Australian Government

Australian Centre for International Agricultural Research

Improving the sustainability of cocoa production in eastern Indonesia

5

ACIAR OUTCOME EVALUATION SERIES

Improving the sustainability of cocoa production in eastern Indonesia

Rodd Myers
Cininta Pertiwi
Dala Institute

ACIAR

2023

The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. ACIAR operates as part of Australia's international development assistance program, with a mission to achieve more productive and sustainable agricultural systems, for the benefit of developing countries and Australia. It commissions collaborative research between Australian and developing-country researchers in areas where Australia has special research competence. It also administers Australia's contribution to the International Agricultural Research Centres.

The Chief Executive Officer of ACIAR reports directly to the Australian Government Minister for Foreign Affairs. ACIAR operates solely on budget appropriation from Australia's Official Development Assistance.

The use of trade names constitutes neither endorsement of nor discrimination against any product by ACIAR.

ACIAR OUTCOME EVALUATION SERIES

By understanding the diverse outcomes delivered by ACIAR-supported research collaborations, ACIAR can demonstrate the value of investment of public funds and continuously improve research designs. ACIAR commissions independent outcome studies approximately 3 years after the conclusion of a project. These studies are designed to investigate the extent to which ACIAR projects have contributed to intended outcomes, whether these were sustained post-project and how these catalysed short- to medium-term development outcomes. Over time, these outcome studies support the development of effective agricultural research-for-development practice. Reports in this series are available on the ACIAR website (**aciar.gov.au**) or as hard copy, in limited numbers.

Suggested citation: Myers R and Cininta P (2023) 'Improving the sustainability of cocoa production in eastern Indonesia' *ACIAR Outcome Evaluation Series* No. 5, Australian Centre for International Agricultural Research, Canberra.

ACIAR Outcome Evaluation No. 5 (OE005)

ISSN 978-1-922983-02-2 (print)
ISSN 978-1-922983-03-9 (pdf)
ISBN 2653-6811 (print)
ISBN 2653-682X (pdf)

Technical editing by The Write Path
Design by Redtail Graphic Design

Cover image: Cocoa clone PBC123, resistant to vascular streak dieback. Photo: Phil Keane.

Foreword

The Australian Centre for International Agricultural Research (ACIAR) brokers and funds international research partnerships between scientists from Australia and partner countries in the Indo-Pacific region to improve the productivity and sustainability of agriculture, fisheries and forestry for smallholder farmers.

This report reviews the longer-term adoption of research results from the 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011) project, conducted in Sulawesi and West Papua between April 2011 and June 2016. The project was largely technical in nature, with an emphasis on research and the enrichment of integrated pest and disease management knowledge in the cacao smallholder sector.

The study shows that smallholders' knowledge of improved soil management, the importance of using better quality and varied planting materials, and the appropriate use of fertilisers that had been developed through the project has been maintained following project completion. However, the implementation of this knowledge has been declining over time due to a variety of social, cultural and market factors.

As a learning organisation, ACIAR is committed to understanding the diverse outcomes delivered by the research collaborations we develop, to demonstrate the value of investment of public funds, to continuously improve research design and to increase the likelihood that ACIAR-funded research improves the lives of farming communities in our partner countries. An important mechanism for achieving our aims is to work closely with the wider Australian aid program to develop promising research into improved agricultural practices and profitable enterprises at scale. The outcome evaluation series draws together the longer-term impacts and learnings from our projects, celebrates successes and informs future program development.

This publication highlights the importance of developing and maintaining relationships between Australian experts, private sector actors and smallholders in successfully extending outcomes beyond the end of research-for-development projects. It also points out the challenges in transitioning knowledge into action for smallholders operating in a market-driven environment and provides design recommendations to address these issues more intentionally in future ACIAR projects.

Prof Wendy Umberger
Chief Executive Officer, ACIAR

Abbreviations and acronyms

ACIAR	Australian Centre for International Agricultural Research
AUD	Australian dollar
BPTP	Balai Pengkajian Teknologi Pertanian, agricultural technology research centre
GERNAS	*Gerakan Nasional*, Indonesian government programme supporting cacao growers
ICRAF	International Council for Research in Agroforestry
IDR	Indonesian rupiah
IPDM	Integrated pest and disease management
Rainforest Alliance	Sustainable agriculture certification body
SOGIE	Sexual Orientation and Gender Identity and Expression
UNIPA	Universitas Papua (University of Papua)

Acknowledgements

The evaluation team would like to thank ACIAR staff who supported the various stages of this evaluation, including Bethany Davies and ACIAR research program manager Irene Kernot. The evaluation team would also like to thank the Project Leader Dr Phil Keane.

List of tables

List of figures

Contents

Summary

Between April 2011 and June 2016, the Australian Centre for International Agricultural Research (ACIAR) supported the 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011) project. The project was intended to address the decline in cacao productivity in smallholdings. The project was designed to address productivity, pest and disease management, and soil fertility issues. It also aimed to support the development of extension models, and to improve the understanding of the impact of policy settings, market-related frameworks and large-scale cacao development activities on smallholders. The stated main focus was on the livelihoods of smallholder cacao growers in areas of Sulawesi and West Papua.

This study was commissioned to establish the extent to which the research resulting from that project has been adopted in the target cacao-producing communities in the project's sites and to identify any lessons about how this was achieved. To gather primary data and information from the field, we sampled farmers and villagers from 4 of the 11 project sites and gathered data through interviews, focus group discussions and observations during on-site visits. Data collection was done in mid-2022, approximately 6 years after the original project's completion date.

Overall, the study found that the project was, and continues to be, held in high esteem by farmers and value chain actors in Indonesia and Australia.

Key findings

The following are highlights of the key findings and discussions from the study.

- **Key messages conveyed by the project in relation to the management of soil health and pests and diseases have been retained by farmers**. The farmers in the project areas acknowledge the project's contribution towards increasing their knowledge and understanding of fertiliser use, the benefits of composting, the use of clones, and practices to mitigate the spread of pests and diseases. Although the farmers report that there are factors that prevent them from sustaining certain practices promoted by the project, they also report having a better understanding of these aspects compared to before the project.
- **The project represented an example of a strong multisector partnership between academia, the private sector (Mars), and the farmer communities, and in many aspects these relationships and collaborations have continued**. The project provided several outcomes and lessons, which have supported continuing efforts by the partners around the project's key theme of integrated pest and disease management (IPDM) for cacao. For instance, the Australian academic partners' subsequent project in Papua New Guinea incorporated some of the lessons learned from the project, while the Indonesian academic partners benefited from an improved research capacity and usage of the facilities obtained through the project. Mars continued expanding its large-scale cacao breeding research program and extension activities, and the farmer communities, who clearly valued the project's presence, have used the project outputs and findings as a source of guidance for implementing better farming practices.
- **Farmers in the project areas have developed a culture of experimentation to explore IPDM-related practices that both suit their needs and can adapt to changes in the sector**. Many practices developed by farmers can be seen, which, although needing further evidence-based investigation of their impact on quality and safety, have spread among farmer communities. Some examples often mentioned in project areas are the sleeving of pods, the brushing of pods with pesticides and/or fungicides, and the selection of farm-developed hybrids resulting from the grafting of trees.
- **There is still a strong dependency on synthetic fertilisers, with many farmers noting that they have observed the benefits of fertilising their plots compared to when they do not apply fertilisers**. Current challenges in obtaining and accessing synthetic fertilisers, however, have affected their practices, but the farmers believe that there are no comparable alternatives that can be easily adopted. Also, while farmers know of and understand the advantages of organic fertilisers and composting, it is still viewed as not practical and/or less potent than using synthetic fertilisers, and so is not considered a viable alternative.
- **There is widespread understanding among farmers of the differences between planting materials and the farmers continue to experiment with different clones**. Though certain clones are thought of as the farmers' 'favourites', such as MCC01 and MCC02, S1 and S2, the farmers continue to be open to trying new clones and to selecting those that they observe to be the best for their respective plots. There is a common understanding that a clone that grows and produces well in one area or plot may not give the same results in another.

Future directions

Future directions in cacao research identified in this study include:

- Exploration of cacao production within agroforestry and/or polyculture systems and the outcomes related to yield, pest and disease resistance, and environmental and economic implications.
- Incorporation of assessments of the market and socioeconomic dynamics in the implementation of introduced practices, systems or technologies.
- Verifying, confirming or testing the quality and safety of farmer-developed techniques in relation to sustainability certifications, such as from the Rainforest Alliance.

Future directions in efforts to improve the adoption of research outcomes identified in this study, specifically in the Indonesian context, include:

- To support the adoption of the research outcomes ***by farmers*** by:
  - communicating the important connections between soil health, tree productivity and IPDM with the yield and continued production
  - developing or enabling access to appropriate tools or aiding mechanisms to support or provide alternatives to practices considered as labour-intensive or costly
  - developing mechanisms to sustain *pembinaan* (coaching) and making coaching available to farmers to help them adapt to changes in the sector.
- To support the adoption of research outcomes ***in policies*** by:
  - ensuring alignment with existing policies, for example, by looking at what extension agents are assigned to teach farmers, commodity-based subsidies, and commodity alignment with national/sub-national strategies
  - developing mechanisms to incorporate the workings of formal farmer groups and extension agents in the formulation of outreach and extension strategies
  - exploring where research can most effectively bridge gaps in existing policies and government programs related to cacao.

Introduction

Overview

The ‘Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment’ (HORT/2010/011) project, referred to here as the Sustainable Indonesian Cacao Project, operated from April 2011 to June 2016 at a cost of AUD2,016,193. It aimed to address the decline in cacao productivity in smallholdings, and the effects of changes in the value chains and regulatory frameworks on the smallholdings. The stated focus was on the livelihoods of smallholder cacao growers in Sulawesi and West Papua. The project was designed to address productivity, pest and disease management, soil fertility, the development of extension models, and the impact of policy settings, market-related frameworks and large-scale cacao development activities on smallholders.

