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International Agricultural Research

An evaluation of the ACIAR Transformative Agriculture and Enterprise Development Program



2

ACIAR OUTCOME
EVALUATION SERIES

An evaluation of the ACIAR Transformative Agriculture and Enterprise Development Program

Clare Hanley and Luke Passfield
Alinea International



2022

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.

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Foreword

This report is the second in a new series of reports that are based on outcome evaluations of research programs supported by the Australian Centre for International Agricultural Research (ACIAR). ACIAR initiates, brokers, funds and manages 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.

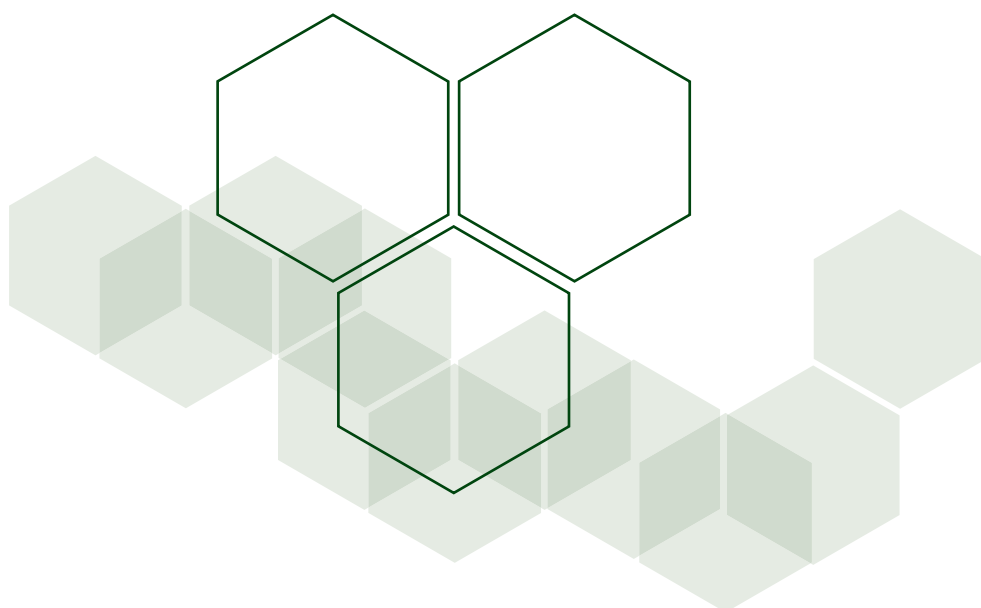
As a learning organisation, ACIAR is committed to understanding the diverse outcomes delivered by the research collaborations we develop, to demonstrate the value of investment of public funds, to inform research design and to boost the capacity of our research to improve the lives of farming communities in partner countries. An important mechanism for achieving our aims is to work closely with the wider Australian aid program to transition promising research into better agricultural practices and more profitable enterprises at scale.

This report presents a suite of evaluations of the Transformative Agriculture and Enterprise Development Program (TADEP), co-funded by the Department of Foreign Affairs and Trade (DFAT) and ACIAR from 2015 to 2021. The program was an opportunity for the 2 agencies to promote agricultural development in Papua New Guinea by leveraging a foundation of strong scientific research. It focused on opportunities to scale up successful innovations from previous ACIAR projects focused on cocoa, galip nut and sweetpotato, as well as a project developing extension methodology through the family farm teams approach. The program was also an opportunity to engage the private sector, expanding reach of the projects over larger areas and to more people. The DFAT and ACIAR investment sought to deliver efficiencies and co-benefits by linking a group of 5 projects into a programmatic structure.

The evaluations ultimately seek to understand the value that this programmatic structure delivered and identify lessons for future research-for-development investments. To inform these insights, a series of project-level outcome evaluations were conducted to see how the funded projects contributed to short-term development outcomes. Outcome evaluations adopt a largely qualitative, theory-based approach and seek to empirically test project logic and underpinning assumptions. These outcome evaluations are also intended to generate data for cross-case analysis that, over time, will help us to improve our research-for-development practice.



Andrew Campbell
Chief Executive Officer, ACIAR



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Part 5: Sweetpotato project

An evaluation of the ACIAR Transformative
Agriculture and Enterprise Development
Program sweetpotato project

Abbreviations and acronyms

ACIAR	Australian Centre for International Agricultural Research
ANU	Australian National University
ASLP	Agriculture Sector Linkages Program
CDW	Community development worker
CQU	Central Queensland University
DFAT	Department of Foreign Affairs and Trade (Australia)
FFT	Family Farm Teams
FPDA	Fresh Produce Development Agency (PNG)
LAMP	Loop-Mediated Isothermal Amplification
NARI	National Agricultural Research Institute (PNG)
NATTB	National Apprenticeships and Trade Testing Board
PGK	Papua New Guinea kina
PNG	Papua New Guinea
QDAF	Queensland Department of Agriculture and Fisheries
TADEP	Transformative Agriculture and Enterprise Development Program
TEAM	Technology evaluation and marketing

Acknowledgements

The evaluation team would like to thank Professor Phil Brown from Central Queensland University (CQU), the project leader, for his time and effort in supporting the evaluation. We also thank all the project stakeholders who gave their time to be interviewed and to participate in the verification workshop to review the evaluation findings.

The evaluation team would also like to thank Australian Centre for International Agricultural Research (ACIAR) staff who supported the evaluation.



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Summary

From 2015 to 2021, the Australian Centre for International Agricultural Research (ACIAR) oversaw the Transformative Agriculture and Enterprise Development Program (TADEP), which was a multidisciplinary research program that aimed to improve the livelihoods of rural men and women in Papua New Guinea (PNG). The program involved 5 research-for-development projects: PNG cocoa, Bougainville cocoa, galip nut, sweetpotato and Family Farm Teams.

This evaluation focuses on the 'Supporting commercial sweetpotato production and marketing in the Papua New Guinea highlands' (HORT/2014/097), known as the sweetpotato project. This project aimed to **expand market-oriented sweetpotato value chains and consequently improve the livelihoods of sweetpotato producers and their communities in the PNG highlands**. It was led by Central Queensland University (CQU), in collaboration with the Australian National University (ANU) and PNG partners, the Fresh Produce Development Agency (FPDA) and the National Agricultural Research Institute (NARI). It commenced in February 2016 and concluded in June 2021 following a 6-month extension due to COVID-19.

The budget for the project was AUD4,990,000.

The sweetpotato project objectives were:

1. To develop and strengthen market-oriented sweetpotato supply chains.
2. To build capacity of sweetpotato value chain players.
3. To develop a 'clean seed' scheme to increase availability of virus-free (or 'clean') sweetpotato planting material.

The project supported smallholders in 5 sites in the Mount Hagen-Goroka corridor (Asaro Valley, Hagen Central, Anglimb, Minj and Tsinsibai) to move from subsistence farming towards market-oriented sweetpotato production, producing specifically for the market and managing production to meet market and customer requirements.

This project evaluation is Part 5 of a suite of evaluations of TADEP, which assess the effectiveness of each of the 5 individual projects (Parts 2–6) and the lessons learned from the overall TADEP programmatic approach (Part 1).

A similar evaluation was conducted on the Agriculture Sector Linkages Program (ASLP) and is reported in ACIAR Outcome Evaluation No. 1.

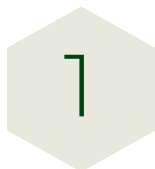
A separate synthesis report, ACIAR Outcome Evaluation No. 3, will summarise lessons from the 2 ACIAR programs, ASLP and TADEP.



Sweetpotato project farmers with a bed of *klin kaukau* seedlings in the nursery. Photo: ACIAR



Key findings



What was the project's theory of change and how did this evolve during implementation?

Based on project documentation and interviews, the evaluation team constructed an indicative theory of change for the project. The theory of change identified several core elements to achieving the project aim of strengthening commercial sweetpotato value chains. These included:

- improving sweetpotato yields and quality
- building capacity of value chain participants
- identifying and evaluating opportunities for market-oriented value chains.

The foundational elements of the theory of change were appropriate for the context of the project and intended results. A core proposition of the theory of change was that production and distribution of clean planting material was critical to increasing sweetpotato production, yields and quality in the PNG highlands. This was based on sound evidence generated through past projects in Australia and PNG evaluating the role of clean seed schemes, which indicate that virus-free planting materials have yield rates 25–75% higher than traditional growing practices.

A further strategy was to work initially with commercial growers to establish the clean seed scheme and build a group of lead farmers to use and distribute clean planting materials. This approach proved effective with these commercial growers, who actively operated secondary clean planting material propagation sites, and influenced other growers and community members in the use of clean planting materials.

An area where the theory of change evolved and adapted related to assumptions about the role and capacity of extension staff within FPDA. Early recognition of the need to build the capacity of FPDA extension officers in community-based development led to greater emphasis on FPDA staff as community development workers (CDWs) and gaining accreditation for project extension staff as CDWs.



What outcomes (intended and unintended) has the project achieved or contributed to?

Outputs

New scientific knowledge was generated through several studies designed to understand the commercial sweetpotato value chain and identify market opportunities and priorities for intervention. This included a published study mapping sweetpotato value chains, and a systematic review of literature on local value chain interventions which was presented at an international conference. The project also involved experiments to identify suitable conditions for multiplication of seed stock and trials to generate best practice recommendations for planting and harvesting of sweetpotato vines (known locally as *klin kaukau*) in the propagation facilities.

The establishment of the clean seed scheme to produce virus-free sweetpotato planting materials is the primary new technology introduced by the project. The foundations of a clean seed scheme have been established through close work and collaboration with NARI, FPDA and select commercial growers. The project has produced a *Clean Seed Scheme Laboratory Manual* to guide the work of NARI laboratory staff and a *kaukau* shade house and seedbed management manual for commercial growers. At the time of evaluation, there were 14 commercial growers operating propagation facilities and successfully multiplying and distributing clean vines for 6 varieties of sweetpotato (Gimani, Wanmun, Wahgi Besta, Beauregard, Korowest and Rachel).

Key findings (cont.)

Capacity development of value chain participants is a core objective of the project and underpinned the introduction of the clean seed scheme, and new production and post-harvest practices. NARI staff at Aiyura significantly increased their skills in virus diagnostics, with accompanying skills in nursery management, herbaceous indexing and trial design. Commercial seed propagators were trained in the management of seedbeds for multiplication of disease-free vines. Training focused on enhancing the extension service capacity within FPDA and demonstrating a community-led model for community engagement was delivered for FPDA extension staff. Community development training was carried out in 14 communities. Using an organisational approach to community engagement supports these communities to identify their goals, aspirations and training needs, which includes those they can address themselves (Road A) and those that require external assistance (Road B).

Adoption

New scientific knowledge on value chains has been used by the project team to identify a number of commercial sweetpotato growers whose value chains hold significant potential to advance the economic and social welfare of their communities. It has assisted in identifying areas for further research.

