the projects alone would not be tenable. However, there can be little doubt that the projects played an important contributory role.

Overall assessment of the integrated evaluation framework

'Good evaluation helps people make better decisions for better outcomes ... Choosing the most suitable methods or processes depends on the nature of what is being evaluated, the nature of the evaluation, and resources and constraints.' [BetterEvaluation 2022]

An evaluation can serve a number of purposes. It can demonstrate to funders and the general public that money is or has been well spent, and support the case for continued funding. It should also identify lessons that can help improve the quality of future projects. The latter is arguably more relevant than the former for an ex-post evaluation such as this one for the Aceh soils projects.

The evaluation methodology needs to match its purpose. The degree to which a particular conceptual framework may or may not be useful for a given impact assessment will ultimately depend on the key goals and impacts of interest, their relevant causal mechanisms, and the degree to which these are measurable. In some circumstances, gross margin calculations and benefit–cost analysis of a research intervention will provide the required information. Incorporating TEV concepts would ensure that different forms of value (beyond direct use) are taken into account, potentially providing greater depth to the analysis. In other circumstances, where the project intends (within its lifetime) to generate outcomes for farming households, understanding the broader system is essential. Whether this is most appropriately tackled through a market-system or food-system lens, a sustainable livelihoods framework, or some other systems-based approach, will depend on the nature of the project and the answers being sought.

For this evaluation, the most useful insights arose from testing the hypothesised ToC. Exploring connections between project interventions and results (KEQs 1–3), and the factors influencing those outcomes (KEQ4), showed that project approaches were generally appropriate to the circumstances, and made impressive contributions to knowledge transfer and farm-household livelihoods. Moreover, in highlighting the mismatch between expected and actual impact pathways, lessons emerged for the ACIAR approaches to capacity development (KEQ5).

The first phase of fieldwork (focusing on partner agencies) was designed to cover all elements of the integrated conceptual framework in a rigorous way. In practice, it quickly became apparent that the resulting questionnaires were too demanding on both the interviewee and interviewer. The additional SLF and TEV questions were perceived as repetitive and did not yield additional information. Based on this experience, the interview and focus group discussion guides for the second fieldwork phase (with extension staff and farmers) took a less direct, more open-ended approach. As noted above, questioning went beyond tangible impacts. It also explored human and social dimensions, including attitudes, aspirations and the community context, and the importance of project-related impacts to those affected. The conscious application of the combined TBIE/SLF/TEV framework (albeit in simplified form) ensured that the team gathered a rich qualitative dataset to supplement other documented evidence.

However, for practical application, the integrated framework is too complex and demanding to use in a rigorous, explicit way with respondents. At the farm-household level in particular, it is unreasonable to prolong discussions beyond what is essential to understand how their lives have changed and how the project might have contributed to this. Questions can certainly be asked about what these changes have meant to the respondents and what other circumstances affect them, but going beyond this (e.g. to elicit unpriced values or develop multi-attribute utility models) would be more appropriate to a long-term academic research exercise than a 'normal' time-limited evaluation.

For any projects with intended livelihood outcomes, evaluators should in any case be exploring the extent to which projects have been appropriately targeted to (female and male) beneficiary needs and preferences (generating value/utility), as well as understanding the broader system within which beneficiaries operate, which influences adoption and impact. While some awareness of SLF and TEV concepts might help an evaluator ensure these factors are not overlooked, care needs to be taken to avoid over-complicating the data collection and analysis. In the Aceh case, the additional insights from SLF and TEV were 'interesting' but did not add significant extra value.

The broad conceptual framework provided a way of capturing a wide range of impacts, but arguably the most important purpose, in terms of generating useful lessons, is to understand the way the impacts were achieved and how the approaches could potentially be improved in future. This means examining the intended and actual impact pathways – in line with the TBIE approach.

Requiring project proponents to articulate their ToC or program logic (including assumptions) at proposal stage – and then revisiting this in project reporting – would ensure that subsequent evaluations can be based on a sound understanding of what the project was aiming to achieve and how, and what assumptions might need to be re-examined. This was not a requirement when the Aceh project proposals were prepared.

Having a clear ToC is particularly pertinent for ACIAR, to avoid misunderstandings of how far a research-for-development project can go in achieving development outcomes. As discussed under KEQ5, adopting a PDIA approach could help identify, clarify and adapt the role of agricultural research for optimal benefit within a broader context that includes other development actors. In the Aceh examples, it is clear that the projects themselves did contribute to improved livelihoods in farming communities (although the extent of attribution can only be guessed). Perhaps more importantly, there is good evidence that the ACIAR projects successfully built the knowledge base needed to underpin higher-level development objectives.

In this context, for many ACIAR research projects, the primary evaluation focus will appropriately be on capacity development processes and outcomes. Further developing the framework and approaches to capacity development, as discussed under KEQ5, would support researchers and research organisations to implement high-quality research. Provided the intended impact pathways and assumptions are articulated up front, a theory-based impact evaluation with a tailored mix of quantitative and qualitative assessment tools should in, most cases, be adequate to meet the needs of ACIAR as a learning organisation. In cases where beneficiary livelihood outcomes also need to be assessed, the corresponding impact pathways and assumptions in the ToC will provide a firm foundation onto which other conceptual tools and systems-wide perspectives can be added as appropriate.



A tomato field planted by the Bungong Jeumpa KWT.

Appendices

Appendix 1: Project overviews



Table A1.1 ACIAR-funded projects in post-tsunami Aceh

SMCN/2005/004		
Duration	Partners	Location/s
Jun 2005 – May 2007	<ul style="list-style-type: none"> • BPTP Aceh • BPTP North Sumatra • ISRI • NSW DPI 	Bireuen Samalanga (Nias)
Objectives	Key activities	
<ul style="list-style-type: none"> • Restore technical capacity • Assessment of constraints to re-establish crop production • Action research for re-establishment of cropping 	<ul style="list-style-type: none"> • Training laboratory staff (4 people) • Training PPL from BPTP and DP Bireuen • Farmer training in soil and crop management for salinity • Dissemination of results to farmers, PPL, NGOs and donors • Assessment of soil conditions and crop performance 	<ul style="list-style-type: none"> • Action research (rice, peanut) • Reduce salinity • Soil constraints (sodicity, levelling, drainage, irrigation) • Cultivation practices, fertiliser use • Crop rotation and appropriate rotation crops • Financial analysis of different strategies

Table A1.1 ACIAR-funded projects in post-tsunami Aceh (continued)

SMCN/2005/118		
Duration	Partners	Location/s
Jun 2006 – Nov 2008	<ul style="list-style-type: none"> • BPTP Aceh • BPTP North Sumatra • DP • ICRR • ISRI • NS • DPI 	21 monitoring sites in 4 districts: <ul style="list-style-type: none"> • Aceh Besar • Banda Aceh • Bireuen • Pidie
Objectives	Key activities	
<ul style="list-style-type: none"> • Rebuild technical capacity of extension services • Develop and demonstrate soil management practices • Develop communication strategy 	<ul style="list-style-type: none"> • Training PPL, NGOs, farmer groups (soil workshops, EM38 use, soil testing, leaf colour charts) • Training of laboratory technicians (and one technician in Bogor) • Pot trials (rice, corn, peanuts) 	<ul style="list-style-type: none"> • Demonstration sites and crop trials <ul style="list-style-type: none"> - rice - peanut - kangkung - amaranth - soybean - watermelon • Field monitoring of 21 sites (2005–2007) • Farmer-to-farmer visits and printed materials
SMCN/2005/075		
Duration	Partners	Location/s
Jan 2007 – Aug 2010	<ul style="list-style-type: none"> • BPTP Aceh • FCAS of DP, Aceh • IVEGRI • NSW DPI • WorldVeg • NGOs: <ul style="list-style-type: none"> - Austcare - KEUMANG 	<ul style="list-style-type: none"> • 5 districts: <ul style="list-style-type: none"> - Aceh Besar - Aceh Utara - Bireuen - Pidie - Pidie Jaya • 4 participatory research sites: <ul style="list-style-type: none"> - Aceh Besar - Bireuen - Pidie - Pidie Jaya
Objectives	Key activities	
<ul style="list-style-type: none"> • Identify constraints to vegetable production • Build technical capacity among researchers, extension workers and farmers • Monitor and evaluate the above activities 	<ul style="list-style-type: none"> • Participatory assessment of constraints for vegetable production • Soil survey in 23 sites • Participatory test of fertiliser • 12 trials: <ul style="list-style-type: none"> - chilli - cucumber - amaranth • Research method workshop (soil research, statistics and experimental design) • Training of trainers on vegetable integrated crop management (35 people) 	<ul style="list-style-type: none"> • Training for farmers (1,648 people) in farmer field school: <ul style="list-style-type: none"> - natural enemies and biopesticides - seed production - soil assessment - making compost/soil fertility - using straw mulching - irrigation (drip) - starter solutions - crop rotation - chilli specific training • Support of adoption: <ul style="list-style-type: none"> - 4 publications distributed to extension workers and farmers (300–1,500 copies) - Farmer field day at trial site

Table A1.1 ACIAR-funded projects in post-tsunami Aceh (continued)

SMCN/2007/040		
Duration	Partners	Location/s
Jan 2009 – Aug 2013	<ul style="list-style-type: none"> • BPTP Aceh • ICRR • ISRI • NSW DPI • University Syiah Kuala 	4 districts: <ul style="list-style-type: none"> • Aceh Besar • Bireuen • Pidie • Pidie Jaya Specific locations of project implementation are shown in Figure A1.1
Objectives	Key activities	
<ul style="list-style-type: none"> • Assess lowland farming systems in Aceh to identify constraints and opportunities to increase incomes • Evaluate technologies and farming system changes that make farms more profitable and resilient • Evaluate strategies to increase the resilience of farming systems by better soil management (biochar) • Build the capacity of farmers and district extension services in Aceh (women's groups) • Facilitate communication between stakeholders 	<ul style="list-style-type: none"> • Survey farmers • Analyse markets • Analysis of soil, climate and infrastructure • 8 long-term demonstration sites on part of farmer land • 75 experiments on integrated crop management • Integrated crop management: <ul style="list-style-type: none"> - seeds/rice variety - timing seedling transplant - timing fertiliser - <i>legowo</i> - 3 plants, 1 hole - integrated pest control - intermittent irrigation - timely harvest 	<ul style="list-style-type: none"> • Organic fertiliser use/chemical fertiliser reduction • Crop rotation • Use of biochar and other soil organic amendments • Organic amendments for vegetables • Workshops for PPL staff on extension methodology • Workshops for PPL on new technologies • Demo sites • Annual PPL forum per district • PPL exchange visits • Farmer exchange visits • Women's groups (posters) • Link with university research

Notes: BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology); DP – Dinas Pertanian (Department of Agriculture); FCAS – Food Crops Agricultural Service; ICRR – Indonesian Centre for Rice Research; ISRI – Indonesian Soil Research Institute; IVEGRI – Indonesian Vegetables Research Institute; NGO – non-government organisation; NSW DPI – New South Wales Department of Primary Industries; PPL – *penyuluh pertanian lapangan* (agricultural extension officer(s)); WorldVeg – World Vegetable Center

Table A1.2 Actual project pathways and activity phases

SMCN/2005/004			SMCN/2005/118		
Activities	Involved	Still in use	Activities	Involved	Still in use
Phase 1: Assessment of the problem					
Salinity levels	BPTP AUS	Yes	21 monitoring sites for salinity	BPTP NRI AUS	No
Soil constraints (sodicity, chemical and biological factors, leveling, drainage, irrigation)	BPTP NRI AUS	+/-			
Training of laboratory staff, equipment	BPTP NRI AUS	No	Training of laboratory staff in Bogor	BPTP NRI AUS	No
Training laboratory staff, peer to peer	BPTP	Yes	Training laboratory staff, peer to peer	BPTP	Yes
Phase 2: Testing of possible solutions					
Action research with farmers	Farmers PPL BPTP AUS	+/-	Pot trials	BPTP NRI AUS	No
Use existing solutions for soil fertility	NRI AUS	?	Field trials	PPL BPTP NRI AUS	No
Phase 3: Selected solutions					
Drainage		No	Drainage, leaching		No
Flushing/leaching		No	Better rotation crop selection		Yes, 040
Cultivation practices		No	Soil improvements		Yes, 040
Fertiliser use		Yes, 040			
Crop rotation		Yes, 040			

