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ARTICLE

Factors affecting the success of collaborative forestry research in Papua New Guinea

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ABSTRACT

Papua New Guinea (PNG) and Australia have a close relationship, including through development assistance in agriculture and forestry. Delivering successful research and development projects in PNG is challenging due to weak government service delivery, poor infrastructure and a clan-based society. This paper reports a qualitative investigation of factors contributing to success in ten collaborative forestry research projects implemented in PNG by the Australian Centre for International Agricultural Research. The relative success of the projects was evaluated, and 37 contributing factors were identified from an analysis of project records and interviews with 33 project participants. The most frequently identified success factors were collaborative scoping and design, funding and equipment, leadership and management, selection and commitment of partner institutions, and effective communications. Relationships between these success factors and the success of the projects were evident in a closer study of four projects with different relative success. This study broadens the understanding of factors that enhance or diminish the success of international forestry research projects, confirms results from companion studies, and identifies some additional aspects that are relevant to the PNG context. This knowledge could help improve the effectiveness of future research for development projects.

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Introduction

The Australian Centre for International Agricultural Research (known as ACIAR) commissions collaborative Research for Development (R4D) (*sensu lato* Høgh-Jensen et al. 2010) projects in the agriculture, fisheries and forestry sectors in developing countries. ACIAR has a mission to achieve more productive and sustainable agricultural systems for the benefit of both developing countries and Australia through international agricultural research partnerships (ACIAR 2014). Research in support of a particular development goal is inherently a medium-risk to high-risk activity, with potentially significant returns generally dependent on complementary development interventions (Fargher & Kelly 2012).

Papua New Guinea (PNG), having gained independence from Australia in 1975, is a young, resource-rich yet poorly developed nation facing major development challenges. Papua New Guinea's development record is generally regarded as poor because, by international standards, its level of development remains extremely low: for example, PNG's Human Development Index ranked 154 out of 188 countries (UNDP 2016). Australia provides the majority of PNG's Official Development Assistance (ODA).[1] In 2016–2017, Australia allocated approximately 21% of its country and regional ODA funding to PNG (DFAT 2017a), with 17% of these funds directed towards agriculture, fisheries and water (DFAT 2017b). However, both official aid program evaluations and other analysts have long painted a bleak picture of aid effectiveness in PNG (Hughes 2003; Feeny 2005; Heinecke et al. 2008). Other studies of aid effectiveness have found that the probability of aid projects and programs being successful in PNG and the Pacific is significantly less than in Asian countries such as China, Vietnam and Indonesia (Feeny & Vuong 2017).

The PNG economy depends largely on the resources sector (minerals, gas and oil), with a smaller contribution from renewable resources, including marine products, timber and agricultural cash crops, such as coffee, tea, palm oil, copra and coconut (Bird et al. 2007a). The potential contribution of PNG's forests resources to economic development was recognised in the 1970s, and in 1979, a revised forest policy paved the way for foreign companies to commence export-oriented logging operations (Bird et al. 2007b). However, forest-based development has a chequered and contested history in PNG, with 'successful' forest-based development projects considered to be relatively rare (Bird et al. 2007b), and seldom delivering long-term benefits to landowners (Forest Trends 2006). Likewise, there are many challenges to be overcome before forest-based communities can benefit from new revenue sources under initiatives such as REDD+ (Babon & Gowae 2013; Cadman et al. 2017). The Papua New Guinea Vision 2050 (Government of Papua New Guinea 2009) articulates the PNG Government's vision to meet the aspirations of its people, including through wealth creation from PNG's forests. The strategies identified for PNG's forestry sector include transitioning from export logging to domestic downstream wood processing, development of a large plantation estate in conjunction with customary landowners and facilitating carbon trade payments from forests.

For ACIAR, PNG is its most important partner country, accounting for 13.6% of its research program budget in 2016–2017 (ACIAR 2016). Papua New Guinea is also a very

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[1]OECD PNG Snapshot of ODA flows http://www.oecd.org/countries/papuanewguinea/aid-at-a-glance.htm

important part of the ACIAR Forestry Program. Over the first 30 years of ACIAR's existence, PNG had the third largest number of projects within the ACIAR Forestry Program (Bartlett 2016a), and in 2015–2016 the five projects being implemented in PNG represented 25% of the Forestry Program budget.[2] Despite the importance of PNG, to both ACIAR investments and Australian development assistance more generally, there is a dearth of published information about the effectiveness of these investments or on what country-specific lessons could help improve the success of future projects.

While PNG is a very logical country in which to implement ACIAR forestry projects, it is a difficult environment in which to deliver successful R4D projects. For example, an ACIAR impact assessment study of ten PNG forestry projects implemented between 1995 and 2010 found that adoption of project outputs was mixed, and appeared to have been greatest in projects aimed at and that engaged with local communities, and least in policy-related projects (Fisher 2011). Other ACIAR impact assessment studies relevant to PNG also indicate mixed results (Fisher 2010; Fisher et al. 2012).

As Ofir (2010) noted, there is a need for a deeper understanding of the context and essential conditions for success to achieve successful implementation and sustained impacts from agricultural research projects. Systematically studying the factors that enhance or diminish success of ODA-funded research projects could assist organisations that implement such projects to improve their understanding of what works when, why and for whom (Bartlett et al. 2017). In this study, success is considered to have two primary dimensions. The first is the extent to which planned research outputs are achieved and adopted by 'next users', such as the participating scientists, here called 'achievements'; the second is the extent of the impacts resulting from wider adoption of the research outputs by 'end users', here called 'impacts' (Pearce 2010).

This article reports a qualitative investigation involving ten collaborative forestry research projects between Australia and PNG, to distil lessons relevant to program managers and project leaders. It seeks to answer two questions: what are the factors that are considered to affect the relative success of collaborative forestry research projects in PNG; and, is there evidence that the presence or absence of these factors has affected the relative success of individual projects? The research is part of a wider study that addresses these questions in Vietnam (Bartlett et al. 2017) and Indonesia (Bartlett 2018), and seeks to inform both researchers and international development practitioners about the project success factors in a way that will enable them to improve project effectiveness.

Forests and forest-based development in Papua New Guinea

Papua New Guinea, with a population of about 8 million people, has the 19th largest area of forest in the world. The 2015 Global Forest Resource Assessment (FAO 2015) reported that PNG has about 33.5 million ha, or 72% of its land area, classified as forest; with the forests of New Guinea being the third largest remaining area of tropical forest after those in the Amazon and Congo basins (Novotny 2010). Since 1990, the total area of forest has not changed substantially; however, the area of primary forest has reduced by 13.73 million ha (FAO 2015). Papua New Guinea's forests are highly biologically diverse, and their conservation is a high priority (Brooks et al. 2006; Pollock et al. 2017).

