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2 Abbreviations

ACTIV	Alternative Communities' Trade in Vanuatu Association
AVRDC	World Vegetable Center
CePaCT	Centre for Pacific Crops and Trees
CMV	Cucumber mosaic virus
DAF	Queensland Department of Agriculture and Fisheries
DFAT	Department of Foreign Affairs and Trade (Australia)
FSC	Forest Stewardship Council
GIZ	Gesellschaft für Internationale Zusammenarbeit
GU	Griffith University
IKSA	Improving Key Services to Agriculture
JCU	James Cook University
LRD	Land Resources Division (SPC)
MOP	Mother-of-pearl
PAG	PARDI Advisory Group
PAPP	Pacific Agriculture Policy Project
PARDI	Pacific Agribusiness Research for Development Initiative
PGS	Participatory guarantee scheme
PHAMA	Pacific Horticultural and Agricultural Market Access program
PIC	Pacific island country
PIFON	Pacific Island Farmers Organisation Network
PRA	PARDI Research Activity
R&D	Research and development
RPM	Research program manager (ACIAR)
RTP	Retail transformation project
SPC	Secretariat of the Pacific Community
SPE	South Pacific Elixirs Limited
SRA	Small Research Activity
SROS	Scientific Research Organisation of Samoa
UoA	University of Adelaide
UQ	University of Queensland
USC	University of the Sunshine Coast
USP	University of the South Pacific

3 Executive summary

PARDI was a 5-year project (2010–2015) that sought to provide sustainable livelihood improvements to communities in Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu. To do this the project used value chain analysis methodology, combined with Pacific island country (PIC) stakeholder consultation, to identify priority commodities, agribusiness value chains or industries with tangible growth potential. Priority was given to those value chains where targeted research interventions or appropriate technical assistance was likely to improve value chain profitability and sustainability. Through this process of value chain assessment, review and prioritisation, 25 research projects were commissioned (14 major contractual projects¹ and 11 short supporting projects). Of the major research projects undertaken, 42% were developed and led by PIC project leaders.

As a result of the research and agribusiness development activities undertaken by PARDI, 1,331 Pacific islanders have benefited economically². This is anticipated to increase by a further 2,070 individuals in the next 3 to 5 years. Through PARDI, five new commercial ventures have been established³, a range of new value-added fisheries and forest products have been developed and launched, and new markets opportunities have been realised.

In seeking enduring impact, PARDI undertook a significant capacity building program. Twenty-five Pacific island and Australian students undertook higher degree research projects in support of PARDI projects, the vast majority enrolled under Masters or PhD programs at the University of the South Pacific (USP). Sixty-two technical workshops were undertaken across six countries (Fiji, Kiribati, Samoa, Solomon Islands, Tonga and Vanuatu). Forty private sector and Pacific government staff received intensive capacity building in agribusiness or technical skill development through participatory involvement in the project. A further 15 Pacific island collaborating researchers were sponsored to attend major international conferences or short-course training.

As of Nov 2015, the research undertaken had resulted in 19 published academic papers with a further five academic papers under review, four completed higher degrees, and 51 published technical and conference papers.

A summary of key achievements (by project/commodity) is given below.

Pearls

- Development plans for the Tongan pearl industry and the non-export sector of the Fiji pearl industry were completed in 2014 and 2015, respectively.
- Juvenile oyster (spat) collection was introduced to 17 communities throughout Fiji as part of a national spat collection program conducted collaboratively with the Fiji Fisheries Department. This will provide livelihood opportunities for communities through sales of spat to pearl farms, and potentially from mother-of-pearl (MOP), half-pearl (mabé) and MOP handicraft production. As a result of this successful program, pearl production in Fiji is no longer limited by oyster supply.

¹ Major contractual projects are defined as having investment greater than A\$100,000 and a project life span of longer than 12 months.

² This is the number of Pacific Islanders receiving direct economic benefit (see section 8.3.1). This figure does not include PARDI fisheries projects as fisheries benefit is included in the projected 5 year benefit.

³ Four farmers groups in Fiji: Nawamagi, Qereqere, Narata and Koronivia PGS farmers' group; plus Ba women's group, also in Fiji.

- Three successful hatchery runs were conducted in Tonga to maintain oyster supply to Tongan pearl farmers. They were conducted with collaborative technical input from commercial producer J. Hunter Pearls (Fiji).
- Half-pearls are now a new export product for the Fijian pearl industry. This development was a direct result of trial mabé production conducted by John Allwright Fellow Pranesh Kishore from Fiji.
- Half-pearl production workshops, focusing on training pearl farmers and community members to improve pearl yield and quality, were held in Fiji in 2013, 2014 and 2015, and in Tonga in 2014 and 2015. These workshops built on previous training held during 2012. To support capacity building outcomes, new extension material was prepared and translated into local languages.
- Research undertaken by Pranesh Kishore to determine factors affecting the quality of round pearls resulted in modification to farming practices by the Fijian pearl industry to maximise pearl quality and crop value. It is estimated that this change to culture methodology has resulted in an increase in the value of the pearl crop by about 30% and an increase in the proportion of export quality pearls.
- Business planning workshops were held for pearl farmers in Fiji in 2012, 2013 and 2015, and in Tonga in 2014 and 2015. Economic modelling and risk assessments were undertaken for individual farms, and generic business skills training was provided to farmers. Outputs included industry-wide economic models for the major pearl farming activities: spat collection, mabé farming and round pearl farming.

Mother-of-pearl

- Value chain research showed that the mother-of-pearl (MOP) handicraft industry in Fiji has an annual value of more than F\$10 million, with 85% of this based on MOP items imported from Asia. To support development of alternative locally made MOP handicrafts, a series of training programs was held in Fiji in partnership with the Ba Women's Forum (BWF) and Ba Town Council.
- In partnership with BWF, 20 variations of 'fashion wear' MOP items and 14 variations of 'everyday wear' items were designed and produced. Products were developed by a traditional jewellery designer and trainer, under direction from a Fiji-based fashion designer and handicrafts buyer from a major Fijian retailer (Tappoo).
- A series of commercial launches was undertaken, and MOP handicraft products from the project became available for purchase at Tappoo retail outlets in Fiji from late 2014.
- Research showed that local women without prior MOP handicraft skills can be trained to produce high quality retail-ready items that find a ready domestic market. Project research also identified interest from international 'ethical' markets. This research provides a basis for further development of a Fijian MOP handicraft sector that is supported by increased availability of pearl oyster shells from the national spat collection program (see above).

Value-added fisheries⁴

- This University of the South Pacific (USP)-led project undertook market and consumer research to identify potential supply chain enhancements and value adding of tilapia (*Oreochromis nilotica*) and the seaweed *Caulerpa* in Fiji, Samoa, and Tonga.
- Two public tasting events were held for tilapia (in Samoa and Fiji) and showed consumer preference for smoked fillets and smoked whole fish. This preservation method has been refined.

⁴ This project was compromised by two successive USP project leaders retiring during the project.

- USP higher degree students extensively supported this project. Janice Natasha gained her Masters degree in 2013 based on value addition for tilapia.
- As a result of this project, value adding of *Caulerpa* has led to extension of shelf-life for up to 12 days, and for a much longer preservation period (up to 12 months). Public evaluation indicated acceptability of the 12-day old samples. A research partnership with the private sector (Pacific Seaweeds Limited) assessed the incorporation of shelf-life extension into the supply chain (for the export market) for *Caulerpa*.