SMCN/2005/075			SMCN/2007/040		
Activities	Involved	Still in use	Activities	Involved	Still in use
Phase 1: Assessment of the problem					
Participatory assessment/PRA	BPTP AUS	Yes	Projects 004 and 118		
Soil survey	BPTP AUS	Yes	Farmer survey	Farmers PPL BPTP AUS	No
			Market analysis	BPTP AUS	No
			Analysis of soil, climate and infrastructure	BPTP AUS	No
Phase 2: Testing of possible solutions					
Participatory test of fertiliser	Farmers PPL BPTP AUS	No	8 long-term demonstration sites	PPL BPTP AUS	No
12 field trials (chilli, cucumber, amaranth)	Farmers PPL BPTP AUS	No	75 experiments on integrated crop management	PPL BPTP AUS	No
Phase 3: Selected solutions					
Natural enemies/biopesticides		Yes	Seeds rice variety		Yes
Seed production		?	Timing seedling transplant		Yes
Soil assessment		+/-	Timing fertiliser		Yes
Making compost/soil fertility		Yes	<i>Legowo</i>		Yes
Using straw mulching		No	3 plants, 1 hole		Yes
Irrigation (drip)		No	Integrated pest control		Yes
Starter solutions		Yes	Intermittent irrigation		Yes
Crop rotation		Yes	Timely harvest		Yes
Chilli-specific		Yes	Organic fertiliser use/chemical fertiliser reduction		Yes
			Crop rotation		Yes
			Use of biochar and other soil organic amendments		Yes
			Organic amendments for vegetables		Yes

Table A1.2 Actual project pathways and activity phases (continued)

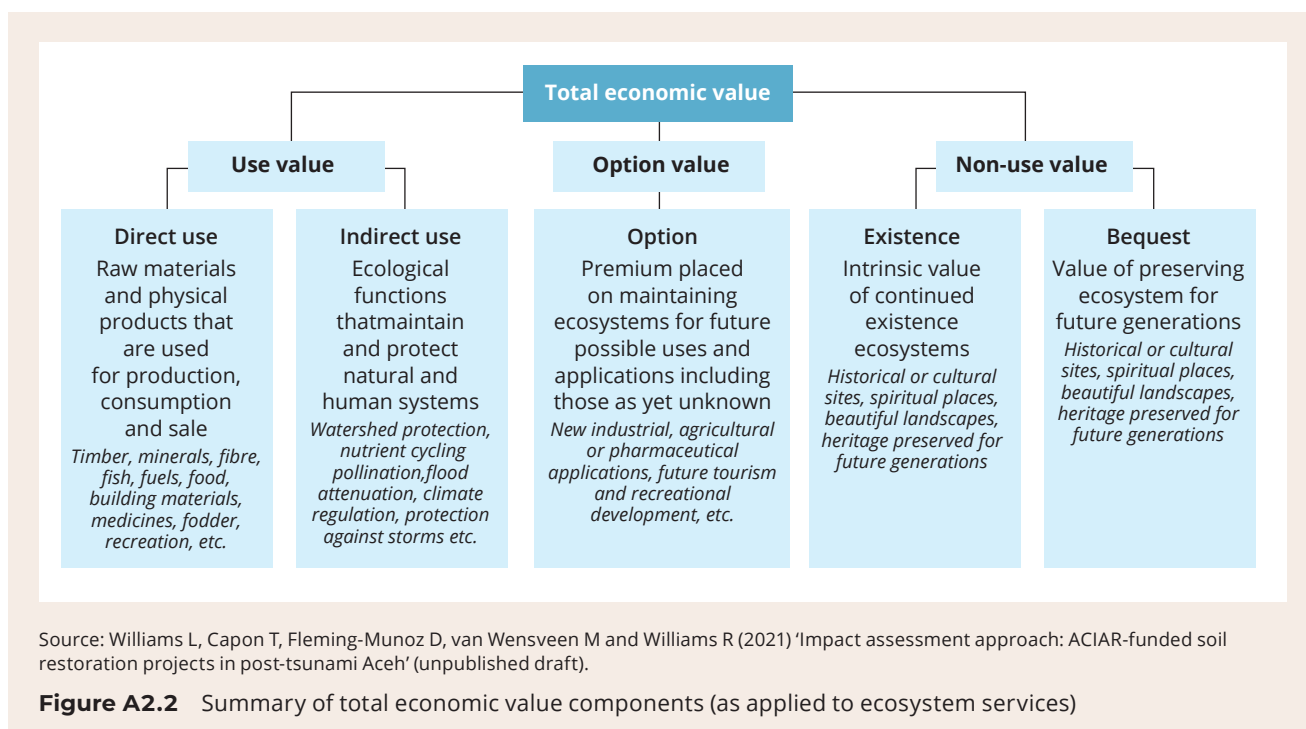
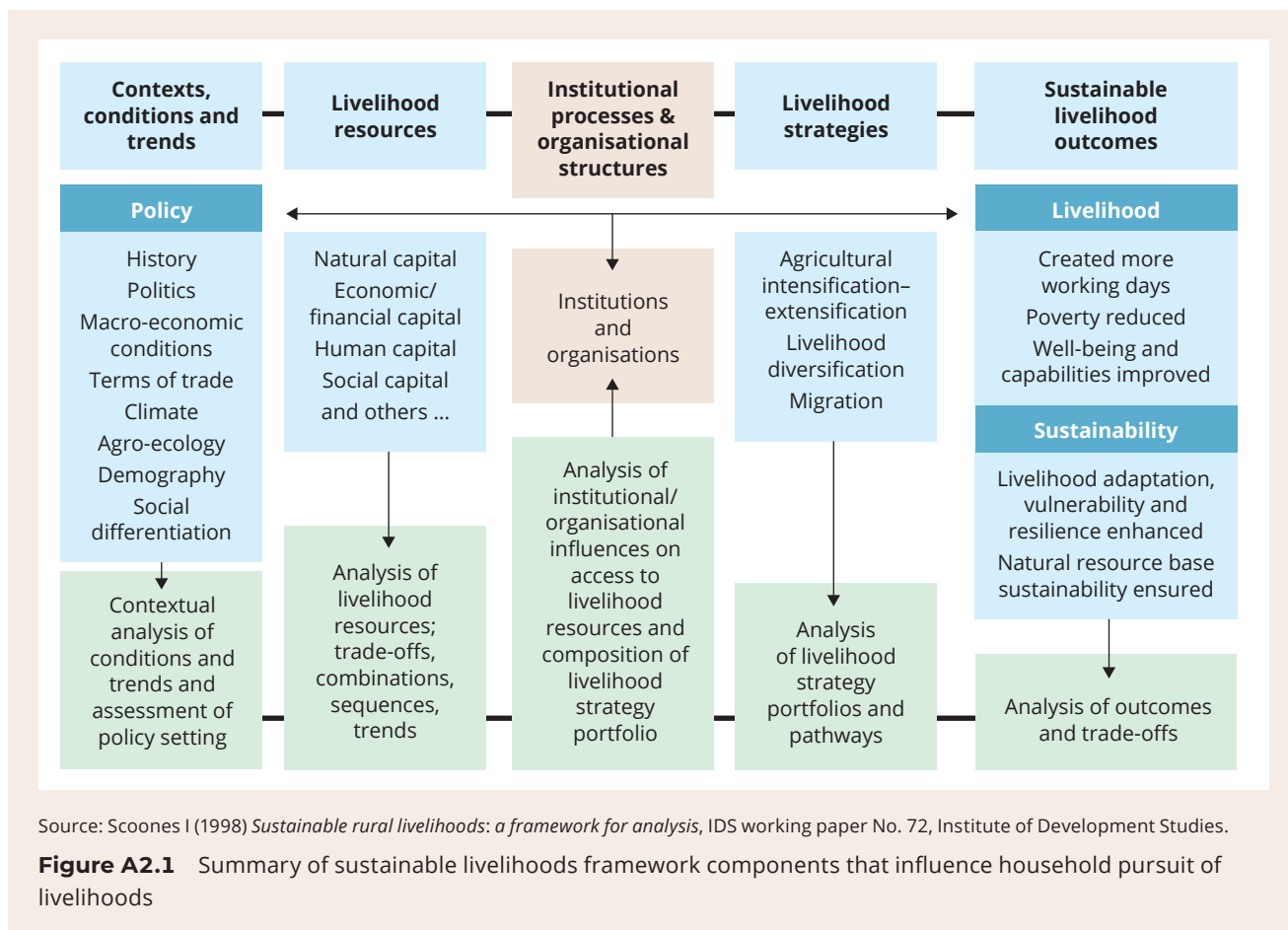
SMCN/2005/004			SMCN/2005/118		
Activities	Involved	Still in use	Activities	Involved	Still in use
Phase 4: Dissemination in BPTP and DP					
Action research on salinity management	Farmers PPL BPTP AUS	No	Training of extension workers	PPL BPTP AUS	No
Training for PPL, NGOs		No	Training of NGOs	PPL BPTP AUS	No
Publication of scientific papers					
Financial analysis of benefits		No			
Phase 5: Dissemination to farmers					
Farmer training	Farmers PPL BPTP AUS	No	Demonstration sites	Farmers PPL BPTP AUS	No
			Training of farmers groups	Farmers PPL BPTP AUS	No
			Crop trials (rice, peanut, kangkung, amaranth, soybean, watermelon)	Farmers PPL BPTP AUS	No
Phase 6: Adoption by other farmers					
			Farmer-to-farmer visits	Farmers PPL BPTP AUS	No

SMCN/2005/075			SMCN/2007/040		
Activities	Involved	Still in use	Activities	Involved	Still in use
Phase 4: Dissemination in BPTP and DP					
Research methods workshop	PPL BPTP AUS	No	Workshops for PPL staff on extension methodology	PPL BPTP AUS	Yes, pre-COVID-19
ToT veg integrated crop management	PPL BPTP AUS	No	Workshops for PPL on new technologies	PPL BPTP AUS	Yes, pre-COVID-19
Publication distributed to extension workers	PPL BPTP AUS	No	Annual PPL forum per district	PPL BPTP AUS	Yes, pre-COVID-19
Training for PPL, BPTP researchers	PPL BPTP AUS	No	PPL exchange visits	PPL BPTP AUS	No
Phase 5: Dissemination to farmers					
Farmers trained in field school	Farmers PPL BPTP AUS	No	Demonstration sites	Farmers PPL BPTP AUS	Yes
Farmer field day at trial sites	Farmers PPL BPTP AUS	No	Women's groups	Farmers PPL BPTP AUS	Yes
			Farmer training	Farmers PPL BPTP AUS	Yes
Phase 6: Adoption by other farmers					
			Farmer exchange visits	Farmers	No
			Visit to fields from friends	Farmers	Yes

Notes:

AUS – Australian researchers or technical advisors
BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology)
DP – Dinas Pertanian (Department of Agriculture)
FCAS – Food Crops Agricultural Service
ICRR – Indonesian Centre for Rice Research
ISRI – Indonesian Soil Research Institute
IVEGRI – Indonesian Vegetables Research Institute
NGO – non-government organisation
NRI – National Research Institutes;
NSW DPI – New South Wales Department of Primary Industries
PPL – *penyuluh pertanian lapangan* (agricultural extension officer(s))
PRA – participatory rural appraisal
ToT – training of trainers
WorldVeg – World Vegetable Center

Appendix 2: Key features of sustainable livelihoods framework and total economic value