The project had 4 key objectives:

1. To investigate the effect of improved soil management on cacao production, quality, and damage caused by cacao pod borer, *Phytophthora* diseases and vascular streak dieback.
2. To investigate the causes of the changed symptoms and severity of vascular streak dieback in cacao.
3. To continue the on-farm testing and dispersal of improved planting materials.
4. To improve the extension systems and policy settings that affect sustainable cacao production in Indonesia.

Objective 1 involved comparing soil fertility and cacao production, foliage nutrient concentrations and damage by cacao pod borer, *Phytophthora* diseases and vascular streak dieback. To do this, the project proponents established sites in Sulawesi and West Papua to conduct on-farm trials of the effects of different levels and combinations of inorganic and farm-sourced organic fertilisers on cacao production, soil fertility, and foliar nutrient concentrations. They also investigated the impact of cacao pod borer, *Phytophthora* diseases and vascular streak dieback to determine useful soil fertilisation recommendations for smallholder cacao producers. Researchers also studied the effects on the cacao yield, pest and disease incidence, and soil fertility of some currently produced composts of cacao wastes and other farm-sourced organic wastes.

Objective 2 assessed the incidence, severity and symptoms of vascular streak dieback through comparisons of the selected sites and in the fertiliser trials. They isolated and characterised the vascular streak dieback pathogen and secondary pathogen(s) and endophytes from diseased trees.

Objective 3 evaluated clone trials for assessing their resistance to vascular streak dieback. Small collections of the most promising clones were used in demonstration to the farmers and as local sources of budwood.

Objective 4 included providing training and policy recommendations. It also included carrying out model IPDM plots, farmer visits and field days, nursery building, and studies on the available extension services.

A summary of the project’s site-based activities is given in Appendix 1.

Purpose and approach

The primary purpose of **this study** is to establish the extent to which the Sustainable Indonesian Cacao Project contributed to the above outcomes by identifying the intended and unintended project results, with a particular focus on differential effects for women and men. It includes understanding the multiple pathways through which the project contributed to the outcomes, including where, how and why the adoption of research knowledge has occurred within the different actor groups.

Our overarching approach to the study was to extract lessons learned from the project, and particularly, the extent to which, and how, the research results from the project have been adopted in the target cacao-producing communities in Sulawesi and West Papua. We did this through a review of the secondary documents and by carrying out primary research interviews with a broad range of actors (including the project partners, government agencies, cacao companies, and women and men farmers), paying close attention to the differences in the perspectives and experiences of the women and men. We also analysed the changing context of cacao and the cacao markets, as starting from mid-2016, when cacao prices started decreasing to today. They are currently still lower than what they were at the end of the original project period.

Scope

This study recognises the project's technical nature and its emphasis on certain activities for the purpose of research and the enrichment of knowledge in the IPDM of cacao. As an outcome study, we sought to establish the enduring influence of the project's research activities 5–6 years after the project's completion, and to see if any remaining activities and/or outcomes from the project were either sustained or picked up by the farmer communities in the project's areas. Table 1 elaborates on the scope of this study in relation to the objectives of the project. Appendix 2 explains the project's objectives and sub-objectives in more detail.

Table 1 Study scope in relation to the project's objectives

Project objectives	Study scope in relation to the objectives
Objective 1: To investigate the effect of improved soil management on cacao production, quality, and damage caused by cacao pod borer, *Phytophthora* diseases and vascular streak dieback	This study sought to examine to what extent activities promoted by the project in relation to improving soil management as part of cacao IPDM were adopted or sustained by farmer communities, including the existing drivers and challenges in doing so. This study also explored how farmers conduct input-based practices that they prefer and/or can implement as part of their own efforts to improve cacao production and defend against pests and diseases.
Objective 2: To investigate the causes of the changed symptoms and severity of vascular streak dieback in cacao	This study did not seek to address this objective as its activities were focused more on experimental research. A relevant aspect from this objective that the study may cover is the partnerships built with universities in Indonesia during the project.
Objective 3: To continue the on-farm testing and dispersal of improved planting materials	This study sought to examine to what extent activities promoted by the project in relation to the dispersal of improved planting materials as part of cacao IPDM were adopted or sustained by farmer communities, including the existing drivers and challenges in doing so.
Objective 4: To improve the extension systems and policy settings that affect sustainable cacao production in Indonesia	This study sought to examine to what extent extension and policy-related activities promoted by the project were adopted or sustained by relevant actors, including the existing drivers and challenges in doing so.

Methodology

Study questions

The following questions were formulated to guide the study's data collection and analysis.

1. How effective was the project in **achieving enduring change** in livelihoods, cacao practices, relationships in the cacao value chain, and policy?
   - 1.1 What are the different results for women and men?
   - 1.2 What are the barriers to the adoption of new practices for directly and indirectly participating women and men?
   - 1.3 Were there gaps in the design that could have improved the project's effectiveness?
   - 1.4 Were there any unexpected benefits and what were these?
2. To what extent was the **private sector partnership** in the project effective at achieving and sustaining the project objectives?
3. What are the most **relevant future directions for cacao research** in the project areas currently?

Data collection

Primary data were collected through a hybrid of remote and in-person key informant interviews and a series of village-level focus group discussions. All the village-level interviews and focus group discussions were conducted in person.

Site selection

Site selection for the primary data collection in this study was conducted in consultation with ACIAR and the research teams and considered the resource constraints. The full list of Sustainable Indonesian Cacao Project sites is shown in Appendix 1, and 4 of these sites were selected for this study, as shown in Table 2.

Table 2 Sites selected for the primary data collection

Village	Sub-district	District	Province
Cendana Hijau	Wotu	East Luwu	South Sulawesi
Saluparemang Selatan	Kamanre	Luwu	South Sulawesi
Landi Kanusuang	Mapili	Polewali Mandar	West Sulawesi
Duampanua	Anreapi	Polewali Mandar	West Sulawesi

Sampling

Sampling for the key informant interviews was done through purposive sampling by selecting those who were likely to have knowledge about the project and the specific context of cacao production. The affiliation and gender breakdown of the key informants is shown in Table 3.

Compared to the inception report, the key informant interview and focus group targets were adjusted slightly to accommodate possible attrition and COVID-19 restrictions that required smaller focus group discussions. The limited travel options reduced the time available for interviews in the field. Whenever possible, remote interviews were performed to make up for any inability to meet in the field.

Table 3 Key informant interview summary

Actor type	Women	Men
ACIAR	-	1
Project partners	-	6
Government officials	2	1
Total	**2**	**8**

The sampling profiles for the focus group discussions are shown in Table 4. Purposive sampling was prioritised to ensure that the actor groups being interviewed were those best able to provide relevant responses and that they were representative based on the project locations. The focal point in each location was the formal or informal cacao farmer's group and/or women's group as coordinated by the head of the group or village, as relevant in each case. Separate women's and men's groups were formed for the interviews to ensure the women felt more comfortable speaking and were able to do so freely.

Purposive sampling of the individuals was performed within each of the sampled groups, with an effort made to speak with as many women as possible to minimise gender imbalance in the overall sample.

The interviews used a semi-structured interview guide developed during the inception stage. The interviews were designed to last for one hour or less and focused on demonstrations of adoption, the provision of specific examples, and lessons learned. Group interviews were approximately 90 minutes each.

Table 4 Summary of the group interview respondents by gender and location

Group	East Luwu	Luwu	Anreapi	Mapili	Total
Women	9	10	11	7	37
Men	13	16	10	14	53
Total	**22**	**26**	**21**	**21**	**90**

Cacao and site-related contexts

The Sustainable Indonesian Cacao Project intended to address concerns about cacao production at the time due to the prevalence of pests and diseases. To provide a broader view of the cacao-related contexts surrounding the project, Figure 1 shows cacao's progression in terms of production, productivity and price over time.

Figure 1a, 1b and 1c show how Indonesia's cacao production, total cacao area and productivity have changed over time. As seen from the grey shading in the figures, the project coincided with decreasing trends in both total cacao production and total cacao area. The decrease in productivity also reflects this, as calculated from the 2 variables. Not long after the project's end, production rose as did productivity. Currently, there is an upward trend in both production and productivity. Despite this, production has not yet returned to the level it was during the late-2000s prior to the start of the project. Meanwhile, productivity, although increasing since the end of the project, is still lower than it was in the mid-1990s to mid-2000s. The area planted with cacao has continued to decrease since the period of the project until now.

Meanwhile, for cacao prices, Figure 1d shows how global cacao prices fluctuated noticeably in the late-2000s into the mid-2010s. The project start coincided with a steep drop in global cacao prices, which midway through the project experienced a jump that persisted until nearing the project's end. As the project transitioned into its completion, prices continued to drop. Since the end of the project, global cacao prices have been fluctuating but in an upward trend. Despite this, prices are still lower than what they were during the latter half of the project. A finding from this study is that farmers perceive low cacao prices as a challenge and often refer to prices not being as high as they were in the past. This is explored in more detail in our findings.