Sea cucumber (beche-de-mer)

- This one-year study documented the current post-harvest processing and trade in Kiribati, Tonga and Fiji, and developed a better understanding of supply chains, market value and preferences of beche-de-mer in China. This provides a solid foundation for a future project to build capacity in fisheries agencies to deliver village-based training, provide simple processing guides for village fishers, and uncover new opportunities for more equitable supply chains of beche-de-mer to Asian markets.
- Five research papers were published as a result of this work, providing an important contribution to our understanding of Pacific beche-de-mer post-harvest handling and marketing systems.

Canarium nut

- This project supported the expansion and commercialisation of the canarium nut industry in Vanuatu and Solomon Islands. As a result of this project canarium nut production in Vanuatu has increased from a small number of farmers in one district to over 100 farmers in four districts. Interest in the canarium industry in Solomon Islands is also expanding. The Nut Grower's Association Solomon Islands (NGASI) now has 500 members and is led by Richard Pauku (Maraghoto Holdings).
- In support of industry development, a canarium nut marketing strategy for the direct business-to-consumer market was undertaken. A range of agribusiness opportunities were identified and explored, including roasted and salted products, a canarium-topped chocolate, and canarium oil as an active ingredient in a skin care range. Trial product lines have been developed or samples provided to collaborating commercial partners, with many now commercially available.
- Shelf-life experiments undertaken with Lapita Café in Vanuatu and Jedom Organic Food Ltd in Solomon Islands on canarium nut-in-shell and kernel have shown that they can be stored successfully for six months at 30°C and for nine months at 25°C when vacuum-packed. Increases in free fatty acids of nuts stored at ambient temperature may limit further storage potential. Our experiments have shown that the risk of pre-harvest microbial contamination is low, though there is a risk of mycotoxins developing during prolonged on-farm storage.
- Capacity building was carried out through a series of community-based technical workshops. Training was provided to Solomon Islands Ministry of Forests staff, and technical training was provided to private sector processors in Vanuatu and Solomon Islands. Balances and other processing equipment were supplied to the Vanuatu Department of Forests for scientific experiments. Private sector led training was also carried out – for example the Kava Store conducted training for approximately 100 farmers in post-harvest care/drying and value adding using a solar dryer and packaging in glass bottles; and Lapita Café trained over 90 women to meet their commercial specifications.

Teak

- This project examined the uptake of sustainability certification through the Forest Stewardship Council (FSC) process. Complexity and cost were the major barriers to

the uptake of this system, which is a major determinant of access to some European markets.

- An inventory of smallholder plantations in one province of Solomon Islands exposed the problems and difficulties of accurate data collection with a fragmented resource scattered across difficult terrain in thousands of locations. Alternative methods were developed and are being trialled through ACIAR project FST/2012/043.
- Workshops to train growers how to assess their own plantations were very successful with 80 people attending, representing over 30 communities. The workshops also highlighted the poor condition of the plantations and the problems facing growers, for example in getting the timber from the plantation to a point where it could be loaded on to suitable transport.
- An examination of the value chain for Solomon Island teak showed that the market is strong, but quality is an issue for the developing market.
- Some smallholder growers have become disillusioned with the prospects of ever getting an economic return from their plantations.

Tamarind

- This project sought to develop new locally produced value-added tamarind products, as well as support wider industry development, to supply local and tourism markets in Vanuatu. Tamarind is currently grown as a shade and fruit tree in many villages throughout Vanuatu, but most people are unaware of the commercial potential of tamarind and have no access to markets. At the start of the project the sole processor could not meet market demand and was sourcing from very few locations, while many villages had many productive trees but no access to the market.
- This project has had major success with the growth of the industry, the emergence of a new tamarind processor (Lapita Café), and the development of a new product line, tamarind chutney, which was launched in Vanuatu in 2014.
- Underpinning this success was a joint Australia–Vanuatu Government value chain analysis and market surveys that identified market opportunities and key constraints that needed to be overcome. Research was then undertaken to identify best practice drying protocols.
- Following use of local media to raise awareness, training was provided to 100 farmers (55 women) in processing techniques including solar drying. This resulted in supply to the existing processor increasingly by approximately 10% during the 2 years of the project, with further increases anticipated over the next 5 years.

Breadfruit

- Forty-two participating farmers in Fiji's Western Division have planted 2,240 breadfruit trees on 18 hectares of land using planting material developed by the PARDI breadfruit project. Farmer-owned demonstration orchards are coming into production some 18 months ahead of expectations, greatly improving the expected viability of breadfruit as a commercial crop. The largest breadfruit orchard of 2.5 ha (312 trees) was established adjacent to the international airport in Nadi. Orchard-sourced fruit will form the basis of Fiji's breadfruit exports from 2016 onwards. The foundation has also been laid for commercial breadfruit processing in Fiji into gluten-free flour and starch products.

Cocoa

- This project supported three Pacific island smallholder cocoa grower networks in Vanuatu and the Solomon Islands (namely the Vanuatu Cocoa Growers Association; Alternative Communities' Trade in Vanuatu (ACTIV) Association; and SolKom in

- Solomon Islands) by improving product quality and establishing commercial agribusiness opportunities for local cocoa producers.
- New commercial agribusiness partnerships have been established through facilitated visits to chocolate retailers in Australia, Malaysia and Singapore. This has improved local cocoa farmers' understanding of the trade environment and the demands required by speciality single origin cocoa niche markets. The visits resulted in boutique chocolate makers requesting samples from the farmer networks for testing, and the results were fed back so that improvement could be made on fermentation and drying. The farmers were able to taste chocolate made from their poorly fermented and dried cocoa beans, and to compare with chocolate made from well-processed beans. These exchanges resulted in improved product quality, increased orders and better prices for farmers.
 - Cocoa samples from one of the project partners (SolKom) and from a farmer/processor in Fiji received international recognition in the Cocoa of Excellence Programme. Their samples have been selected as among the best 50 from a total of 146 received from 35 countries in 2015. Samples have been processed into chocolate and are currently under evaluation by a panel of 35 experts. The selection of the 12–15 best in the International Cocoa Awards (ICA) will be known by mid-October.
 - The project held a chocolate competition in Vanuatu, which involved a number of cocoa bean producers from Epi, Espiritu Santo and Malekula, and a panel of judges that included two boutique chocolate manufacturers from Australia, a local biscuit processor and a hotel chef. This historic event was attended by the Vanuatu Minister of Agriculture and the Australian High Commissioner, and provided local cocoa growers with first-hand experience of sensory evaluation of their product, contributing to their understanding of need for quality.
 - To support local value adding, ACTIV has received equipment for producing chocolate locally and has begun producing and packaging chocolate under the brand name 'Aelan'.

Participatory guarantee scheme (PGS)/Vegetables

- This project has successfully established four PGS farmers' groups in Fiji (registered companies Nawamagi, Qereqere and Narata⁵; and Koronivia farmers' group). Each of the PGS groups now has market access agreements for the supply of tomatoes to major hotels, including the Intercontinental and Fijian Shangri La Resorts on the Coral Coast, and the Grand Pacific Hotel and the Holiday Inn in Suva. The project further assisted three existing PGS groups in Solomon Islands (Areatakiki and Aruligo Community Company Ltd and MK Company Ltd) supplying the Heritage Hotel in Honiara.
- Forty-eight growers linked to these groups have benefited from training on production, organisational and business structure and operation, appropriate post-harvest handling, and seedling production, increasing farm productivity and product quality. Post-harvest losses of PGS-produced tomatoes in Fiji have been reduced from an industry average of 27–30% to 10%.
- As of July 2015, 36 tonnes of product had been traded through the established PGS groups, providing participating growers with an increased collective profit of A\$145,000. Based on the success of this project, the Government of Fiji and the Government of Australia (through the Department of Foreign Affairs and Trade, DFAT) have both provided further funding to support PGS farmers and assist in the establishment of additional PGS groups in Fiji.