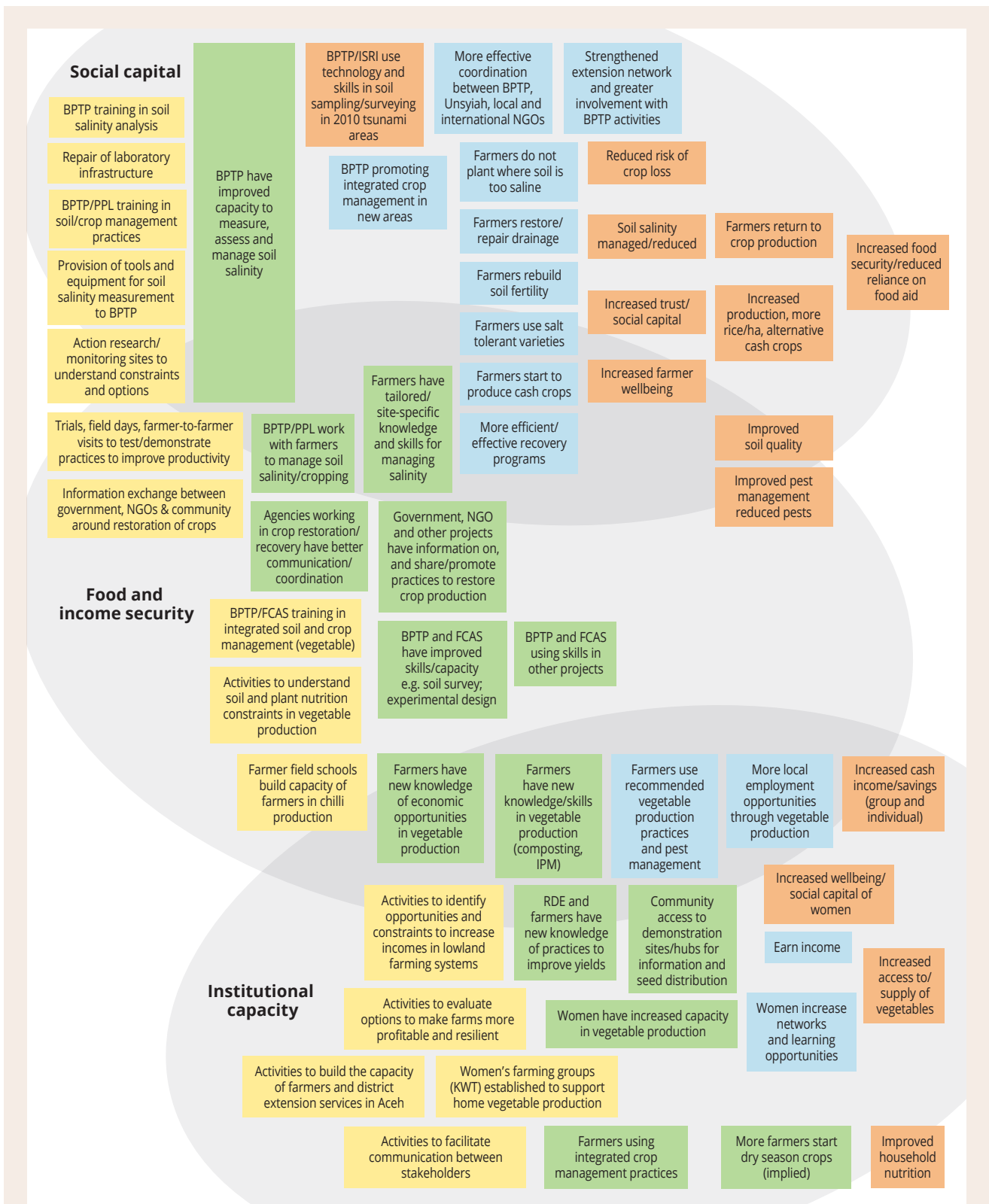
Appendix 3: Indicative theories of change

Phase I: Focusing on partner agency impacts

High level outcomes	Livelihoods are restored and enhanced				
Final outcomes	Partners work with farmers to increase their capacity to manage soil salinity and improve productivity				
Intermediate outcomes	Partners employ and disseminate newfound knowledge and skills across other, non-ACIAR associated projects and activities			Partners, government and NGOs share and promote practices to restore and enhance crop production	
Outputs	Partners have improved capacity to measure, assess and manage soil salinity			Partners, government and NGOs increase and improve their communication and coordination	
	Partners have increased knowledge and skills relating to crop restoration and production				
	Partners have gained new knowledge on practices to improve crop yields				
	Partners have improved skills and capacity to conduct soil surveys and develop experimental designs				
	Communities gain access to demonstration sites and hubs for information and seed distribution				
Activities	Opportunities and constraints to increase incomes are identified	Options to make farms more profitable and resilient are identified	Laboratory infrastructure is repaired	Partners are provided with tools and equipment to assist with soil salinity measurement	Training and capability development supports partners, government and NGOs to engage with one another
Capability	Autonomy		Equality		Trust

Phase II: Focusing on farm livelihoods

High level outcomes	Livelihoods are restored and enhanced						
	Economic capital is restored and enhanced	Human capital is restored and enhanced			Natural capital is restored and enhanced	Social capital is restored and enhanced	
Final outcomes	Cash income and savings are increased for households and individuals	Agri ext'n services have increased technical capacity	Production of alternative cash crops is increased	Food security & nutrition are enhanced	Soil quality is improved	Social networks and structures are rehabilitated	Social capital of women is heightened
Intermediate outcomes	More employment opportunities are created as a result of increased and diversified vegetable and crop production	Annual cropping is re-established	Farmers use integrated crop management practices		Soil salinity is managed and reduced	Social isolation is reduced	Women have increased capacity in vegetable production
		Access to and supply of crops is increased	Reliance on food aid is diminished				
Outputs	Farmers have new knowledge of economic opportunities in vegetable and crop production	Farmers return to crop production	Farmers use salt-tolerant crop varieties		Farmers don't plant where soil is too saline	Women's farmer groups are established to support home vegetable production	
		Farmers have new knowledge and skills in vegetable production and yields	Farmers have new knowledge and skills in managing soil salinity				
Activities	Partners work with farmers to increase their capacity to manage soil salinity and improve productivity						



Note: Yellow boxes indicate project activities; green – initial outcomes; blue – next-level outcomes; orange – impacts. Background shading highlights broad areas for impact (social capital, food and income security, and institutional capacity).
 BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology); FCAS – Food Crops Agricultural Service; IPM – integrated pest management; ISRI – Indonesian Soil Research Institute; NGO – non-government organisation; PPL – *penyuluh pertanian lapangan* (agricultural extension officer(s)); Unsyiah – University Syiah Kuala
 Source: Williams L, Capon T, Fleming-Munoz D, van Wensveen M and Williams R (2021) 'Impact assessment approach: ACIAR-funded soil restoration projects in post-tsunami Aceh' (unpublished draft).

Figure A3.1 Indicative/broad impact pathways

Appendix 4: Framework for capacity development and its operationalisation

There are many theoretical frameworks that try to capture the complex process of capacity development. ACIAR is using a definition that distinguishes 3 levels – individual, organisational and institutional – and describes ‘a process of strengthening the abilities of individuals, organisations and systems to undertake agricultural research and to continue to advance development outcomes effectively, efficiently and sustainably’ (ACIAR 2022a).

The use of 3 levels of capacity development is in line with the definition used by the OECD and most development institutions. There are various other categorisations (e.g. those with the level of project or activity as a separate tier of capacity development). Regardless, all conventions use individuals at one end of the spectrum. Depending on the direction of analysis, the individual is either the building block for further capacity building, or the ultimate result shaped by the wider layers of capacity development. Beyond the individual, slightly varied terminologies may be used to identify the intermediate levels, but the organisation and the enabling environment are standard features in most frameworks. All frameworks define an interdependence between the levels of capacity, so each level influences and is influenced by the surrounding layers. Each level of the ACIAR definition is analysed in more detail below.

Individual level

ACIAR defines this level as ‘formal or informal capacity development activities that strengthen the abilities and agency of individual partner country researchers. Most research capacity building efforts within projects are usually at this level.’

This is consistent with the explanation on capacity development on the ACIAR website, which states ‘capacity building is much more than merely transferring skills and knowledge through training. It includes on-the-job training, leadership, mentoring, two-way transfers of ideas and technologies, and empowerment to undertake research.’ Even though this is an overall definition of capacity development, most of these activities (with the possible exception of ‘empowerment’) would normally be considered as examples of capacity development at the individual level.

Agency of the individual researcher is listed in the above individual-level definition, but agency depends crucially on the organisation in which people work and would be better referred to as part of the organisational level of capacity development.

In addition to the activities listed above, hiring staff and collaborating with experts can have an influence on individual capacities. A fast way to increase individual capacity is through hiring (or promoting) staff who have the right expertise and/or who are driven by learning. Individual capacity can also be strengthened by attracting the right experts to work with individuals in the organisation. The knowledge and methods from the experts are transferred ‘on the job’ to the organisation’s staff.

Organisational level

ACIAR defines this level as ‘activities designed to strengthen a partner organisation in its abilities to achieve its objectives and fulfil its role in the national agricultural innovation system. As the immediate supporting environment for individual researchers and research systems, this should always be considered alongside individual capacity building.’

Organisations use constraints to support and limit the actions of individuals so they can achieve organisational objectives. Constraints can be informal (sanctions, taboos, customs, traditions, propriety) or formal (rules, coordination, structures, division of labour, hierarchy, process, procedures, standards, training, locations, systems, operations, tools).

Pending implementation of the 2020 *Recommendations for ACIAR’s approach to institutional strengthening* (ACIAR 2020), ACIAR seems to focus its capacity development for research organisations mostly on formal rules and mostly on knowledge management. The reasons for this selectivity are obvious but not necessarily appropriate:

- **Mostly formal rules:** Informal rules are hard to identify, let alone change. But informal rules have an enormous influence over the success of an organisation, so awareness of their existence and ways of working is advisable.

- **Mostly knowledge management:** The organisation providing the capacity development support is often a knowledge organisation, with a focus on generating knowledge. ('Capacity development is not a core competency for researchers, nor should it be.') But since other issues, like recruitment, planning, evaluation and governance, can be the limiting factor to an organisation's ability to develop its capacity, it is important to have a broader perspective on the types of capacity a research organisation needs.

A broader perspective, noting trade-offs between different choices, is captured in Figure A4.1.