During interviews, stakeholders reported uptake and use of clean planting materials by commercial growers, as well as increasing numbers of smallholders, across the target regions. There was also a growing interest in *klin kaukau* in neighbouring communities. Commercial growers are trialling or have adopted practices relating to production and post-harvest activities to maximise the benefits from the use of *klin kaukau*.

Through its strong focus on building the capacity of FPDA extension workers and CDW training within FPDA, the project has supported a shift in how FPDA engages with growers and communities. Two significant development actors, Oil Search and Ok Tedi Development Foundation, are in the process of adopting the CDW standard and complementary technology, including training materials on the organisational planning approach.

Outcomes

There is increased understanding of sweetpotato value chains, including production, distribution and marketing of sweetpotato in the 3 main commercial growing areas of the PNG highlands. It is too early to fully assess the extent to which scientific knowledge outputs will influence key institutions such as NARI and FPDA into the future. However, FPDA has established a sweetpotato program as a result of the project.

The clean seed scheme along with changes in agronomic practices has resulted in an increase in the value of sweetpotato commercial production.

Greater levels of production and increased yields of sweetpotato in the targeted communities are enabling a shift towards more market-oriented production. Higher yields and improved sweetpotato appearance are beginning to provide access to new, higher value markets for growers, including direct sales to supermarkets in centres such as Port Moresby.

New business opportunities now exist and are being used by value chain participants to generate improved incomes. Commercial growers participating in the project have established new income sources through the sale of clean sweetpotato vines. Training and support to other value chain participants, including grower groups and community members, has led to the emergence of new sweetpotato-related businesses generating new income streams. These include selling products made from sweetpotato such as cakes, biscuits and noodles, and using sweetpotato roots and vines as feed to improve the quality of poultry and livestock.

There is also reported evidence of broader community social and health outcomes of the project, including better nutrition and improved housing as a result of increased incomes. There is the potential for improved soil health through greater crop rotation and enhanced resilience through access to the new 'seed bank'.



3

How did project activities and outputs contribute to the outcomes achieved?

The clean seed scheme has been the key driver of increasing production levels and yields of sweetpotato in the 5 sites in the Mount Hagen-Goroka corridor. The project's focus on targeting a select group of commercial growers as the entry point to introducing *klin kaukau* was an important factor in achieving outcomes. Initial concerns and resistance were overcome by demonstration of the potential yield and quality benefits of using clean planting material. This has led to strong demand for vines.

Stakeholders credit FPDA extension officers as playing a critical role in adoption of clean planting materials. This occurred in a context where there were staff and management-level changes within FPDA. The key FPDA extension staff working on the project were seen as playing an essential role in selecting farmers to work with, engaging with farmers, building trust, providing ongoing support, and progressing the rollout of the clean seed scheme and adoption of *klin kaukau* by growers, grower groups and other smallholders across the region. An important shift in the project design was increasing the focus on developing the skills and capability of FPDA extension staff in community-led development. A key factor in success of this process was drawing on the expertise of community development professionals with significant experience in PNG and leveraging and aligning with PNG national standards for CDWs.

A 2019 study tour to Australia for commercial farmers played an important role in motivating them to develop their enterprises and adopt improved production and post-harvest practices. Most of the growers that participated in the training are reported to have adopted new production and post-harvest practices and have developed a strong interest in developing irrigation systems and infrastructure.

Some issues were raised related to sustainability of the project outputs. Specifically, there was concern that the project funds the purchase of clean planting material from NARI and distribution to commercial growers by FPDA, and that this will cease at the end of the project. Supporting growers to develop a profitable business model that includes buying the clean vines, propagating and selling them will be important moving forward.

Key findings (cont.)

4

What strategies were adopted to address gender equity and social inclusion and how effective were these?

According to the project design, a secondary focus and enabling strategy of the project is to create economic opportunities for rural women through small enterprise development. There were actions taken by the project to address gender equity. These included ensuring women commercial growers were part of the select group to propagate *klin kaukau*, encouraging women's participation in training and community development workshops, and supporting the development of women-led enterprises for value-added products.

Like their male counterparts, women commercial growers participating in the project improved their sweetpotato production and yields and benefited from business development support. There is also evidence of more fledging women-led small enterprises being established. However, it is unknown what impact this had on gender equity and the extent to which women have control of this income.

Consistent with our findings in other project-level reports in TADEP, a gender and social inclusion analysis undertaken early during project design, and a targeted gender strategy, might have contributed to more strategic gender outcomes. Issues relating to the selection of commercial growers to be supported by the project, such as the potential impact on social inequalities, could have been addressed as part of these early processes.

5

How did management arrangements impact delivery of the project?

The project leader had a strong commitment to empowering PNG partners, in particular FPDA, to drive the project and let each partner take leadership of their respective areas. The project demonstrated a participatory and adaptive approach to working with communities and addressing community-identified needs and priorities.

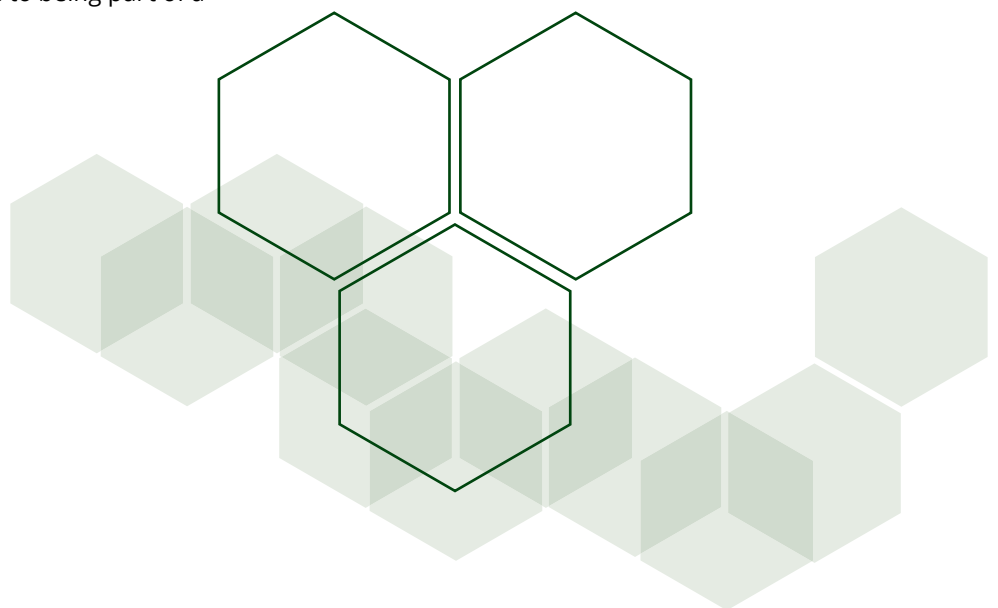
Communication between NARI and FPDA was a challenge and could have been improved through more frequent conversations between the organisations and coordination meetings. There were some signs that the project's Australian partners tended to work in silos with their PNG counterparts without knowledge of the actions of other project team members. More regular project coordination meetings may have enhanced communication, coordination and delivery of the project.



6

How well did the project align with and contribute to the overall goals of its umbrella program?

The project aligns with and has contributed directly to 4 of the 5 overall TADEP goals. The project was conceived with the intention of engaging with and drawing on the work of other TADEP projects, particularly the Family Farm Teams (FFT) project, for approaches to empowering women and increasing their business skills. While the project supported the delivery of FFT in some communities where this was requested, there was generally very limited collaboration with other TADEP projects. The different focus of the projects, dispersed geographies and differing challenges faced by the projects were raised as possible reasons for this lack of collaboration. The sweetpotato project was perceived as quite different to the galip nut and cocoa projects and therefore an outlier to an extent. Overall, there were benefits of being part of TADEP, including information sharing between projects (particularly through annual workshops), informal mentoring from other projects, access to the CommCare app, and greater prominence and traction with PNG partners due to being part of a broader program.



Conclusions and lessons learned

Since its commencement in February 2016, the sweetpotato project has achieved significant results in terms of establishing the foundations of a scheme to provide clean planting materials, and enabling commercial growers to expand production through the use of higher yielding and better quality *klin kaukau*. These lead farmers are taking on increased roles as farmer traders – coordinating and aggregating produce from growers in their communities and encouraging the expanded use of *klin kaukau*. These farmers have also established new sources of income through the sale of clean planting material, and new enterprises in the sweetpotato value chain are emerging. Access to higher value markets has commenced, underpinned by research identifying challenges and opportunities with the value chain relating to post-harvest practices, distribution and marketing. This is an area requiring further research, strategic interventions and investment.

Significant effort has been invested in capacity development of staff within NARI and FPDA in PNG, farmers, grower groups and communities. The project has taken an adaptive approach responding to identified capacity-building needs within partner organisations and communities more broadly.

Lesson learned

Endline studies will provide comparative ‘hard’ data on changes to the sweetpotato value chain including production levels and business development. General lessons for ACIAR in relation to implementation of research-for-development projects and the programmatic approach include:

- 1. The project design made some implicit assumptions about the capacity of partner organisations, particularly FPDA, to engage effectively with farmers and communities using a community-led development approach.** This project highlights the importance of identifying and assessing assumptions about the capacity of partner organisations, including their internal operating environments at the design stage and developing appropriate strategies to address these development needs. **A strength of the project was the willingness to respond to capacity-development needs** by initially focusing on building the capacity of FPDA staff in community-led engagement.
- 2. This project illustrates the value of drawing on existing knowledge and local structures and standards,** for instance for the CDWs. Developing training compliant with the PNG standards, building internal policy to support the change, and accrediting staff has led to broader institutional adoption and impact in FPDA, and adoption by other key development actors.
- 3. Gender and social inclusion analysis and development of a targeted gender equality and social inclusion strategy would assist projects in developing a more strategic approach** to influencing gender equity and women’s empowerment, and ensuring people with disability and other marginalised groups can also benefit from the project. This needs to be monitored during implementation. This observation is common across a number of TADEP projects considered by the evaluation team.
- 4. There are opportunities to enhance the value of a programmatic approach more broadly.** While collaboration between projects is one element, there are broader opportunities for considering more strategic whole-of-program investment in key enablers such as capacity development for common project partners such as NARI and FPDA.



Introduction

Purpose, scope and audience

Since 1982, the Australian Centre for International Agricultural Research (ACIAR) has brokered and funded research partnerships between Australian scientists and their counterparts in developing countries.

As Australia’s specialist international agricultural research-for-development agency, ACIAR articulates its current mission as ‘achieving more productive and sustainable agricultural systems, for the benefit of developing countries and Australia, through international agricultural research partnerships’. ACIAR receives a direct funding appropriation from the official development assistance budget, as well as contributions for specific initiatives from external sources including the Department of Foreign Affairs and Trade (DFAT).