⁵ These enterprises are also registered under the umbrella company the Sigatoka Valley PGS Farmers Company.

Taro

- This project, led by the Secretariat of the Pacific Community (SPC)'s Centre for Pacific Crops and Trees (CePaCT), assisted the recovery of the Samoa taro export industry by developing improved methods for multiplying planting material, and developing a new rapid mass propagation system.
- CePaCT has successfully optimised taro tissue culture protocols using the bioreactor system, which has reduced field readiness to 20 weeks instead of 28 weeks. As a result CePaCT can now produce up to 768,000 plantlets annually. The use of the bioreactor system has also improved the quality of taro planting material, similar to the result achieved in the PARDI breadfruit project.
- Under the taro breeding program, three new taro lines (Talo Fusi, Talo Salani and Talo Tanu) from cycle 6 lines were selected based on identified market demand, agronomic performance (using four multi-locational trials in Samoa) and eating quality. Four phenotypes of cycle 8 cross outperformed existing export varieties (Samoa 1 and 2 and Fiji Tausala ni Samoa) in terms of taste and consumer acceptance, with three lines also having higher carbohydrate and protein content. The four phenotypes from the cycle 8 have been released to the Samoa Ministry of Agriculture and Fisheries for multiplication and multi-locational trials to further assess their performance under the different agro-climatic conditions of Samoa.
- A preliminary financial assessment showed that under the established price assumptions the nurseries would not make enough income to cover their costs and seedling production would not be viable as a purely private undertaking.

Protected cropping/Vegetables

- This two-year project established demonstration and research trials of protected cropping systems in Fiji and Samoa to develop plant-growing methods that increase production and extend seasonality of high-value vegetables to meet increasing demand from the hospitality industry and urban markets.
- Five specially designed 360 m² structures with improved ventilation and irrigation have been established in Fiji (at Sigatoka, Tavua, Lautoka, and Koronivia) and Samoa (Nu'u and Tapatapao). The design principles have been tailored for warm conditions and lower cost options made from wood.
- The first cropping from these structures has given good yield and quality of tomatoes, capsicums and cucumbers as well as other potential commodities. Lebanese cucumbers grown in these structures have become a new specialty vegetable in demand by the hospitality industry in Samoa.
- 'Hands-on' training activities reached 160 farmers and local collaborators, who witnessed (in most cases for the first time) improved irrigation efficiency using drip irrigation, and plant production practices specific for protected cultivation. To address potential commercial supply constraints the project team worked in partnership with commercial suppliers throughout the project, to further assist technology transfer. The project has also provided additional capacity building in identifying and managing key pests and diseases under protected cultivation, and has been assisting with introduction of specific pesticides in collaboration with project ACIAR PC/2010/090.

Retail transformation

- This collaborative study between USP, the University of Adelaide (UoA), the Fiji Bureau of Statistics, the Fiji Ministry of Agriculture, the Secretariat of the Pacific Community (SPC) and UN Women surveyed 1,000 urban Fijian households, 1,200 Fijian producers and 85 traders, and interviewed all major supermarkets, resorts, food processors and municipal markets to get a better understanding of how the Fijian

food system is changing and the potential impacts for smallholder farmers, food security and government policy.

- Supermarkets now account for over 54% of food expenditure, with the municipal markets retaining 28%, which is mostly the purchase of fresh fruit and vegetables.
- Only 1.58% of producers sell through supermarkets, the majority (87.22%) selling through the municipal market.
- PhDs and articles covering these topics will be concluded and published in early 2016.

Kava

- Kava propagation and nursery protocols developed by this project have led to a significant improvement in multiplication rates, and have been adopted by the 180 commercial growers⁶ currently supplying Fiji-based South Pacific Elixirs Limited. The company anticipates a further 1,800 Fiji kava growers will benefit from the research within the next 5 years.
- Research to investigate the role of soil health on plant tolerance to kava dieback has shown higher incidence of cucumber mosaic virus (CMV)-positive⁷ material when sourced from soils with a pH of 5.5 or less.
- Tissue culturing of CMV-free material has achieved an overall 41% success rate, which is a good result considering kava is a difficult species to establish in tissue culture because of the level of endogenous contamination.
- While there has been insufficient time to establish the protocol for the bioreactor (temporary immersion technology), this research is continuing through supplementary funding provided by South Pacific Elixirs Limited.
- Through this project, the University of the South Pacific has established tissue culture research expertise, with further infrastructure and equipment investment planned.

⁶ Zane Yoshida, personal communication (2015).

⁷ A causal relationship between kava dieback and CMV infection has been clearly demonstrated (Davis et al., 2005).

4 Background

Pacific island nations have experienced significant challenges in recent years due to a number of natural disasters (Lal, 2010), the impact of the global economic crisis (Feeny, 2010; Feeny and Clarke, 2010), food and fuel price surges, civil unrest, difficulties in maintaining infrastructure and the continuing effects of poor diet and nutrition (Tuifa'asisina and Martyn, 2009). Collectively these have eroded advances against many of the Millennium Development Goals (MDGs). While recognising regional divergence (Hughes and Sodhi, 2006), the fact that generic progress towards MDG 1 (reducing poverty and hunger⁸) has been the slowest (Anon., 2009) clearly provides grounds for concern.

The importance of agriculture, forestry and fisheries sectoral development in alleviating poverty and catalysing sustainable economic growth has been widely documented (Hazell and Diao, 2005; Valdés and William, 2005; Byerlee et al., 2009; Weinberger et al., 2009). Realising the economic potential of these sectors in the Pacific requires tackling endemic issues such as low agronomic productivity, inconsistent volumes of supply (Duncan and Sing, 2009), high post-harvest transition costs and associated wastage (Weinberger and Lumpkin, 2006), market access and trade constraints (McGregor, 2007), limited adoption of value-adding opportunities, and adverse public-sector policies (Cheng and Zhang, 2009).

Faced with such complexities, identifying effective intervention strategies can be challenging. Market-oriented and supply chain driven strategies have gained wide acceptance as a framework for targeting aid-based investment in developing countries (Francis, 2007). Central to this thinking is the premise that by directly addressing the competitiveness of business enterprises, a stronger and more enduring platform for economic growth can be achieved, leading to positive livelihood benefits. This approach is thematic to several current international aid-based initiatives in the Pacific, and was the rationale behind the Pacific Agribusiness Research for Development Initiative (PARDI). In translating this intent, PARDI sought to implement the following research strategies:

- Identify markets and supply chains that have the potential to deliver substantial livelihood benefits to Pacific island peoples;
- Identify researchable constraints that limit the ability of these market chains to be more competitive;
- Develop research-based and product-oriented interventions that enable identified supply chains to overcome these constraints;
- Analyse and document the success of PARDI activities and interventions in contributing to more sustainable and efficient supply chains and improved livelihoods and thus increase our understanding of the factors underpinning competitiveness in Pacific island supply chains;
- Build the capacity of partners to use value chain analysis as a means to prioritise agribusiness interventions.

⁸ In the Pacific, hunger is most appropriately considered in the context of poor human nutrition.

5 Objectives

PARDI had five core objectives:

1. Develop value chain analysis as a means to prioritise research and development (R&D) interventions in agribusiness development.
2. Strengthen value chains for selected high-value fisheries products.
3. Strengthen value chains for selected high-value forestry products.
4. Strengthen value chains for selected high-value horticulture and agriculture products.
5. Develop and apply appropriate methodologies to evaluate how PARDI activities and interventions: (i) contribute to sustainable and efficient supply chains; (ii) improve livelihoods; (iii) and increase our understanding of the factors underpinning competitiveness in Pacific island supply chains.