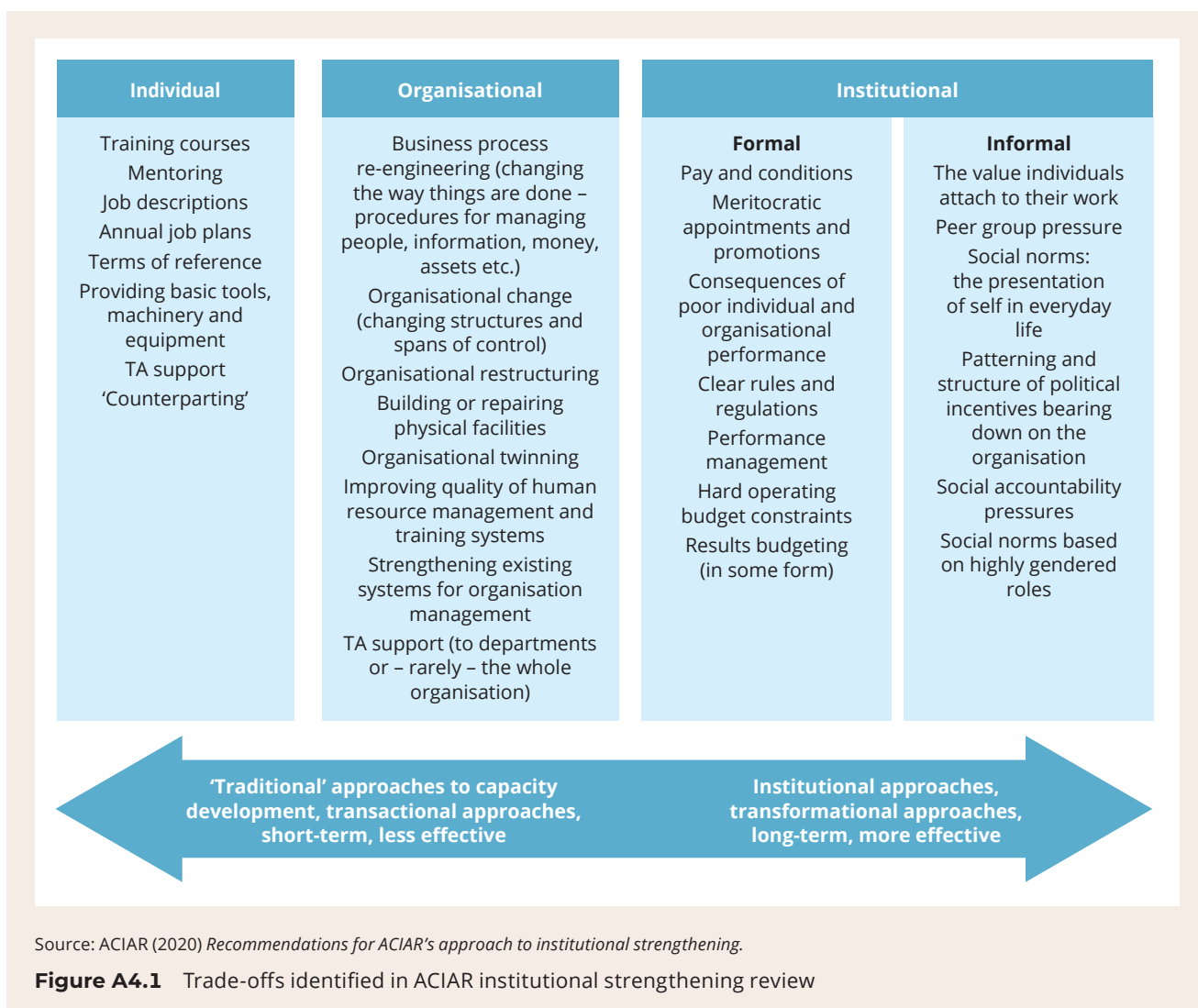
SECI model

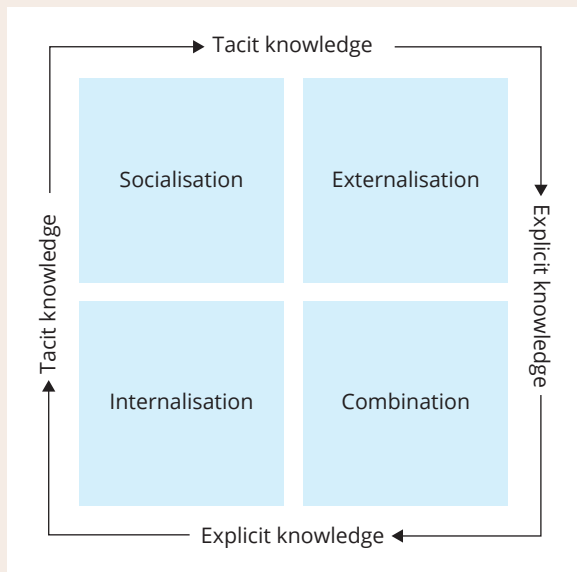
For the Aceh projects, the team looked at capacity development focused on knowledge management, which in turn hinges on capturing the knowledge and experience generated through an activity and making this knowledge available to the organisation and beyond. For this evaluation, the team has used

the socialisation, externalisation, combination and internalisation (SECI) model of knowledge dimensions (or the Nonaka-Takeuchi model) to assess to what extent knowledge is made explicit and available for reuse in the organisation (Figure A4.2).

Socialisation (tacit to tacit)

Socialisation is a process of sharing knowledge, including observation, imitation and practice through apprenticeship. Apprentices work with their teachers or mentors to gain knowledge by imitation, observation and practice. In effect, socialisation is about capturing knowledge by physical proximity, wherein direct interaction is a supported method to acquire knowledge. Socialisation comes from sharing the experience with others. It also can come from direct interactions with customers/clients and from inside the organisation, just by interacting with another section or working group – for example, brainstorming with colleagues. The tacit knowledge is transferred by common activity in the organisations, such as being together and living in the same environment.





Source: Nonaka I and Takeuchi H (1995) *The knowledge creating company: how Japanese companies create the dynamics of innovation*, Oxford University Press, Figure 3.3, p. 71.

Figure A4.2 SECI model of knowledge dimensions

Externalisation (tacit to explicit)

Externalisation is the process of making tacit knowledge explicit, wherein knowledge is crystallised and thus can be shared by others, becoming the basis of new knowledge. This includes publishing or articulating knowledge. For example, concepts, images and written documents can support this kind of interaction.

Combination (explicit to explicit)

Combination involves organising and integrating knowledge, whereby different types of explicit knowledge are merged (for example, building prototypes). The creative use of computerised communication networks and large-scale databases can support this mode of knowledge conversion: explicit knowledge is collected from inside or outside the organisation and then combined, edited or processed to form new knowledge. The new explicit knowledge is then disseminated among the members of the organisation.

Internalisation (explicit to tacit)

Internalisation involves the receiving and application of knowledge by an individual, enclosed by learning-by-doing. On the other hand, explicit knowledge becomes part of an individual's knowledge and will be an asset for an organisation. Internalisation is also a process of continuous individual and collective reflection, as well as the ability to see connections and recognise patterns, and the capacity to make sense of fields, ideas and concepts.

The most common challenge faced by organisations is making knowledge explicit. It is common (and easier) to skip the externalisation process and move from socialisation to internalisation and back to socialisation. The process of externalisation is demanding and does not create added value for the individual staff. It is, however, the crucial process in institutionalising knowledge.

Organisational characteristics							
Structure		Membership		Relationship		Strategy	
Vertical	Horizontal	Individual	Collective	Systematic	Ad hoc	Reactive	Innovative
Focused	Opportunistic	Private	Public	Prescribed	Adaptive	Exploitative	Explorative
Acquisition		Storage		Diffusion		Application	
Knowledge management value chain							

Source: Magnier-Watanabe R and Senoo D (2008) 'Organizational characteristics as prescriptive factors of knowledge management initiatives', *Journal of Knowledge Management*, 12:21–36.

Figure A4.3 Magnier-Watanabe and Senoo model

Organisations and knowledge management

Beyond pure knowledge management, this evaluation has used the Magnier-Watanabe and Senoo (2008) assessment to cover changes to the organisational structure to facilitate knowledge sharing or changing the strategy of the organisation to focus on innovation (Figure A4.3).

The organisational characteristics of a knowledge organisation are linked to 4 dimensions of knowledge management: knowledge acquisition, storage, diffusion and application (or use).

Gonzalez and Martins (2014) have linked the 4 dimensions of organisational knowledge management with practical activities the institution can implement in Table A4.1. This list of organisational actions could be a useful checklist for impact evaluations like this one.

Table A4.1 Knowledge management process and organisational actions

Phase	Central objectives	Organisational actions
Acquisition	Knowledge creation starting from the skills of individuals (Pacharapha & Ractham, 2012). Knowledge acquisition involves the ability of the firm to absorb knowledge from their primary knowledge basis in a learning perspective (Lopez & Esteves, 2012). The acquisition of knowledge can be seen as a process of transformation in which knowledge migrates from its explicit form to the tacit one (Nonaka & Takeuchi, 1995)	<ul style="list-style-type: none"> • Training of individuals; • Encouraging the trial and error process; • Development of a culture aimed at learning; • Hiring and partnerships with other firms; • Hiring new employees representing new knowledge; • Acquisition of patents.
Storage	Retention of knowledge generated by individuals and socialized in groups (Yigitcanlar et al., 2007), forming an organisational memory (Walsh & Ungson, 1991). Explanation process of tacit knowledge (Nonaka & Takeuchi, 1995). Development of organisational culture and structure that represent the routine of the company (Madsen et al., 2003).	<ul style="list-style-type: none"> • Identification and registration of best practices; • Registration of learned lessons; • Incorporation of knowledge acquired in procedures and rules of the organization; • Retention of individuals (tacit knowledge repository); • Development of an organizational culture that represents the values and beliefs of the company; • Use of IT as a tool for knowledge retention and training of organizational memory.
Distribution	Dissemination of knowledge between individuals through continuous social contact (Levine & Prietula, 2012) and of specialised groups that share a language and objectives, in a community of practice approach (Brown & Duguid, 2001). Using IT as a facilitator of the dissemination process.	<ul style="list-style-type: none"> • Disclosure to employees of the retained knowledge basis; • Development of work in groups; • Development of communities of practice; • Exchange of specialised knowledge; • Use IT as a tool for the distribution of organizational knowledge.
Use	Knowledge of the firm being exploitative (reactive form) or explored (innovative form) (Cohen & Levinthal, 1990). The use of knowledge in order to rebuild its routines and skills (Volberda et al., 2010). Retrieval and transformation of knowledge acquired by promoting the expansion of the organisational knowledge base (Walsh & Ungson, 1991)	<ul style="list-style-type: none"> • Creation of problem-solving teams; • Development of activities for improving products and processes; • Changes in routines and procedures of the organization; • Use of procedures and instructions that incorporate best practices and learned lessons.

Source: Gonzalez R and Martins M (2014) 'Knowledge management: an analysis from the organizational development', *Journal of Technology Management & Innovation*, 9:131-147.

Enabling environment (institutional) level

The ultimate level of capacity development is at the enabling environment level. Organisations determine how individual researchers perform, but the operation of particular organisations is influenced by the broader operating environment. This goes beyond the research organisation and covers the position of the organisation into a wider ecosystem, structures of power, incentives, influence, legislation, etc.

ACIAR applies a more limited definition of the enabling environment (aka institutional) level:

'The broader system – such as policies, regulations and governance – within which agricultural research-for-development operates, and which supports (or not) the abilities of individuals and institutions to successfully use their skills and capabilities. This may be difficult to address at project level, but targeted interventions (for instance, addressing a relevant policy or regulation), and building capacity for research engagement with policy processes.'

[ACIAR 2022a]

In this evaluation, the team has focused on the research organisation's use of its influence on its partners, suppliers and clients to foster a learning culture based on knowledge development and sharing. The 'suppliers' for an organisation like BPTP include both national research institutes and policy makers who provide resources. The 'clients' include DP and its extension workers, and farmers.

Farmers as the clients of BPTP are the ultimate beneficiaries of the knowledge generated and the success of BPTP can only be measured by the benefits reaped by the farmers. Farmers will likely be hesitant to change, as they often go into debt in the planting season with a return on this investment only becoming clear several months later. Any change can have an unforeseen but detrimental effect on the harvest, so trying new techniques is a risky endeavour. Knowledge organisations like BPTP can create a culture of learning and innovation among farmers by de-risking the adoption of new approaches. De-risking can be done through farmer-led assessments, test sites, field demonstrations, yield guarantees, etc.

National research institutions already have a learning culture but BPTP could profit from formalising relationships.

Policymakers are crucial in the knowledge dissemination process because they control the resources to upscale research outcomes to local or national policy. Researchers often shy away from this process, so the organisation should acquire the capacity to promote research findings to policymakers.

Appendix 5: Key project documents

SMCN/2005/118	
Document type	Title
Proposal	Project document: LWR/2005/118 Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia
Monthly report (x 12)	12 x monthly report: ACIAR project SMCN/2005/118
Annual report	Annual report: SMCN/2005/118 Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia
Final report	Project final report: Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia

SMCN/2005/075	
Document type	Title
Proposal	Project document: SMCN/2005/075 (formerly CP/2005/075) Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia
Annual report (x 3)	Annual progress report: Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia
Final report	Final report: Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam province, Indonesia
Review	External review CP/2005/075

SMCN/2007/040	
Document type	Title
Proposal	Project proposal: Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales
Proposal	SMCN/2007/040 Project variation 1
Annual reports (2009, 2010, 2012)	Annual report: Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales
Impact assessment	Impact assessment of SMCN2007/040 Women farmer group program
Final report	Final report: Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales

Appendix 6: Consultation lists

Phase 1			
Gender	Organisation	Role in ACIAR Project	Current Role
Male	NSW DPI	Project lead (projects 1,2 & 4)	Retired
Female	ACIAR Jakarta	Country manager	Country manager
Male	BPTP	Project manager	Head of BPTP Aceh
Male	BPTP	Project director	Retired
Male	BPTP	Communication Department	BPTP staff
Male	BPTP	Trainer	BPTP staff
Male	BPTP	Trainer	Retired
Male	BPTP	Laboratory technician	Laboratory coordinator
Female	BPTP	Coordinator for women's groups	BPTP Staff
Male	BPTP	Extension staff	Extension staff
Female	BPTP	Trainer	Retired
Female	BPTP	Had not yet joined BPTP	Researcher
Female	BPTP	In charge of finance	Researcher
Female	DP	Extension staff	Extension staff
Male	DP	Extension staff	Extension staff
Male	UnSyiah	Research coordinator	Professor
Female	UnSyiah	Researcher	Lecturer
Male	Indonesian Soil Research Institute	Trainer for Indonesian Centre for Rice Research	Senior researcher
Male	Indonesian Centre for Rice Research	Head of BPTP Medan	Senior researcher
Female	Indonesian Legumes and Tuber Crops Research Institute	Trainer	Senior researcher
Phase 2			
Gender	Organisation	Role in ACIAR Project	Current Role
Male	NSW DPI	Project lead (projects 1, 2, 4)	Retired
Female	NSW DPI	Hydrologist (projects 1, 2, 4)	NSW DPI
Male	WorldVeg	Project lead (project 3)	Consultant
Male	BPTP	Project manager	Head of BPTP
Male	BPTP	Laboratory technician	Laboratory coordinator
Female	BPTP	Librarian in BPTP	BPTP librarian
Female	BPTP	Trainer	Retired
Female	Teuku Umar University	Extension staff	PhD Student
Male	Teuku Umar University	-	Agriculture lecturer
Female	Teuku Umar University	-	Dean of Agr Faculty
Male	Teuku Umar University	-	Deputy Dean
Female	BPP	Extension staff	Extension staff