Customary ownership of land and forests is enshrined in the PNG Constitution, applying to about 97% of all land (Turia et al. 2011) and operating in a variety of ways (Holzknecht 1996). Customary ownership and clan loyalties have supported food security in communities, but may restrict indigenous entrepreneurship in Pacific societies (Hughes 2003), and present major challenges for economic development (Bird et al. 2007b). Various institutional mechanisms have been established to involve landowners in forest exploitation decisions (Bird et al. 2007b), and many communities sell logging rights to generate income, as there are no operational mechanisms to generate income from forest conservation (Novotny 2010; Sillitoe 2014). The establishment of commercial forestry plantations depends on the ability of investors to negotiate long-term access to land from customary landowners; this is one reason why only around 62 000 ha of plantations has been established since the 1950s (Turia et al. 2011).

Papua New Guineans have traditionally included trees in their agricultural gardens (Bourke & Harwood 2009), and four distinct systems of customary agroforestry are discernible with numerous variations (Kanowski et al. 2014). Many of these systems incorporate commercially valuable trees — for example, in East New Britain, smallholders have incorporated fast-growing balsa trees into their farming systems as part of their livelihood strategies (Ghaffariyan et al. 2016). Utilisation and commercialisation of a variety of non-timber forest products, including indigenous nuts, gums, sandalwood and sago, have long been practiced at a small scale by local communities, but more could be done to develop and promote these products at national and international levels (Saulei & Aruga 1994).

There is a long history of concerns about the PNG forestry sector, including allocation of timber rights, levels of corruption, sustainability of timber harvesting, loss of national economic surplus, human rights abuses and the limited benefits accruing to customary landowners (Duncan 1994; Hughes 2003; CELCoR-ACF 2006; Shearman et al. 2009). Papua New Guinea's commercial forestry sector, which involves large scale export-oriented harvesting of natural forests, suffers from weak governance and over-exploitation (Laurance et al. 2011), an unstable policy environment and a poorly developed domestic wood processing sector (Hunt 2001).

For the PNG economy, the benefits derived from the forest sector fall into three components: (1) government revenue, (2) rural jobs and payments and (3) the provision of infrastructure and services (Bird et al. 2007a). Historically, about 90% of industrial timber harvested has been exported in log form, with the balance being processed domestically (FAO 2009), though the proportion processed domestically may now be 20% (Government of Papua New Guinea 2016). In 2010, the PNG Government received approximately PGK890 million (AU$367 million) in revenues from the forest industries (FAO 2015). Papua New Guinea's Medium Term Development Plan includes the challenging targets of

[2]Sourced from internal ACIAR records.

achieving 150 000 ha of plantations by 2030 and 800 000 ha by 2050, as well as having 100% of timber processed domestically by 2020 (Government of Papua New Guinea 2016).

ACIAR forestry research investments in Papua New Guinea

ACIAR investments in PNG comprise about one-fifth of the total number of forestry projects commissioned by ACIAR over three decades (Bartlett 2016a). From 1987 to December 2016, ACIAR has completed 20 forestry research projects in PNG (see Table 1), including four implemented as multi-country projects. These projects have covered five of ACIAR's forestry research themes (Bartlett 2016a), reflecting the nature of priorities identified by PNG, and ACIAR's long-standing preference to support research related to smallholder aspects of forest-based development. The research topics have included technical, social and policy aspects of smallholder and plantation forestry systems, including germplasm improvement; growth studies; value chain analysis; value-added processing of timber and non-timber products; and elements of forest inventory and yield modelling for natural forests.

While there is currently no documented evidence of economic benefits arising from ACIAR forestry projects in PNG, Fisher (2011) estimated potential benefits of AU$51 million from three projects related to the development of a new industry utilising the indigenous *Canarium indicum* L. (galip) nut. In a review of Australia's aid investments in rural development, Fargher and Kelly (2012) found that these projects had established a good foundation for growth of a new industry that would benefit PNG smallholders.

Methods

The methods for this case study follow those developed by Bartlett (2016b) to identify the relative success of selected research projects, and the three-phase methodology applied in a companion study by Bartlett et al. (2017) to identify factors that affect project success in Vietnam. A qualitative analysis was undertaken of information obtained from project records and from interviews with project staff. Ten of the 20 ACIAR forestry projects completed in PNG between 1992 and 2016 (Table 1) were selected for the case study, taking into account the following factors:

(1) focusing on medium to large research projects conducted entirely in PNG, including some projects that were part of a longer-term program, and ensuring representation of projects from the five different ACIAR research themes
(2) having adequate project records available for analysis and being able to locate researchers involved in a project for interview.

Phase 1: identification of project success factors

Thirty-three scientists who had worked as project leaders, PNG project coordinators or collaborating researchers on the selected projects were interviewed. They comprised 12 scientists from Australian agencies and 21 scientists from PNG agencies. Interviewees were asked a series of open-ended questions, including being asked to describe what they thought constituted success for an ACIAR project, and to nominate five factors that can enhance project success and five factors that can diminish project success. Other questions sought their views on aspects of the design, implementation and other contextual factors of specific projects that they had worked on. The research protocol was approved by the Australian National University Human Ethics Committee (Protocol No. 2014/051).

HyperRESEARCH[3] qualitative data analysis software was used to analyse interview response data thematically to establish what constitutes success, and participants' perspectives on those factors that enhance and those factors that diminish project success. The author reviewed the two lists of factors to identify complementary expressions of the same factor and then prepared concisely worded statements for each success factor. For example, the factor 'good leadership and effective project planning and oversight', considered to enhance success, and the factor 'poor leadership and inefficient project management', considered to diminish success, were collectively expressed as 'leadership and management'. The results were aggregated into two groups, of PNG and Australian participants, respectively, and the frequency of identification of each success factor was calculated for each group. The frequency data also enabled determination of the most important success factors, being those most frequently identified factors that together represented about three-quarters of the responses.

Phase 2: evaluation of relative success of the case study projects

Each project's relative success was evaluated using the score-card matrix methodology described in Bartlett (2016b), which enables comparative evaluations of multiple projects to be undertaken in a cost-effective manner from existing project records. A range of qualitative data drawn from ACIAR project records was analysed, including from project proposals, annual and final reports, mid-term and final reviews, adoption and impact assessments, project-related publications, and written correspondence between ACIAR and project staff. These data provided perspectives from project participants, research program managers and external reviewers of projects. A disadvantage of this methodology is that, unlike participatory evaluation methodologies, it does not engage users of the research in the evaluation.