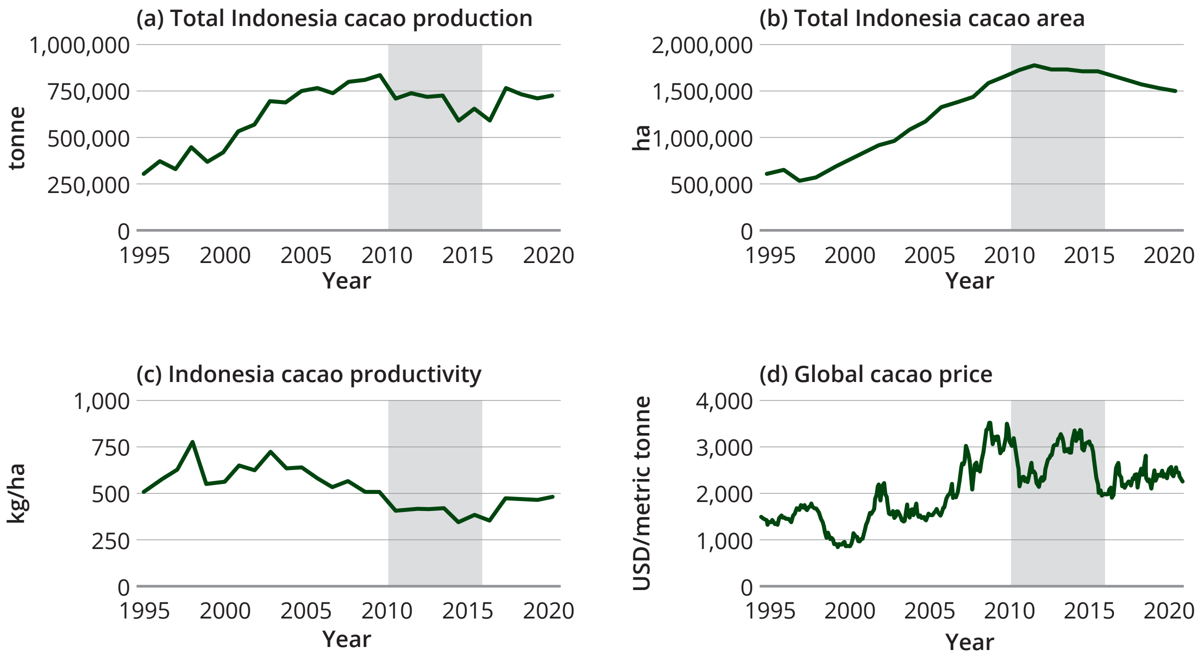

Figure 1 Cacao progression over time

Notes: The shaded areas in the graphs point to the time period of the project.

Sources: [a, b] Directorate General for Estate Crops, Indonesian Ministry of Agriculture; [c] calculated from a and b; [d] International Monetary Fund as compiled by Federal Reserve Economic Data (FRED) **https://fred.stlouisfed.org/**

Figure 2 maps the project sites (see Appendix 1 for details). As previously mentioned, selection of sites for this study considered the travel viability given the limitations brought about by the COVID-19 pandemic. Sites in the provinces of South Sulawesi (Luwu and East Luwu) and West Sulawesi (Polewali Mandar) were selected as sample sites for the study and this was discussed with the ACIAR team during the study's inception phase.

As with the national and global level cacao contexts, during visits to the sites we also encountered relevant site-specific contexts in relation to cacao. Although the information gathered was not always in relation to the questions of this study, it provided additional insights as to how certain site-specific contexts may have influenced or informed the farmers' adoption of certain cacao production practices that were promoted by the project. Table 5 provides a brief look at various aspects of the cacao context in each site, which can provide more information to understand the site-specific nuances of the study findings.

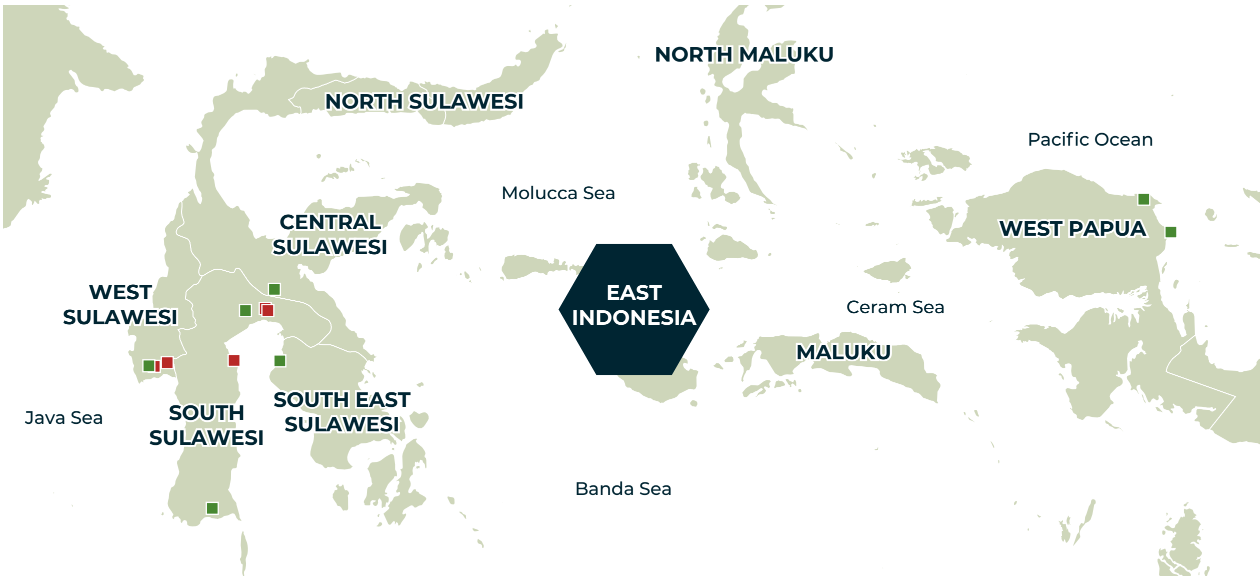

Figure 2 Sustainable Indonesian Cacao Project site locations
Note: Sites sampled for this study are noted in red.

Table 5 Site-specific cacao contexts

Site location	Cacao context
Cendana Hijau	• Limited availability of subsidised fertilisers • Cacao prices have remained low • Soil quality declining
Saluparemang Selatan	• High cost of subsidised fertilisers • Government prioritising rice; flooded lowlands • Too much rain in the wet season • Women have no activities because they are not involved in rice and the cacao sites are generally too far from home
Landi Kanusuang	• High cost of subsidised fertilisers • No alternatives to synthetic inputs • Goat urine tested as organic fertiliser but not viable for social reasons
Duampanua	• High cost of subsidised fertilisers • No market information • Women experimenting with value-add cacao activities helped by another project • Cacao sites generally far from home

Findings

The findings are presented according to evaluation questions: relevance of the project; effectiveness in achieving enduring change; partnerships, market and environmental linkages; and relevant future directions for cacao research in the project areas. Evidence is cited using the source in [square brackets], which corresponds to the interview or document number shown in Appendix 4.

Relevance of the project

Crop diseases and pests were a major problem when the project began, along with the issue of old trees that were no longer productive [02]. Cacao pod borer, known locally as *penggerek buah kakao*, causes beans to harden and become stone-like. As a result, farmers are unable to harvest the beans. In 1995–96, during the peak of the *penggerek buah kakao* infestation there was already a national government program for cacao known as *Gerakan Nasional* (GERNAS) that aimed to promote diversifying the species through the distribution of planting materials. However, there were no great clone options. *Penggerek buah kakao* was a major problem when the project started, and the local cacao varieties were not that strong against it [21b]. Some farmers recall the *penggerek buah kakao* disruptions starting as far back as 1999; yet by 2011, *penggerek buah kakao* was out of control, with more than half of the harvests lost due to it [22b].

Now there are other clones available, like MCC01, which, according to the farmers, are much better at resisting pests and diseases such as cacao pod borer and vascular streak dieback [21b]. The first clones were introduced to farmers in Saluparemang Selatan village in 2007 [22b]. For the farmers in Cendana Hijau village, 2009 was the first time they had used clones, namely S1 and S2, which could yield about 500 kg/ha [21b]. The clones that were identified by local farmers as 'superior' were then used in the project's clone testing activity as parent clones [02, 08]. The clone testing activity involved cross-pollinating different clones with the aim to find clones with a higher yield and that were resistant to pests and diseases [02, 03].

Australian experts through the project were important to the process of addressing the pest and disease problem in the project areas. 'Australia was prepared to come to the table with money, and wanted Indonesians to do the work, which was great, and then the additional expertise from Australia was a great support for the project, especially in terms of designing and implementing proper research' [01, see also 02]. The project really brought all the key actors together in a way that had not happened before [02]. The project was among the first in many areas to develop the cacao production [01]. The main objective was to find resistant varieties to address the *penggerek buah kakao* outbreak at the time [02], so the Australian experts both from the universities and Mars helped to create the process to find the best varieties [02]. There were 19 clones tested using 40,000 trees to select the best ones and the farmers were part of the process and selection. Once the best ones were selected, they were then proposed as an official variety. So, starting in 2011, the project really inspired the development of new clones until today [02].

Effectiveness in achieving enduring change

In this section, we examine the effectiveness of the Sustainable Indonesian Cacao Project in achieving enduring change through meeting the project objectives as covered in the scope of this study:

- Objective 1: To investigate the effect of improved soil management on cacao production and quality, and damage caused by pests and diseases.
- Objective 3: To continue the on-farm testing and dispersal of improved planting material.
- Objective 4: To improve the extension systems and policy settings that affect sustainable cacao production in Indonesia.

Objective 2 is outside the scope of this study and so is omitted here.

Some findings that are not within the scope of the original project objectives were found to be a lasting result from the project or were influential in how the outcomes from the project were able to be retained. These findings are covered in the partnerships, market and environmental linkages section.

Objective 1: To investigate the effect of improved soil management on cacao production, quality, and damage caused by pests and diseases

Farmers now consider the inputs for fertilising and preventing pests and diseases more because of the project. Prior to the project, the farmers generally did not use any inputs since they were expensive, but now they purchase such inputs, albeit sometimes not enough [01, 21a–24b]. 'We are now better at using pesticides than before the project', said one of the farmers [22b].