Objectives 2 to 4 were achieved through a portfolio of research projects undertaken across the six target countries. For each of the 13 commissioned commodity-based research projects a further set of objectives was identified (see attached project reports for details). Through the mid-term review the project objectives were further refined to include identified research projects and to integrate an initially separate capacity objective within the delivery of objectives 2 to 4.

Activities (research projects) under each objective are given below.

Objective 1: Develop value chain analysis as a means to prioritise R&D interventions in agribusiness development.

- 1.1 Identify markets and supply chains that have the potential to deliver substantial livelihood benefits to Pacific island people.
- 1.2 Enhance supply chain management expertise in the Pacific in ways that assist PARDI project goals and the long-term success of agricultural value chains.

Objective 2: Strengthen value chains for selected high-value fisheries products.

- 2.1 PRA/2010/001a: Supporting development of the cultured pearl industries in Fiji and Tonga.
- 2.2 PRA/2010/001b: Supporting development of the cultured pearl industries in Fiji and Tonga.
- 2.3 PRA/2010/002: Value-adding and supply chain development for fisheries products in Fiji, Samoa, and Tonga.
- 2.4 PRA/2010/004: Improving income of Pacific island fishers through better post-harvest processing of sea cucumber: scoping study.
- 2.5 Development and delivery of additional targeted small research projects that address key knowledge or skill gaps, or provide support for ongoing projects.
- 2.6 Ensure effective coordination and knowledge sharing between commissioned PARDI fisheries projects.

Objective 3: Strengthen value chains for selected high-value forestry products.

- 3.1 PRA/2010/003: Developing markets and products for the Pacific island and PNG canarium nut industry.
- 3.2 PRA/2011/06: Development of a market mechanism for teak and other high-value timber in the Western Province of the Solomon Islands.
- 3.3 PRA/2012/03: Improving processing and marketing to improve the tamarind value chain in Vanuatu.
- 3.4 Development and delivery of additional targeted small research projects that address key knowledge or skill gaps, or provide support for ongoing projects.
- 3.5 Ensure effective coordination and knowledge sharing between commissioned PARDI forestry projects.

Objective 4: Strengthen value chains for selected high-value horticulture and agriculture products.

- 4.1 Identify, prioritise and develop interventions to strengthen horticulture value chains in the Pacific.
- 4.2 PRA/2010/05: Developing commercial breadfruit production systems for the Pacific islands.
- 4.3 PRA/2011/01: Facilitating improved livelihoods for Pacific cocoa producer networks through premium market access.
- 4.4 PRA/2011/03: Developing an integrated participatory guarantee scheme in the Pacific islands in support of sustainable production of high-value vegetable crops.
- 4.5 PRA/2011/04: Developing a clean seed system for market-ready taro cultivars in Samoa.
- 4.6 PRA/2012/05: Developing protected cropping systems for production of high-value vegetables in the South Pacific islands (Fiji and Samoa) and Australia.
- 4.7 PRA/2012/02: The implications of evolving food retail markets on small producers' livelihoods.
- 4.8 Development and delivery of additional targeted small research projects that address key knowledge or skill gaps, or provide support for ongoing projects.
- 4.9 Ensure effective coordination and knowledge sharing between commissioned PARDI horticultural projects.

Objective 5: Develop and apply appropriate methodologies to evaluate how PARDI activities and interventions: (i) contribute to sustainable and efficient supply chains; (ii) improve livelihoods; and (iii) increase our understanding of the factors underpinning competitiveness in Pacific island supply chains.

- 5.1 Establish and apply a framework for monitoring, comparison and evaluation of project progress and guiding project management.
- 5.2 Identify opportunities for new partnerships to strengthen or grow chains.
- 5.3 Develop effective communication tools and products to disseminate PARDI outputs and ensure long-term information accessibility.

6 Methodology

The PARDI project framework was developed by ACIAR in 2009 in consultation with PIC stakeholders. The University of Queensland (UQ) was awarded project leadership based on a competitive expression of interest process, with PARDI commencing in February 2010. Initially commissioned as a 3-year project in 2010 but subsequently extended twice, PARDI and its associated portfolio of research projects were undertaken between March 2010 and July 2015.

The methodology and research approach applied within PARDI was centred on supply chain, market and business analyses with the objectives of:

- Identifying opportunities for high-value Pacific products based on sound market and supply chain analysis;
- Developing strategies to address researchable constraints through the identified intervention points;
- Focusing interventions at a value-adding level, where appropriate;
- Using interventions to improve chain competitiveness;
- Applying lessons learnt on improving competitiveness to influence supply chains in other sectors.

Value chain identification and assessment

The initial selection of value chains for assessment was based on a PIC stakeholder workshop held in Fiji in June 2010, consultations with ACIAR, pre-existing ACIAR reports and associated information supplied to the project team⁹, and direct submissions from PIC stakeholders.

A hybrid value chain analysis approach was adopted that included rapid diagnostic reviews, in-depth systematic value chain assessments and broad market, sectoral and consumer analyses, and this was undertaken by agribusiness specialists from the University of Adelaide (UoA) and UQ. Value chain methodology was deliberately kept flexible and therefore adaptive so that adjustments could be made to reflect the diverse nature of commodities, sectors and country-specific situations. The research methods used included:

- Rapid reconnaissance scoping involving interviews and informal discussions with specialists and chain participants;
- Structured key informant interviews with individuals from industry, policy, banks, NGOs, academic and donor community, and chain participants;
- Review of existing data, literature, secondary sources, sector reports, industry studies, policy analysis, and statistical collections;
- Qualitative focus groups and representative quantitative surveys that included consumers, producers, traders, wholesalers, retailers, processors, and related chain partners;
- Workshops to verify sector and market analysis;
- Detailed interviews with specific value chain players to explore issues and opportunities across product flows, information flows and relationship flows.

⁹ ACIAR commodity briefs – developed by ACIAR in 2009.

Commissioning research interventions

Potential research interventions were developed into project concepts and subjected to three levels of evaluation: an initial internal project review; an external assessment coordinated by the PARDI advisory group (PAG) chair (Dr Richard Beyer) involving two PIC-based reviewers; and a final review by the ACIAR technical consultation committee.

Of the total of 40 project concepts presented for review, 25 (63%) were eventually commissioned: 14 major contractual projects and 11 supporting non-contractual activities. Of the major projects, 42% were developed and led by PIC project leaders.

Once approved, projects were administrated through individual third-party contracts managed and coordinated by UQ. Where additional supply chain reviews were required, or the required research intervention would take less than 6 months and involved limited additional investment, an internal project review and approval process was adopted.

Commodity-based value chain development activities

For specific methodology within the commodity-based research projects, please see the following individual end-of-project reports. Projected denoted with * have not yet supplied end of project reports (as of Nov 2015) and will supplied directly to ACIAR. All other are attached.