Scores were assigned for four criteria related to research achievements (project design, results achieved, collaboration and publications) and for four criteria related to research impacts (capacity building outcomes, scientific outcomes, economic outcomes, and social and policy outcomes). Under this methodology, scores up to a maximum of ten were assigned for each of research achievements and research impacts. Scores of 0.0–5.0 were considered to be low achievements or low impacts; scores of 5.1–10.0 were considered to be high achievements or high impacts. This approach generates four different categories of project success: high achievements-high impacts, high achievements-low impacts, low achievements-low impacts and low achievements-high impacts.

[3]Researchware, Inc. http://www.researchware.com/ [accessed 13 June 2014].

Table 1. ACIAR completed Papua New Guinea forestry projects

ACIAR project code	Duration	Funding AU$ m	Research theme[a]	Focus of research
FST/1991/014	1992–96	1.29	T3	Nutrition and mycorrhizal requirements of tropical trees for plantation and agroforestry systems
FST/1994/033	1995–00	1.28	T6	New leucaenas for south-east Asian, Pacific and Australian agriculture
FST/1995/123	1997–98	0.16	T8	Testing the utility of the north Queensland rainforest growth and timber yield model in PNG
FST/1998/113	2000–05	0.67	T7	Development of a sustainable, community-based essential oil industry in the Western Province of PNG
FST/1998/115	2000–05	1.55	T3	Domestication of PNG's indigenous forest species
FST/1998/118	2001–05	0.84	T8	Planning methods for sustainable management of timber stocks in PNG's forests
FST/2002/010	2004–05	0.20	T3	Domestication and commercialisation of multi-purpose indigenous trees and shrubs for food and other products
FST/2003/049	2005–08	0.15	T5	Review of portable sawmills in the Pacific: identifying the factors for success
FST/2004/009	2005–08	0.63	T3	Facilitating the availability and use of improved germplasm for forestry and agroforestry in PNG
FST/2005/050	2005–06	0.15	T6	Exploring PNG agroforestry systems
FST/2004/050	2007–12	0.91	T6	Value adding to PNG agroforestry systems
FST/2004/055	2006–09	0.63	T3	Domestication and commercialisation of *Canarium indicum* in PNG
FST/2004/061	2007–11	0.78	T8	Assessment, management and marketing of goods and services from cutover native forests in PNG
FST/2006/048	2008–11	0.65	T7	Processing of *C. indicum* nuts: adapting techniques to benefit South Pacific farmers
FST/2006/088	2008–12	0.92	T3/T7	Promoting diverse fuelwood production systems in PNG
FST/2006/120	2008–11	0.68	T5	Increasing downstream value adding in PNG's forest and wood products industry
FST/2007/078	2009–15	1.06	T3	Development of a PNG timber industry based on community-based planted forests
FST/2009/016	2011–16	1.08	T3	Improving the PNG balsa value chain to enhance smallholder livelihoods
FST/2010/013	2012–16	0.48	T7	Developing markets and products for the Pacific and PNG *Canarium* nut industry
FST/2011/058	2012–13	0.11	T7	Facilitating the establishment of charcoal producer groups in PNG

Highlighted projects: projects analysed in the case study. [a]ACIAR forestry program research themes as described in Bartlett (2016a) (Theme 3, Domestication and silviculture of non-Australian trees; Theme 5, Value-added processing and treatment of wood; Theme 6, Agroforestry and community forestry; Theme 7, Non-timber forest products; Theme 8, Native forest management)
ACIAR, Australian Centre for International Agricultural Research; PNG, Papua New Guinea

Phase 3: identification of relationships between success factors and the level of relative success achieved by different projects

Four projects, representing two different success categories, were selected for a more detailed analysis to better understand the relationships between the identified success factors and a project's evaluated success. The features of the selected projects are shown in Table 2; further information on the type of research conducted in each project and the way in which various success factors influenced its level of success are presented in Appendix 1.

For each selected project, the ACIAR project records and interview responses from the project leader and two PNG participants were further analysed to identify any evidence of the way the identified success factors had enhanced or diminished success. Using these two sources of information, subjective ratings were assigned for the apparent influence of each of these success factors on the project's success. The following rating system of five categories was used:

(1) *Strongly enhances* — presence of factor appears to have strongly enhanced success
(2) *Enhances* — presence of factor appears to have enhanced success
(3) *Neutral* — no evidence that the factor enhanced or diminished success
(4) *Diminishes* — absence of factor appears to have diminished success
(5) *Strongly diminishes* — absence of factor appears to have strongly diminished success.

Results

Interpreting success in a collaborative research project

The views expressed by participants on what constitutes project success varied considerably, with about one-third of participants articulating factors that influence success rather than articulating what success meant to them. The thematic analysis enabled a common definition of success to be developed from participants' responses. A successful ACIAR forestry research project in PNG was perceived to be one which achieves its specified objectives and outputs, enhances the capacity of partners, facilitates ongoing scientific relationships and networks, and results in tangible scientific impacts and benefits for project stakeholders and local communities. About one-third of participants considered a successful project should have some evidence of adoption and impact by the end users of the research outputs; however, (Fisher 2011) found that many ACIAR forestry projects in PNG have achieved only limited impact.

Table 2. Projects for which relationships between success factors and project success categories were explored

Project success category				
Achievements	Impacts	Project number	Theme	Title of project
High	Low	FST/2009/016	T3	Improving the PNG balsa value chain to enhance smallholder livelihoods
High	Low	FST/2006/048	T5	Processing of *Canarium indicum* nuts: adapting techniques to benefit South Pacific farmers
Low	Low	FST/1998/115	T3	Domestication of PNG's indigenous forest species
Low	Low	FST/2006/120	T5	Increasing downstream value adding in PNG's forest and wood products industry

PNG, Papua New Guinea

Identification of success factors

The thematic analysis of participants' responses on the factors that can enhance or diminish project success identified 33 factors that were considered to enhance, and 34 factors that were considered to diminish, project success; when taken as a whole, there were 37 different factors identified that influence project success (Table 3). While most factors that diminish success were the converse of factors that enhance success, there were three factors identified that enhance success (alignment with national objectives, user champions and collaboration with international scientists), and four factors identified that diminish success (duration of project, donor influence on design, community or land disputes, and gender roles and empowering women), for which no converse factor was identified by participants.