From the project, farmers in all areas know about composting but its practice has not been sustained since the completion of the project. The overall reasons that farmers have not bought into composting are myriad, including that chemical inputs are still needed for effective production [01, 02], and that while composting is good for vegetative growth, it is not so effective for the development of fruits [02, 03, 22b]. Farmers stated that chemical fertiliser use is easier. Over the last 2 years, there has been a special cacao fertiliser formula available that is subsidised and it is better than what was available in the past, so farmers prefer to use that if they can [21b, 22b]. One farmer reported, 'We have more rain than before and composting makes the water problem worse since the soil retains the water' [22b]. Another commented that 'Organic is good, but it is too much work' [22b]. While most farmers do not compost, they admitted they might if subsidised fertiliser was not available, as indeed was the case found in the discussions with the farmers.

There are some examples of composting and trenching, but these are relatively uncommon and not always a direct result of the project [04]. The government used to support a method of trench composting with different types of fertilisers known as 'rorak', but the initiative was cut short and was not continued. The main person from the Department of Agriculture who was involved in the project and in composting left in 2014 and their successors did not carry that mantle forward [04]. Universitas Hasanuddin keeps in touch with the communities and has brought them machines for composting, but the ownership structure of the machines and maintenance plans are still unclear and it remains difficult to convince the farmers of the benefits of composting [01]. Prior and subsequent projects have also encouraged composting in the project areas, but farmers were reluctant as they did not see immediate results from it [22b].

Viable alternatives to synthetic inputs remain limited. As one farmer in Luwu commented, 'Right now we can't get any subsidised fertiliser, so we all compost a bit and just use a very small amount of fertiliser, but if we can get subsidised fertiliser, we won't compost anymore' [21b]. Farmers in other areas suggested 'We have subsidised fertilisers, but the formula they prescribe is not always the right one for the farm' [22b]. Despite this, farmers suggested that many of the non-synthetic fertiliser options were not accessible either because they are not in the market, or they are overpriced. Some of them have heard of or tried on-farm production, such as compost tea, but no farmers have been practising these methods regularly. Farmers suggested an appetite for natural and organic input alternatives, but due to the reliance on subsidised synthetic fertilisers, no products have been able to attract the interest of farmers. For other types of inputs, the farmers have not heard of organic pesticides that work well.

While farmers are aware of non-chemical techniques, like composting, sleeving and the application of goat urine as pesticides, they find these methods involve too much work and/or have undesirable side effects. For example, farmers report that the sleeving technique is expensive and can cost about IDR1.5 million (AUD150) per hectare each year [22b]. They are doing pod brushing more, even though they know it is toxic and makes them dizzy sometimes, joking that their book is mostly pesticide now [21b, 22b, 23b]. Another example given by farmers is the persistent odour of goat urine, which cannot be washed off clothes or skin (suggesting that the biggest side effect is that their wives do not want to be near them for days after application) [22b]. Farmers cite that unless there is a price or market incentive for reducing chemical applications, they prefer the time-efficient and cost-efficient alternatives over the organic production techniques.

Farmers in several group interviews expressed that they tend to utilise the most cost-efficient form of inputs that the market will tolerate. So long as the market will purchase their harvest, farmers suggest they will apply any methods that save time and/or costs. For example, farmers use a pod brushing application of a mixture of pesticide and fungicide. They apply a concentrated mixture of the chemical treatment directly to the pods rather than a spraying application as the manufacturer recommends. Farmers suggest that in this way they can reduce the total amount of chemicals applied and that the method is more effective than spraying. However, the mixture is concentrated, and its application has begun to be detected by buyers, who have noted high levels of toxicity in some beans [22b].

Objective 3: To continue testing improved planting materials

In terms of the adoption of **new varieties of cacao, there was a positive, sustained uptake.** Prior to the project, farmers were using non-controlled local varieties, but by the project end, almost all had incorporated new clones into their farms. When the project started, farmers really did not know about clones or what to do about diseases and losses [01, 21a–24b]. According to a research partner, 'The project was proof of concept. Today, farmers are running their own farms and trialling new clones and practices' [01]. MCC01 is the most common clone used in Luwu, but MMC02 is also popular, and some S1/2 is still used as farmers see it as more resilient than the MCC varieties. Farmers consider that some clones look good on the first test, but do not produce well over the long run [03]. MCC01 can produce up to 3.5 t/ha in ideal conditions, but it suffers from pests more than S1 and S2. Efforts to breed improved clones continue, with hopes to produce a clone that could provide 20% more production than common production [03]. Mars is continuing to test for more clones, but no new ones have officially been approved [02].

Farmers have continued to experiment with and trial new varieties since the project ended on their own farms [01], and there have been some new varieties that are being tested, like KW617 [03]. Farmers are aware of the new varieties, and some have been involved in testing them, but since the clones are not approved by the Ministry of Agriculture, they are not yet available for broad application. Farmers are aware that KW617, for example, is highly compatible with other clones like S2, and are open to trying it on their farms [03, 21b].

However, many **farmers continue to use too few varieties on their farms and are over-dependent on one or 2 clones**, which creates risks from disease and production losses. One academic respondent said, 'Many farmers are still using just one clone on their farm … they should mix at least 3 clones to help stop the spread of diseases … Farmers just go for whatever will result in the most harvest but are not always thinking about disease control or long-term sustainability' [01, 02]. The farmers interviewed, however, acknowledged that the use of multiple clones was a good strategy. As one farmer said, 'We have to use multiple clones on the farm – should be 2 to 4 types' [22b]. In the group interviews, most farmers agreed that multiple varieties should be used, but a show of hands revealed that many farmers still do not use multiple varieties.

Demplots are no longer operational. Demplots have returned to the owners of the land, who still use them for cacao production, but they do not function as demonstration plots anymore [01, confirmed in field visits]. The farmers claimed that since the clones are readily available and there have been no new approved clones since the end of the project, there was no real need for the demplots anymore [22b].

Objective 4: To improve the extension systems and policy settings

The training within the project was well received by farmers who cited it as useful. Farmers were responsive to the training within the project and were excited to talk about cacao, have training and apply new techniques on their farms [01]. All the village-level group interviews confirmed the extent to which the farmers valued the project, even though, as will be revealed shortly, many only adopted parts of what they had learned. Women farmers and the wives of the farmers echoed the usefulness of the training despite only attending if their husbands were unable to [21a, 23a, 24a]. Some noted that they hoped more training could be offered [22a, 23a] and training specifically geared towards women would be preferred [23a].

The nurseries are no longer operational. Nurseries have closed for myriad reasons. One of which is that certified clones are too costly for the farmers and the seller must pay IDR3,500 for the permit per plant but the government facilitates the sale of seedlings of S1/2 for about IDR3,000, so it is impossible to compete [22b]. Instead, farmers source genetic material from cacao doctors or other market actors, but the availability of clones is often limited, and the rootstock and stem are both not certified [03]. The government is promoting MCC02 but recommends using at least 2 different varieties. Farmers use the best performing varieties, despite the government-recommended varieties, so according to a government respondent, it is difficult to control [04]. The first choice among farmers is MCC01, but S1 and S2 are also usually acceptable [21b]. One farmer reported that, 'The project introduced us to new clones, but we chose ourselves what we wanted to try on our farm' [22b]. S1 and S2 are the most pest-resistant in most areas, but MCC01 and MCC02 have better production according to farmers – but the best-suited variety depends greatly on the farm. 'S2 is better in the highlands but not as productive in lowlands', according to farmers [22b]. Farmers commented that, 'Although the clones are good now, the production is still not as good as 20 years ago without the clones – it's the land, it is not as fertile as before' [22b].

Figure 3 Ex-cacao nursery in Desa Salu Paremang Selatan, repurposed for garden vegetables
Photo: Rodd Myers

Partnerships, market and environmental linkages

There are continued institutional partnerships between Mars, the university partners and the communities that started during the project. There is a WhatsApp group that is maintained for collective support and information sharing [01] (farmers could not confirm this). The cacao doctor program was started after the project and makes quality seedlings available [01].

Mars setting up the Cacao Research Station was an indirect result of the project. Mars respondents attribute the impetus to start the research station to the momentum generated by the project. The research station continues to trial old and new clones under various conditions. The linkages with the project were made clear by the recognition of the Sustainable Indonesian Cacao Project team members on plaques and signs throughout the facility, including the naming of ponds in the facility which are given names such as 'David Guest' and 'Smilja Lambert' among others.

Figure 4 The Mars Cacao Research Station in Pangkep, South Sulawesi
Photo: Rodd Myers

Figure 5 Mars' daily wet bean price posted in Salu Paremang Selatan village
Photo: Rodd Myers

Market access varies in the field visit areas. Companies tend to select a whole village and try to work with all the farmers from that village [04]. In Luwu and East Luwu, Mars' presence was strong and farmers depended on them exclusively for the sale of their cacao. As one farmer expressed, 'At least with Mars we know the price. We don't know how it compares to other buyers, but they always let us know each day so we can decide to harvest or not.' The price at the time of field visits was about IDR15,000/kg (AUD1.50/kg) wet, but sometimes went down to IDR12,000/kg (AUD1.20/kg) [21b]. In some areas, there are cooperatives that can get farmers a better price, but most farmers were not members of these cooperatives because they had to travel too far to sell their cacao to the co-op [01, 23b].

Environmental changes that have occurred since the end of the project affect the appropriate practices for cacao production, harvesting and storage.

Generally, the weather has become hotter and the rain has shifted in different areas, creating new pest and cultivation problems that did not exist at the time of the project. Soil conditions have been worsening too over time, such that composting is insufficient to support effective production in many places, with one interviewee noting, 'In some ways, we have had to go back to the basics with the farmers' [01]. Also, there is much more rain now than 10 years ago [22b].

Role of the private sector partnership

In Luwu, the private sector was effective at achieving and sustaining the project objectives. Mars has educational facilities and programs, and a market dominance, which are all lacking in Polewali Mandar. This has fostered a deep market relationship with some extension services and the provision of ongoing technical assistance. More importantly, there is trust among farmers and Mars that reduces market risks and has created loyalty [21b, 22b].