1. PRA/2010/01: Supporting development of the cultured pearl industries in Fiji and Tonga*.
2. PRA/2010/02: Value-adding and supply chain development for fisheries products in Fiji, Samoa, and Tonga*.
3. PRA/2010/03: Developing markets and products for the Pacific island and PNG canarium nut industry.
4. PRA/2010/04: Improving the income of Pacific island fishers through better post-harvest processing of sea cucumber.
5. PRA/2010/05: Developing commercial breadfruit production systems for the Pacific islands.
6. PRA/2011/01: Facilitating improved livelihoods for Pacific cocoa producer networks through premium market access*.
7. PRA/2011/03: Developing an integrated participatory guarantee scheme in the Pacific islands in support of sustainable production of high-value vegetable crops.
8. PRA/2011/04: Developing a clean seed system for market-ready taro cultivars in Samoa*.
9. PRA/2011/06: Development of a market mechanism for teak and other high-value timber in the Western Province of the Solomon Islands.
10. PRA/2011/07: Improving processing and marketing to improve the tamarind value chain in Vanuatu.
11. PRA/2012/01: Fiji retail transformation study*.
12. PRA/2012/05: Developing protected cropping systems for production of high-value vegetables in the South Pacific (Fiji and Samoa) and Australia*.
13. PRA/2013/01: Red papaya export market analysis.
14. PRA/2014/01: Development of a mass propagation system for elite varieties of *Piper methysticum* (kava).

Monitoring and evaluation of commissioned projects was undertaken at several levels.

- Each project was required to provide 6 monthly progress updates which were reported through the regular PARDI newsletter;
- An annual performance summary was presented through the PARDI annual report;

- Updates were presented at the annual ACIAR PARDI technical review meeting held in Brisbane in 2012 and 2013 and in Canberra in 2014;
- Project progress was formally assessed through an extensive mid-term review in 2011; and through the external end-of-project review in 2014.
- The PARDI project leader and/or the chair of the PAG attended individual project meetings and the various component leaders' project review meetings.

7 Achievements against activities and outputs/milestones

Objective 1: Develop value chain analysis as a means to prioritise R&D interventions in agribusiness development (led by UoA)

No.	Activity	Output/ Milestone	Due date	Comments
1.1	Identify markets and supply chains that have the potential to deliver substantial livelihood benefits to Pacific Island people			
1.1.1	Undertake a desk study highlighting past experiences with similar commodity-focused projects in the PICs and reasons for their success or failure	Report produced Updated report covering additional lessons learnt, including an inventory of on-going efforts and more rigorous value chain assessments on 3 key chains	March 2010 March 2013	<p>Rather than just providing initial direction for PARDI and a rapid analysis of best bets, UoA dedicated resources and funding to play an ongoing role in a majority of the projects undertaken by PARDI. It was anticipated that this approach would result in a much more whole-of-chain and market-led understanding of the opportunities, researchable issues and lessons learnt. This helped direct existing projects and will also help future ACIAR work in the Pacific.</p> <p>An Objective 1 summary report was presented to ACIAR in August 2012 covering the approach used in the different stages of PARDI, the strategic framework adopted, selection criteria used and the progress of various market and value chain activities across all of the PRAs and SRAs.</p> <p>Methodology, assessments and a detailed project example were shared and presented at a Pacific value chain conference entitled 'Agri-food Value Chain Development in the South Pacific'. Details of Pacific value chain projects can be found on the website www.pacificAgLinks.net</p>
1.1.2	Perform rapid market and chain appraisal on the 'best bet' basis, selecting the most appropriate method to assess the sector or product	Inception workshop and stakeholder engagement to choose best bet sectors Rapid sector analysis of best bets	August 2010 December 2011	<p>ACIAR provided initial insights on 13 best bets. Selection criteria were agreed upon with project partners and the inception workshop was used to discuss, prioritise and assess (through PAG) the first line of PRAs to ensure PARDI activities started as early as possible. This process is described in more detail in the Objective 1 report.</p> <p>UoA in partnership with the other component leaders undertook rapid sector analysis and industry mapping of 'best bets' to help mould the initial PRA as well as the ongoing activities (nine PRAs and five SRAs).</p>

1.1.3	Build on sector and market analyses carried out in the selection process, focusing on specific chains relevant to that market and identifying potential domestic and export markets	Selection of specific chains and target markets	December 2010 December 2011 December 2012 December 2013	<p>Value chain and market analysis activities are included in PRA milestones for projects on pearls, fisheries value adding, sea cucumber, canarium, teak, tamarind, cocoa and PGS vegetable projects. More details are available in the adjoining PRA tables.</p> <p>These activities build on the initial rapid appraisal and mapping activity used to identify private sector partners, target markets and consumer and market research needed to drive interventions along the whole chain.</p>
1.1.4	Rank, assess and choose supply chains and associated priority interventions (i), review relevant project documents (ii), external expert input (iii), reach a consensus (the project team and relevant partners)	PRA proposal development and approval	December 2010 December 2011 December 2012 December 2013	Supply chain selection and interventions have been discussed and agreed upon by the wider project team and described within each PRA.

<p>1.1.5</p>	<p>Conduct more detailed consumer research to understand consumer drivers and market requirements for both domestic and export markets</p>	<p>Consumer, household and producer surveys in PICs</p> <p>Research across retailers, food service and processors in PICs</p> <p>Consumer research in key target export market</p> <p>PRA-specific consumer and market research</p>	<p>Conducted by December 2012; analysed by June 2013</p>	<p>A number of surveys and interviews involving consumers, households, producers, retailers, food service providers, processors and traders were undertaken. The insights gained from these studies fed directly into PRA-based interventions and the identification of trends in buying patterns, which will highlight future opportunities. Examples of research include:</p> <p><u>Fiji</u></p> <ul style="list-style-type: none"> • Consumer research undertaken in the Suva municipal market in April/May 2011 • Household consumer research undertaken for the retail transformation project in June 2012 • Retailer interviews as part of the retail transformation project in July 2012 • Food service interviews for the retail transformation and PGS projects completed in October 2012 and presented at a workshop in November 2012 • Processor interviews as part of the retail transformation project conducted February 2013 • Producer survey as part of the retail transformation project in April 2014 • Trader survey as part of the retail transformation project undertaken in May 2014 • Consumer research on value-added tilapia and <i>Caulerpa</i> in April 2012 <p><u>Vanuatu</u></p> <ul style="list-style-type: none"> • Tourist and local consumer research undertaken in Vanuatu for cocoa and canarium nut in August 2011 and followed up in July 2012 • Processor and retailer interviews completed for tamarind in October 2011 • Vendor research and training in municipal and roadside markets in March 2012 • Producer surveys undertaken for cocoa in July 2012 • Tamarind retailer interviews and presentation at the inception workshop in August 2013 • Presentation of consumer research was given to canarium nut processors in Vanuatu in April 2012 and stakeholders from three countries in Honiara in November 2013 <p><u>Solomon Islands</u></p> <ul style="list-style-type: none"> • Tourist and local consumer research and restaurants and hotels interviewed for canarium nuts in October 2011 • Key stakeholder interviews undertaken for teak in February 2012. Follow up teak value chain interviews including saw mill owners and transport operators undertaken in December 2012
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				<ul style="list-style-type: none"> • Project staff attended the world teak conference in Thailand in March 2013 to gain market insights and interview key teak buyers • Global teak market analysis report completed December 2013 • Follow up tourist and local consumer research for canarium nuts in February 2014 <p><u>Australia</u></p> <ul style="list-style-type: none"> • Australian nut enterprises: survey of buyer requirements and consumer preferences undertaken in December 2012 <p><u>China</u></p> <ul style="list-style-type: none"> • Guangzhou province market and export pathway assessment for sea cucumber in 2012
1.1.6	Produce value chain mapping and analysis integrating market analysis and consumer studies	<p>Reports within PRA milestones</p> <p>Separate reports for PIC consumer research, export markets and broad chain research</p>	June 2014	11 rapid value chain reviews were completed and the documents were updated as we learnt more from the individual research projects: canarium nuts, tamarind, teak, cocoa, coconut, <i>Caulerpa</i> , tilapia, pearls in Fiji, half-pearls in Tonga, MOP in Fiji, sea cucumber.
1.1.7	Review international market access requirements and consider biosecurity challenges likely to be encountered by PICs, providing relevant information to the Pacific Horticultural and Agricultural Market Access program (PHAMA)	<p>Review any market access issues in target markets for sector-based PRAs</p> <p>Review any market access issues for the two export markets where broad consumer research is being conducted</p>	<p>Ongoing throughout the project</p> <p>December 2013</p>	No market access or biosecurity issues were identified in the key sectors we have been involved with but we worked closely with PHAMA, particularly on cocoa and teak, sharing information and even project staff.