The interview data comprised 606 responses related to individual success factors, of which 339 responses are from the 21 PNG participants and 267 responses are from the 12 Australian participants. The frequency of identification of the 37 success factors by PNG and Australian participants, for each factor considered to enhance or diminish project success, is shown in Figure 1. As shown in Figure 1, some factors are much more frequently identified than others, and for almost all the factors interviewees considered that the same factor could either enhance or diminish project success. The three most frequently identified factors, which together represented 22% of the responses, were: collaborative scoping and design (47 responses), funding facilities and equipment (44 responses), and leadership and management (42 responses). Sixteen of the success factors (Nos. 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 25 and 26) together represented 76% of the responses, and so can be considered as the most important factors affecting project success identified in this study.

Most of the success factors were consistently identified across the two groups (PNG and Australian), but some differences were apparent. Papua New Guinea participants considered factors such as effective communications and research networks, links to impact pathway and user benefits, continuation of research post project, and clarity of roles and responsibilities, as being more important than did the Australian participants. Australian participants considered factors such as publication and dissemination of results, strong culturally appropriate team relationships, time spent on in-country collaboration, continuity of partner institutions and team, and engagement with the private sector, as being more important than did the PNG participants.

Evaluation of the relative success of the forestry projects

The results of the evaluation of project achievements and project impacts for each of the ten forestry research projects are shown in Figure 2. The ten projects had different levels of apparent success, with scores ranging from 3 to 9 for research achievements and 1.5–4.5 for research impacts. All projects achieved much higher scores for research achievements than for research impacts, and no two projects achieved the same combination of scores for research achievements and research impacts. Even when projects received the same total evaluation score for research achievements (as was the case for FST/2009/016 and FST/2004/061), they received different scores for the constituent criteria. These results highlight both the variability between projects within a country and the usefulness of this evaluation methodology to compare the relative degrees of success within a group of projects.

Bartlett et al. (2017) demonstrated the utility of considering categories of project success based on combinations of the evaluation scores for research achievements and research impacts. Applying that approach to these ten projects results in two categories of project success (Fig. 3): four projects with low achievements and low impacts, and six projects with high achievements but low impacts. In this case study, there were no projects with high achievements and high impacts, and no projects with the unlikely combination of low achievements yet high impacts. The absence of any projects with high achievements and high impacts is in stark contrast to the findings from companion studies of other ACIAR forestry projects from Vietnam (Bartlett et al. 2017) and Indonesia (Bartlett 2018).

Evidence of success factors in selected projects

The author's assessment, derived from the interview responses and evidence from project records, of the apparent influence of each of the 37 success factors on the success of the four selected projects is shown in Table 4. This analysis provided a clear indication of the importance of many of the identified success factors that can be influenced during project design and project implementation.

For the two projects evaluated as having high achievements and low impacts, evidence existed that taking appropriate account of the success factors had contributed to enhanced success. In general, this pattern seemed to be stronger for the more frequently identified success factors than for those less frequently identified. For one of these two projects (FST/2009/016), the project team engaged the private sector and local communities as well as working with the government and academic research partners. For the two projects evaluated as having low achievements and low impacts, it was apparent that failing to take appropriate account of the success factors had contributed to the diminished project success. However, the pattern was not evident for two of the most commonly identified factors that can be influenced during project implementation: 'leadership and management', and 'strong, culturally appropriate team relationships'. This suggests that having effective leadership and management as well as strong team relationships are necessary but not sufficient to facilitate project success in PNG. For the identified success factors that are outside the control of a project, there was little evidence of any relationships between the success factors and the evaluated level of success in the four projects assessed. For example, the factor 'lack of continuity of partner institutions and individual team members' appeared to have contributed to diminished success in all four assessed projects, although perhaps more strongly in the two projects with low achievements and low impacts.

These relationships were reasonably consistent regardless of whether the assessment was based on information from the project records or from the interview responses. In some cases, evidence could not be found within the interview

Table 3. Participants' views of success factors

Factor no.	Success factors	Participants' views on factors that enhance success or diminish success	
		Enhance success	Diminish success
1	Collaborative scoping and design	Good collaboration with partners on scoping and the specifics and achievability of project design	Inadequate consultation with partners, incorrect assumptions and too ambitious or poorly focussed design
2	Skills mix and time allocations	Having appropriate skilled and experienced scientists with sufficient time allocations, including some full-time staff	Team with inappropriate skills mix, inexperienced or overcommitted scientists and no dedicated project staff
3	Funding, facilities and equipment	Adequate funding and other resources, including donor and partner contributions	Inadequate funding, facilities or equipment to undertake planned activities and delays in provision of funds to project activities
4	Scientists commitment, collaboration and focus	Dedicated and focused and accountable scientists and with collaborative team work	Scientists lacking interest, commitment or focus and poor collaboration within team
5	Team and technical capacity building	Supporting team and institutional capacity building, informal and formal study opportunities	Poor focus on capacity building of project partners
6	Mutual benefit of research topic	Selection of research issue with mutual benefits	Research does not provide mutual benefits for each country
7	Selection and commitment of partner institutions	Effective selection and ongoing commitment of project partners	Poor institutional support or functionality, changes in priorities or conflict with partners and having too many partners to coordinate
8	Site selection and scientific rigour of trials	Appropriate sites for research trials with good scientific design and stakeholder support	Inappropriate trial location or poor scientific discipline in trial establishment
9	Leadership and management	Good leadership and effective project planning and oversight	Poor leadership and inefficient project management
10	Strong, culturally appropriate team relationships	Respect of culture, patience and developing friendships	Poor relationships or misunderstandings within team and no mechanisms for resolving conflicts or misunderstandings
11	Time spent on in-country collaboration	Sufficient resourcing to enable adequate time of external researchers in country, with frequent visits by project leader and various project staff	Infrequent visits by project leader, lengthy gaps in visits from project staff, inadequate travel funds or other restrictions limiting travel
12	Effective communications and research networks	Good and regular communications within project and effective dissemination of knowledge	Poor communications between team members, unavailability and unreliability of public communications systems and failure to disseminate results to stakeholders
13	Links to impact pathway and user benefits	Results linked to stakeholder benefits	Poor communication of project results to users or lack of benefits for stakeholders from research
14	Implementation flexibility, monitoring and review	Flexibility to adapt activities and appropriate monitoring and review of progress, including a mid-term review process	Overly prescriptive outputs, no flexibility to adapt, poor monitoring, no mid-term review or lack of follow-up on review recommendations
15	Continuity of partner institutions and team	Continuity of key staff in partner institutions and with partner researchers	High turnover or non-replacement of project staff and changes of structures or leadership support within partner institutions
16	Duration of project	Not identified	Duration too short to implement activities and obtain results
17	Donor influence on design	Not identified	Donor finalising project or insisting on design elements not agreed to by all partners
18	Long-term research collaborations	Long-term relationships supported via follow on projects	Lack of follow on research projects
19	Continuation of research post-project	Agencies continue research after project, donor facilitates ongoing monitoring of trials or has a clear exit strategy	No funding available after project or no exit strategy
20	Alignment with national development objectives	Research relevant to national policies, priorities and programs	Not identified
21	Experience of project leader in country	Good understanding of local culture and operating environment	Naivety of project leader about local context
22	Trust within team	Trust between project participants	Lack of trust within team or of confidence with stakeholders
23	Local government and community support	Engaging with local government and communities to achieve good support but manage expectations	Poor collaboration or conflicts with local government or communities
24	Engagement with private sector	Effective engagement of private sector partners in conduct and adoption of research, including managing expectations	Lack of engagement with or support from private sector partners
25	Publication and dissemination of results	Joint involvement in scientific articles and effective dissemination of scientific and extension information	Ineffective dissemination of scientific or extension information
26	External factors: policies, markets, environmental, security	Supportive policies, established markets, good local security situation	External factors influencing research facilities, trials or markets and lack of appropriate supporting policies or unforeseen delays related to national elections or security problems affecting travel
27	Engagement of policy actors	Effective engagement of policy actors to translate findings into policy	Inability to engage policy makers to generate supportive policies
28	Willingness to adopt innovation	Farmers and communities willing and able to adopt and adapt innovations	Culture, finance or risk limit adoption of technologies
29	User champions	Engagement of farmer or industry champions	Not identified