From 2015 to 2021, ACIAR managed the Transformative Agriculture and Enterprise Development Program (TADEP) in Papua New Guinea (PNG). The program focused on opportunities to scale up successful innovations from previous ACIAR projects in PNG, with impetus provided by private sector involvement, over larger areas and for more people. It was expected to achieve economic benefits, especially increased employment and incomes in rural areas, and enhanced rural-urban supply chains. It worked in the sectors of greatest benefit to rural communities and had a particular focus on the empowerment of women and commodities that could be brought to market.

ACIAR commissioned project-level evaluations of the TADEP projects shown in Table 18 to identify lessons that will inform the design and implementation of future ACIAR projects and improve the quality of outcomes. These evaluations form Parts 2–6 of Outcome Evaluation 2.

Drawing on these project evaluations, the program-level evaluation (Outcome Evaluation 2, Part 1) includes an analysis of the program structure and the value-add from these management arrangements.

A similar evaluation has been undertaken for the ACIAR Agriculture Sector Linkages Program (ASLP) in Pakistan (Outcome Evaluation 1), and the ASLP and TADEP evaluations will be synthesised into a final report to outline common lessons from ACIAR programs (Outcome Evaluation 3).

This evaluation focuses on the commodity-specific sweetpotato project.

Purpose

The project-level evaluation has 2 key purposes:

1. Compile performance information from each project under TADEP and investigate the contribution to specific project outcomes, with a particular focus on differential effects for women and men.
2. Generate project-level case studies for use in a qualitative cross-case analysis.

Table 18 Projects in TADEP

Program / Project	Project full name
PNG cocoa	Enterprise-driven transformation of family cocoa production in East Sepik, Madang, New Ireland and Chimbu provinces of Papua New Guinea
Bougainville cocoa	Developing the cocoa value chain in Bougainville
Sweetpotato	Supporting commercial sweetpotato production and marketing in the Papua New Guinea highlands
Galip Nut	Enhancing private sector-led development of the <i>Canarium</i> industry in Papua New Guinea
Family Farm Teams	Improving opportunities for economic development for women smallholders in rural Papua New Guinea

Scope

This project-level evaluation assesses 'Supporting commercial sweetpotato production and marketing in the PNG highlands' (HORT/2014/097), known as the sweetpotato project. It provides an assessment against the following key evaluation questions:

1. What was the project's theory of change and how did this evolve during implementation?
 - Was the theory of change appropriate to the project context and desired results?
2. What outcomes (intended and unintended) has the project achieved or contributed to?
 - What was the unique knowledge contribution of the project/cluster that was/is expected to influence practice/policy?
 - To what extent is there evidence of adoption of new practices based on research process and findings?
3. How did project activities and outputs contribute to the outcomes achieved?
 - To what extent and how did they differ from what was planned?
4. What strategies were adopted to address gender equity and social inclusion and how effective were these?
 - How did the project impact men and women differently?
5. How did management arrangements impact delivery of the project?
 - What other factors influenced project performance?
6. How well did the project align with and contribute to the overall goals of its umbrella program?
 - To what extent has the programmatic approach added value at project level?

Audiences

The primary audience for this programmatic evaluation is ACIAR staff with direct responsibilities for programs and/or their constituent projects. This includes Canberra-based research program managers and field-based program managers and coordinators.



Methodology

Data collection and analysis

Data was primarily drawn from existing project reports and reviews, supplemented by data collected from key stakeholders through semi-structured interviews and written responses to interview questions. Stakeholders were intentionally selected in consultation with Australian Centre for International Agricultural Research (ACIAR) (see Appendix 5.1). Interviews were conducted with 8 stakeholders online using Zoom and via telephone. Thematic analysis of data collected through these processes was undertaken using NVivo qualitative data analysis software to distil findings.

ACIAR working definitions and assessment frameworks for project outputs, outcomes and ‘next users’ were used to analyse, categorise and summarise findings (see Table 19). In addition, economic and gender equality outcomes were assessed in line with the project design. Preliminary findings were shared and tested in a project validation workshop involving most of the stakeholders consulted. These workshops provided the opportunity to ‘ground-truth’ the assessments, identify any key issues not addressed, clarify any areas of uncertainty and correct any misinterpretations. A draft evaluation report was then prepared for review by ACIAR and finalised in accordance with feedback received.

Limitations

The evaluation relied heavily on data produced through project analysis and reporting, with only a small number of interviews completed. Interviewees were intentionally selected by ACIAR, the evaluation team and the project leader, and interviews were primarily undertaken with members of the project team. This meant there were limited opportunities to triangulate some findings, and perspectives on the outcomes of the project may have a positive bias.

Conducting interviews via Zoom or phone provided limited opportunity to build rapport with interviewees, and in some cases, poor phone/internet connections disrupted interviews and may have limited understanding and interpretation of non-verbal communication cues.

The project was extended a further 6 months until the end of June 2021, which means that further data will become available. In particular, an endline study of sweetpotato production, supply and marketing in the Papua New Guinea (PNG) highlands will include additional quantitative analysis of changes in commercial sweetpotato value chains in the region.

Table 19 ACIAR project outcome assessment terminology

Outputs	Next users	Outcomes
Scientific knowledge: New knowledge or current knowledge tested in other conditions, locations, etc.	<ul style="list-style-type: none"> Individual scientists/researchers/ agricultural professionals Individuals responsible for the management of research or a government institution Producers that the project engages directly or influences outside its immediate zone of operation (for instance, at scale), including crop and livestock producers as well as fisherfolk Public and private extension service providers Public policy actors Public and private value chain operators Consumers 	Scientific achievement: Researchers use scientific knowledge outputs to make new discoveries or do their work differently
Technologies: New or adapted technologies and products that offer added value to intended end users		Capacity built: Project partners or stakeholders use enhanced capacity to do something differently
Practices: New practices and processes		Innovation enabled: Includes the adoption of improved technologies, systems or processes, access to new markets, or changes in the opinions or practices of policymakers and advocates
Policy: Evidence for policy formulation		
Capacity building: Short courses, academic training, coaching and mentoring		

Ethical considerations

The evaluation was conducted in accordance with the *DFAT Monitoring and Evaluation Standards* (2017). This included considering:

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



A farmer harvests clean sweetpotato with the support of relatives and other growers. Photo: Conor Ashleigh, ACIAR



Overview of project

Project number	HORT/2014/097
Project title	Supporting commercial sweetpotato production and marketing in the Papua New Guinea highlands
Collaborating institutions	<p>Australian organisations Central Queensland University (CQU) Queensland Department of Agriculture and Fisheries (QDAF) Australian National University (ANU)</p> <p>PNG partners Fresh Produce Development Agency (FPDA) National Agricultural Research Institute (NARI)</p>
Project leaders	Professor Philip Brown, CQU, Australia Mark Worinu and Robert Lutulele, FPDA Dr Ramakrishna Akkinapally, NARI
Project duration	February 2016 to February 2021 (extended to June 2021)
Funding	A\$4,998,084
Countries involved	Papua New Guinea
Commodities involved	Sweetpotato
Related projects	Sustaining soil fertility in support of intensification of sweetpotato cropping systems (SMCN/2012/105) Developing improved crop protection options in support of intensification of sweetpotato production in Papua New Guinea (HORT/2014/083)

Context

Sweetpotato is a major staple food crop in Papua New Guinea (PNG) and is grown by a high proportion of the semi-subsistence smallholder farmers in the country. Traditionally, sweetpotato is a low value, low input crop often used as animal feed. Crops benefit from fertiliser applied to a previous crop such as cabbage or carrot in a rotation system.

In many areas of the PNG highlands, the economy is evolving, particularly where there is relatively good transport infrastructure. Smallholders are turning from subsistence farming to market-oriented production. Sweetpotato has more recently become a cash crop in its own right, improving food security and providing a cash income alongside coffee, other vegetables and livestock. There is increasing commerce in sweetpotato with growers developing marketing and distribution chains into centres such as Port Moresby and Lae.

Low crop yields, infrastructure issues, and limited technical and business skills on the part of farmers and potential entrepreneurs are reported as constraining the impact that the market-oriented sweetpotato sector in PNG could have on rural communities in sweetpotato production areas. Previous ACIAR projects including 'Validating and documenting a strategy for producing virus-free sweetpotato planting material in Papua New Guinea' (PC/2010/026) considered the use of pathogen-tested planting materials, marketing efficiency, post-harvest management and value addition in the sweetpotato value chain. These projects informed the design of the current project, which sought to build on existing relationships with key PNG partners.

The project

The project's aim was to sustainably increase the contribution that sweetpotato makes to cash income and food security by improving sweet potato value chains. This was intended to contribute to the broader development goal of improving the livelihoods of sweetpotato producers and their communities in the highlands of PNG. The project focused on 5 technology evaluation and marketing (TEAM) sites in the Mount Hagen-Goroka corridor:

- Asaro Valley
- Hagen Central
- Anglimb
- Minj
- Tsinsibai.

These sites had different characteristics in terms of production potential and existing levels of marketing activity, but all had emerging links to markets for sweetpotato or other similar products.

The project supported smallholders in these 5 sub-regions of the highlands to move from subsistence farming towards producing specifically for the market and managing production to meet market and customer requirements.

The project's objectives were:

1. To develop and strengthen market-oriented sweetpotato supply chains.
2. To build capacity of sweetpotato value chain players.
3. To develop a 'clean seed' scheme to increase availability of clean planting material of sweetpotato (referred to locally in PNG as *klin kaukau*).

The project was conceived after the establishment of TADEP and was designed with the intent of drawing on components of other TADEP projects, in particular 'Family Farm Teams' (ASEM/2014/095), which focused on women's empowerment and improving women's skills in business management.



Findings

1. What was the project's theory of change and how did this evolve during implementation?

A project theory of change (or impact pathway) was apparently developed during the early stages of implementation of the project. Most stakeholders interviewed, however, were not aware of the project's theory of change, and it was not available for consideration as part of this evaluation. For the purpose of the evaluation, the evaluation team developed a representative theory of change drawing on the description of the project aims, objectives and activities, causal pathways in the project design proposal, and information from interviews with stakeholders. Importantly, while there may not have been a documented theory of change in the project proposal, the proposal itself outlines a narrative of the project goal, objectives, and outputs and how the project's activities would contribute to the change.

Description of the theory of change

The core aim of the project was to strengthen commercial sweetpotato value chains. The underlying theory was that sweetpotato producers in the selected highland sites and their local communities would benefit from moving from subsistence farming towards market-oriented sweetpotato production. This transition would enable growers and other community members to improve incomes by producing sweetpotato or sweetpotato food products. This in turn was expected to contribute to achieving the broader development goals (or impacts) of greater food security, and improved health and livelihoods of sweetpotato growers, traders and communities.