1.1.8	In collaboration with all project partners, evaluate the results and evidence from the market analysis and value chain study, ranking from potentially researchable to scope intervention projects	Reports within PRA milestones Separate reports for PIC consumer research, export markets and broad chain research	Ongoing throughout the project June 2014	UoA actively collaborated with PARDI partners, government departments, NGOs, key private sector companies and other Pacific projects like PHAMA, the Market Development Facility (MDF) and Improving Key Services to Agriculture (IKSA). Market, consumer and value chain analysis activities have been embedded into the PRAs and linked between projects (e.g. Fiji food service insights were used for the PGS and retail transformation projects; Vanuatu tourist surveys were conducted jointly for both the cocoa and canarium nut projects). This information was then evaluated within the project teams and used to drive researchable interventions. Relevant reports have been provided for specific PRA-based activities and cross-sector research projects.
1.2	Enhance supply chain management expertise in the Pacific in ways that assist PARDI project goals and long-term success of agricultural value chains			
1.2.1	Provide capacity building support at the individual, group and organisational levels through participation in PARDI project activities	Incorporate capacity-building activities into PRAs and SRAs	December 2010 December 2011 December 2012 December 2013 December 2014	Capacity building activities were built into each PRA and interlinked across PRAs. To illustrate some of the key recipients of these activities a matrix has been developed. An excellent example of capacity-building support was our relationship with UNWomen with whom we worked to improve central and roadside markets across Fiji, Vanuatu and Solomon Islands. UoA/PARDI was asked by UNWomen to help with the capacity building of women vendors and vendor organisations in collaboration with municipal governments and improvement committees. UNWomen staff were involved in the Fiji producer survey to train them on techniques they can use for their own future surveys. The Pacific value chain conference had a key focus on value chain capacity building at all levels of the private and public sectors. PARDI contributed to the conference and the development of the website www.pacificAgLinks.net , which is being used to store and communicate a range of information about Pacific value chains.

<p>1.2.2</p>	<p>Undertake mentoring and training activities for research, extension and policy groups using a value chain framework to improve institutional knowledge and expertise in supply chain methodology and analysis</p>	<p>SRAs to mentor and train PIC staff on value chain methodology and analysis</p>	<p>Ongoing throughout the project</p>	<p>Capacity building took a number of different forms. For many value chain analyses, UoA was proactive in ensuring relevant local personnel were involved in interviews and surveys within the PRAs.</p> <p>In the case of tamarind in Vanuatu, the process was formalised into an SRA where staff at the Department of Industry were trained and then mentored on value chain techniques. Staff are now working on their own projects in the cattle and kava industries.</p> <p>The retail transformation project in Fiji allowed PhD students to ‘shadow’ analysts while they were collecting information from key members along the chain. In addition to developing the students’ skills, there has been capacity building and joint learning between the retail transformation project team and the Fiji Bureau of Statistics and Department of Agriculture on survey development, enumerator training, survey implementation and data entry. Similar capacity building also occurred with the Vanuatu Bureau of Statistics and private sector partners on producer and tourist surveys for the cocoa and canarium nut projects.</p> <p>The marine component was responsible for a range of capacity building activities involving USP, JCU as well as private sector and government partners across pearls, tilapia, <i>Caulerpa</i> and sea cucumber. Capacity building also focused on new farming technologies, village spat and pearl handicraft training. Numerous USP staff and students have built up their capacity within these projects.</p> <p>The forestry component was also active in capacity building and worked closely with government departments and the private sector in both Vanuatu and Solomon Islands. Value chain analyses led to canarium nut quality and shelf life trials to provide guidelines to processors and the wider industry. Value-adding opportunities led to drying ovens and other equipment being installed for use on a range of products requiring food or seed drying.</p> <p>There was also significant capacity building between PARDI project partners: UoA, USC, JCU, QDAF, USP and SPC.</p>
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1.2.3	Coordinate, facilitate or provide target skill development of Pacific supply chain participants associated with PARDI project activities, including promoting supply chain champions, enhancing retail linkages, engaging with certification programs, and networking with industry associations	Involve chain members in value chain intervention activities to help develop their skills	December 2010 December 2011 December 2012 December 2013 December 2014	This activity was built into the project approach. Chain champions were identified during the initial analysis and then PARDI worked with the chain champions and the rest of the chain to identify opportunities and researchable issues. The PARDI team collaborated in this work, but ultimately it was the chain members who drove the intervention activities for their own benefit and that of the wider industry. Votausi at Lapita Cafe is a great example of a chain champion for the canarium nut industry. She worked with PARDI to identify researchable issues, opportunities and target markets for the whole industry.
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Objective 2: Strengthen value chains for selected high-value fisheries products (led by James Cook University, JCU)

No.	Activity	Output/Milestone	Due date	Comments
2.1	Identify, prioritise and develop interventions to strengthen fisheries value chains in the Pacific based on regional commodity priorities and ACIAR-identified 'best bets'	Chain reviews completed	December 2011	Chain reviews were completed and reports for fisheries projects were finalised as scheduled by July 2012. Reports were used to inform research interventions and as a basis for PRA development. In some cases this was done in the project development stage (e.g. pearls) but in others it was done to guide project direction once the project was running (e.g. sea cucumbers).
		Chain reports for pearls, sea cucumbers, tilapia and <i>Caulerpa</i>	July 2012	

2.2a	PRA/2010/01a: Support development of cultured pearl industries in Fiji and Tonga (project leader: Paul Southgate, JCU)	Draft pearl industry development plans for Fiji and Tonga	July 2012	<p>First draft for Fiji was completed by July 2012 and further consultation continued with stakeholders to November 2012 when the draft was completed. The broad range of scale within the Fiji industry presents problems in developing a single plan for the whole industry. Facilitated by the PARDI consultation, the larger (export) farms decided to develop their own strategy and priorities for future expansion. The project worked with Fiji Fisheries Department to further formulate the draft development plan with particular emphasis on the smaller (non-export) sector of the industry which was a priority for Fisheries. The plan was completed in early 2015.</p> <p>The first draft for Tonga was completed in early 2013. Further stakeholder meetings took place in Tonga in September 2013 when inputs to the draft were finalised. The project team met with the Minister in September 2013 to run through the draft plan, and a follow-up meeting in November 2013 presented the final development plan, which was endorsed by the Minister.</p>
		Expansion of village spat collection program (Fiji)	June 2012	<p>Considerable delay was experienced in sourcing and delivery of spat collection equipment from China.</p> <p>For logistical reasons, spat collector deployment was divided into two phases. The first deployed spat collectors close to existing pearl farms and was completed in December 2012. Maintenance of spat collectors and extension activities was conducted by Fisheries and PARDI staff. Spat collectors were harvested in mid-late 2013. Data on recruitment and oyster size were collected at each site. Most collectors successfully recruited oysters so that for the first time they were readily available to all Fijian pearl farms.</p> <p>The second phase of spat collector deployment in late 2013 was expanded at high recruitment sites and to new sites within Fiji. Spat collectors were deployed to 17 communities in Fiji in total. The second phase of deployment will provide livelihood opportunities to communities not yet involved with the pearl industry, and all 17 communities have the potential to enter the industry at a number of levels additional to spat sales (MOP supply, mabé production, MOP handicraft production, etc.).</p>