Phase 2

Gender	Organisation	Role in ACIAR Project	Current Role
Female	BPP	Extension staff	Trainer
Male	DP West Aceh	-	Head of DP
Female	KWT Padang Jawa	Head of KWT	Head of KWT
Female	KWT Padang Jawa	Member of KWT	Member of KWT
Female	KWT Alue Bagok	Head of KWT	Head of KWT
Female	KWT Alue Bagok	Member of KWT	Member of KWT
Female	KWT Baru Kembang	Head of KWT	Head of KWT
Female	KWT Baru Kembang	Member of KWT	Member of KWT
Female	KWT Liceh	Head of KWT	Head of KWT
Female	KWT Liceh	Member of KWT	Member of KWT
Female	KWT Suka Maju	Head of KWT	Head of KWT
Female	KWT Suka Maju	Member of KWT	Member of KWT
Female	KWT Semangat Baru	Head of KWT	Member of KWT
Female	KWT Semangat Baru	Member of KWT	Member of KWT
Female	KWT Kembang Tani	Head of KWT	Head of KWT
Female	KWT Kembang Tani	Member of KWT	Member of KWT
M/F	BPP Bubon	-	BPP Bubon staff
Male	BPP	Extension staff	Head of BPP Peudada
Male	BPP Kota Juang	-	Head of BPP Kota Juang
Female	BPP Kota Juang	-	Extension staff
Female	BPP Kota Juang	-	Extension staff
Male	Male farmers' group	Farmers	Farmers
Male	BPP Jeumpa	-	Head of BPP Jeumpa
M/F	BPP Jeumpa	-	Extension staff
Male	BPP Padang Tiji	Extension staff	Head of BPP Padang Tiji
Female	BPP Padang Tiji	-	Extension staff
Male	Male farmers' group	-	Farmers
Male	BPP	Extension staff	Extension staff
Female	BPP	Extension staff	Extension staff
Male	Male farmers' group	Farmer	Farmer
Female	BPP	-	Extension staff
Female	BPP	-	Extension staff
Female	BPP	Extension staff	Extension staff
Male	BPTP research farm	BPTP staff	BPTP staff
Male	DP Aceh	-	Head of Extension Dept

Notes:

BPP – Balai Penyuluhan Pertanian (District Agricultural Extension Offices, under Dinas Pertanian); BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology); DP – Dinas Pertanian (Department of Agriculture); KWT – *kelompok wanita tani* (women's farming group(s)); NSW DPI – New South Wales Department of Primary Industries; UnSyiah – University Syiah Kuala; WorldVeg – World Vegetable Center

Appendix 7: Project costs and benefits

The summaries below are gleaned from project proposals and reports, supplemented with official statistical sources.

Project costs

Cost data are summarised in Table A7.1. Note that these figures are from project proposals (or subsequent budget variations), and hence show intended rather than actual expenditure. In total, ACIAR contributed just over AUD3.3 million across the 4 projects, while imputed contributions from the lead organisations (NSW DPI and WorldVeg) and project partners totalled around AUD460,000.

Quantified benefits during project lifetimes

The first 2 projects discussed economic benefits in general terms in their final reports but did not attempt to quantify these.

WorldVeg: Chilli

For the WorldVeg project (SMCN/2005/075), baseline information was collected on a range of vegetable crops. This found chilli to be by far the most profitable: net income per hectare from chilli was '1.5 times higher than tomato, 5 times higher than cucumber, and 10 times higher than paddy rice'. This was in large part due to the high chilli prices prevailing at the time. However, production costs were also significantly higher than rice:

'The study shows that an average market-oriented chilli farmer in Aceh obtained net return of about USD3500 per hectare of chilli cultivation; for this the farmer needed to invest (i.e. the production cost) about USD3700 per hectare, which is more than 3 times that of paddy rice cultivation.' [Luther 2010]

This is a return on investment of 1.95, compared to a revenue:cost ratio of 2.78, estimated in Java in 2021 (Sundari et al. 2021).

Table A7.1 Summary of project costs by funding source (AUD)

Funding source	Project costs				Total costs
	SMCN/2005/004 [†]	SMCN/2005/118	SMCN/2005/075	SMCN/2007/040	
ACIAR	412,034	783,515	500,007	1,608,803	3,304,359
In-kind contributions	35,334	67,191	297,979	60,804	461,308
NSW DPI	n/a	35,748	9,705	-	
ISRI	n/a	6,084	-	14,405	
IIRR	-	6,656	-	7,412	
BPTP NAD	n/a	14,996	90,000	34,347	
BPTP Sumut	n/a	3,707	-	-	
ILETRI	-	-	-	4,640	
WorldVeg	-	-	155,466	-	
AustCare	-	-	10,858	-	
IVEGRI	-	-	7,875	-	
FCAS	-	-	9,000	-	
UnSyiah	-	-	9,450	-	
KEUMANG	-	-	5,625	-	
Total costs	447,368	850,706	797,986	1,669,607	3,765,667

Notes:

[†] Breakdown not available, but assumed same ratio as SMCN/2005/118

AUD – Australian dollar; BPTP – Balai Pengkajian Teknologi Pertanian (Institute for Assessment of Agricultural Technology); BPTP Sumut – Balai Pengkajian Teknologi Pertanian Sumatera Utara (North Sumatra); NAD – Nanggroe Aceh Darussalam Province, Indonesia; FCAS – Food Crops Agricultural Service; IIRR – International Institute of Rural Reconstruction; ILETRI – Indonesia Legumes and Tuber Crops Research Institute; ISRI – Indonesian Soil Research Institute; IVEGRI – Indonesian Vegetables Research Institute; NSW DPI – New South Wales Department of Primary Industries; UnSyiah – University Syiah Kuala; WorldVeg – World Vegetable Center

'Given farmer interest in chilli, this crop received most project attention, including through 77 farmer field schools. Project reporting concluded that "through the project's FFS [farmer field schools] sessions, 1,648 farmers have directly benefited in terms of improving their knowledge and skills on efficient use of input resources and other aspects of crop management for chilli production".' [Luther 2010]

NSW DPI: ICM rice

The fourth project (SMCN/2007/040) established 8 long-term experiment and demonstration sites in rice-based cropping areas across 4 *kabupaten*, involving 103 farmers (9 to 16 farmers per site). Excerpts from project results reporting are reproduced below.

'Rice production in Aceh increased 221,880 tonnes or 14.25%, from 2009 to 2012. In the districts where the long-term sites were located, production increased 26.6%. The area of rice ICM planted in these districts ranged from 43% to 84%, indicating widespread adoption of ICM within 3 years. BPTP Aceh attributes recent increases in rice production in Aceh to the adoption of ICM, particularly the improvements in seedling establishment, crop layouts and new varieties.' [McLeod and Tinning n.d.]

Across the various trial sites, yield increases ranged from 9% to 44%, with potential gross margins of between AUD152 and AUD510 (Table A7.2).

Economic benefits for direct project participants were calculated at AUD8,592 across 103 farmers on 17.9 ha, an average of AUD480/ha or AUD84 per farmer per rice crop. Similar benefits were estimated for the surrounding villages, resulting in a total economic contribution of over AUD50,000 per season across a

rice area of 112 ha (Table A7.3). Assuming 2 crops per season in these immediate project areas and similar gain from the new techniques for 3 years (from trial time to project completion or soon after), benefits within the project locations (112 ha) would be around AUD300,000 (AUD50,000 x 2 x 3). Potential benefits beyond the project areas are discussed further below.

Project reporting also states that:

'... over 90% of participating farmers increased their gross margins for rice following adoption of ICM, 45% by greater than 20%. More than 77% of these farmers rely on farming for their income.' [McLeod and Tinning n.d.]

NSW DPI: other crops

Project SMCN/2007/040 also reported significant yield increases in rainfed project sites – 39% for rainfed rice, 89% for peanut and 31% for soybean – with corresponding gross margin increases of AUD399/ha for rainfed rice, AUD518/ha for peanut and AUD331/ha for soybean (Table A7.4).

Additional statistics on soybean are shown in Table A7.5.

NSW DPI: vegetables (KWT)

Project SMCN/2007/040 worked with around 750 women in 35 KWT in 6 districts. Local impact surveys carried out in 2012 found:

'monthly income benefits to group members from vegetable farming of between AUD26 and AUD74, with some individuals reporting higher seasonal incomes. The total economic benefit to the 750 women participating in the program is estimated

Table A7.2 Comparison between yield and income of ICM trials and farmer practice

Location	Yield (t/ha)		Difference		Potential gross margin (IDR/AUD/ha) [†]
	ICM experiments	Farmer practice	(t/ha)	(%)	
Naga Umbang 2010 and 2011 average	5.04	3.51	+1.53	44	IDR4,590,000 AUD510
Naga Umbang trial 2012–13	6.39	5.04	+1.35	27	IDR4,050,000 AUD450
Manyang Lancok 2011	5.7	5.25	+0.45	9	IDR1,365,300 AUD152
Manyang Lancok 2012	7.25	6.15	+1.10	18	IDR3,289,300 AUD365
Drien Bungong 2012	6.1	5.37	+0.73	14	IDR2,179,300 AUD242

Notes: † Based on farm gate price IDR3000/kg
AUD1 = IDR9,000; AUD – Australian dollar; ICM – integrated crop management; IDR – Indonesian rupiah

Table A7.3 Average yield increase, cost reduction, gross margin increase and total economic contribution per rice crop for farmers at long-term project sites and in surrounding villages

Farmer location (sample size)	Mean yield increase post-ICM adoption (t/ha)	Mean cost reduction (%)	Mean gross margin increase/ha (%)	Gross economic gain per crop from ICM [†]
Long-term project sites (103 farmers in 17.9 ha)	1.44 (33%)	22.0	23.7	IDR77,328,000 AUD8.592
Surrounding villages (618 farmers in 112.5 ha)	1.37 (34%)	17.7	18.9	IDR462,375,000 AUD51,375

[†] Based on farm gate prices: IDR3000/kg

AUD1 = IDR9,000; AUD – Australian dollar; ICM – integrated crop management; IDR – Indonesian rupiah

Source: McLeod M and Tinning G (n.d.) *Final report, Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales* (SMCN/2007/040), ACIAR.

Table A7.4 Comparison of average yield and gross margin data for farmer practice and trial results on rainfed sites in SMCN/2007/040 trials in Bireuen and Aceh Besar, 2010

Crop type	Local average [†]	Farmer practice		Improved crop management	
	Yield (t/ha)	Yield (t/ha)	Gross margin (AUD/ha)	Yield (t/ha)	Gross margin (AUD/ha)
Rainfed rice	4.0	4.1	533	5.1	912
Soybean	1.3	1.2	245	1.7	576
Peanut	1.0	0.95	210	1.8	728

[†] Aceh Besar data from BPS Aceh, 2012.

Rice IDR3500/kg, soybean IDR5000/kg, peanut IDR5000/kg.

AUD1 = IDR9000; AUD – Australian dollar

Source: McLeod M and Tinning G (n.d.) *Final report, Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales* (SMCN/2007/040), ACIAR.

Table A7.5 Soybean harvest area, production and yield, Aceh, 2007–2011

	Year				
	2007	2008	2009	2010	2011
Area harvested (ha) [†]	14,7743	32,898	45,110	37,469	37,503
Production (t) [†]	19,025	43,885	63,538	53,347	53,637
Productivity (t/ha) [†]	1.29	1.33	1.41	1.42	1.43
Average farm gate price (IDR/kg) [‡]	6,600	7,400	7,300	6,937	6,266

[†] Badan Pusat Statistik – Food and Agriculture Agency of Aceh Province, 2012

[‡] Dinas Pertanian Aceh Province

IDR – Indonesian rupiah

Source: McLeod M and Tinning G (n.d.) *Final report, Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales* (SMCN/2007/040), ACIAR.