The theory of change is summarised at Appendix 5.2. There are several linked causal pathways that contribute to improvements in sweetpotato value chains:

- **Improving sweetpotato yields and quality.** Commercial crop yields and quality can be improved through the establishment of a clean seed scheme. This scheme will ensure that pathogen-tested plant vines (referred to as clean planting material) are propagated, distributed and used by a group of commercially oriented growers. These lead growers will be responsible for the multiplication and distribution of clean planting material to broader grower groups and communities. In order to establish the foundations of a clean seed scheme the following needs to occur:
 - Research on effective seedbed management practices to optimise yield of clean planting material.
 - Improving the infrastructure for tissue culturing and plantlet growth at National Agricultural Research Institute (NARI) facilities and training of NARI staff in pathogen-tested plant material production according to established protocols (primary multiplication sites).
 - Establishing secondary multiplication sites in screenhouses (igloos) at locations within each of the technology evaluation and marketing (TEAM) sites and training farmers in these sites to manage production and distribution of clean planting material.
- **Building capacity of value chain participants.** Participants in sweetpotato value chains (family-based village producers, women's groups, other community groups, growers and traders) require enhanced capacity to plan and execute the production and sale of sweetpotato and associated crops and products. Capacity will be built by:
 - identifying technical and capability gaps in high priority value chains
 - participatory training for existing or emerging supply chain participants through farmer field/business schools in commercial production, business management and market orientation
 - participatory planning and training of community members in establishing new value chains
 - building capacity of NARI and FPDA staff in value chain analysis and facilitating interventions.

- **Identifying and evaluating opportunities for market-oriented value chains.** Research is necessary to identify priority areas where the project can support viable and sustainable value chain development to build commercial production. This requires:
 - Socio-economic review and analysis of current value chains.
 - Participatory planning workshops and surveys on current knowledge of sweetpotato production, demand and marketing, and production of sweetpotato-based products.
 - Identifying technical and capability gaps in high priority chains.
 - Follow-on research and development activity specific to each targeted value chain, including product consistency and supply, post-harvest research (transport, storage and processing) and social science research on communications, finance, relationships and governance aspects of value chain functionality and marketing research.

There are number of basic assumptions that underpin the theory of change, including:

- NARI and FPDA staff have capacity to support the project and are able to develop enhanced capacity to work with farmers, communities and other value chain participants.
- Commercial growers are willing to take the potential risks of producing and using clean planting material.
- Farmers, traders and communities are willing to adopt new practices relating to the use of *klin kaukau*.
- Women and women's groups will be engaged in the project support activities and gain skills and confidence to develop sweetpotato-based enterprises.
- Targeted support to communities will lead to new enterprise development using sweetpotato.
- Increased *klin kaukau* yields and quality will, with other supports, open up access for producers to higher value markets in larger urban centres.

Analysis of the theory of change

The foundational elements of the theory of change were appropriate for the context of the project and intended result. A core proposition of the theory of change was that production and distribution of clean planting material is critical to increasing sweetpotato production, yields and quality in the PNG highlands. This was based on sound evidence, generated through past projects in Australia and PNG, that virus-free materials propagated through clean seed schemes have yield rates 25–75% higher than traditional growing practices.

A further underlying rationale was to focus initial efforts on commercial growers: those who had foundational business skills, awareness and willingness to accept the business risks (as opposed to family-based smallholder risk) of participating in the clean seed scheme. It was intended that the actions of lead farmers would influence actions of other growers and community members in the target regions. The evidence discussed below shows that commercial growers have actively operated secondary clean planting material production sites. However, there were some earlier challenges with farmers distributing primarily to their own villages (and initially at no cost), impacting on assumptions on the geographic reach of clean planting material, and the commerciality of producing and selling clean planting materials. This issue was addressed with the support of the FPDA, which worked with growers and communities to ensure a broader geographic distribution of clean planting materials.

An area where the theory of change evolved and adapted related to assumptions about the role and capacity of extension staff within FPDA. As some stakeholders highlighted, it was recognised early in the project that it was of critical importance to invest in building the skills and capacity of extension staff to engage effectively with growers and communities through an approach informed by community development principles. This led to greater emphasis on building the capacity of FPDA staff as community development workers (CDWs) and accreditation of staff as CDWs. This in turn led to an enhanced focus on a more inclusive community-led approach where FPDA staff worked with communities to identify technical and business development needs and provided tailored support to address the identified needs.

While research has been undertaken on opportunities within the value chain, it has also highlighted existing barriers to accessing higher value markets and building more sustainable market-oriented supply chains. Access to higher value markets is largely impacted by transport infrastructure and the supply chain participants – traders and intermediaries – and is an area that will require increased focus as production levels and quality continues to improve and become more consistent.



2. What outcomes (intended and unintended) has the project achieved or contributed to?

Outputs

Scientific knowledge

The project conducted several studies to understand the commercial sweetpotato value chain and identify market opportunities and priorities for intervention. These included:

- A socioeconomic review of sweetpotato production and marketing in the PNG highlands was completed in 2017. The review drew on secondary information from published sources, and participatory planning workshops with target communities, to review local knowledge of sweetpotato production and marketing. The report identified several factors which were driving expansion of commercial production and sales, particularly from the Hagen Central area. The movement of sweetpotato from Mount Hagen to urban centres and resource camps in adjacent provinces had not been previously reported.
- Detailed mapping of sweetpotato value chains was completed to identify those chains which showed the greatest potential to advance the economic and social welfare of their communities. Through the use of CommCare (a web-based survey tool) and working alongside FPDA extension staff, the research identified a number of commercial sweetpotato growers, whose value chains hold significant potential to advance the economic and social welfare of their communities. The survey also revealed that commercial growers and traders in the highlands had been consistently supplying sweetpotato in large quantities to the urban markets of Mount Hagen, Lae and Port Moresby by utilising family and *wantok* networks. The findings of this mapping study and survey were published by the project team in 2019 (Brown et al.). The paper outlined the need for further research directed toward identifying post-harvest management strategies, reducing marketing costs, and determining the breakeven point for different levels of the commercialisation spectrum so that sweetpotato businesses can be profitable and sustainable.

- A systematic review of literature on local value chain interventions was completed. This was undertaken to inform the design of interventions for those growers with the greatest capacity to engage with formal markets. The findings of the review were presented as a conference paper at the 2018 International Horticulture Congress (Brown et al. 2018) and accepted for publication in the *Journal of Agribusiness in Developing and Emerging Economies* (Hainzer, Best and Brown 2019).

Further work is also underway on a publication examining the value of study tours following the growers study tour of Australia in 2019. The project has also conducted:

- Baseline and midline surveys of demand and marketing for sweetpotato in Port Moresby, Lae and the highlands, and production aspects in TEAM locations. The project team is in the process of undertaking the end of project surveys to compare changes over time.
- Experiments and trials on conditions for multiplication of seed stocks and to generate best practice recommendations for planting and harvesting of *kaukau* vines in the propagation facilities.

Technologies or practical approaches

The project established the foundations of a 'clean seed scheme', consistent with Objective 3. Through the scheme, farmers in the 3 main commercial sweetpotato production regions in the PNG highlands had access to virus-free clean planting material. The core components of the scheme included:

- production of pathogen-tested planting materials (or vines) at the NARI laboratory in Aiyura – primary multiplication facilities
- distribution of clean planting materials to a select group of commercial sweetpotato growers, who multiply the vines and distribute them to other growers and community members – secondary multiplication sites.

A facility to clean virus-infected material and maintain this clean material for delivery to multiplication sites is integral to a clean seed scheme. Queensland Department of Agriculture and Fisheries (QDAF) worked with the staff of the NARI tissue culture laboratory and screenhouses at Aiyura Research Station to ensure the effective operation of primary multiplication facilities at the station. Key activities included clean seed foundation stock preparation, review of virus testing protocols, experiments to determine optimum conditions for multiplication, introduction of 2 new varieties, and provision of a Loop-Mediated Isothermal Amplification (LAMP) unit and establishment of initial protocols for rapid virus testing. Significantly, QDAF and NARI project team members prepared a draft *Clean Seed Scheme Laboratory Manual*, ensuring that all processes were documented in detail to provide rigidity to the *klin kaukau* scheme in the long-term and to assist in training of new laboratory staff. The draft is being peer-reviewed by QDAF.

Commercial growers across the Eastern Highlands, Western Highlands and Jiwaka provinces were selected to be secondary multiplication sites for clean vines. The project worked with these growers to establish igloos (screenhouses) on their farms to propagate clean vines. At the time of evaluation, there were 14 commercial growers who multiply and distribute clean vines. Activities to establish and support the operation of these secondary multiplication facilities included:

- training of commercial seed propagators in the management of seedbeds for field multiplication of clean vines
- trials to generate best practice recommendations for planting and harvesting of *klin kaukau* vines in the propagation facilities
- establishing a network of contact farmers to manage field multiplication in new locations to deliver clean seed to more PNG *kaukau* farmers.

A key product has been the development of the *kaukau* shade house and seedbed management manual for use by farmers managing screenhouses. The manual includes 12 standalone fact sheets, which cover a range of topics on best practice handling and maintenance of *klin kaukau* planting material.

Capacity building

Capacity building of value chain participants is a core objective of the project and has underpinned the introduction of the clean seed scheme. As outlined in the project design, the focus under this objective was to:

- build the capacity of participants in existing or emerging sweetpotato supply chains in commercial production, business management and market orientation through farmer field/business schools
- enhance the capacity of community members to define and develop the support needed to enable them to participate in value chain opportunities
- build capacity of NARI and FPDA staff in value chain analysis and facilitating interventions.

During implementation, key project personnel recognised the central importance of building the capacity of FPDA extension staff to engage effectively with farmers, traders and communities through a community-led model. Accordingly, the farmer capacity building component of the project focused on enhancing the extension service capacity within FPDA and demonstrating a community-led model for community engagement. This involved targeting the PNG National Standard for CDWs to train, assess and accredit FPDA extension officers. It also included hosting National Apprenticeships and Trade Testing Board (NATTB) workplace assessor training, policy development within FPDA, and working with national government and peak bodies to develop national policy and technology associated with the Standard.

The project developed material for training of grower groups involved in commercial *kaukau* production using clean seed. The training program was designed to meet the CDW standards set by NATTB and was accredited through NATTB. A new technical training package covering business development skills was produced by the project in 2019–20.

FPDA staff

The project supported several FPDA extension staff with the development of research and value chain analysis skills. FPDA extension staff were involved in the development and design of research tools, and undertook direct engagement with growers and stakeholders as part of research processes. Four FPDA staff undertook training in the use of CommCare, and FPDA was examining the potential to implement the technology for a range of processes where efficiency improvements were likely to result.

One of the more significant outputs was the upskilling of FPDA extension staff as CDWs. Three FPDA members of the team completed the 2-week nationally accredited CDW training, enabling them to be accredited to deliver training and provide recognition for participants, such as village extension workers, as CDWs.