(*Continued*)

Table 3. (Continued).

Factor no.	Success factors	Participants' views on factors that enhance success or diminish success: Enhance success	Diminish success
30	Collaboration with international scientists	Benefits from collaboration with international scientists	Not identified
31	Clarity of roles and responsibilities	Clear definition of roles, responsibilities and delivery expectations	Partner staff do not understand their roles or what is expected of them
32	Stakeholder and partner coordination	Appropriate mechanism to coordinate stakeholders and provide feedback	Lack of an advisory committee mechanism to discuss issues and promulgate results to key stakeholders
33	Provision of incentives	Payment of incentives to local staff and collaborators	No tangible or financial incentives to participate in project
34	Community or land disputes	Not identified	Disputes within community or about land tenure disrupt project
35	Corruption or misuse of funds	Appropriate management of project funding	Corrupt practices and misappropriation of project funding
36	Political support or interference	Supportive political and institutional environment	Unsupportive political environment or direct interference in project
37	Gender roles and empowering women	Not identified	Focusing on empowering women without understanding role of men

responses, perhaps because the open-ended project-specific questions did not directly ask how their identified success factors had influenced the project. In the case of oldest project (FST/1998/118), the comparative paucity of available project records made it difficult to assess the relevance of some success factors. It is nevertheless very clear that, for the project that received the lowest relative success score (FST/2006/120), most (23 out of 37) of the identified success factors were considered to have contributed to either diminished or strongly diminished project success.

Discussion

Papua New Guinea is a very challenging environment in which to deliver successful R4D projects, or for those projects to achieve impact. Papua New Guinea has some deep-rooted development constraints, including consistently weak government capacity for service delivery, maintaining law and order, an unstable political environment, widespread acceptance of corruption, poor infrastructure, and a firmly clan-based civil society (AusAID 2003; ADB 2012).

ACIAR supports collaborative research partnerships implemented through individual research projects. In many cases, these projects form part of a long-term program to address a R4D priority identified by the partner country. As such, there is an inherent duality in ACIAR's mission, by performing related roles as a research broker and funder as well as a research-led development facilitator (Nairn et al. 1998). However, almost invariably, ACIAR needs to work with and through others to achieve adoption of research findings and the intended broader development outcomes. When research is appropriate and the project delivers its planned outputs and the wider development environment facilitates adoption, ACIAR projects can bring large-scale benefits (Fargher & Kelly 2012), as evidenced by long-term support for Vietnam's smallholder-driven plantation forestry sector (Fisher & Gordon 2007). However, when the research is not embedded in an effective rural development strategy, which may include relevant private sector initiatives, or there are severe constraints to development, the development impacts from ACIAR projects are likely to be relatively small (Fargher & Kelly 2012).

Fisher (2011) concluded that there are various barriers to achieving adoption from ACIAR forestry projects in PNG, including weak governance, resistance to change, lack of extension services and infrastructure, inadequate supply of tree germplasm, and the long time frames to receive benefits. He also noted that ACIAR's delivery model is not well-suited to addressing governance issues and, for research on downstream processing, commitments to long-term funding and marketing support activities are needed. ACIAR's forestry program portfolio in PNG has sought to work with the breadth of forest sector actors — government agencies, companies, non-governmental and community organisations, landowner groups and champion farmers — and has progressively emphasised greater engagement with actors other than government, in recognition of the constraints on government agencies. In both the sampled and other projects, this approach has been relatively successful in some cases, and less so in others (Kanowski & Mulung 2017). The discussion below considers the lessons arising from this study's analysis in this context.