Table A7.6 Average monthly gross margin for women farmers' groups, Aceh Besar

Group	Land area (m ²)	Production cost (IDR)	Income (IDR)	Gross margin		Home consumption	Net benefit
				Group (IDR)	Member (IDR)	Member/month (IDR)	Member/month (IDR)
Average	800	364,000	3,087,000	2,722,667	146,000	150,000 [†]	296,000

[†] Average value of home consumption from group plots (IDR5,000/day)

AUD1 = IDR9,000; AUD – Australian dollar; IDR – Indonesian rupiah

at AUD297,000/year. If this program maintains the current annual average growth in beneficiaries, within 5 years it is expected that at least an additional AUD297,000/year will benefit the families of a further 750 women farmer group members.'

Averages across all groups are shown in Table A7.6. For consistency with other 'beneficiary-only' estimates, it is assumed that 750 women gain AUD297,000 over 3 years, giving a total net gain of AUD891,000.

Aceh-wide statistics

The national and Aceh provincial levels of the Indonesian Government's statistical bureau have some time-series data available on productivity and cropping areas, although many of these do not cover the full period since the ACIAR projects began (Badan Pusat Statistik 2022a and 2022b). Nonetheless they can provide some guidance on potential Aceh-wide benefits that may have resulted from the projects over time.

Summary: project costs and benefits

The estimates and statistics above are used to give an indicative sense of returns from the 4 projects, with a range of assumptions on the dissemination of improved techniques beyond the immediate project areas and in subsequent years.

ICM rice

Limited data are available on rice price variability and the cost and usage of farm inputs since the project period. For simplicity, a constant rice price of IDR3000/kg (as pertained during SMCN/2007/040) is used, and it is assumed that input costs remained unchanged. In actuality, the cost of chemical inputs should have declined through greater efficiency (although prices are said to have increased significantly in the last year or so). On the other hand, *legowo* planting is more labour-intensive than traditional practices, so labour (and/or machinery) costs would likely have increased. These various cost factors may have approximately balanced each other out. In the absence of definitive data, all yield increases are simply assumed to translate into additional net returns to the farmer.

Based on the statistics and calculations in Table A7.9, further calculations are shown in Table A7.10 of the value of increased yields per hectare and across the entire Aceh *padi* area since ICM adoption began.

Table A7.10 suggests a total gain since 2010 of nearly AUD3400/ha, or over AUD1.2 billion across all of Aceh's *padi*-growing areas. Clearly it would be unrealistic to attribute even a small proportion of these gains to the ACIAR projects. If 10% is attributable across the entire area and timeframe, this would be a gain of around AUD121.6 million. However, as discussed elsewhere in

this report, it appears likely that ICM adoption would have taken place even without the ACIAR projects (given ICM was already national policy), albeit a few years later and perhaps with slower rollout. Moreover, unrelated improvements, such as better irrigation infrastructure, would also have likely contributed to yield increases.

With a relatively conservative attribution of 10% of the increased productivity value over just the first 3 years (and zero thereafter), the financial benefit to farmers across Aceh from the projects' ICM activities would be around AUD13.7 million (at constant 2012 prices). Alternatively, if 100% of the 3-year increase is attributed, this would equate to a total gain of nearly AUD136.8 million. The truth probably lies somewhere between these 2 figures. (Unfortunately the official statistics do not show *padi* area by *kabupaten*, so it is not possible to make attribution assumptions based on proximity to the project areas.)

Chilli

The project results and statistics above on chilli can be extrapolated to provide some rough estimates of key benefits from SMCN/2005/075. Estimates of financial returns were not provided in reporting, but if the new farmer knowledge is hypothesised to have led to a reduction of 10% in production costs (through lower input purchases), this would equate to net returns increasing by USD370 (AUD400) per farmer, or more than USD600,000 (AUD659,200) across the 1,648 trained farmers per farmer.

If the return on investment increased from 1.95 to 2.78, as recorded in Java in 2021, each farmer involved in the Aceh project would have benefited by around USD1,100 (AUD1,200) (again assuming this resulted purely from reduced production costs). Across the 1,648 farmers trained, the total net benefit would have been USD1.8 million (just under AUD2 million).

Based on Table A7.7, the average chilli production area in Aceh across the years 2015 to 2019 was 4,725 ha. Numbers of farmers are unknown, but average plot size of Java's chilli producers is around 0.32 ha (Sundari et al. 2021). Applying that figure would equate to 14,765 farmers. This suggests the project directly worked with around 11% of Aceh's chilli producers.

Using similar logic and assumptions as for ICM rice, if each of the 1,648 farmers directly trained continued to gain AUD400 as a result of project learnings for a further 3 years, then they would have collectively gained close to AUD2 million. If a further 10% of Aceh's chilli farmers also gained AUD400 annually for 3 years from learning and applying project methods, then the total project benefit would be around AUD3.5 million.

Table A7.7 Area of vegetable production, Aceh, 2015–2019

Commodity	Area (ha)				
	2015	2016	2017	2018	2019
Big chilli peppers	4,622	4,273	4,972	4,900	4,857
Cayenne pepper	3,601	3,059	3,601	3,951	4,046
String beans	2,083	2,086	1,813	1,735	1,606
Potato	3,247	2,633	1,405	803	2,166
Cucumber	1,796	1,704	932	1,375	1,421
Watermelon	1,422	1,636	747	–	–
Tomato	946	811	950	680	741

Table A7.8 Non-rice food crop productivity, Aceh, 2011–2015

Commodity	Productivity (t/ha)				
	2011	2012	2013	2014	2015
Corn	4,000	3,800	4,000	4,300	4,300
Soybean	1,400	1,400	1,500	1,500	1,500
Peanut	1,200	1,200	1,200	1,200	1,300
Green bean	1,000	1,100	1,100	1,100	1,100
Cassava	12,800	12,900	12,700	13,000	12,800
Sweetpotato	10,400	10,600	10,600	10,700	10,900

Vegetables (KWT)

Project results for KWT (SMCN/2007/040) showed a gain from vegetable production of AUD297,000 per year for 750 women, or around AUD400 per family. Again assuming constant costs and prices, replicating this gain for the same number of women over 3 years would give a benefit figure of AUD891,000. The project report suggested it was reasonable to expect similar benefits to accrue to a further 750 KWT members over the course of the following 5 years. (Although KWT now exist in most villages across Aceh, it is difficult to justify attribution beyond this.) If it is assumed that economic gains of a total of 1,500 women are attributable over 3 years, then the project's benefit to KWT totalled AUD2.673 million.

Benefit-cost comparisons

The benefit assessments above are indicative at best, but can be used to give a rough estimate of the relationship between project costs and the main financial benefits that can reasonably be attributed to the ACIAR projects. Relevant estimates and calculations are summarised in Table A7.11. Note that while no specific benefits have been calculated for the first 2 projects, their costs are included below since they effectively laid the groundwork for the later projects.

Two sets of calculations are provided. The first captures benefits only to immediate project beneficiaries over a 3-year period (within project lifetime or soon after). The second attributes a proportion of net gains across the broader Aceh farming population, as outlined in the more conservative estimates above.

If the projects only resulted in relatively short-term benefits to the farmers directly involved, then total returns would have been slightly below expenditure. However, this can confidently be viewed as an underestimate of project benefits. Using conservative assumptions on wider attributable benefits, the ratio of benefits to ACIAR expenditure is estimated at 6.08.

Table A7.9 Rice area and productivity, Aceh, 2000–2021

Year	Area			Productivity (t/ha)	Imputed padi production (area x productivity) (t/ha)	Additional yield after ICM introduction (t/ha)
	Padi rice (ha)	Other rice [†] (ha)	Total rice (ha)			
2000	293,392	5,659	299,051	4.171	1,223,738	
2001	276,626	1,771	278,397	4.223	1,168,192	
2002	351,106	4,003	355,109	4.170	1,464,112	
2003	330,298	2,455	332,753	4.209	1,390,224	
2004	310,003	3,406	313,409	4.184	1,297,053	
2005	345,291	3,587	348,878	4.178	1,442,626	
2006	316,387	4,474	320,861	4.211	1,332,306	
2007	380,095	3,256	383,351	4.251	1,615,784	
2008	314,490	2,593	317,083	4.261	1,340,042	
2009	365,363	8,833	374,196	4.332	1,582,753	
2010	359,645	4,614	364,259	4.492	1,615,525	0.2454
2011	400,917	4,159	405,076	4.657	1,867,070	0.4104
2012	431,277	7,578	438,855	4.612	1,989,050	0.3654
2013	388,881	9,006	397,887	4.668	1,815,297	0.4214
2014	428,284	11,249	439,533	4.839	2,072,466	0.5924
2015	<i>433,829</i>			5.056		0.8094
2016	439,373	8,345	447,718	5.200		0.9534
2017	<i>381,374</i>		<i>388,617</i>	<i>5.400</i>		1.1534
2018	<i>323,374</i>		329,516	5.649		1.4024
2019	<i>304,234</i>		310,012	5.530		1.2834
2020	<i>311,944</i>		317,869	5.528		1.2814
2021	<i>291,521</i>		297,058	5.503		1.2564

Notes: Area figures for 2000–2016 are from BPS Aceh; area figures for 2018–2021 and the productivity data are from national BPS. Other calculations are by the evaluation team. Gaps in data have been filled using assumptions of similar trajectories or averages. These are in italics. The 'additional yield' in the final column is in comparison to the post-tsunami, pre-ICM average over the years 2005–2009 (4.2466t/ha).

[†] Presumably dryland rice

ICM - integrated crop management

Table A7.10 Estimates of returns to rice production post-ICM introduction

Year	Area <i>padi</i> rice (ha)	Productivity (t/ha)	Additional yield after ICM introduction (t/ha)	Value [†] (constant AUD/ha)	Value across total <i>padi</i> area [†] (constant AUD)
2010	359,645	4.492	0.2454	81.80	29,418,961
2011	400,917	4.657	0.4104	136.80	54,845,446
2012	431,277	4.612	0.3654	121.80	52,529,539
2013	388,881	4.668	0.4214	140.47	54,624,818
2014	428,284	4.839	0.5924	197.47	84,571,814
2015	433,829	5.056	0.8094	269.80	117,046,929
2016	439,373	5.200	0.9534	317.80	139,632,739
2017	381,374	5.400	1.1534	384.47	146,625,430
2018	323,374	5.649	1.4024	467.47	151,166,642
2019	304,234	5.530	1.2834	427.80	130,151,176
2020	311,944	5.528	1.2814	427.13	133,241,788
2021	291,521	5.503	1.2564	418.80	122,089,056
Total				3391.60	1,215,944,337

[†] Using constant (012 farm-gate price of IDR3000/kg
AUD1 = IDR9000; AUD – Australian dollar; IDR – Indonesian rupiah.