NARI staff

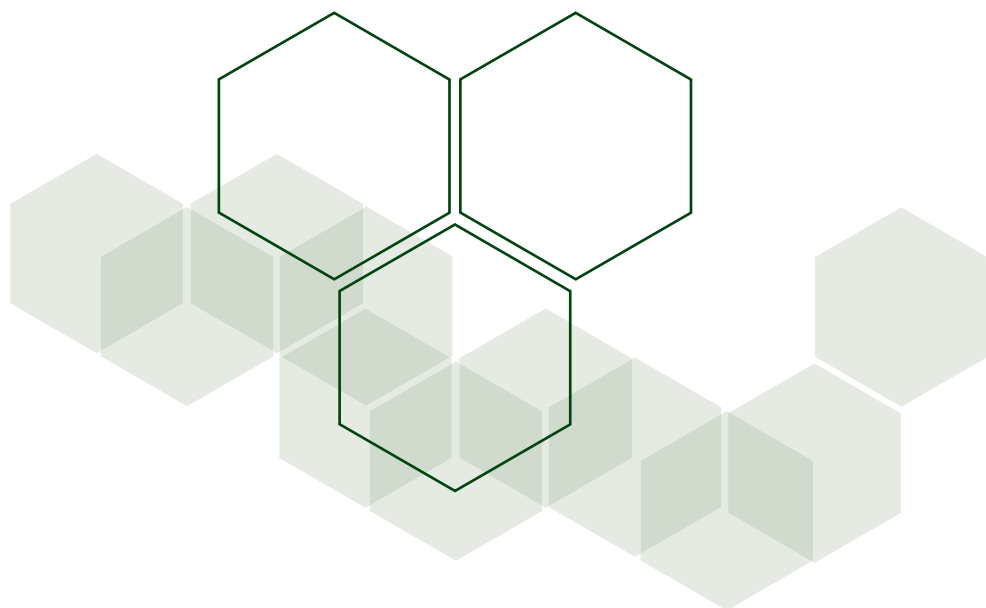
NARI staff at Aiyura significantly increased their skills in virus diagnostics, with accompanying skills in nursery management, herbaceous indexing and trial design. QDAF staff worked with 3 key staff at the NARI Aiyura station providing technical support, advice and mentoring in the development and management of clean seed material at the station. The culmination of this work was the development of the draft *Clean Seed Scheme Laboratory Manual*.

Some NARI facility staff undertook training in Australia on virus diagnostics. One staff member was awarded an ACIAR John Allwright Fellowship Scholarship and is undertaking a Master of Philosophy on sweetpotato virus management focused on the use of LAMP technology in PNG. It is expected that she will guide the use of LAMP technology at the NARI facility on her return.

Growers, grower groups and community members

Capacity-development activities have supported selected commercial growers operating screenhouses, along with grower groups and community members. As part of establishing the clean seed scheme, commercial seed propagators have been trained in the management of seedbeds for the multiplication of clean vines. They also received training (through other related sweetpotato projects) in agronomic practices, including soil fertility and pest and disease control. These growers, along with FPDA and NARI staff, also participated in a study tour to Australia in 2019 to learn from Australian growers and gain firsthand experience with production practices such as vine grading and *kaukau* packing.

Community development training was carried out in 14 communities in the PNG highlands. **An organisational approach to community engagement supports these communities to identify their goals, aspirations and training needs.** The objective of the training was to coordinate inputs to strengthen the community resolve for addressing technical problems they identified and document these in a Community Development Plan. The plan identified Road A – actions the community can take themselves, and Road B – activities that cannot be delivered internally by the community. Key areas identified as requiring support (Road B) have included markets and marketing, crop agronomy, farm management, downstream processing into stockfeed, livestock management, and livelihood skills in home food processing and preparation. The non-technical support the project delivered to farmer groups followed an organisation cycle and built the capacity of farmer groups to follow an organisation cycle themselves. FPDA staff who have achieved accreditation as CDWs facilitated this training for communities. This training assisted the commercial growers engaged in the project to develop their businesses, and their communities to develop plans incorporating commercial sweetpotato production.



Adoption

ACIAR uses a 4-level classification scheme to indicate the level of uptake of key outputs. This has been used by the evaluation team to summarise output adoption for the projects reviewed under each program, as illustrated in Table 20.

New scientific knowledge

Information on sweetpotato value chain and value chain interventions

The information generated through the sequenced research, including social economic analysis of the sweetpotato value chains and value chain mapping, enabled the project team to identify a number of commercial sweetpotato growers whose value chains hold significant potential to advance the economic and social welfare of their communities. It assisted in identifying areas for further research including post-harvest management strategies and marketing. One example of application of this research is the provision of training to growers in grading and washing roots prior to transport to higher value markets. This follows the identification of issues with existing post-harvest practices of packing sweetpotatoes into 100 kg bags, which commonly causes damage to roots and diminishes product quality and market value.

New technologies or practical approaches

Establishment of the clean seed scheme and uptake of clean planting materials

Establishment of the clean seed scheme involved close work and collaboration with NARI, FPDA and selected commercial growers to produce virus-free planting material at primary and secondary sites. Fourteen commercial growers were operating propagation facilities or screenhouses with the support of project staff. They successfully multiplied and distributed clean vines for 6 varieties of sweetpotato (Gimani, Wanmun, Wahgi Besta, Beauregard, Korowest and Rachel).

All stakeholders reported strong take-up and use of *klin kaukau* planting materials by commercial growers and other smallholders in the community, including family-based growers and grower groups across the target regions, with growing interest in neighbouring communities. It is reported that during 2017-18, some 7,000 clean vines were established in propagation facilities, generating over 5,000 first cut and 3,000 second cut vines for crop planting. More than 1,500 vines were distributed to other farmers to demonstrate the potential of clean planting material (Brown et al. 2018a).

Table 20 Levels of adoption of key project outputs

Category	Output	Users	Level of adoption
New scientific knowledge	<ul style="list-style-type: none"> Information on sweetpotato value chain in PNG highlands, and gaps and capacity development needs of value chain participants 	<ul style="list-style-type: none"> Initial user is project team (including FPDA) to assess priorities and inform value chain interventions Final users will be FPDA into the future 	Nf*
	<ul style="list-style-type: none"> New information on value chain interventions 	<ul style="list-style-type: none"> Used by project team to design value chain interventions, including training and outreach Final users will be FPDA in design of future interventions 	Nf*
New technologies or practical approaches	<ul style="list-style-type: none"> Clean seed scheme providing access to virus-free sweetpotato plant materials 	<ul style="list-style-type: none"> Commercial growers are initial users Broader grower groups and smallholders are subsequent and final users 	NF
	<ul style="list-style-type: none"> New package of CDW training 	<ul style="list-style-type: none"> FPDA is initial user FPDA and other agriculture extension services are final users 	Nf*

Notes:

* Given the project is yet to conclude it is too early to assess uptake of final users for this output

O No uptake by either initial or final users

N Some use of results by the initial users but no uptake by the final users

Nf Demonstrated and considerable use of results by the initial users but only minimal uptake by the final users

NF Demonstrated and considerable use of results by the initial and final users



As a result of participation in the project, FPDA has now approved the establishment of a program focused on supporting commercial sweetpotato production. FPDA has employed a manager to guide implementation of this program.

Production and post-harvest practices

Larger-scale commercial farmers have been supported with production practices such as irrigation and post-harvest activities to maximise productivity benefits from the use of *klin kaukau*. Some of these activities have been undertaken through 2 other related ACIAR sweetpotato projects in PNG focused on improved crop protection (HORT/2014/083) and soil fertility (SMCN/2012/105).

Growers who participated in the 2019 study trip to Australia have adopted production practices observed in Australia including irrigation, vine grading and packing. The project has provided basic support to some of these growers who have, since the visit, established irrigation infrastructure on their farms. Further, some growers have also adopted grading and washing of roots prior to transport to higher value markets and are testing alternative packaging to reduce the damage to roots caused by packing into 100 kg bags.

CDW training and approaches

A community-led model for engagement founded on CDW skills is now embedded in the FPDA approach to engagement with growers and communities. The project, through its strong focus on building the capacity of FPDA extension workers and CDW training within FPDA, supported a shift in how the FPDA approaches its engagement with growers and communities. The training program developed as part of the project will allow FPDA to become a training provider, embedding a 'bottom-up' training capacity in the PNG agriculture sector.

The training has been adopted by FPDA more broadly to train extension workers and inform the development of village extension workers. Two significant development actors, Oil Search and Ok Tedi Development Foundation, are adopting the CDW standard and complementary technology, including training materials on the organisational planning approach to community development.

Outcomes

Scientific outcomes

The scientific knowledge gained through the project increased the understanding of sweetpotato value chains, including production, distribution and marketing of sweetpotato in the 3 main commercial growing areas of the PNG highlands. This knowledge has been used by the project team and FPDA to develop targeted training and support for growers and communities engaged in sweetpotato production in the region. The studies, including a forthcoming endline study, will be used to assess the changes in the sweetpotato value chain across production, distribution and marketing.

It is too early to fully assess the extent to which these scientific knowledge outputs will influence key institutions such as NARI and FPDA into the future. At this stage, the project's research outputs highlighted the potential of commercial sweetpotato production in PNG, leading to the FPDA establishing a new program focused on commercial sweetpotato production.

Experimental research and trials supported by the project have also been used to inform best practice approaches and protocols for virus testing and laboratory processes at the NARI facility, and the development of a manual for the management of *klin kaukau* shade houses and seedbeds.

Innovation enabled through use of technologies, practices and processes

Increased sweetpotato production, quality and market access

The project – principally through the clean seed scheme along with changes in agronomic practices – has increased in the value of commercial sweetpotato production. Greater levels of production and increasing yields of sweetpotato in the targeted communities are enabling a shift towards more market-oriented production. *Klin kaukau* is reported to have a superior taste, leading to an increased demand in the marketplace. Endline studies are being undertaken by the project and will attempt to quantify the overall changes in production levels from the respective regions of the highlands.

Higher yields and improved sweetpotato appearance are beginning to deliver grower access to new, higher value markets, including direct sales to supermarkets in centres such as Port Moresby, although matching supply and demand and addressing logistics remain issues to be addressed. Potential new markets for *kaukau*, and transport logistics options to improve post-harvest management, have been identified as a result of promoting the project through the media and the project's Facebook page. Development of export markets for sweetpotato is at a very early stage and has not been a focus of the project to date.

Interest in clean planting material has continued to grow with requests for access to *klin kaukau* from regions outside the program and other provinces interested in establishing screenhouses for clean planting material.

'This project has made huge gains with growers first to establish trust in the new kaukau and then an understanding of how this new material can form the basis for higher value markets locally and in supermarkets in urban centres.'

– Mid-term review (ACIAR, 2019)

New business opportunities and increased incomes

The project established a new product in the form of clean vines, which commercial growers responsible for their multiplication can sell. Commercial growers participating in the project established new income sources through the sale of clean sweetpotato vines. For example, Chris Bugajim (personal communication) reported a Jiwaka grower sold over PGK4,000 worth of *klin kaukau* vines since the project installed a vine multiplication screenhouse in her village. Supplying growers with clean vines led to monthly sales of clean vines from the scheme of PGK500–1,000 for commercial growers. With growing interest in the clean seed scheme through social media, vines have been distributed to other provinces including Enga, Southern Highlands and Morobe.