Mars extension workers attempt to provide ongoing technical assistance, but the farmers have the choice of whether to adopt their advice or not [03]. If the farmer has to travel too far to get good seeds or seedlings, they are more likely to purchase them locally, even though the quality might be lower [03]. Therefore, Mars facilitates bringing the seeds and seedling sellers to them to ensure good quality inputs at a price point acceptable to the farmer [03]. Mars also facilitates the ongoing trialling of new clones with farmers [03]. Other companies in the area, such as Olam or Callebaut, are focused on monitoring, which makes farmers feel under scrutiny and they do not like it. Farmers and Mars alike attributed this relationship as key to the adoption of methods and inputs [03, 21b]. In Polewali Mandar, there is little evidence of lasting private sector linkages. While farmers remain engaged with the main market actors, this is strictly on a transactional basis and there is no ongoing commitment with Mars or any other company at a collective level.

Almost all the farmers reported that they obtain advice on production and inputs, if any, from the representatives of various companies, both the buyers, like Mars, and the sellers of the inputs. Government extension workers are not considered a source of wider information or assistance aside from determining fertiliser quotas. None of the farmers interviewed suggested that government extension workers were helpful in learning new methods or techniques. They generally mentioned that the extension workers visited once or twice a year and only to verify the land to assign the fertiliser quota for access to subsidised fertilisers [21b, 23b].

Relevant future directions for cacao research in the project areas

All the farmer respondents are heavily dependent on cacao beans for income. As one farmer put it, 'There is nothing else for us' [21b]. Cacao is still better than alternatives like coconut, palm oil, *Indigofera*, durian and others. All the farmer respondents in Desa Cendana Hijau have chickens for domestic consumption [21b]. In some areas, the farmers have rice fields and vegetable plots for domestic consumption [21b, 22a, 22b, 23a, 23b]. Despite some farmers having switched from cacao to palm oil, most still put their confidence in cacao.

In Desa Salu Paremang Selatan, government regional plans specified the farmer's area for rice production. Even though some farmland included existing cacao trees, it was flooded by irrigation canals constructed by the government. Consequently, the Department of Agriculture stated that land could be used for rice fields and the farmers have been instructed of this by the district government. However, the farmers assert that they were not made party to these plans and the irrigation canals killed their cacao trees, forcing them to move their cacao production upland. The farmers also say that the canals are not correctly positioned for rice cultivation, and as a result, the canals flood the land and the farmers do not have the ability to control the flooding, so that the village is also flooded in the rainy season. An example of one of these canals is shown in Figure 6. The farmers suggest that, 'Rice is always good, but not for income since it can only be harvested every 6 months while cacao always has a bit of harvest' [22b]. Despite continued interest in growing cacao, the farmers would prefer that their children get jobs in the city rather than work as cacao farmers [22b].

The biggest issues for farmers are:

- fertilisers
- market price
- genetic materials
- access to the market [21b].

Due to the common role of women farmers and the wives of farmers in opening pods and harvesting beans, the main challenges for them are those related to pests and diseases, which can prevent them from being able to harvest the beans.

Figure 6 Irrigation canals in the centre of the Salu Paremang Selatan village

Photo: Rodd Myers

Although the farmers have sufficient technical knowledge, there are barriers limiting actual practice. As one respondent observed, 'The same farmer will pay great attention to his rice fields but ignore cacao, then get frustrated when production is not good' [02]. Another commented, 'The social uptake is very slow with farmers – they are always excited to try but if anything doesn't fit with their expectations, they go back to normal' [02, 03]. The challenges to adoption have already been mentioned in this report, including labour and cost constraints, as well as the lack of market incentives to change. Mars is now looking at getting more young people involved, who they suggest are more willing to try new things for the longer term [02].

Clones have different strengths and weaknesses in different locations. The implications of adopting different species are still not always clear in all areas [02]. For Mars, the opening of its Cacao Research Centre in 2017 was a direct result of the project and the centre does important work in continuing to find new clones; however, the conditions under which the testing is done are not always consistent with the field, since water and fertiliser use are tightly controlled [02].

Agroforestry/polyculture holds the potential to address both the environmental and agricultural objectives together. Mars is keen to promote agroforestry and the government is happy to test it [02], however there are no official directives from the government for polyculture or agroforestry [04]. There have also been several instances of the poor application of agroforestry in the area, causing some hesitation among farmers. In these instances, the proponents chose inappropriate planting densities and the wrong varieties for intercropping. In a government program to promote agroforestry in Mapili, trees were planted every 2 metres, but cacao needs at least 5 metres between their top and the bottom of the canopy. Further, the cacao was too shaded as it needs 75% light penetration, and many agroforestry systems only have 2%, so the method is not yet perfected [03]. Mars is now working with the International Council for Research in Agroforestry (ICRAF) to find the best species [02]. Other crops, such as many vegetables, also hold potential, at least for local markets and consumption [02]. Farmers report that pest management is too hard in intercropped farms [22b].

Water supply and control remains a problem. In many cacao-growing areas, there may be no rain for 5 months of the year. This is not the case in other cacao-producing countries, like Ecuador, so in many cases the land is not ideal for cacao in Sulawesi [02]. Similarly, when the rains fall, they often provide excessive water that can flood cacao crops, as occurs in the Desa Salu Paremang Selata. Floods have also given rise to new pest problems, such as mice, which have become a problem by eating the fruits [22b].

Even though the soil quality continues to decline, the farmers have not taken up composting. The high dependency on chemical fertilisers remains. Mars is now promoting trench composting for soil health rather than for fruit production [03]. While there are some local solutions and the occasional farmer who experiments with innovative soil management, most farmers acknowledge the problem but feel that feasible solutions are out of their reach [03, 24b]. The proposition of using organic fertilisers is offset by the subsidies for synthetic fertilisers from the government [03]. The issues around composting for soil health (as a long-term strategy) must be made more urgent [03].

There is too little diversity of species in cacao production in general. Generally, the farmers continue to use too few cacao varieties on their farms, leading to an increase in diseases and issues of low production [01, 02, 03]. Even when participatory selection is used on a demonstration plot, for example, all the farmers will pick the biggest producing variety, but there is a risk that if everyone uses the same clone, production will be poor [03]. For example, MCC02 pollen is not self-compatible, so production always goes down when there is too much of it in any area. S1/2 survives better in poorer conditions and is more resilient, but also needs other clones for pollination [03]. Not only is this an issue of compatibility for pollination, but applying a diversity of varieties has advantages for pest management [03]. Mars is working with local governments to encourage farmers to maintain genetic diversity on their farms.

Farmers' pesticide practices will be curtailed by market limitations in the future. Mars is preparing to align its position with the Rainforest Alliance qualifications in 2025, meaning that synthetic pesticides or fungicides will not be permitted within the supply chain. The current practices of pod brushing are already alerting buyers to the potential of high toxicity being present, but in the coming years, these levels will not be accepted by several buyers [03]. Currently, pesticides are increasingly expensive according to farmers, and there is no subsidy for them, so organic methods are becoming more attractive to farmers [03, 24b].

Cocoa doctors remain a main source of seedlings in most areas. The 2012 cocoa doctor program trained specific farmers to become seedling suppliers to gain easy access to high-quality generic material and this remains one of the best local sources for farmers [22b, 23b].

Conclusions

The Sustainable Indonesian Cacao Project was highly relevant to the cacao actors in the target locations at the time of its implementation. It addressed the immediate needs at the time to curb cacao pod borer infestation and improve production overall. Not only was the introduction of new genetic materials and processes for production valued by the farmers, but the implementers were also adamant that the partnership with Australian institutions was critical to ensuring the quality of the research implementation and outputs.

Compared to before the project, the farmers are now more aware of the processes and inputs required for better cacao production and are more inclined to experiment with new inputs or methods. Further, the culture of farmer experimentation has continued after project completion. While this is often a positive result, there are some concerns about the parameters of the farmer experimentations, especially pertaining to activities with potential quality and safety implications. An example is the pod brushing innovation that farmers have developed, which has dubious safety implications both for the farmer and due to the level of toxicity found in the fruits. Nevertheless, the culture of experimentation seeded by the project among farmers is still evident, with examples such as a competition from farmers to make the best sample fruits from their plots. While the demonstration plots developed for the project are no longer active, the farmers suggest that all farms are now effectively demonstration plots as they are filled with the improved varieties, and when new clones are proposed, the farmers know how to experiment with them to understand their benefits and weaknesses.

Farmers have retained the knowledge of composting and pest management, but the only consistently applied practices adopted by the farmers today are the use of improved clones and basic sanitation to guard against cacao pod borer. Many of the farmers also reported the continued application of grafting techniques that they learned from the project. While the training provided during the project was highly regarded by the farmers, they have not adopted all the proposed measures, although they report having tried them on their farms.

The main barriers to adoption for certain practices are the costs – both financial and labour. Further, there are external counterforces to certain practices, like the use of organic fertilisers. The government provides subsidised synthetic fertilisers, and organic fertilisers cannot compete with these on price. Even with the awareness of improved soil health that results from composting, the farmers are more concerned with the immediate production and costs. Similarly, there remain no viable organic pesticides on the market despite the absence of subsidies on pesticides. Farms continue to favour the best-producing varieties of cacao in their fields and may be paying too little attention to genetic diversity and compatibility, which could compromise production, even of the improved species.

Another strong outcome of the project is the **relationships that were forged among the diverse cast of implementers from academia and the private sector in Australia and Indonesia**. The implementers cite this as a significant outcome that has resulted in further collaboration.

The project addressed several pressing technical issues in the cacao industry as raised by the farmers at the time of its implementation. There were clear benefits in terms of the use of improved genetic materials and improved technical production methods. However, there was **little attention given to the social and cultural dimensions of the farmers and farm families.** While the project successfully addressed the urgent need to fight the cacao pod borer infestation at the time, it was also a participatory research project that engaged deeply with farmers.