Table A7.11 Project costs and estimated direct and (conservative) attributable benefits

	Costs (AUD)	Benefits (AUD)	Net benefits (AUD)	Benefit:cost ratio
ACIAR funds	3,304,359			
In-kind contributions	461,308			
Total expenditure	3,765,667			
Immediate beneficiaries only				
SMCN/2007/040 ICM		300,000		
SMCN/2005/075 Chilli		1,977,600		
SMCN/2007/040 KWT		891,000		
Total returns to ACIAR investment		3,168,600	(135,759)	0.96
Total returns to total project investment		3,168,600	(597,067)	0.84
Additional limited attribution				
SMCN/2007/040 ICM		13,679,395		
SMCN/2005/075 Chilli		3,749,400		
SMCN/2007/040 KWT		2,673,000		
Total returns to ACIAR investment		20,101,795	16,797,436	6.08
Total returns to total project investment		20,101,795	16,336,128	5.34

Note: Constant 2012 AUD
AUD – Australian dollar

Appendix 8: Publications resulting from the projects

'Management of soil fertility for restoring cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province' (SMCN/2005/004)

Scientific journals	Lead author gender	Lead author nationality
Rachman A (2005) 'Bagaimana sumberdaya lahan di NAD pasca tsunami', <i>Warta penelitian dan Pengembangan Pertanian</i> , 27(1).	Male	Indonesian
Conference proceedings	Lead author gender	Lead author nationality
McLeod M, Slavich P, Rachman A, Iskandar T and Moore N (2006) 'Soil and crop assessment in the tsunami affected agriculture lands of Nanggroe Aceh Darussalam Province, Indonesia', National Soils Conference, Adelaide, Australia.	Female	Australian
Iskandar T, Rachman A, Nur M, McLeod M, Subagyono K, Moore N and Slavich P (2006), 'Crop Production and soil salinity in the tsunami affected areas of the eastern coast of Aceh Province, Indonesia, Aceh Assessment Institute for Agricultural Technology, 18th World Congress of Soil Science, Philadelphia, USA.	Male	Indonesian
Associated publications and seminars	Lead author gender	Lead author nationality
Rachman A (2006) Impacts of tsunami on soil properties in Aceh. Report of the Regional Workshop on Rehabilitation of Agriculture in Tsunami Affected Areas: One and a half years later, FAO, <i>RAP Publication</i> , 17.	Male	Indonesian
Rachman A (2006) Dampak tsunami terhadap sifat-sifat tanah pertanian di NAD dan strategi rehabilitasinya, Workshop Rehabilitasi Lahan Pertanian Provinsi NAD Pasca Tsunami di Banda Aceh tanggal 23 Mei 2006.	Male	Indonesian
Slavich P (2006) Rapid assessment of soil salinity in tsunami-affected areas: Experiences from Nanggroe Aceh Darussalam province, Indonesia.	Male	Australian
Slavich P (2006) Reducing impacts of salinity on crops growing in tsunami-affected areas in Nanggroe Aceh Darussalam Province, Indonesia.	Male	Australian
Chairunas M, Ali N, Iskandar T, Nur HI, Ferizal M, Khalid J, Hamzah A and Irhas D (2006), Perkembangan salinitas dan producttivitas lahan di Kabupaten Aceh Besar, <i>Pidie dan Birreuen Provinsi NAD</i> , Communication forum Banda Aceh May 2006: Management of tsunami affected land and increasing crop productivity and farmer income.	Male	Indonesian
Nasir A, Chairunas M, Nur HI, Iskandar T, Ferizal M, Irhas, Hamzah A and Khalid J (2006) <i>Pengaruh pencucian dan pemberian pupuk terhadap padi varietas Ciherang pada lahan sawah terkena tsunami</i> , Communication forum Banda Aceh May 2006: Management of tsunami affected land and increasing crop productivity and farmer income.	Male	Indonesian
McLeod M, Slavich P and Hunt C (2006) <i>Metode untuk mengevaluasi salinitas tanah dan dinamikanya di daerah yang terkena dampak tsunami di prov. NAD</i> , Communication forum Banda Aceh May 2006: Management of tsunami affected land and increasing crop productivity and farmer income.	Female	Australian
Slavich P and McLeod M (2006) Tsunami dan salinitas tanah, Communication forum Banda Aceh May 2006: Management of tsunami affected land and increasing crop productivity and farmer income.	Male	Australian
Rachman A (2006) Damak tsunami terhadap sifat-sifat tanah pertanian di provinsi Nanggroe Aceh Daruussalam dan strategi rehbilasinya, Communication forum Banda Aceh May 2006: Management of tsunami affected land and increasing crop productivity and farmer income.	Male	Indonesian

Associated publications and seminars	Lead author gender	Lead author nationality
Yufdy PM, Sebayang L and Siagaian DJ (2006) <i>Rehabilitasi lahan dan pengembangan pertanian paca tsunami di Kabupaten Nias Selatan</i> , Communication forum Banda Aceh: Management of tsunami affected land and increasing crop productivity and farmer income.	Male	Indonesian
Rachman A (2006) <i>Rice production systems in Indonesia and the activities in the tsunami-affected areas in Aceh</i> , Yanco Agricultural Institute.	Male	Indonesian
Rachman A (2006) <i>Restoring crop production on tsunami affected soils</i> , The National Institute of Agriculture Science and Technology (NIAST), Rural Development Administration (RDA), Republic of Korea.	Male	Indonesian
Rachman A (2007) <i>Vertical and lateral movement of salt</i> . Training Workshop, Banda Aceh.	Male	Indonesian
General project presentations were made by NSW DPI team members at NSW DPI Sydney Office, NSW DPI Head Office Orange, Wollongbar Agricultural Institute (3), Grafton Research and Advisory Station, Tamworth Agricultural Institute, ACIAR Canberra.	Author unknown	Author unknown
Young E (2005) Crop Revival for Aceh after the Tsunami, <i>New Scientist</i> , Issue 2514, August.	Female	Australian
Anon (nd) <i>Australians help Acehnese farmers recover from tsunami</i> , Radio Australia	Author unknown	Author unknown
Anon (2006) Washing the salt from Aceh's wounds, <i>Ecos 128</i> , December and January.	Author unknown	Author unknown
Anon (2005) <i>The Daily Examiner</i> , Grafton, July.	Author unknown	Author unknown
Anon (2005) Australia Teliti Lahan pertanian Tsunami, <i>Serambi Indonesia</i> , 11 August. www.serambinews.com/index.php?aksi=bacaberita&rubrik=7&topik=33&beritaid=11886	Author unknown	Author unknown
Finlay J (2005) Restoring agriculture after tsunami, <i>Agriculture Today</i> , 25 August.	Female	Australian
NSW DPI (nd) <i>Research update: NSW salinity expertise aids tsunami-affected farmers</i> .	Author unknown	Author unknown
Anon (2005) Rehabilitasi Lahan Tsunami Butuh Waktu, <i>Serambi Indonesia</i> , October. www.serambinews.com/index.php?aksi=bacaberita&rubrik=2&topik=33&beritaid=13479	Author unknown	Author unknown

'Restoration of annual cropping in tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/118)

Scientific journals	Lead author gender	Lead author nationality
McLeod M, Iskandar T, Rachman A, Hunt C, Irhas Y, Ali N, Moore N, Caniago C and Slavich P (2010) 'Assessment of soil salinity using the electromagnetic induction method in tsunami affected areas of Aceh, Indonesia', <i>Agricultural Management</i> , 97(5).	Female	Australian
Conference Proceedings	Lead author gender	Lead author nationality
Agus F, Subagio H, Rachman A and Subiksa GM (31 March – 3 April 2008) 'Properties of tsunami affected soils and the management implications' 2nd International Salinity Forum, Adelaide, Australia.	Male	Indonesian
McLeod M, Slavich P, Rachman A, Iskandar T and Moore N. (3–7 December 2006) 'Soil and crop assessment in the tsunami affected agriculture lands of Nanggroe Aceh Darussalam Province, Indonesia', ASSSI National Soil Conference, Adelaide, Australia.	Female	Australian
Rachman A, Erfandi D and Dariah A (2007) 'Dinamika kondisi tanah pada lahan pertanian pasca tsunami', Balai Penelitian Tanah - Seminar Nasional BBSDLP.	Male	Indonesian
Rachman A and Erfandi D (2007) 'Dampak tsunami terhadap kondisi tanah pada lahan pertanian', Balai Penelitian Tanah – Makalah disampaikan pada Kongres Nasional IX HITI, Yogyakarta, Indonesia.	Male	Indonesian
Rachman A, Agus F, McLeod M and Slavich P (31 March – 3 April 2008) 'Salt leaching processes in the tsunami-affected areas of Aceh, Indonesia', 2nd International Salinity Forum, Adelaide, Australia.	Male	Indonesian
Slavich P, McLeod M, Moore N, Tinning G, Lines-Kelly R, Iskandar T, Rachman A, Agus F and Yufdy P (31 March – 3 April 2008) 'Tsunami impacts on farming in Aceh and Nias, Indonesia', 2nd International Salinity Forum, Adelaide, Australia	Male	Australian
Iskandar T, Rachman A, Nur M, McLeod M, Subagyono K, Moore N and Slavich P (July 9–15 2006) 'Crop production and soil salinity in the tsunami affected areas of the eastern coast of Aceh Province, Indonesia', 18th World Congress of Soil Science, Pennsylvania, USA.	Male	Indonesian
Agus F and Tinning G (1–2 July 2008) 'Proceedings International Workshop on Post-tsunami Soil Management', Cisarua, Bogor, Indonesia. Indonesian Agency for Agricultural Research and Development, Jakarta, Indonesia and New South Wales Department of Primary Industries, Wallongbar, NSW, Australia.	Male	Indonesian
Poster Anon (2007) <i>Effective communication in Aceh</i> , Indonesia, Presented at APEN (Australasia Pacific Extension Network) Conference.	Author unknown	Author unknown
Associated publications and seminars	Lead author gender	Lead author nationality
Slavich P, McLeod M, Moore N, Iskandar T and Rachman A (2006) <i>Rapid assessment of soil salinity in tsunami-affected areas: experiences from Nanggore Aceh Darussalam province, Indonesia</i> , NSW DPI Internet publication.	Male	Australian
Slavich P, McLeod M, Moore N, Iskandar T and Rachman A (2006) <i>Reducing impacts of salinity on crops growing in tsunami-affected areas in Nanggore Aceh Darussalam Province, Indonesia</i> . NSW DPI Internet publication.	Male	Australian
Extension leaflet (Indonesian) BPTP (2006) <i>Mengelola pertanian pada lahan tsunami (Managing tsunami-affected farmland)</i> , 1(1).	Author unknown	Author unknown

Associated publications and seminars	Lead author gender	Lead author nationality
Extension leaflet (Indonesian) BPTP (2006) Rapid assessment of soil salinity in tsunami affected area, 1(2).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2006) Teknologi rehabilitasi lahan tsunami untuk budidaya kacang tanah (Rehabilitation technology on tsunami-affected land for peanut), 1(3).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2006) Teknologi rehabilitasi lahan sawah tsunami untuk pengembangan padi di Prov. NAD (Lowland rehabilitation technology for rice development in NAD Province), 1(4).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Pengelolaan praktis tanaman pada tanah salin (Crop management practice on salin soil), 2(1).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Pemurnian kedelai varietas kipas putih (Purification of soybean variety of kipas putih), 2(2).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Perangkat uji tanah sawah (Soil test kits), 2(3).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Bagan warna daun (Leaf chart color), 2(4).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Komponen teknologi budidaya kedelai pada lahan kering (Technological component of soybean cultivation on dry land), 2(7).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Teknologi budidaya bawang merah (Cultivation technology of shallot), 2(7).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Teknologi pengembangan kedelai pada lahan sawah pascatsunami (Development technology of soybean on post-tsunami lowland), 2(10).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Teknologi peningkatan produksi padi sawah di lahan tsunami (Production improvement technology for lowland rice), 2(11).	Author unknown	Author unknown
Extension leaflet (Indonesian) BPTP (2007) Teknologi pengembangan padi pada lahan sawah gambut pascatsunami (Rice development technology on tsunami-affected peat soil), 2(12).	Author unknown	Author unknown
Newsletter (Indonesian and English) Anon (January 2007) Pertanian pasca tsunami (Agriculture after the tsunami).	Author unknown	Author unknown
Newsletter (Indonesian and English) Anon (April 2007) Pertanian pasca tsunami (Agriculture after the tsunami).	Author unknown	Author unknown
Newsletter (Indonesian and English) Anon (September 2007) PPertanian pasca tsunami (Agriculture after the tsunami).	Author unknown	Author unknown
Newsletter (Indonesian and English) Anon (January 2008) Pertanian pasca tsunami (Agriculture after the tsunami).	Author unknown	Author unknown
Newsletter (Indonesian and English) Anon (May 2008) Pertanian pasca tsunami (Agriculture after the tsunami).	Author unknown	Author unknown
Newsletter (Indonesian and English) Anon (July 2008) Pertanian pasca tsunami (Agriculture after the tsunami).	Author unknown	Author unknown
Booklet BPTP (2008) Soybean cultivation in Aceh.	Author unknown	Author unknown
Anon (nd) Project brochure.	Author unknown	Author unknown