Lead farmers producing sweetpotato are benefiting through increased income from higher yields, faster sales and better returns from *klin kaukau*, which is recognised as better quality in the marketplace. Some stakeholders reported that some farmers are shifting to become farmer traders. As farmer traders, they work with the community and other growers to establish a cooperative or group arrangement under which smallholders grow for the farmer trader who aggregates the sweetpotatoes for sale to the market. This is viewed as a new mode of operation that did not exist (or at least at the current scale) before the project.

Training and support to other value chain participants, including grower groups and community members, has led to the emergence of new sweetpotato-related businesses. Training provided to communities in food processing and preparation has led to one community in Jiwaka initiating a commercial venture drying *kaukau* to produce flour, and making cakes, biscuits and noodles for sale. In other communities, farmers are taking advantage of the higher yields obtained in clean *kaukau* crops. They are diversifying by feeding roots and vines to animals to improve the quality of poultry and livestock – generating a new income stream. Women growers and women's groups have successfully improved incomes through production and value-add product sales.

Capacity built

These outcomes are underpinned by the improved capacity of key project stakeholders, including PNG partner organisations, growers and communities. The key capacities are summarised in Table 21.

Community social, health and environmental benefits

Project reports and stakeholder feedback referred to other benefits associated with improved sweetpotato production and income. Farming families reportedly have improved nutrition through increased consumption of sweetpotato, reducing reliance on rice and noodles, which have lower nutritional value. Additional income has also enabled growers to improve housing.

One of the findings of the crop agronomy studies has been that the *klin kaukau* crops mature faster than conventional *kaukau* crops. This may lead to more crop rotation opportunities for growers and longer fallow periods to sustain soil health. It was also noted that the clean seed scheme enabled the establishment of a 'seed bank', which provides access to planting materials during times of drought and crop recovery in the event of severe drought or other adverse climatic events.

Table 21 Capacity built relevant to project objectives

Who	Skills and knowledge
NARI Aiyura research facility staff	<ul style="list-style-type: none"> • Virus diagnostics, with accompanying skills in nursery management, herbaceous indexing and trial design
Commercial sweetpotato farmers	<ul style="list-style-type: none"> • Management of seedbeds for multiplication of disease-free vines • Enhanced production and post-harvest practices for production of sweetpotato • Business planning and management
FPDA extension staff	<ul style="list-style-type: none"> • Community-based research capabilities • CDWs (community-driven development)
Grower groups and community	<ul style="list-style-type: none"> • Business planning and enterprise development



3. How did project activities and outputs contribute to the outcomes achieved?

Factors influencing adoption and outcomes

Table 22 provides key findings against the categories and factors influencing adoption and outcomes as part of the ACIAR evaluation framework. It should be noted that no systematic research was undertaken about the factors influencing adoption of the project outputs, so the findings are primarily based on what key stakeholders and the evaluator perceive to be the factors.

The clean seed scheme has been the key driver behind increasing production levels and yields of sweetpotato in the TEAM sites. This is consistent with past evidence of clean seed schemes in Australia, and trials in PNG and other countries. There were a number of key activities that underpinned the establishment of the scheme, from working with NARI staff in laboratory facilities to selecting and supporting commercial growers. Some of the more central factors contributing to change are discussed below.

Table 22 Factors influencing adoption and impact

	Factor	Key findings
Knowledge	Do potential users know about the outputs?	<ul style="list-style-type: none"> Not identified as a constraint for this project.
	Is there continuity of staff in organisations associated with adoption?	<ul style="list-style-type: none"> There were several changes in staff at FPDA, however the project has benefited from new staff commitment to adoption of CDW training components.
	Are outputs complex in comparison with the capability of users?	<ul style="list-style-type: none"> Not identified as a constraint for this project, noting that the project involved significant capacity development with commercial growers, as well as FPDA and NARI staff involved in the project.
Incentives	Are there sufficient incentives to adopt the outputs?	<ul style="list-style-type: none"> There are strong commercial incentives for commercial growers to produce clean planting materials, and for growers of differing scales to use clean sweetpotato planting materials.
	Does adoption increase risk or uncertainty?	<ul style="list-style-type: none"> Not identified as a constraint for this project.
	Is adoption compulsory or effectively prohibited?	<ul style="list-style-type: none"> Not identified as a constraint for this project.
Barriers	Do potential users face capital or infrastructure constraints?	<ul style="list-style-type: none"> Growers are purchasing clean planting material or receiving it for free from commercial growers. The project funds the purchase of clean planting materials from NARI by FPDA, for provision to commercial growers. There are issues with the sustainability of this model beyond the life of the project if lead growers are not willing to purchase directly from NARI.
	Are there cultural or social barriers to adoption?	<ul style="list-style-type: none"> While female smallholders are adopting the use of clean planting material, further research is required to understand the impact of increased market-oriented production on the role of women in sweetpotato production, marketing and sales.

The project's focus on targeting a select group of commercial growers as the entry point to introducing *klin kaukau* was an important success factor. The project team was aware of the farmers' perception of risk in introducing new planting material. Project reports refer to initial apprehension about clean planting materials within some communities, based on a belief that the failure of the potato crop in the region (due to late blight outbreaks) had been caused by introduction of certified potato planting material. Farmers therefore feared that construction and operation of the new propagation facilities might lead to sweetpotato crops being wiped out. Using elements of a lead farmer model, the project team was guided by research on value chains and FPDA advice on the selection of 14 commercial farmers who were willing to participate in the clean seed scheme as secondary propagators of clean planting material. It took a while to establish trust in the clean planting material and for lead growers to be satisfied before distributing material to the village. Resistance was gradually overcome, with demonstration of the potential yield and quality benefits from using clean planting material leading to strong demand for vines.

Stakeholders credit FPDA extension officers as playing a critical role in encouraging adoption of clean planting materials. This occurred in a context where there were staff changes and significant management changes due to other donor activities in the area. The key FPDA extension staff working on the project were seen as essential in selecting farmers to work with, engaging with farmers, building trust, providing ongoing support, and progressing the roll-out of the clean seed scheme and adoption by growers, grower groups and other smallholders across the region. One notable area of support was facilitating distribution of *klin kaukau* beyond discrete villages. The project had assumed that commercial growers with greenhouses would distribute and sell *klin kaukau* vines more widely; however, in the early stages, distribution occurred only within the villages of the lead farmers, and largely for free. With the assistance of FPDA, the project has facilitated wider distribution from the 14 commercial grower sites to different villages across the region.

As has been discussed, a key shift in the project design was increasing the focus on developing the skills and capability of FPDA extension staff in community development. This has led to significant capability development in FPDA extension staff and broader institutional commitment to community-led engagement. Important factors in this success included:

- Drawing on the expertise of community development professionals with significant experience in PNG. Through their guidance, the project was able to draw on established training and development processes, including the existing national standards for CDWs and the ward planning process to guide engagement and training for farmers, growers and communities.
- Embedding 2 local officers with community development experience in FPDA to pass on these skills and knowledge in an informal mentoring and one-on-one process.

As noted in project reports, training for farmers and their communities facilitated community ownership of commercial sweetpotato development. This ownership, along with production of resource materials and capacity building within partner PNG agencies, has established a foundation for continuation of project outputs beyond the life of the project.

The 2019 study tour to Australia was also seen as a significant factor in motivating the commercial farmers who participated in the tour to develop their enterprises and adopt improved production and post-harvest practices. The 14 growers had the opportunity to learn from Australian growers and gain firsthand experience with production practices such as vine grading and *kaukau* packing. The training reportedly resulted in most of the growers adopting new practices (Brown et al. 2020). During interviews, stakeholders elaborated on the interest of PNG growers in establishing irrigation systems to support sweetpotato production. At the request of several farmers, the project provided support to establish basic irrigation infrastructure and systems on farms. Given the study tour occurred later in the project (after growers had started using clean planting materials and developed their businesses), this was considered an important factor for its success – growers had seen results and were ready to take on new ideas and approaches.

*'When I came back everyone was excited to see me and eager to hear about my experience and what I learned from my trip. I am a proud woman now and I am pushing for further develop *kaukau* in Jiwaka. I want to go into mechanisation. I will establish a big nursery to supply the demand.'*

– 2019 study tour participant and commercial grower in Jiwaka



The mid-term review noted that the participatory research methodology chosen by the project team was the right choice for this project and was well executed. The review discussion reaffirmed the need to take on farmers as research partners and recognise that they are active decision-makers and have the best knowledge of the complex systems in which they work.

The program has led to the establishment of a sweetpotato program within FPDA, recognising the opportunities but also a need for ongoing development, particularly in respect to post-harvest management, marketing, and supply chains for higher value markets. In discussions with stakeholders, some issues were identified about sustainability of the project's impacts. These related to sustainability of the FPDA commitment to the CDW approach, potential costs of maintaining screenhouse and related on-farm infrastructure, and costs associated with the provision of clean planting material to commercial propagators. The last of these is seen as more significant. The concern is that the project currently funds the purchase of clean planting material from NARI and distribution to commercial growers by FPDA, and that this will cease at the end of the project. Supporting growers to continue to sell clean planting materials and use these funds to purchase them directly from NARI is important for sustainability of the scheme. The mid-term review alluded to this issue, recommending that the clean seed system needed a simple strategy for renewal of virus-free sources not reliant on lengthy and costly testing to establish virus infection status. It suggested that the project needed to develop a commercial business case for the supply of virus-free material and for cleaning up new varieties that will be needed by growers in different regions to respond to market demands across PNG.

4. What strategies were adopted to address gender equity and social inclusion and how effective were these?

Gender equity

The project design had a secondary focus and enabling strategy to create economic opportunities for rural women through small enterprise development. More specifically, the project planned to support women-led village enterprises in value-added sweetpotato product development. The proposal outlined an intention to adopt the methodologies developed in the Family Farm Teams (FFT) project (ASEM/2014/095), focused on family teams training, financial literacy education, banking and saving training, and agricultural planning techniques, as well as the training of village community educators to deliver training developed in the FFT project.

While it was not discussed in the design document, stakeholder interviews and project publications referred to the important role of women in traditional sweetpotato production. Sweetpotato, as a staple food, has traditionally been considered a women's crop. Its cultivation from planting to harvest is predominately in the hands of women. Women are also generally responsible for selling sweetpotato at markets. The men's role in the cultivation of sweetpotato is confined to land preparation and other pre-planting roles such as digging drainage channels, building mounds and clearing new land.

Women's participation in project activities was evident in several areas. The project supported the small team of 4 people (2 of whom were women) responsible for production of clean planting material at the NARI research facility. Project staff also supported one of these female staff members to undertake postgraduate study in Australia on pathogen testing. Two women growers were part of the group of 14 commercial growers selected to manage screenhouses and propagate clean planting materials on their farms. These particular women were chosen by FPDA staff because of their standing in the community, and ability to provide community leadership and influence other women. Endline studies in progress suggest strong levels of participation by women in training and community development workshops. Women and women's groups have received training and support on establishing value-added sweetpotato enterprises.