		Upgrade capacity of hatchery facility in Tonga	June 2012	<p>A new filter system was installed and the seawater system upgraded at the Tonga Fisheries Sopu hatchery facility. These changes supported hatchery production from 2012.</p> <p>An ACIAR/USP scholarship holder (Jerome Taio) completed his research into the use of micro-algae pastes as a food for hatchery culture of pearl oysters. His results have helped develop more productive hatchery culture methods.</p> <p>Three successful (annual) hatchery runs have been conducted since May 2013 with technical input from the hatchery manager at J. Hunter Pearls Fiji. The spat produced are the only source of oysters for pearl farmers in Tonga and development of more effective hatchery culture methods supporting routine hatchery production brings sustainability and supports expansion of the Tongan pearl industry.</p>
		Extension materials	December 2012	<p>Extension materials were developed to support project activities (business planning and mabé workshops – see below). They were fine-tuned during the project on the basis of new project findings and stakeholder requirements.</p>
		Business planning workshops in Fiji	December 2012	<p>Business planning workshops were held for pearl farmers in Fiji in 2012, 2013 and 2015. Economic modelling and risk assessments were undertaken for individual farms and generic business skills training was provided to farmers. Outputs included industry-wide economic models for the major pearl farming activities spat collection, mabé farming and round pearl farming.</p> <p>Workshops were organised and run by Bill Johnson (QDAF) and Damian Hine (UQ). Some involved groups of postgraduate MBA students from UQ who provided one-on-one consultation with pearl farmers.</p> <p>Workshops generated detailed information and operational costs for a broad range of pearl farming models in Fiji. These data support development of more sensitive economic modelling for pearl farming in Fiji, which can be used by farmers (and prospective farmers) to make informed business decisions.</p> <p>Workshops in 2013 and 2015 were jointly funded by the European Union IACT project administered by SPC. This funding allowed more workshops than were originally planned and with broader scope.</p>

		Business planning workshops in Tonga	June 2012	Business-planning workshops (as described above for Fiji) were held for pearl farmers in Tonga in 2014 and 2015. The workshop in 2015 was jointly funded by the European Union IACT project administered by SPC.
		Improved product quality, product diversity and value adding	December 2013	<p>Half-pearl (mabé) production workshops were held for pearl farmers in Fiji in 2012, 2013, 2014 and 2015. In particular, some trial mabé seeding was conducted at spat collecting communities to introduce them to pearl farming. Similar workshops were conducted in Tonga in 2014 and 2015. Formal training of farmers will improve pearl yield and quality. Later workshops were supported by new extension materials that were translated into local languages during 2014.</p> <p>John Allwright Fellow Pranesh Kishore from Fiji has completed a number of experiments to determine factors affecting the quality of round pearls. Assessment of the quality of pearls cultured under varying conditions has resulted in modification to farming practices by the Fijian pearl industry to maximise pearl quality. The largest pearl farm in Fiji estimates that this change to culture methodology has resulted in an increase in the value of the pearl crop of ~30% and increased the proportion of export quality pearls produced by the industry.</p> <p>Mabé are now an export product for the Fijian industry. This development was a direct result of trials on mabé production conducted by Pranesh Kishore, and is a significant PARDI outcome.</p>
		Finalise pearl industry development plans for Fiji and Tonga	December 2013	Milestone achieved – see above.
2.2b	PRA/2010/01b: Support development of cultured pearl industries in Fiji and Tonga (project leader: Anand Chand, USP)	Complete industry 'snapshot' review for Fiji	May 2011	Research and snapshot of Fiji pearl industry completed in May 2011. Report submitted and data incorporated into value chain report for the Fijian pearl industry.
		Complete industry 'snapshot' review for Tonga	August 2011	Research and snapshot of Tongan pearl industry completed in May 2011. Report submitted and data incorporated into value chain report for the Tongan pearl industry.

		Overview of mother-of-pearl (MOP) handicraft sector in Fiji	December 2011	Research on MOP (Fiji) completed and report submitted in December 2011. A paper was presented at the Australasian Aquaculture Conference in Melbourne, Australia (May 2012), and a manuscript on this work was published in the book <i>Tourism in Pacific Islands: Current Issues and Future Challenges</i> (Routledge, Oxford, UK). This research led directly to the development of a new PARDI PRA which assessed the feasibility of developing the Fijian MOP handicraft sector (see below).
		Industry development strategy for the Fijian MOP handicraft sector	December 2012	This milestone was delayed pending consultation with stakeholders. A MOP handicraft case study began in 2013 and involved training of a dedicated handicraft group, marketing of MOP products and market assessment. This initiative was possible because of increased availability of oyster shells from the spat collection program (see above).
		Revised industry 'snapshot' review for Fiji	December 2013	Milestone completed. The updated economic score card led directly to revision of value chain information for pearls and the MOP handicraft sector in Fiji.
		Revised industry 'snapshot' review for Tonga	December 2013	Milestone completed. The updated economic score card led directly to revision of value chain information for pearls and the MOP handicraft sector in Tonga.
		Revised industry 'snapshot' review for Fiji	January 2015	Milestone completed. The updated economic score card allowed finalisation of value chain information for pearls and the MOP handicraft sector in Fiji.
		Revised industry 'snapshot' review for Tonga	May 2015	Milestone completed. The updated economic score card allowed finalisation of value chain information for pearls and the MOP handicraft sector in Tonga.
2.3	PRA/2010/02: Value-adding and supply chain development for fisheries products in Fiji, Samoa and Tonga (project leader: Robin South, USP)	Scoping studies on all commodities in the three target countries	May 2010	Scoping studies for <i>Caulerpa</i> and tilapia completed, and reports published as USP Institute of Marine Resources Technical Reports

		Supply chain and market chain analyses for two commodities in three target countries	December 2011	<p>These have been completed and are now available as USP Institute of Marine Resources Technical Reports. A manuscript describing the supply chain work on <i>Caulerpa</i> has been published in the Journal of Applied Phycology. Some of the work was also reported at the 21st International Seaweed Symposium held in Bali, Indonesia in May 2013.</p> <p>A cold chain and hazard analysis and critical control points (HACCP) analysis of the <i>Caulerpa</i> supply chain was undertaken, and this hopefully will lead to training of harvesters and middlemen, to improve quality of the crop reaching the market (J. Lako, C. Morris, and S. Bala). The different forms of <i>Caulerpa</i> sold in Fiji's markets were studied by Amit Kumar (undergraduate student). He found that two varieties of <i>Caulerpa racemosa</i>, var. <i>occidentalis</i> and var. <i>turbinata</i>, were involved. The socio-economic aspects of the seagrapes industry in Fiji is the subject of an ACIAR-funded postgraduate scholarship project being conducted.</p>
		New value-added products are identified and tested, and subjected to cost-benefit analyses	December 2012	Value-adding of <i>Caulerpa</i> (J. Lako) has led to extension of shelf-life for up to 12 days, and for a much longer preservation period (up to 12 months). Public taste evaluation indicated acceptability of the 12-day extension. Further testing of this for the export market is ongoing. The two public tasting events for tilapia (in Samoa and Fiji) showed preference for smoked fillets and smoked whole fish, and the preservation method has been refined over the past several months. Janice Natasha completed her master's thesis on value-adding of tilapia. Cost-benefit analyses are ongoing; undergraduate student Madeline Solo did some preliminary work on cost-benefit analysis of tilapia smoking.
2.4	PRA/2010/04: Improving income of Pacific island fishers through better post-harvest processing of sea cucumber: scoping study (project leader: Steve Purcell, SCU)	Report on current information sources on processing methods in the Pacific	February 2011	Report completed. Of note is the fact that post-harvest handling quality is commonly poor. A large number of fishers and even some processors in both Kiribati and Tonga commented that they wanted information and training on processing methods.
		Report including separate assessments for each of the three target countries on the current use of value-adding	October 2011	Report completed. Based on the number of sea cucumber fishers in villages visited and the number of fishing villages in the countries, it was estimated that there are 3,000–5,000 sea cucumber fishers in Kiribati, around 1,500 in Tonga and about 3,000–5,000 in Fiji.