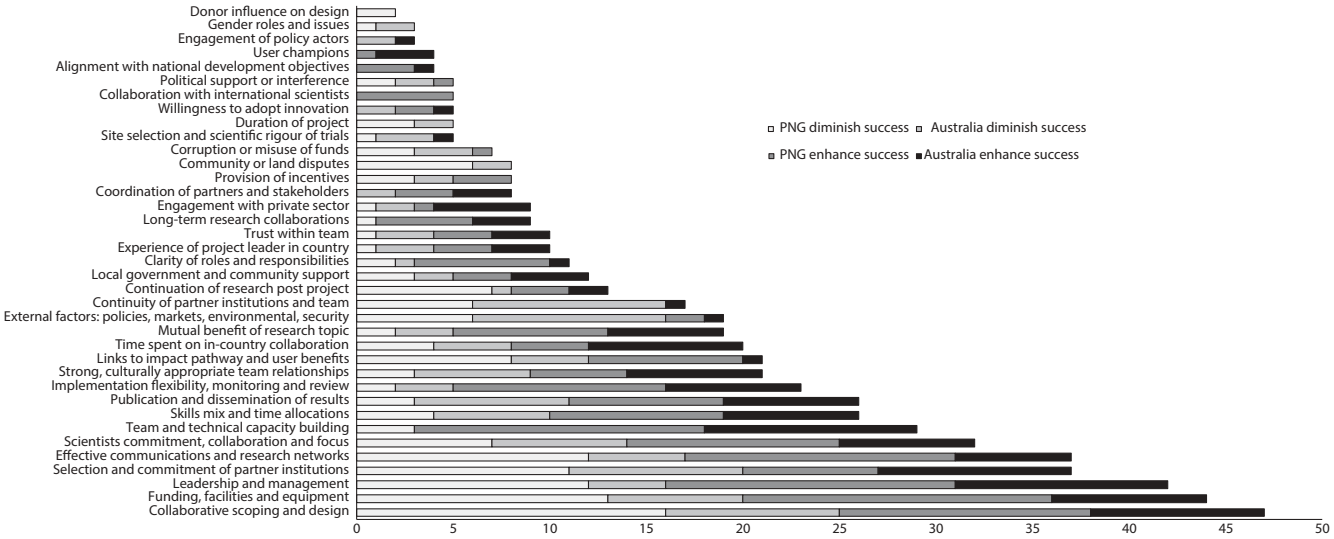

Figure 1. Frequency of identification of the 37 project success factors by the Papua New Guinea and Australian participants

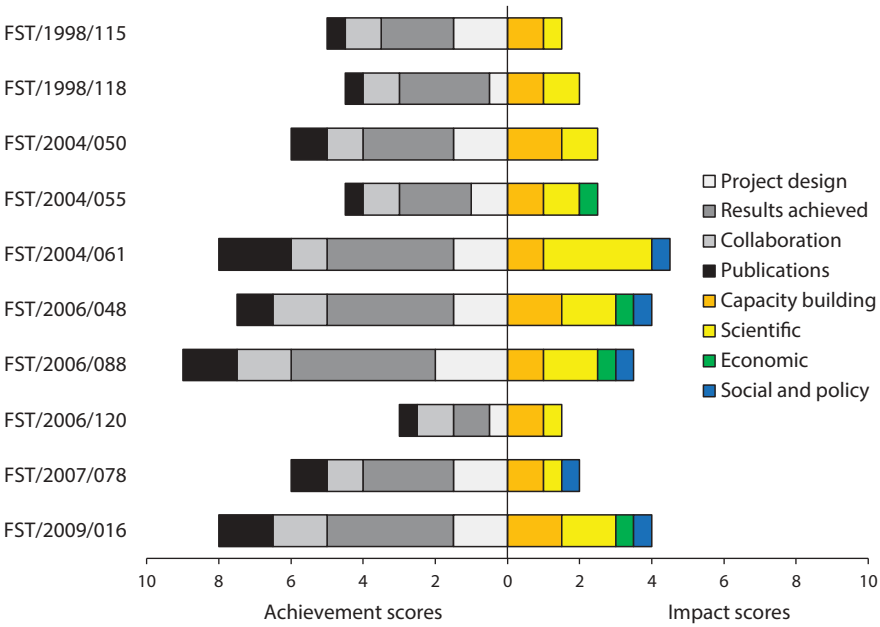

Figure 2. Evaluation of relative success of the ten Papua New Guinea forestry projects

In this study, six projects (60%) received scores of more than 5 for the evaluation based on research achievements, whereas no projects received scores of more than 5 for the evaluation based on research impacts. The absence of any projects evaluated as having high achievements and high impacts contrasts with the findings from companion studies of other ACIAR forestry projects from Vietnam (Bartlett et al. 2017) and Indonesia (Bartlett 2018). If success is defined in terms of high scores for both achievements and impacts, then none of these ten projects could be considered successful. That may well be too harsh a judgement of the outcomes of many of these projects. It would fail to recognise the challenging context in PNG for implementing R4D projects and the relatively low level of existing research capacity, as well as the incremental progress towards development goals that often occurs through a series of related projects. As noted by Fargher and Kelly (2012), research of the kind supported by ACIAR, which is pre-commercial in most instances and often of considerable duration, can only be expected to lead to significant direct impacts in a small proportion of cases.

An example of the general challenges for forestry research and the specific challenges for projects implemented in PNG can be seen in the three projects on domestication and breeding of high-value timber species that spanned a 15-year period. This research commenced in 2000 under project FST/1998/115, which received evaluation scores of 5 for achievements and 1.5 for impacts. It continued under project FST/2004/009 and subsequently under project FST/2008/078. The latter project concluded in 2015 and received evaluation scores of 6 for achievements and 2 for impacts in this study. This example of tree breeding research, which generally requires long-term programs, shows a modest increase in both achievement and impact between the first and most recent projects. Even so, the desired outcome and impact have not yet been achieved, because of the time required to assess performance of the various teak genotypes before

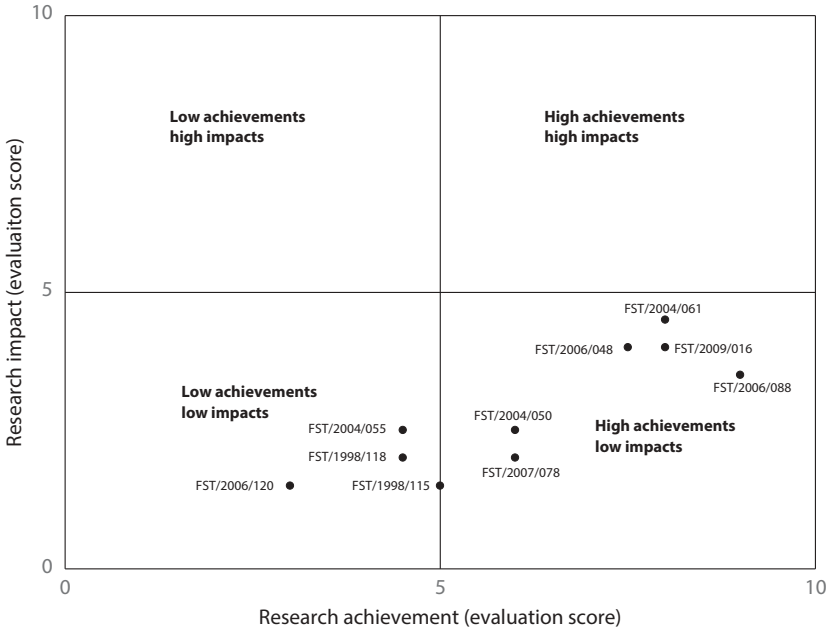

Figure 3. Project success categories based on combinations of research achievement and impact evaluation scores, and location of case study projects within those categories

widespread dissemination of germplasm can occur. When compared with similar ACIAR tree breeding research conducted in Vietnam over a similar period, there are much lower achievements and impacts, reflecting the different contexts under which these two programs were implemented.