Like their male counterparts, women commercial growers participating in the technical training have introduced new methods of planting to improve sweetpotato yields and benefited from business development support. They are also earning income from selling clean planting materials. At the community level, women growers have benefited from increased income from the sale of clean sweetpotato, with women – particularly single mothers – being able to send children to school, meet expenses and better provide for their families. There is also evidence of more fledging female-led small enterprises being established. A number of women in Jiwaka developed a business producing and selling sweetpotato flour and related products. Other women's groups have focused on using the improved and higher yield sweetpotato to feed pigs and poultry, and increasing the value of these livestock and poultry for sale.

The project has had some observed impacts on the role of women in the growing and selling of sweetpotato. On the positive side it was noted in reports that because *klin kaukau* sells faster, women (who are nearly always responsible for selling produce at markets) are required to spend less time at the markets, which commonly present safety and security issues for them. On the other hand, it was observed by stakeholders that as production moves to a more commercial scale, men are likely to take responsibility for production, distribution and marketing. A key area where further evidence is required is in assessing whether improved income for women means that they are more empowered, that is, they have control over this income. It is also important to understand whether engagement in enterprise activities has negative impacts in terms of the increased workload of women.

Stakeholders recognised that greater analysis could have been undertaken at the project design stage to understand the community social and gender dynamics and how these would influence, and could be influenced by, project delivery. This is particularly critical given the information to hand about the traditional role of women in farming sweetpotato and how this may shift to men with increased commercial production. There is a real possibility, for example, that if men take on a greater role in production of commercial sweetpotato, then they may also gain greater control over income from sweetpotato sales. **To strengthen gender equity outcomes, in-depth gender analysis undertaken in project design should form the basis of a strategy of how the program will both ensure women's active participation in the project, but also contribute to improved gender equity and women's empowerment, and at a minimum do no harm.** Implementation of this strategy should be closely monitored to ensure identification of intended and unintended gender-related consequences of the project. This monitoring is particularly critical in the PNG context where rates of gender-based violence are so high, and efforts to positively influence gender norms can have unintended consequences.

Social inclusion

There are no specific references in the project design to targeting other vulnerable community members including youth, people with disability, and other commonly excluded community members. The project targeted those growers on the more commercial end of sweetpotato production. However, this was done with the intention that these lead farmers and their actions would enable opportunities for participation by other community members who were involved in subsistence farming. The project also adopted participatory community development approaches to engage all community members. There is no known evidence that this resulted in the inclusion of people with disability or other commonly excluded community members. Future projects could consider strategies to ensure existing inequalities experienced by youth, people with disability, and other marginalised groups are not further entrenched, and how project activities can include and provide benefits for these community members.



A smallholder market stall selling sweetpotato.
Photo: Conor Ashleigh, ACIAR

5. How did management arrangements impact delivery of the project?

Central Queensland University (CQU) was the lead organisation. CQU project leader, Professor Phil Brown, had primary responsibility for overall project coordination. Research and development activities were to be led by NARI, CQU and QDAF, while enterprise development activities were to be led by FPDA and the Australian National University (ANU). Broadly, the roles were:

- CQU provided project leadership and research components on value chain assessment and commercial opportunities.
- ANU was part of the initial phase of the project with responsibility for technical capacity development, community training and enterprise development.
- FPDA coordinated PNG partner inputs and provided support and connection with growers through extension officers involved in research activities relating to value chain, training and community development.
- QDAF worked with NARI to support the development of the *klin kaukau* scheme and build the capacity for virus diagnostics.

The project leader showed a strong commitment to empowering PNG partners, in particular FPDA, to drive the project and largely letting each partner take leadership of their respective areas. An evident strength of the project was its participatory and adaptive approach, working with communities to identify priorities and needs and responding flexibly to these community development needs. Specific examples include the shift in focus to building capacity of FPDA extension workers to work with community members and growers, and responding to commercial grower aspirations to establish irrigation systems after their field visit to Australia in 2019.

The project's first annual report noted concerns on role clarity for project partners and project coordination within PNG. These issues were addressed at the annual project review and planning meeting, but it is evident that communication between NARI and FPDA remained an issue and could have been improved through more frequent communication and coordination meetings. There were also some signs that the project's Australian partners worked in silos, with their PNG counterparts left without knowledge of the actions of other project team members. Stakeholders suggested that more regular project coordination meetings may have enhanced communication, coordination and delivery of the project.

While ANU was involved in the project from the start, a clear difference of approach and direction emerged between key ANU project members and CQU, with ANU subsequently ceasing formal involvement in the project. Some members of the ANU team were contracted by CQU to continue work on the community development activities within the project, minimising the impact of this decision on project implementation and outcomes.



6. How well did the project align with and contribute to the overall goals of its umbrella program?

The project aligned with, and contributed directly to, 4 of the 5 Transformative Agriculture and Enterprise Development Program (TADEP) goals:

- 1. To sustainably increase agricultural productivity, quality and value.** Sweetpotato is a staple crop, which is in demand across PNG, and less impacted by external market forces than other commodities that are produced for international markets. The project assisted commercial growers lead growth in the production of sweetpotato, and improved quality through the use of clean planting material. *Klin kaukau* is better quality, in greater demand and can be sold at better prices than traditionally grown sweetpotato.
- 2. To improve access to markets and strengthen value chains.** The focus of the project was on expanding market-oriented sweetpotato value chains and consequently improving the livelihoods of sweetpotato producers and their communities in the PNG highlands. With the growth in production and improvements in quality, new businesses are emerging as part of the sweetpotato value chain. Access to higher value markets is in the early stage of development as commercial growers scale up production of higher quality sweetpotato. Further elements of the value chain relating to marketing and post-harvest production need future intervention to support sustainable market access and strengthening of the value chains.
- 3. To promote gender equity and women's empowerment in rural communities.** The project was intended to support economic opportunities for rural women. Women commercial growers have been part of the project and other women have participated in project training opportunities, leading to the establishment of women-driven enterprises in value-add products.
- 4. To build individual and institutional capacity.** The project has built the capacity of staff in partner agencies, NARI and FPDA, and supported the development of institutional capacity in these organisations. The project has also built the capacity of growers, grower groups and community members in a range of areas, including propagation and use of clean vines, and developing commercially oriented sweetpotato businesses, including for value-added products.

Stakeholders based in Australia and some PNG stakeholders were aware of TADEP and its objectives. For Australian project team members beyond those at CQU, the only level of engagement in program-level activities was participation in the annual meeting, providing information to support program reporting and reading program-level newsletters and updates. Staff based in Australia highlighted some marginal benefits of the project being part of TADEP.

The program was conceived with the intention of engaging with and drawing on the work of other TADEP projects, particularly the FFT project for approaches to empowering women and increasing their business skills, and the TADEP umbrella for 'approaches to developing participatory impact pathways and assessing impacts on livelihoods'. While the project has supported the delivery of FFT in some communities where this has been requested, there was generally very limited collaboration with other TADEP projects. The different focus of the projects, dispersed geographies and differing challenges faced by the projects were raised as possible reasons for this lack of collaboration. The sweetpotato project was perceived as quite different to the galip nut and cocoa projects and therefore an outlier to an extent. Notably the project has operated concurrently to 2 other ACIAR-funded PNG sweetpotato projects focused on soil fertility, and pest and disease control. A mid-term review of the 3 projects conducted in early 2019 highlighted the need for this project to engage more and collaborate with the other 2 (non-TADEP) sweetpotato projects. While the projects worked in the same communities with key growers, the research focus of the other 2 projects, compared to the commercial focus of this project, meant that more frequent collaboration and engagement was more difficult.

There were several key benefits of participation in TADEP identified by Australia-based stakeholders:

- **Information sharing.** Team members gained value from participating in the annual TADEP workshops to learn about other projects and develop connections with project leads and members. Some team members would have liked the opportunity to bring additional staff to these meetings, recognising the potential value to be gained by project staff and other employees of the collaborating organisations. ACIAR investment in promoting and marketing the program, including via newsletters, was considered valuable and assisted in developing sharable public information on the project and program more broadly.
- **Informal mentoring from other projects.** Project staff with different roles including team leaders could engage with and access advice and support from staff on other TADEP projects.
- **CommCare app.** The CommCare app made available through the program was used in the research conducted by the project. FPDA staff were trained in using the app and there were intentions on the part of FPDA to use the app more broadly.
- **Traction with PNG partners.** It was observed by one key stakeholder that being part of the broader TADEP umbrella meant that the project had greater prominence. This assisted the project gain traction and political leverage with the key PNG partners, FPDA and NARI.

There were very few negative aspects identified related to being part of TADEP. While the time demands associated with program-level meetings and bi-monthly reporting were noted as the downsides of being part of a program, the benefits of these processes, in particular connecting with other project leads and hearing of challenges, made the time and effort involved worthwhile.

Some stakeholders referred to opportunities to leverage the programmatic approach more effectively and strategically, beyond basic collaboration between projects, to achieve broader impact. The question posed was how the program could work collectively in a more forward looking way to harness the investments to achieve greater impact. One area identified as an example was institutional capacity building. The projects commonly work with PNG institutions such as NARI and FPDA, but the focus tends to be on building individual capacity. There is an opportunity for a more strategic and coordinated approach to working with PNG partners to build greater institutional capacity.



Conclusions and lessons learned

Since its commencement in February 2016, the sweetpotato project has achieved significant results in terms of establishing the foundations of a scheme to provide clean planting materials, and enabling commercial growers to expand production through the use of higher yielding and better quality *klin kaukau*. Lead farmers are taking on increased roles as farmer traders, coordinating and aggregating produce from growers in their communities, and encouraging the expanded use of *klin kaukau*. These farmers have also established new sources of income through the sale of clean planting material, and new enterprises in the sweetpotato value chain are emerging. Access to higher value markets has commenced, underpinned by research identifying challenges and opportunities with the value chain relating to post-harvest practices, distribution and marketing. This is an area requiring further research, and strategic interventions and investment.

Significant effort has been invested in capacity development of staff within Papua New Guinea (PNG) partners – National Agricultural Research Institute (NARI) and Fresh Produce Development Agency (FPDA) – farmers, grower groups and communities. The project has taken an adaptive approach responding to identified capacity-building needs within partners and communities more broadly.