Associated publications and seminars	Lead author gender	Lead author nationality
Poster Anon (nd) Rehabilitasi lahan sawah terkena tsunami.	Author unknown	Author unknown
Poster Anon (nd) Metoda pengukuran salinitas tanah secara cepat.	Author unknown	Author unknown
Poster Anon (nd) Pemupukan pasca-tsunami di desa Tanjung, Lhoknga penelitian pot.	Author unknown	Author unknown
Poster Anon (nd) Kegiatan penyuluhan untuk pemulihan tanah tsunami di Meulaboh.	Author unknown	Author unknown
Poster Anon (nd) Pengalaman membina kelompok wanita tani untuk meningkatkan produksi pertanian di Kabupaten Aceh Barat.	Author unknown	Author unknown
Poster Anon (nd) Integrated soil and crop management for rehabilitation of vegetable production in tsunami-affected areas of NAD, Indonesia.	Author unknown	Author unknown
Poster Anon (2007) Multiple posters presented at Communications Forum in Saree.	Author unknown	Author unknown
Workshop Anon (January 2007) Soils training.	Author unknown	Author unknown
BPTP (2007) Soils training workshop activity report for Bireuen, Pidie and Meulaboh.	Author unknown	Author unknown
Anon (2008) Rehabilitating agriculture after a tsunami: a guideline.	Author unknown	Author unknown
Booklet World Vegetable Centre (2008) Bekerjasama dengan organisme tanah; teman-teman kita di dalam tanah. Panduan untuk petani mengenai kehidupan organisme tanah: Working with our friends in the soil.	Author unknown	Author unknown
Extension folder (published with 2 titles) Iskandar (nd) Teknologi pengembangan padi pada lahan gambut terkena tsunami (Rice Development technology on tsunami-affected peat soil). Iskandar (nd) Demonstrasi penanaman beberapa varietas padi sawah di lahan gambut terkena tsunami (Demonstration of rice planting on tsunami-affected peat soil).	Male	Indonesian
Short film Anon (nd) Farmer-to-farmer visit to Palembang.	Author unknown	Author unknown
Short film Anon (nd) Communication meeting activity.	Author unknown	Author unknown
Short film Anon (nd) Rehabilitation of soil salinity on tsunami-affected land at Blang Krueng village, Aceh Besar.	Author unknown	Author unknown
Short film Anon (nd) Peanut demonstration plot in Lhong Aceh Besar.	Author unknown	Author unknown
Short film Anon (nd) Rice harvest: promotion of soil test kit and LCC in integrated crop management program for rice.	Author unknown	Author unknown

'Integrated soil and crop management for rehabilitation of vegetable production in the tsunami-affected areas of Nanggroe Aceh Darussalam Province, Indonesia' (SMCN/2005/075)

Scientific journals	Lead author gender	Lead author nationality
Hulugalle NR, Jaya R, Luther GC, Ferizal M, Daud S, Yatiman, Irhas, Yufniati ZA, Feriyanti F, Tamrin and Han B (2009) 'Physical properties of tsunami-affected soils in Aceh, Indonesia: 2½ years after the tsunami', <i>Catena</i> 77, 224–231.	Male	Australian
Mariyono J, Luther GC, Bhattarai M, Ferizal M, Jaya R, Fitriana N (2013). Farmer field schools on chili peppers in Aceh, Indonesia: activities and impacts. <i>Agroecology and Sustainable Food Systems</i> , 37:9, 1063–1077.	Male	Indonesian
Mariyono, Joko. (2018). Empowering rural livelihoods through farmers' field school on vegetable production in Aceh Province-Indonesia. <i>Journal of Rural Development</i> . 37. 129. 10.25175/jrd/2018/v37/i1/122696.	Male	Indonesian
Conference proceedings	Lead author gender	Lead author nationality
Bhattarai M, Ferizal M, Luther GC and Jaya R (November 4–6 2008) 'Socio-institutional and economic analysis of vegetable farming in tsunami-affected communities in Aceh, Indonesia', International Symposium on Land Use after the Tsunami: Supporting Education, Research and Development in the Aceh Region, Banda Aceh, Indonesia.	Male	Nepali
Associated publications and seminars	Lead author gender	Lead author nationality
Extension booklet (Indonesian) Fitriana N, Luther GC, Iskandar T, Ferizal M, Jaya R, Ramlan M, Tamrin, Yatiman, Daud S and Ferayanti F (2009) Red chilli pepper cultivation.	Female	Indonesian
Extension brochure (Indonesian) Luther GC and Mangan J, (2009) Natural enemies help farmers control pests.	Male	American
Bhattarai M, Fitriana N, Ferizal M, Luther GC, Mariyono J, Wu M-H. (2011). Vegetables for improving livelihoods in disaster-affected areas: a socioeconomic analysis of Aceh, Indonesia. AVRDC/WORLDVEG – The World Vegetable Center Publication No. 11–752 (<i>Research in Action</i> ; no. 6), AVRDC/WORLDVEG – The World Vegetable Center, Taiwan. 69 p.	Male	Nepali
Extension publication (Indonesian) Ma CH, Ramlan M, Luther GC and Palada MC (2009) Starter solution technology: Teknologi pupuk cair perangsang pertumbuhan.	Female	Taiwanese
Extension brochure (Indonesian) Ramlan M, Dorahy C, Luther GC and Ferayanti F (2009) How to make compost.	Male	Indonesian

'Building more profitable and resilient farming systems in Nanggroe Aceh Darussalam and New South Wales' (SMCN/2007/040)

Scientific journals	Lead author gender	Lead author nationality
McLeod M, Slavich P, Irhas Y, Moore N, Rachman A, Ali N, Iskandar T, Hunt C and Caniago C (2010) 'Soil salinity in Aceh after the December 2004 Indian Ocean tsunami', <i>Agricultural Water Management</i> , 97(5):605–613.	Female	Australian
Erfandi D and Rachman A (2011) 'Identification of soil salinity due to seawater intrusion on rice field in the northern coast of Indramayu, West Java', <i>Journal of Tropical Soils</i> , 16(2):115–121.	Male	Indonesian
Tinning G (2011) 'The role of agriculture in recovery following natural disasters: a focus on post-tsunami recovery in Aceh, Indonesia', <i>Asian Journal of Agriculture and Development</i> , 8(1).	Male	Australian
Conference proceedings	Lead author gender	Lead author nationality
McLeod M, Slavich P, Nuraida N and Huseyn E (2011) 'Nutrient mineralisation and soil carbon from organic amendments mixed with biochar in temperate Australia and tropical Indonesia', Asia-Pacific Biochar Conference, Kyoto, Japan.	Female	Australian
Slavich P, Gani A, McLeod M and Chairunas (2011) 'Rice husk biochar increases nitrogen use efficiency of low land rice in Aceh', Asia-Pacific Biochar Conference, Kyoto, Japan.	Male	Australian
Sufardi, Nisa K, Zaitun, Chairunas, Gani A, Slavich P and McLeod M (November 29–30 2011) 'Effect of NPK fertilizer and biochar application to soil chemical properties of irrigation paddy', The First Annual International Conference, Syiah Kuala University, Banda Aceh, Indonesia.	Female	Indonesian
Tinning G, Irhas, Ali N, Ismail M and Iskandar T (26–29 September 2011) 'Acehnese farmers trial conservation farming techniques', 5th World Congress of Conservation Agriculture, Brisbane, Australia.	Male	Australian
Zaitun, Nisa K, Sufardi, Chairunas, Gani A., Slavich P and McLeod M (27–30 September 2011) 'Effect of NPK fertiliser and biochar application to growth and yield of irrigation rice', The 7th Asian Crop Science Association Conference: Improving food, energy, and environment with better crops, Bogor, Indonesia.	Female	Indonesian
Samira D, Sufardi, Zaitun, Chairunas, Gani A, Slavich P and McLeod M (22–24 November 2012) 'Effect of NPK fertilizer and biochar residue on paddy growth and yield of second planting', The 2nd Annual International Conference, Syiah Kuala University Banda Aceh.	Female	Indonesian
Samira D, Sufardi, Zaitun, Chairunas and Gani A (2012) 'Pengaruh pemberian pupuk NPK dan residu biochar terhadap kandungan hara tanaman padi pada musim tanam kedua', Seminar of Aceh Food Security, Banda Aceh, Indonesia.	Female	Indonesian
Novrian F, Hayati M, Zaitun, Chairunas, Slavich P, McLeod M, Tinning G and Brad Keen (22–24 November 2012) 'Effect of biochar and compost application on Kailan yield (Brassica oleraceae)', The 2nd Annual International Conference, Banda Aceh.	Male	Indonesian
McLeod M, Slavich P, McLeod RJ and Harden S (14–18 October 2012) 'Soil and pasture responses to poultry litter biochar combined with nitrogen fertiliser on a degraded red vertisol in Tamworth, NSW, Australia', The 16th Australian Agronomy Conference, Armidale, Australia.	Female	Australian
McLeod M and Slavich P (2–7 December 2012) 'Poultry litter biochar enhances and maintains nutrient content of a degraded red vertisol amended with cow manure and maize stubble on the north west slopes of NSW, Australia', Joint SSA and NZSSS Soils Conference, Hobart, Australia.	Female	Australian

Conference proceedings	Lead author gender	Lead author nationality
McLeod M, Slavich P, Irhas B, Keen M, Ferizal C, Caniago M, Ramlan M, Ismail G, Tinning G, Gani and Iskandar T (14–18 October 2012) 'Soil and crop management to increase income of rice farmers in Aceh, Indonesia', 16th Australian Agronomy Conference, Armidale, Australia.	Female	Australian
Nazariah, Tinning G, Supriyani SP, Strempele A, Lines-Kelly R and McLeod M (2012) 'Aceh's women farmers take action on food security', International Women in Agriculture Conference, India.	Female	Indonesian
Strempele A, Nazariah, Tinning G, Lines-Kelly R and McLeod M (2012) 'Aceh's women farmers take charge of their future', International Women's Conference, Cairns, Australia.	Female	Australian
Tinning G, Nazariah and Strempele A (2012) 'Developing an agricultural network for Aceh's isolated rural women', International Rural Network Forum, Whyalla, Australia.	Male	Australian
Tinning G, Ismail M and Irhas (2011) 'Adapting to a changing climate – farmers' experience in Aceh, Indonesia', Climate II - Impacts and Adaptations, Wagga Wagga, Australia.	Male	Australian
McLeod M, Slavich P, Rachman A, Gani A, Husen E, Tinning E and Lines-Kelly R (17–20 May 2009) 'Developing collaborative biochar research in Aceh, Indonesia', 1st Asia Pacific Biochar Conference, Gold Coast, Australia.	Female	Australian
McLeod M and Slavich P (2010) 'Using EM38 to assess the progress and mechanism of salt leaching from tsunami affected soil in Aceh, Indonesia', 19th World Congress of Soil Science, Brisbane, Australia.	Female	Australian
McLeod M, Slavich P and McLeod R (2010) 'Biochar and productivity of <i>Digitaria eriantha</i> cv. <i>Premier</i> on a degraded soil in northern NSW', 25th Annual NSW Grassland Conference, Dubbo, Australia.	Female	Australian
Nisa K, Zaitun S, Chairunas, Gani A, Slavich P and McLeod M (26–27 Novemebr 2011) 'Pengaruh pemberian pupuk NPK dan biochar terhadap penyerapan N, P dan K pada tanaman padi', National Seminar of Biology, Banda Aceh, Indonesia.	Female	Indonesian
McLeod M, Slavich P, McLeod R and Harden S (3–4 May 2011) 'Biochar, water use, and productivity of <i>Digitaria eriantha</i> cv. <i>Premier</i> on a degraded soil in northern NSW', Rural Climate Change Solutions Symposium, Armidale, Australia.	Female	Australian
Associated publications and seminars	Lead author gender	Lead author nationality
Booklet Lines-Kelly R, McLeod M, Slavich P, Tinning G, Iskandar T, Moore M, Rachman A, Jenkins A and Cox J (2009) Working with our friends in the soil: A farmer's guide to life in the soil.	Female	Australian
Slavich P, McLeod M, Keen B, Tam HM and Anishan G (7 December 2012) Rice husk biochar as a soil amendment, The Joint SSA and NZSSS Soil Science Conference, Hobart, Australia.	Male	Australian
Tinning G (2010) Crop and knowledge emerge from tsunami fields.	Male	Australian
Tinning G, Slavich P, McLeod M, Lines-Kelly R, Ferizal M, Iskandar T, Nasir Ali and Irhas (2010) Intensive cropping in Aceh means more food and income, but what about the soil.	Male	Australian

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