Research on value-added processing of *C. indicum* nuts has been considered by other evaluators (Fargher & Kelly 2012) to be a good example of a R4D project successfully facilitating rural development. In this study, that project received evaluation scores of 7.5 for achievements and 4 for impact, as when it concluded in 2011 there was still not any commercial production of processed *C. indicum* nuts. Research has continued to the present under two further projects in an effort to achieve greater scale-up of benefits for smallholders and longer-term sustainability through private sector investment of commercial processing plants. After 11 years of research and development investment, *C. indicum* nuts are now being processed in a government-run pilot factory and sold in commercial outlets in East New Britain. However, the private sector still does not yet have sufficient confidence to invest in a large-scale processing plant. This demonstrates both the considerable challenges of commercialising new products in PNG and the necessity of taking a long-term view on success from forestry research investments.

A number of authors (Byron 2001; Pearce 2010; Baynes et al. 2015; Bartlett et al. 2017) have examined the factors that influence the success of forestry development initiatives, while Pearce (2010) examined project-level factors that affect the success of ACIAR projects. The findings of this study both confirm and supplement the findings from these previous studies. All 14 success factors relevant to ACIAR research projects identified by Pearce (2010) were identified in this study. The findings from two companion studies of forestry research projects in Vietnam (Bartlett et al. 2017) and Indonesia (Bartlett 2018), which respectively identified 22 and 30 success factors, are of particular relevance here. All of the success factors identified in those cases were again identified here, although their relative frequency differed, and a further seven success factors have been identified. In this study, over 80% of the factors identified as affecting project success, including 14 of the 16 most frequently identified factors (shown in bold text in Table 4), relate to either project design or project implementation. This finding that the great majority of the identified success factors relate to aspects that can be influenced during project design or project implementation is consistent with the findings from the two companion studies. Eleven of the 12 and all 13 of the most frequently identified success factors were related to project design or project implementation in the Vietnam and Indonesia studies, respectively. In contrast to the findings from those two studies, participants in this study considered three success factors (site selection and scientific rigour of trials, local government and community support, and engagement with private sector) to be less important to success in PNG forestry projects. This response contrasts to the observations made elsewhere in this article about the importance of engaging the private sector and local communities to improve project success in PNG.

The seven new success factors identified in this study were:

Clarity of roles and responsibilities (No. 31) — this reflects the need for the project leadership team to provide clarity to individual team members of the expectations regarding their role in project activities and the expected timelines for completing various activities.

Stakeholder and partner coordination (No. 32) — this reflects the lesson that, in projects where there are multiple partner organisations and/or key stakeholders who need to be engaged, it is beneficial to have an advisory committee or coordination forum that meets periodically.

Provision of incentives (No. 33) — this reflects an expectation of PNG partners and some stakeholders that they will receive financial incentives to participate in the project.

Community or land disputes (No. 34) — this reflects the situation in PNG whereby disputes within communities or about land ownership or use can impact adversely on project implementation.

Table 4. Expression of success factors within four projects with different evaluated levels of success

Project	FST/2009/016		FST/2006/048		FST/1998/115		FST/2006/120	
Evaluated level of success	**High A – Low I**		**High A – Low I**		**Low A – Low I**		**Low A – Low I**	
Response type	**IR**	**PR**	**IR**	**PR**	**IR**	**PR**	**IR**	**PR**
Factors that can be influenced during project design								
Collaborative scoping and design								
Funding, facilities and equipment								
Selection and commitment of partner institutions								
Skills mix and time allocations								
Mutual benefit of research topic								
Experience of project leader in country								
Duration of project								
Collaboration with international scientists								
Alignment with national development objectives								
Donor influence on design								
Factors that can be influenced during project implementation								
Leadership and management								
Effective communications and research networks								
Scientists commitment, collaboration and focus								
Team and technical capacity building								
Publication and dissemination of results								
Implementation flexibility, monitoring and review								
Strong, culturally appropriate team relationships								
Links to impact pathway and user benefits								
Time spent on in-country collaboration								
Local government and community support								
Clarity of roles and responsibilities								
Trust within team								
Engagement with private sector								
Coordination of partners and stakeholders								
Provision of incentives								
Corruption or misuse of funds								
User champions								
Engagement of policy actors								
Site selection and scientific rigour of trials								
Gender roles and empowering women								
Factors outside the project's control								
External factors: policies, markets, environmental, security								
Continuity of partner institutions and team								
Continuation of research post-project								
Long-term research collaborations								
Community or land disputes								
Willingness to adopt innovation								
Political support or interference								

Cell shading codes	
	Strongly enhanced
	Enhanced
	Neutral
	Diminished
	Strongly diminished

The 16 most frequently identified factors are shown in **bold**. FST/2009/016, FST/2006/048, FST/1998/115 and FST/2006/120 are the four projects

A, achievement; I, impact; IR, evidence from interview responses; PR, evidence from project records

Corruption or misuse of funds (No. 35) — this reflects a cultural practice in PNG whereby individuals not directly involved in a project seek payments, or those with management responsibilities misuse project funds.

Political support or interference (No. 36) — this reflects the situation whereby either politicians or senior officials can use their influence to assist or hinder project activities.

Gender roles and empowering women (No. 37) — this reflects cultural norms in PNG whereby men and women have different roles in families and communities, which can differ in different locations, and sometimes women's empowerment activities may cause social unrest.

It is possible that three of these newly identified success factors (Nos. 31, 32 and 37) could be equally relevant to collaborative research projects implemented in Vietnam or Indonesia, depending on the nature of the research being conducted and number of partners involved. However, other factors (i.e. Nos. 33–36) are highly likely to be more country-specific, but important in situations where salaries are low, corruption exists, or disputes and unrest are prevalent. The results related to the new success factor 'gender roles and empowering women' (No. 37) may be context-specific. In PNG, there are differences and disparities in the traditional roles of men and women in forest-related activities; in general, women have higher workloads related to agricultural activities, while men have greater roles in dispute resolution (Pamphilon et al. 2013). In this study, the success factor on gender roles and women's empowerment was identified as diminishing success by three participants, with each case being related to attempts to undertake women's empowerment activities without properly understanding gender roles within the participating communities.

These results illustrate how the factors that affect project success may be both common and different between countries. Differences are likely to be attributable to both differences in the nature of the research itself, and to the country-specific contexts within which research and adoption occur. This confirms the importance of having a flexible, evidence-based and context-dependent approach to identifying and managing the success factors, rather than having a predetermined list that is presumed to apply universally.