Lessons learned

The project has now concluded and endline studies will provide comparative 'hard' data on changes to the sweetpotato value chain, including production levels and business development. General lessons for ACIAR in relation to implementation of research-for-development projects and the programmatic approach include:

- 1. The project design made some implicit assumptions about the capacity of partner organisations, particularly FPDA, to engage effectively with farmers and communities using a community-led development approach.** This project highlights the importance of identifying and assessing assumptions about the capacity of partner organisations, including their internal operating environments, at the design stage and developing appropriate strategies to address these development needs. **A strength of the project was the willingness to respond to capacity-development needs** by initially focusing on building the capacity of FPDA staff in community-led engagement.
- 2. This project illustrates the value of drawing on existing knowledge, and local structures and standards,** for instance, for the community development workers (CDWs). Developing training compliant with the PNG standards, building internal policy to support the change, and accrediting staff has led to broader institutional adoption and impact in FPDA and adoption by other key development actors.
- 3. Gender analysis, social inclusion analysis and development of a targeted gender equality and social inclusion strategy would assist projects in developing a more strategic approach** to influencing gender equity and women's empowerment, and ensuring people with disability and other marginalised groups can also benefit from the project. This needs to be monitored during implementation. This observation is common across a number of TADEP projects considered by the evaluation team.
- 4. There are opportunities to enhance the value of a programmatic approach more broadly.** While collaboration between projects is one element, there are broader opportunities for considering more strategic whole-of-program investment in key enablers, such as capacity development of common project partners, NARI and FPDA.

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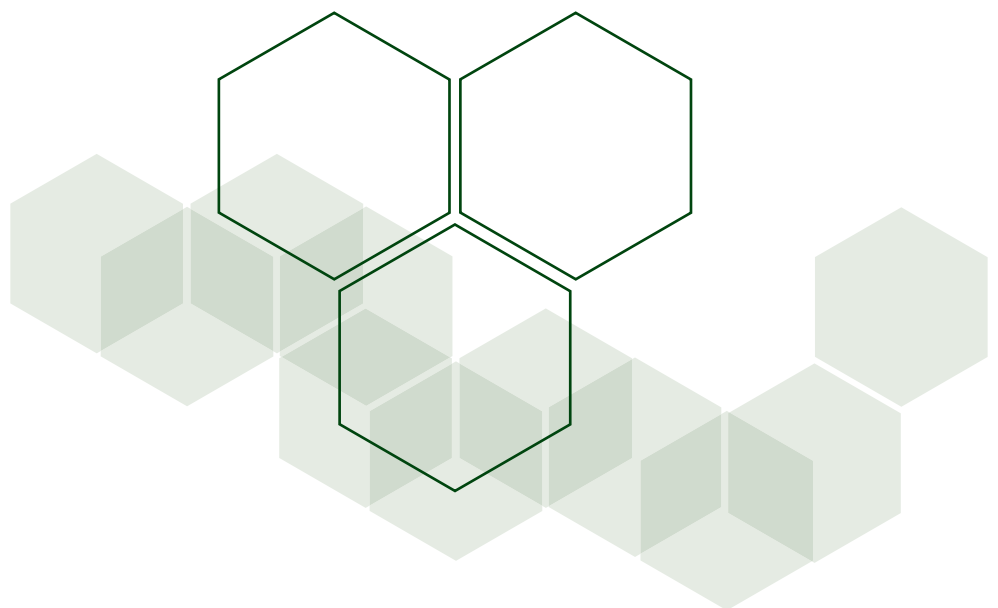
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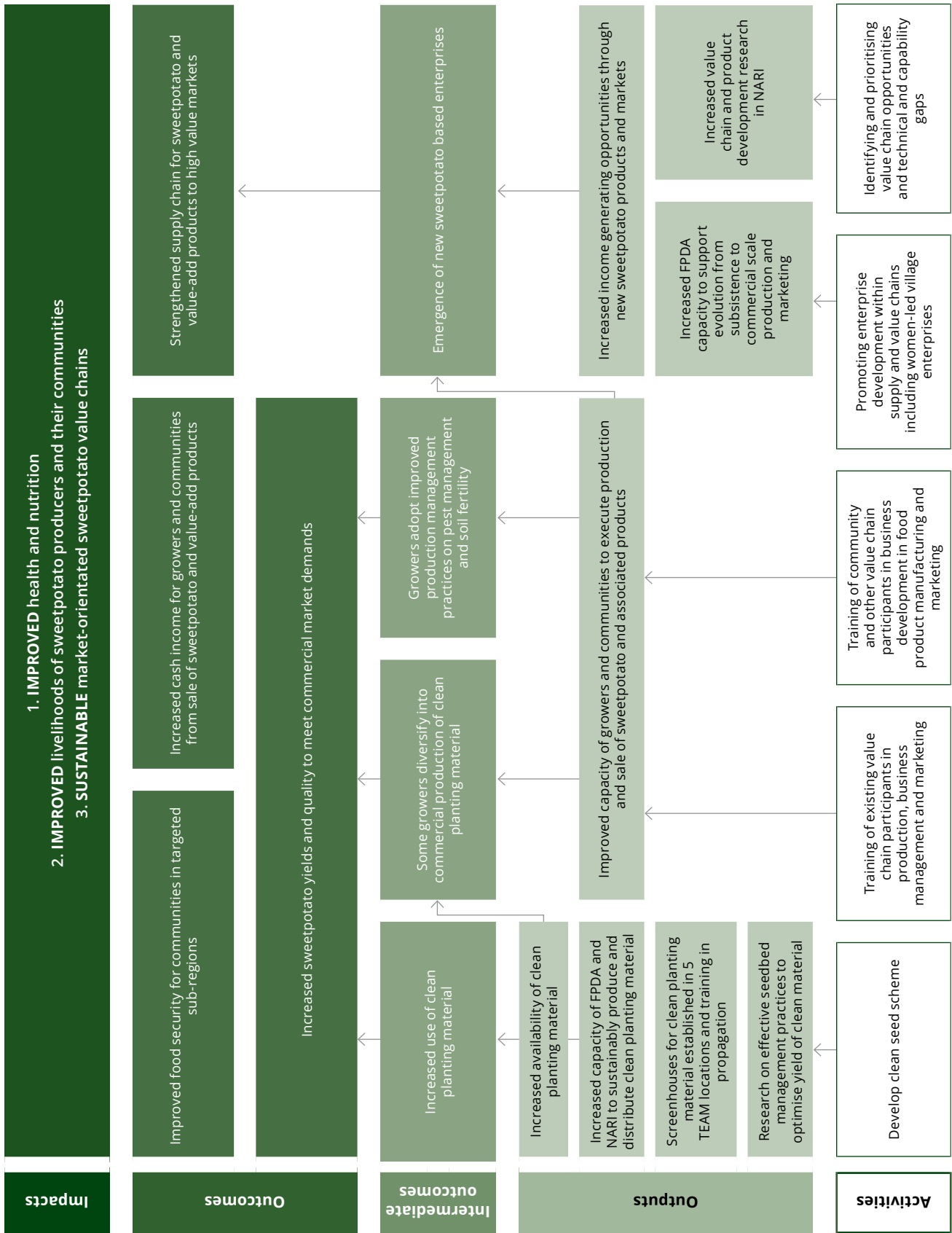
Appendices

Appendix 5.1: Stakeholders consulted

Name	Role	Organisation
Professor Philip Brown	Professor in Agricultural Ecology (Project Leader)	Central Queensland University
Mr Kirt Hainzer	Research Fellow	Central Queensland University
Mr John Kewa	Manager, Research, Policy and Communication	Fresh Produce Development Agency
Mr Chris Bugajim	Project Officer	Fresh Produce Development Agency
Mr Bennie Atigini	Project Officer	Fresh Produce Development Agency
Dr Birte Komolong	Program Director, Agricultural Systems	National Agricultural Research Institute
Ms Winnie Maso	Research Scientist	National Agricultural Research Institute
Mr Mike Hughes	Farming Systems Development Officer	Queensland Department of Agriculture and Fisheries
Mr Chris Gard	Community Development Consultant	Independent consultant



Appendix 5.2: Theory of change





Appendix 5.3: Project team members

#	Team member	Gender	International/National Researchers
1	Professor Phil Brown	M	International
2	Mr Craig Henderson	M	International
3	Mr Michael Hughes	M	International
4	Dr Talith Best	F	International
5	Dr Mike Bourke	M	International
6	Mr Chris Gard	M	International
7	Ms Sandra Dennien	F	International
8	Ms Rachael Langenbaker	F	International
9	Mr Eric Coleman	M	International
10	Ms Jean Bobby	F	International
11	Mr Bill O'Donnel	M	International
12	Dr A Ramakrishna	M	National
13	Dr Sim Sar	M	National
14	Ms Winnie Maso	F	National
15	Ms Myla Deros	F	National
16	Mr Kud Sitango	M	National
17	Mr Johannes Pakatul	M	National
18	Dr Matthew Kanua	M	National
19	Mr Mark Worinu	M	National
20	Mr Robert Lutulele	M	National
21	Mr Johnny Wemin	M	National
22	Mr Noel Kuman	M	National
23	Mr Chris Suya	M	National
24	Mr Chris Suya	M	National
25	Ms Lornica Harris	M	National
26	Mr Thomas Kol	M	National
27	Mr Conrad Anton	M	National
28	Ms Regina Malie	F	National
29	Ms McKenzie Zikian	M	National
30	Mr John Kewa	M	National
31	Ms Debbie Kapal	F	National

Appendix 5.4: Research outputs

Publication	Peer-reviewed	Author (gender, nation)
Brown P, Hainzer K, Best T, Wemin J, Aris L and Bugajim C (2019) 'Commercial sweetpotato production in the highlands of Papua New Guinea', <i>Acta Horticulturae</i> , 1251, 65–72.	Yes	Brown (Male, Australia) Hainzer (Male, Australia) Best (Female, Australia) Wemin (Male, Papua New Guinea) Aris (Female Papua New Guinea) Bugajim (Male, Papua New Guinea)
Brown P, Hainzer K, Best T, Wemin J, Aris L and Bugajim C (12–16 August 2018) 'Commercial sweetpotato production in the highlands of Papua New Guinea' [conference presentation], 30th International Horticultural Congress IHC2018: II International Symposium on Root and Tuber Crops: Value Added Crops for the Next Generation, Istanbul Turkey.		Brown (Male, Australia) Hainzer (Male, Australia) Best (Female, Australia) Wemin (Male, Papua New Guinea) Aris (Female Papua New Guinea) Bugajim (Male, Papua New Guinea)
Hainzer K, Best T and Brown P (2019) 'Local value chain interventions: a systematic review' <i>Journal of Agribusiness in Developing and Emerging Economies</i> , 9(4):369–390.	Yes	Hainzer (Male, Australia) Best (Female, Australia) Brown (Male, Australia)
Hainzer K, O'Mullan C, Bugajim C and Brown P (2021) 'Farmer to farmer education: learnings from an international study tour', <i>Development in Practice</i> , 31:5, 665–675.	Yes	Hainzer (Male, Australia) O'Mullan (Female, Australia) Brown (Male, Australia) Bugajim (Male, Papua New Guinea)
Best, Axtens, Hainzer, Wemin, Ovah and Bugajim (in preparation) 'Leveraging Social Cognitive Theory to understand value-chains in semi-subsistence sweet potato farming in Papua New Guinea'.	Yes	Best (Female, Australia) Axtens (Female, Australia) Hainzer (Male, Australia) Wemin (Male, Papua New Guinea) Ovah (Male Papua New Guinea) Bugajim (Male, Papua New Guinea)

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