The foremost of the social and cultural dimensions mostly overlooked was the **notable lack of any explicit consideration of the gender roles in cacao production.** In the farm communities visited for this outcome study, women and men both played roles in cacao production, and women generally handled the family finances, if not the marketing of the cacao harvest. Men were generally responsible for assessing the inputs required. In some communities, especially the Bugis, the women were culturally better suited to cacao production than to other crops, because it did not involve getting muddy, like in rice paddy production. However, the project design was gender agnostic and the women farmers reported attending training if their husband was unable to, but generally as a back-up. Women were therefore not explicitly excluded from participation in the project, but there was no real effort to specifically explore the roles of women and men in production nor to understand in what ways they might benefit differently from the project results. While there may have been some missed opportunities in terms of empowering women in the communities through cacao production (value chain addition), since women are generally primarily responsible for money in the communities, the community members reported that the overall family benefited. This outcome is rather fortunate given the gender-agnostic design of the project, and may look quite different in other project areas, especially West Papua, which was not sampled for the outcome study and features quite different gender roles related to labour and decision-making in the family.

Farmers continue to formally connect with each other through farmer groups, but the collaboration is usually limited to the formation of a group for the purpose of receiving subsidised fertilisers. The project engaged with farmer groups but mostly at the level of the individual farmers, and therefore reinforced the convention of individual farming practices. Only one respondent in the group interviews suggested that he was a member of a cooperative, which was involved in collective sales and input purchases and information sharing. The project did little to engage in strengthening the capacity of farmers to negotiate or associate with buyers to obtain better prices for harvests and lower input costs. Again, the singular technical focus of the project may have resulted in missed opportunities for improving the farmers' positioning in markets or taking part in collective negotiations to the benefit of farm families.

Like the point above, while **the purpose of the project was not focused on ways to improve the bargaining power of the farmers, there was an opportunity to do so had a social science dimension been considered in the project design**. The nurseries developed in the project are now no longer operational and the farmers in some areas cite challenges in obtaining good genetic material. Similarly, a well-organised social group trained in the business of developing and selling seedlings might have been able to overcome some of these challenges today. While the technical aspects of seedling production were part of the project, the sustainability of an enterprise or association that would continue to market and sell these seedlings was not. This could have been an area to explore as an added value activity for women's groups, for example.

There was little focus on policy within the project, although there were relationships formed with policy influencers, such as researchers and Mars, and to some extent local governments. Policies that avail subsidised fertilisers at rates that make organic inputs unattractive to farmers, that repurpose land for other crops, such as rice production, and that aim to control the certification of genetic material have all affected different aspects of the sustainability of the project.

Partnership with the private sector, in this case Mars, amplified the market connections between the farmers and buyers. The design of the project helped build improved relationships between the farmers and Mars, a major buyer of cacao-based products. These relationships have been sustained in Luwu and East Luwu, where Mars have a continued and ongoing market dominance. Mars-led field schools and ongoing training also operate in these areas. Further, farmers sell almost exclusively to Mars there and are generally aware of the price of cacao every day. This greatly reduces the risks for farmers, as well as the transaction costs. However, it also means that farmers are dependent on Mars and have no linkages with other companies. The farmers reported that although they were aware of the price that Mars offers, they do not know how that price compares to other companies nor if there is a way to obtain a better price. Meanwhile, Mars' presence in Polewali Mandar is not as prominent. In Polewali Mandar, the farmers sell to a variety of different buyers, but suggest it is more a function of which buyers come to the farmgate on a given day rather than a strategic decision to sell to a buyer offering the best price. In both situations, the farmers have little knowledge about the market prices or how to get a better price for their harvest. The farmers are dependent on buyers and lack a sense of agency when it comes to shopping prices.

A final limitation of the project in terms of adoption is that there was **insufficient attention paid to reducing labour and transaction costs for farmers** in terms of the technical inputs that could overcome the barriers to adoption. For example, farmers are aware that composting can reduce the need to purchase fertiliser and that it improves soil health and water management, both of which are a concern for them. But they choose not to compost because of the intensity of labour. While the social implications of operating shared equipment is always complicated, there are machines that can help to make light work of composting, and there are varieties of trees and plants that can improve the quality and ease of composting.

Farmers continue to rely on cacao for their income and this has been maintained as the main income-generating activity in all the project areas visited for this study. Only in cases where external forces, such as the weather and land conditions, have changed was there a noted withdrawal from cacao. Farmers are concerned that the market prices have remained stagnant for a decade and are still below the high prices of 20 or 30 years ago. However, they find alternatives such as oil palm equally as unattractive and therefore have little motivation to shift to other crops. Other external forces have also dissuaded cacao production, such as district-level planning to convert farmers to rice production, in which case, farmers have had no choice but to convert flooded lands to rice and to move cacao-production upland. In a few instances, farmers also mentioned that shifts in the rain patterns made cacao production more difficult through a prolonged dry season and intense rainfall in the wet season.

Farmers continue to face challenges related to input prices, soil quality, water control and overall production. While some respondents suggested that polyculture/agroforestry systems could overcome some of these challenges, most farmers had their doubts and were primarily concerned about additional demands on their labour. The farmers suggested that they will continue to conduct the most fiscally optimal and least labour-intensive activities related to cacao production and that if markets demand that they change, they will need to be sure that any changes will result in improved financial conditions for them. Specifically, Mars' commitment to Rainforest Alliance/UTZ standards by 2025 requiring that they not use synthetic pesticides could result in them seeking other buyers or even switching crops if there are no viable alternatives offered to them. Soil quality remains a problem today, just as it was then. Although farmers have tried composting, its uptake is still not as common as the use of synthetic fertilisers.

Recommendations and lessons learned

Lessons learned

1. **Private sector partnerships can improve the sustainability of the action–research results in some contexts**. In this project, there are some specific factors that have contributed to the productive role of Mars in the communities:
   a. Cacao is predominantly a smallholder crop, meaning production is not sourced from corporate plantations, which enables farmers to have more autonomy.
   b. Mars is oriented to relationship-building with farmers in which farmers feel respected rather than exploited.

   These features will not be prevalent in all global production networks, but in this case, despite the project paying little specific attention to social and cultural issues, these have formed the basis for lasting market relationships.
2. **Knowledge and action are not the same thing**. Farmers are highly aware of what needs to be done for more sustainable production, but generally find the costs, in terms of time and finances, too high.
3. **Lack of attention to policy can compromise sustainability**. The technical nature of the project meant that the project proponents did not interact directly with government policies. This could be seen in several instances, including government planning for land-use transition from cacao to rice paddy, requirements for certified genetic material by sellers, and the subsidies of synthetic fertilisers.

Recommendations

1. **Explore agroforestry/polyculture research** for soil quality improvement, improved compost quality and additional income generation. Farmers, Mars, researchers and the government respondents all identified declining soil quality as a significant risk to cacao production.
2. **Research alternatives to prepare for Rainforest Alliance/UTZ certification** to which Mars is committed and which will require, among other conditions, no synthetic pesticides or fungicides to be used in cacao production. Farmers currently have not identified any viable alternatives to synthetic inputs. Failure to address this issue could compromise the ability of these farmers to access Mars' and possibly other cacao-buyers' markets.
3. **Design future programming with the market sociocultural dimensions of farmers in mind**, including specific components in projects that aim to address, or research, the differential impacts of initiatives on different sociocultural groups and/or vulnerable and marginalised members of communities. Further, long-term work should aim to consider the behavioural changes desired for increased cacao production, including issues of collective action for improved market access, such as enabling farmers to work together to have more decision-making authority in the global production network of cacao.

Bibliography

ACIAR (n.d.) Pilot rollout activity farmer visit and training April 2013, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

ACIAR (2015) Intro project outline Feb 2015, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

Johnson G and Sudarsono I (2015) Project final review, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

Keane P (2015) Summary of activities and key results, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

Keane P, Guest D, Lamber S and McMahon P and Neilson J (2020) Project document – comments on HORT/2010/011, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

Keane P, McMahon P, Neilson J and Guest D (2014) Annual report 2014, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

Markham R (2015) Project proposal – variation 2, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

McMahon P and Keane P (2013) Annual report 2013, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

McMahon P, Keane P and Neilson J (2012) Annual report 2012, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

McMahon P, Keane P and Guest D (2015) Project final report, 'Improving the sustainability of cocoa production in eastern Indonesia through integrated pest, disease and soil management in an effective extension and policy environment' (HORT/2010/011), ACIAR (not published).

Purwantara A and Iswanto A (2017) *Pengelolaan tanaman terpadu pada kakao: panduan bagi petani,* ACIAR Monograph No. 183, Australian Centre for International Agricultural Research, Canberra.

Appendices

Appendix 1: Summary of site-based activities in Sulawesi and West Papua

District	Village/ Sub-district	Activity	Reported results
South Sulawesi			
Bantaeng	Tana Loe	• Fertiliser in situ farm trials • Studies of pest/diseases and soil properties at project trial sites	-
North Luwu	Bone-bone, Masamba	• Fertiliser in situ farm trials • Compost in situ farm trials	• Trial microbial activity was significantly higher in the treatments that included compost. • Biomass was significantly higher in compost treatments.
		• Vascular streak dieback resistant clone (PBC123)	• Low incidence of vascular streak dieback.
East Luwu	Tarengge / Cendana Hijau, Wotu	• IPDM demplots • Clone testing demplots • District handover	• Establishment in Sulawesi of one of the world's most ambitious cacao cross-breeding programs. • Clones with potential yields of 3,000 kg/ha/year, double that of standard clones.
	Parumpanai, Wasuponda	• IPDM site / Clone testing demplots • District handover	
Luwu	Toangkajang, Kamanre	• IPDM site / Clone testing demplots • District handover • Farmer exchanges	
Pinrang (now North Kolaka, SE Sulawesi)	Tiwu	• Clone testing demplots	• Farmer selected clones (Mars) M05 and M06 showed useful resistance to *Phytophthora*.
West Sulawesi			
Polewali Mandar	Mapilli	• Compost in situ farm trials • Nursery • District handover • Farmer centre • Farmer exchanges	• Nursery constructed; skill on nursery management, including grafting technique. The farmer group is now keen to grow grafted cacao seedlings for commercial purposes. • A model farm and extension centre in West Sulawesi will continue to be used for district farmer meetings and training. • Establishment in Sulawesi of one of the world's most ambitious cacao cross-breeding programs.
	Anreapi	• Clone testing demplots • IPDM demplots • Extension officer training • Extension model design • Nursery • District handover • Farmer exchanges	
	Sumarang	• Clone testing demplots	-
West Papua			
Manokwari	Prafi	• IPDM site / Clone testing demplots • Training by Balai Pengkajian Teknologi Pertanian (BPTP) and Universitas Papua (UNIPA)	• Improved clones brought to Papua previously by project staff were grafted by farmers in Prafi and other locations.
	Oransbari	• Training by BPTP and UNIPA	-

Shaded = selected sites for primary data collection in this study.