Conclusion

As PNG is likely to remain one of the most important countries for ACIAR's forestry program, it is important to build an evidence base about the success of individual projects and to better understand the factors that contribute to enhanced or diminished success of these projects over time. This need is consistent with the intent of the Paris Declaration on Aid Effectiveness (OECD 2005), and with AusAID (2003) findings about the importance of conducting further research into the contribution of Australian aid to PNG's development. As the agriculture, fisheries and forestry sectors will continue to contribute to the economic and social well-being of much of PNG's population well into the future (ADB 2012), it is important to ensure that the research needed to address the needs and constraints of these sectors is both well targeted and effective. The evaluation method and the findings on project success factors could assist research funders to better target and improve the effectiveness of future research investments in PNG.

This study has shown that, in comparison with similar studies of forestry projects in Vietnam and Indonesia, ACIAR's PNG forestry projects are less successful in terms of their achievements and their impacts. It is quite likely that this is related to the different contexts between these three countries but understanding the reasons for these apparent differences requires further research. The findings from this study provide some evidence of modestly increasing levels of relative success in successive projects within a thematic program of research, as well as a need for long-term programs if the primary goal is to achieve development impact. In addition, several factors are identified that contribute mainly to diminished project success. These findings are of particular significance for projects implemented in countries like PNG, in which aid effectiveness is similarly low.

As Feeny and Vuong (2017) noted, more detailed project-level data, on factors such as the calibre of leadership, the quality of project design and the extent of supervision, need to be collected in order to assess the importance of micro-level factors on project success. This study has contributed to this task, by broadening the understanding of the nature of success factors affecting collaborative forestry research projects implemented in developing countries. It also reveals that, while project participants identified many factors that influence project success, there was a good convergence of opinion about which are the most important factors. The findings on the nature of these success factors, and the finding that some of the factors are country-specific and context-specific, provide important insights that could help improve the effectiveness of future investments in both PNG and other countries in which it has proven difficult to deliver successful R4D projects.

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Appendix 1. Projects studied to explore the expression of success factors

FST/1998/115 'Domestication of Papua New Guinea's indigenous forest species'

This five-year project aimed to develop the use of indigenous forest tree species for reforestation and agroforestry activities by developing domestication processes for four high-value species (*Calophyllum euryphyllum* Lauterb., *Dracontomelon dao* (Blanco) Merr. & Rolfe., *Pometia pinnata* J. R. Forst. & G. Forst., and *Casuarina oligodon* L. Johnson) and preparing conservation strategies for two species (*Santalum macgregorii* F. Muell. and *Gyrinops ledermannii* Domke). Substantial capacity was built within Papua New Guinea (PNG) partner agencies and related research and tree seed infrastructure was strengthened. A seed handling manual was developed for 27 species.

The external review of the project found that the project attempted to achieve more than was reasonably possible given the complexity of the PNG biota and the prevailing social, technical and administrative environments. Collaboration was variable throughout the life of the project and very little dissemination of results occurred. Impacts were limited to capacity and some scientific impact. More than 10 years after the project concluded, seed from these domestication plantings was not widely available and the conservation strategy for the indigenous sandalwood strategy had not been implemented.

FST/2006/048 'Processing of *Canarium indicum* nuts: adapting techniques to benefit South Pacific farmers'

This three-year project aimed to develop post-harvest value-adding processes for the nutritious indigenous galip nut (from the *Canarium indicum* tree) that could be used by smallholder farmers and larger commercial enterprises. The design was informed by a scoping study and importantly the team included a specialist who had worked extensively on the development of the Australian macadamia industry. The project partnered with the Papua New Guinea (PNG) National Agricultural Research Institute (NARI), and a European Union aid project supported aspects of the development of a galip nut industry. There was very good collaboration within the team and a lot of capacity building of NARI staff through direct engagement with the Australian scientists.

The project's main results are summarised in Wallace et al. (2010). It achieved most of the planned outputs with a strong focus on the nut drying and processing research done at NARI in PNG. A range of processing methods was developed involving drying the kernel and utilising nut cracking technologies adapted from the macadamia industry. The major impacts related to capacity building and science, as the technologies could not be commercialised within the project's short timeframe.

FST/2006/120 'Increasing downstream value adding in Papua New Guinea's forest and wood products industry'

This three-year project aimed to provide the foundation for an enhanced domestic timber-processing industry in Papua New Guinea (PNG). The planned activities included exploring the development of products and designs based on solid wood and veneers, as well as the potential for value chains integrating timber from agroforestry systems and community forests with advanced processing facilities. It also included a significant focus on enhancing capacity in timber processing research and related training and education programs. The major outputs related to expanding the availability of research equipment and upgrading research and technical skills in partner organisations. The project has also produced technical outputs on mechanical and durability properties of some lesser known PNG timber species as well as an updated wood properties database. The project's results are summarised in Ozarska et al. (2013) and a 72-page book on the research outputs was prepared and distributed to partners.

The factors that reduced project success related to the project design and its implementation. The project was poorly designed with overly ambitious objectives for a three-year project and insufficient scoping and understanding of the situation in PNG regarding capacity, equipment, logistics, communications and willingness of partners to participate. Three years was inadequate for this type of research especially for a new collaboration, with dispersed in-country partners and inadequate research facilities. During implementation, there were numerous problems with lack of the availability of key equipment, slow arrival and installation of new equipment, poor communication infrastructure and significant staff turnover, including project leader and key roles in all partner organisations.

FST/2009/016 'Improving the Papua New Guinea balsa value chain to enhance smallholder livelihoods'

This four-year project aimed to enhance the value, value recovery and international competitiveness of the Papua New Guinea (PNG) balsa industry and optimise its benefits for smallholder growers. It included activities on smallholder decision-making and organisation, improving balsa germplasm and management, harvesting and transport systems, and product development and marketing. The design process included a significant scoping mission, published as an ACIAR technical report (Midgley et al. 2010). During project implementation, the project team engaged private sector partners and a training college and had good support from the local government and champion farmers.

The project was quite successful for a PNG project, with some good scientific, capacity, economic and social impacts already evident. Most of the planned activities were achieved and the project partners collaborated well. The project's results are summarised in Kanowski and Jenkin (2016) and five journal articles have been published. The breeding and silviculture activities will have a significant impact on the East New Britain balsa industry. A novel and award-winning balsa panel product represents a very significant innovation resulting from the project. A balsa training manual was produced and the partners delivered training to 116 farmers. The project was less successful with its smallholder survey and grower group activities, and the results of the policy research are yet to be adopted by the PNG Forest Authority.