Appendix 2: Objectives of the Sustainable Indonesian Cacao Project

Objective	
Objective 1: To investigate the effect of improved soil management on cacao production, quality and damage caused by cacao pod borer, *Phytophthora* diseases and vascular streak dieback.	
1.1	To compare soil fertility and cacao production, foliage nutrient concentrations and damage by cacao pod borer, *Phytophthora* diseases and vascular streak dieback at selected contrasting pairs of sites (for example, sites with high or low vascular streak dieback damage, high or low *Phytophthora* diseases damage, high or low production, good or poor levels of management, generally chlorotic or normal dark green foliage, hill country or alluvial plains), sites treated with various organic fertilisers (in Indonesian Coffee and Cocoa Research Institute, Mars and Cocoa Sustainability Partnership trials), and sites with different times since conversion of forest to cacao.
1.2	To establish at one site in Sulawesi and one in West Papua for on-farm trials of the effect of different levels and combinations of inorganic and farm-sourced organic fertilisers on cacao production, soil fertility, foliar nutrient concentrations and the impact of cacao pod borer, *Phytophthora* diseases and vascular streak dieback, in order to determine useful soil fertilisation recommendations for smallholder cacao producers and for further multilocation testing in participatory trials (Objective 4.1).
1.3	To study the effect on cacao yield, pest and disease incidence, and soil fertility of some currently produced composts of cacao wastes and other farm-sourced organic wastes (for example, by the Mars Symbioscience compost program), and of microbial promoters and other commercial products (for example, chelating agents) applied to soil (this will primarily be delivered by involving Hasanuddin University students in research activities).
Objective 2: To investigate the causes of the changed symptoms and severity of vascular streak dieback in cacao.	
2.1	To assess the incidence, severity and symptoms of vascular streak dieback in the comparisons of selected sites (1.1 above) and in the fertiliser trials (1.2 above) in order to study possible edaphic causes of the changes in vascular streak dieback. In the comparisons between sites with high or low incidence and damage by vascular streak dieback (1.1 above) to also measure climatic variables, and to analyse regional climatic data, to determine if these are correlated with the changes in vascular streak dieback.
2.2	To isolate and characterise the vascular streak dieback pathogen and secondary pathogen(s) and endophytes from diseased trees using both traditional methods of fungus culturing and morphological studies and new methods of DNA amplification and sequencing to determine whether a change in the pathogen and associated organisms is responsible for the changed vascular streak dieback situation.
2.3	To facilitate detailed studies by Hasanuddin University staff and students of the epidemiology of vascular streak dieback and other pests and diseases in fertiliser, clonal and IPDM trials.
Objective 3: To continue on-farm testing and dispersal of improved planting material.	
3.1	To complete the study of the current ACIAR multilocation clonal trials for resistance to vascular streak dieback and, as trees begin to bear pods, by assessing yield and quality of beans and resistance of pods to cacao pod borer and *Phytophthora* pod rot, with particular emphasis on performance of clones at particular sites.
3.2	At each IPDM site (4.1 below), to also establish small collections of the most promising clones from the earlier ACIAR and Mars cacao selection programs and the Indonesian Coffee and Cocoa Research Institute breeding program for ongoing multilocation testing, for demonstration to farmers and as local sources of budwood, and at these sites, to assess the performance of clonal material from other sources (for example, the somaclonal material distributed in the GERNAS program) on nearby farms.

Appendix 2: Objectives of the Sustainable Indonesian Cacao Project (*cont.*)

Objective	
Objective 4: To improve the extension systems and policy settings that affect sustainable cacao production in Indonesia.	
4.1	With farmer participation, conduct workshops to design and establish IPDM trials at one strategic location in Sulawesi and one in West Papua. These would be similar to those used in ASEM/2005/014 and SMAR/2005/074 but including more soil fertilisation options in addition to the one currently recommended under ASEM/2003/015, along with tree management and regular complete harvesting options. These trials will be established on farms with the participation of farmers and farmer groups and provide a focus for farmer field schools and farmer-to-farmer extension of management options. These trial sites will be integrated into evolving local extension systems and support will be provided to participating extension agencies to replicate them elsewhere. In West Papua, these trials will focus on the socially appropriate integration of cacao production into existing farming systems through intercropping. This objective will be integrated with the wider network of similar participatory trials managed by Mars as part of their technical extension activities.
4.2	To establish and test interactive models for knowledge transfer to extension services and farmers, including the use of web-based and mobile phone technology. These systems will deliver information on cacao management and the activities in the participatory trials (4.1), clone trials (3.1, 3.2) and fertiliser trials (1.2, 1.3) to all extension services at the district level, including Dinas Perkebunan, district-based extension centres, GERNAS-built resource installations, private sector buyers, and research institutes. The Cocoa Sustainability Partnership, of which Mars is the major partner active in the field, will be heavily involved in the development and testing of these systems which will also be used to deliver information on cacao prices.
4.3	To assess the role of market-based incentives and private sector certification schemes, such as UTZ Certified and Rainforest Alliance, in facilitating knowledge transfer and shaping farmer behaviour in eastern Indonesia, and to contribute to initiatives such as the National Reference Group on Cocoa, which has recently developed national indicators for sustainable cacao certification. Mars is in the process of instituting cacao certification in Sulawesi and this will provide an opportunity to assess its impact on farm management.
4.4	To develop policy recommendations to support recent government programs (such as GERNAS), and to ensure a sustainable transition to future programs upon completion of GERNAS. Policy findings will be presented to government in collaboration with key industry associations, such as Asosiasi Kakao Indonesia and the Cocoa Sustainability Partnership.

Appendix 3: List of documents reviewed

Document	Status	Purpose
Project proposal	Received by consultant	Clarification of project objectives
Project monitoring framework/plan	N/A	Clarification of project objectives
Project logical framework	In proposal	Clarification of project objectives
Project Reports – Narratives	Final Project Report received	Clarification of project progress toward objectives, unintended results, and challenges
Project Monitoring Data	Partially received	Clarification of project progress toward objectives
Project Contracts and MOUs among partners	Requested	Clarification of the nature of partnerships and agreed upon responsibilities or respective partners
Modules/materials used in Extension Training Activities	Requested; Appendix 9 of final report may suffice	Clarification of the content of the training, to align with adoption reported by respondents
Knowledge Products resulting from the project's objectives 3 and 4	Requested	Clarification of the new knowledge generated by the project activities for cross-reference with the adoption claimed by respondents

Appendix 4: List of respondents

Code	Location	Interview type	Actor type
01	Makassar	Interview	University partner
02	Makassar	Interview	Mars partner
03	Desa Cendana Hijau, Wotu, East Luwu	Interview	Mars partner
04	Desa Cendana Hijau, Wotu, East Luwu	Interview	Government
05	Polewali, Polewali Mandar	Group Interview (2 respondents)	Government
06	Remote	Interview	ACIAR
07	Remote	Interview	Mars partner
08	Remote	Group Interview (3 respondents)	University partners
21a	Desa Cendana Hijau, Wotu, East Luwu	Focus Group Discussion (Women)	Farmers, villagers, NGO
21b	Desa Cendana Hijau, Wotu, East Luwu	Focus Group Discussion (Men)	Farmers, villagers, Mars, NGO
22a	Desa Saluparemang Selatan, Toangkajang, Kamanre, Luwu	Focus Group Discussion (Women)	Farmers, villagers, government
22b	Desa Saluparemang Selatan, Toangkajang, Kamanre, Luwu	Focus Group Discussion (Men)	Farmers, villagers, government
23a	Desa Landi Kanusuang, Mapili, Polewali Mandar	Focus Group Discussion (Women)	Farmers and villagers
23b	Desa Landi Kanusuang, Mapili, Polewali Mandar	Focus Group Discussion (Men)	Farmers and villagers
24a	Desa Duampanua, Anreapi, Polewali Mandar	Focus Group Discussion (Women)	Farmers and villagers
24b	Desa Duampanua, Anreapi, Polewali Mandar	Focus Group Discussion (Men)	Farmers and villagers

Appendix 5: ACIAR outcome summary

The following table was provided by ACIAR to summarise the outcomes of the project. The scope of this study, however, was not the full project, but the adoption of the methods introduced to the farmers. Therefore, several of the indicators below are marked as outside the scope of this study, represented by [X].

Outcome	Evidence of outcome found	Supporting reference in report
Science		
Advancement of science **through the production of highly credible quality science research indicated by the following:**		
(i) The project published in peer-reviewed journals AND	[X]	
(ii) X% of outputs are articles published in peer-reviewed local language (where English is not the academic language of the context)	[X]	
Development of knowledge unique for application in context which includes:		
(i) Development of appropriate science outputs that contribute to application including training manuals, handbooks, technologies AND	Yes	Technologies, yes, seen in the findings section. We have not been able to obtain manuals.
(ii) Translation of the above science outputs for use by a clearly identified next user.	Yes	Well-documented in the findings section.

Appendix 5: ACIAR outcome summary (*cont.*)

Outcome	Evidence of outcome found	Supporting reference in report
Socioeconomic outcomes		
Improved access to socialeconomic institutions and organisations, (e.g. markets, social organisations, producer groups, cooperatives, unions, etc.) which includes:		
(i) a reduction in barriers to access (i.e. regulatory, logistic, informational) OR	Yes	Yes, to markets especially through Mars.
(ii) the enhanced capacity to meet requirements for participation (i.e. quality and food safety standards in markets).	Yes	
Expanded range of socialeconomic opportunities, which are realistic and appropriate in the context, and includes:		
(i) expanded range of employment opportunities OR	No	There was no value addition in this project, but some post-harvest options, especially selling wet beans were made possible by better market linkages in some areas.
(ii) expanded range of agricultural production options OR	No	
(iii) expanded range of post-harvest value-add options OR	Yes	
(iv) expanded range of options to extract/harvest natural resources (i.e. forests, fisheries).	No	
Reduced barriers to switching between alternative socialeconomic activities, which includes:		
(i) reduction in social barriers (e.g. gender norms, stigmas, status, etc.) OR	No	No explicit gender focus.
(ii) improved knowledge which facilitates switching (i.e. from cropping to livestock raising) OR	No	Singular focus on cacao.
(iii) decreased financial barriers to switching (i.e. better access to micro-credit, or improved application of government subsidies) OR	No	No policy engagement.
(iv) reduced regulatory/legal barriers to switching.	No	
Reduced exposure to risk (e.g. human health risk, production risk, social risk), which includes:		
(i) improved risk management/response OR	No	Risk reduction by focus on organic practices, improving market relations, and increased awareness among farmers on how to solve problems.
(ii) increased avoidance of risks OR	Yes	
(iii) improved opportunities to mitigate risk through community, government or financial arrangements (i.e. crop insurance).	No	
Increased socialeconomic returns, (e.g. wellbeing, profits) which for the systems households engage with, includes:		
(i) increased benefit flows for same cost outlay OR	Yes	Better crop resistance means better production. Potential for cost saving through composting and avoided crop losses. Generally, this is a same with less, but also avoided less with the same.
(ii) sustainment of benefit flows with decreased cost outlays OR	No	
(iii) increased benefit flows and decreased cost outlays.	Yes	
Examples include: (1) 'more with same', such as increased availability of food or resources to the household from the same outlay of effort (2) 'same with less', labour-saving techniques allow same income to be achieved with less time (3) 'more with less', new crop variety generates higher incomes with less labour time and land.		

Outcome	Evidence of outcome found	Supporting reference in report
Gender		
Increased inclusion and opportunity for women and/or diverse Sexual Orientation and Gender Identity and Expression (SOGIE) researchers within the project, in both the Australian and partner country teams, specifically:		
(i) project team composed of a minimum of either 40% women or men	No	See final report.
(ii) women and/or diverse SOGIE researchers held position of project leadership	Yes	See final report.
(iii) women and/or diverse SOGIE researchers appeared as first author on at least one of the peer-reviewed or conference publications/presentations produced in a relevant and high-ranking journal	[X]	
(iv) women and/or diverse SOGIE researchers were given scholarships and/or training opportunities.	[X]	
Where appropriate, projects may also be working toward outcomes that include:		
***Partners identify the project as influencing organisational decisions to adopt gender-inclusive policies and procedures*, including:**		
(i) a clear gender strategy	No	
(ii) HR policies are gender-sensitive	No	
(iii) representation of women and/or SOGIE researchers has increased in the higher-level functions within an organisation.	[X]	
***The generation of gender-sensitive knowledge*, which includes gender-specific publications and/or publications that include gender-disaggregated data, and there is evidence that the research has been translated for use at:**		
(i) the project level	No	See gender findings.
(ii) the organisational level	No	
(iii) the community level.	No	
Positive socioeconomic outcomes for women and/or diverse SOGIE community members, which includes:		
(i) improved access to socialeconomic institutions and organisations, (e.g. markets, social organisations, producer groups, cooperatives, unions, etc.)	Not specifically	
(ii) expanded range of socialeconomic opportunities, which are realistic and appropriate in the context	No	
(iii) reduced barriers to switching between alternative socialeconomic activities	No	
(iv) reduced exposure to risk, (e.g. human health risk, production risk, social risk)	No	
(v) increased socialeconomic agency	No	
(vi) improved socialeconomic equity (i.e. an improvement in an individual's equity share in their outputs).	No	

Appendix 5: ACIAR outcome summary (*cont.*)

Outcome	Evidence of outcome found	Supporting reference in report
Policy		
Implementation of a policy that informed stakeholders acknowledge draws on ACIAR supported research, **which is evident:**		
(i) in such a way that observable changes in state can be determined to be positive AND	No	There were no policy-oriented objectives in the project.
(ii) qualitative studies with a deliberate sample that demonstrate an acknowledged contribution to the policy process of a piece of research and analysis of the impact of these policies.	No	
Direct referencing of research in publicly available policy documents, **which include:**		
(i) reference to technical manuscripts	[X]	
(ii) sections of ACIAR support research text directly incorporated into policy		
(iii) footnoting of research documents in formal policy papers OR		
(iv) reference to ACIAR supported research in Ministerial statements and/or speeches.		
Policy actors acknowledge that there was a contribution to the policy formation process from the research outputs, **which includes an acknowledgement by policymakers in:**		
(i) impact study interviews that the research was 'one of many influences'	No	
(ii) emails and other written communication received by researchers from individual policy actors demonstrating engagement with research.	No	
The research team self-reports that policy-relevant findings were produced and communicated to known actors within the policy-making realm, **which includes the following activities being undertaken during the life of the project:**		
(i) policy dialogues convened	No	
(ii) policy briefs produced and distributed	No	
(iii) high-level stakeholder meetings held to discuss policy-relevant findings.	No	

Outcome	Evidence of outcome found	Supporting reference in report
Improved natural resource management outcomes		
Reduced production and/or better management of pollutants, which includes:		
(i) reduction in the use of harmful chemicals (herbicides, pesticides, etc.)	Yes/no	Farmers report more awareness of chemicals even if they haven't gone organic. Some have increased composting.
(ii) reduction in the overuse/run-off of nutrients OR	[X]	
(iii) reduced discharge and/or better management of wastewater.	No	
More efficient and sustainable use of available water resources, which includes:		
(i) growing more food using less water (reducing agricultural water demand) OR	[X]	This is a rainfed system. Not clear whether level of composting leads to better water retention in soil.
(ii) reducing groundwater depletion.	No	
Increased natural resource stocks, which includes:		
(i) improved soil health (i.e. improved soil structure, pH level, nutrient levels)	No	The methods taught in the project would lead to improved soil, but they are not widely adopted.
(ii) increased forest/vegetation cover OR	No	
(iii) increased wild aquatic species stocks.	No	
Increased ecological resilience, which includes:		
(i) increased or restored ecosystem biodiversity (including increased soil carbon) OR	No	Not part of project design.
(ii) rehabilitated ecosystems (i.e. coral reef systems/wetlands).	No	
Improved biosecurity, which includes:		
(i) better management of pests and diseases (animal, plant and human).	Yes	Several strategies to manage pests.
Improved climate change mitigation, which includes:		
(i) an observed improvement of natural resources (i.e. increased forest cover, improved soil carbon) OR	No	Not part of project design.
(ii) a reduced energy consumption (e.g. solar water pumps) OR	No	
(iii) establishment of new climate mitigation incentive schemes, support mechanism, extension at an institutional level.	No	
Establishment of a sustainable natural resource management system, which includes:	No	
(i) the institutionalising and implementation of sustainable practices and management of natural resources (i.e. groundwater systems, salinity management, forest resources, waterways, biodiversity).	No	Not part of project design.

Appendix 5: ACIAR outcome summary (*cont.*)

Outcome	Evidence of outcome found	Supporting reference in report
Innovation system outcomes		
Enhanced individual capacity achieved for the project team members, which includes:		
(i) improved skills development of the individual OR	Yes	Several project and partner staff cited increased networks and professional development, especially related to publications.
(ii) career progression for an individual (i.e. a promotion) OR	[X]	
(iii) an individual on the project team was awarded an ACIAR fellowship, including a John Allwright Fellowship, Pacific Scholarship or John Dillon Fellowship OR	[X]	
(iv) an individual gains an external grant for professional development OR	[X]	
(v) an individual is formally part of a mentor program with senior academics in Australia OR	[X]	
(vi) ACIAR funded individuals are contributing in the international research-for-development space.	[X]	
Improved capacity of implementing partners at an organisational level, which includes:		
(i) improved processes and procedures OR	Yes	Mars cited improved methods to engage with communities and conduct research.
(ii) improved human resources procedures OR	Yes	
(iii) the organisation has developed a clear strategy OR	[X]	
(iv) the team has the appropriate skill set for the work OR	[X]	
(v) stronger organisational leadership is demonstrated OR	Yes	
(vi) strengthened culture of research innovation and collaboration is demonstrated.		
Improved capacity of groups and/or individuals in the local community who were members of the project team (i.e. directly engaged people within the target community), which includes:		
(i) improved skills development within the engagement target area of the project	Yes	Farmers developed a culture of experimentation.
(ii) completion of training programs (including work placements) as part of the project that are relevant to their employment/daily activities OR	Yes	
(iii) completion of a formal qualification relevant to their employment/daily activities.	No	
Improved capacity of groups and/or individuals in the local community who were not directly engaged with the project, including:		
(i) the community has increased knowledge and resources relevant to the environment OR	[X]	
(ii) the community has improved skills to continue the project.		