		Report of supply chain structures existing in trade from Fiji, Tonga and Kiribati to Asian markets	July 2011	Report completed. The project team conducted questionnaire-based interviews with 84 sea cucumber fishers and 21 processors in Kiribati, 134 sea cucumber fishers and 13 processors in Tonga, and four processors in Fiji. The surveys were carried out over five atolls in Kiribati and four island groups in Tonga.
		Desk study of emerging market opportunities for value-adding of sea cucumbers and assessment of the practicality of promoting these in the Pacific	October 2011	Desk study completed. A large amount of data on price vs length and weight of a range of species was taken from various retail and wholesale shops in Hong Kong and Guangzhou. Concomitantly, the cut (made to the gut of the animal), colour and odour of each specimen was recorded.
		Best practice methods identified for processing various sea cucumber species	August 2011	Completed and outlined in project final report.
		Report on cost-benefit analysis	October 2011	All associated reports and studies have been completed.
		Project final report	May 2012	Final report submitted on 7/5/2012. Recommendations from this project report provided the basis for a new project within the ACIAR Fisheries Program; 'Benefits of improving postharvest processing of sea cucumbers in the Western Pacific' is a four-year project that began in 2013. The project incorporates the PhD studies of John Allwright Fellow Ravinesh Ram from Fiji who is studying at James Cook University. Ravinesh worked on PRA/2010/04.
2.5	Development and delivery of additional targeted small research projects that address key knowledge or skill gaps, or provide supplemental support	SRA applications where appropriate	December 2010 December 2011 December 2012 December 2013 December 2014	Concurrent with PRA/2010/04, a UoA-led SRA 'Refinement of the sea cucumber China marketing study' was undertaken. This project reported in 2012. An SRA to assess the potential for development of the MOP handicraft sector in Fiji was developed in 2013. This project was led by University of Adelaide. A farmer adoption survey for tilapia in Fiji was developed and the SRA began in early 2014. This project was led by University of Adelaide. An SRA to provide a better understanding of poor oyster condition and disease at the main pearl farming site in Fiji (Savusavu) was developed in response to this important ongoing issue. The project began March 2014 and was led by SPC.

2.6	Ensure effective coordination and knowledge sharing between commissioned PARDI fisheries projects; synthesise lessons relating to strengthening fisheries value chains	Annual PARDI fisheries component meetings	May 2011 May 2012	<p>Annual fisheries component workshops were held in 2011 and 2012 in Suva to review project progress and undertake forward planning.</p> <p>A similar workshop was not held in 2013 because of the completion of PRA/2010/04 and pending completion of PRA/2010/03.</p> <p>PARDI project reviews in 2012 and again in 2014 provided additional opportunities for review of fisheries component activities, for future research planning and coordination, and for knowledge sharing between PARDI fisheries projects and partners.</p>
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Objective 3: Strengthen value chains for selected high-value forestry products (led by Sunshine Coast University, SCU)

No.	Activity	Output/Milestone	Due date	Comments
3.1	PRA/2010/003 Developing markets and products for the Pacific island and PNG canarium nut industry (project leader: Helen Wallace USC)	Consumer and customer research to understand the markets and the market segments	June 2014	<p>Market opportunities have been identified in Vanuatu and Solomon Islands.</p> <p>A review of the related tourism literature found that the consumption of local food by tourists is an emerging area of interest, confirming that a tourist-focused strategy centring on 'pro-social' consumption of local food is a worthwhile pursuit.</p> <p>Differential market segments, consumer preferences and product development opportunities have been identified through multiple surveys and interviews in Vanuatu and Solomon Islands. The findings from the surveys formed the basis of the recommendations in the draft canarium nut marketing strategy report. An additional 450 surveys of locals and tourists in Solomon Islands was conducted and summarised in a report that was shared with project stakeholders including the private sector.</p> <p>Chain champions were identified in Vanuatu and the Solomon Islands and worked closely with the project team.</p> <p>Australian nut enterprises were given canarium nut samples, nutritional and background information, and then surveyed to assess their interest in the nuts, buyer requirements and general consumer preferences. The results indicated that 67% of companies believed canarium nuts have commercial appeal in the Australian market; and the most suitable market segments are health stores, gourmet food, boutique stores, bakery and confectionary.</p> <p>Best value-adding option was thought to be roasted and salted nuts to bring out the flavour. Nut samples have also been provided to Haigh's chocolates, and canarium oil to Jurlique for possible inclusion as an active ingredient in their skin care range.</p>
		Processing techniques tailored to each country's	December 2014	Shelf life experiments on <i>Canarium indicum</i> nut-in-shell and kernel were undertaken. Dried kernels

		<p>circumstances</p>	<p>can be stored with low increases in oxidation for six months at 30°C and for nine months at 25°C. Increases in free fatty acids while stored at ambient temperature may limit further storage potential.</p> <p>The risk of pre-harvest microbial contamination is low. There is a risk of contamination where cracking is done in the village. Nut-in-testa is supplied in Vanuatu which affords some protection when coupled with blanching to remove the testa. Standard protocols for sampling and testing kernel for aflatoxins and human pathogens need to be developed.</p> <p>There is a risk that mycotoxins could developing during prolonged on-farm storage. Safe moisture contents need to be achieved as soon as possible after harvest, either using on-farm dryers (for larger farmers) or delivery to a central collection point for accumulation into commercial batches and dried.</p> <p>Microbial content for samples taken through the processing chain in Solomon Islands and Vanuatu were tested. Standard plate count results for fresh and solar dried samples indicate that they are unsatisfactory as a ready-to-eat, but satisfactory if undergoing further processing.</p>
		<p>Analysis of drivers and barriers to stakeholder industry participation and capacity</p>	<p>December 2014</p> <p><u>Key positive impacts:</u></p> <p>There is a nut industry association established in six provinces for information, planting support, collaboration and industry development.</p> <p>Lapita Café is proactive with village collectors and has expanded its supply base from family farmers on Marlo Island in 2010 to over 100 farmers spread across four districts in 2014.</p> <p><u>Further capacity needed:</u></p> <p>Arrangements and motivation needed for farmers to supply processors, possibly based on coffee and sandalwood training models, sustained informal training and formal training. Training to include understanding of quantity as well as quality so that farmer expectations for returns on effort are managed.</p> <p><u>Supply challenges:</u></p> <p>Primary processing methodology needs to be developed and implemented in remote districts to</p>

				<p>ensure food hygiene and quality is maintained.</p> <p>Cracking continues to be perceived as labour intensive and returns not worth effort. Further research is required on mechanical crackers.</p> <p>Cost of dryers or methods for on-farm drying.</p>
3.2	PRA/2011/06: Development of a market mechanism for teak and other high value timber in the Western Province of Solomon Islands (project leader: Tim Blumfield, Griffith University)	Strategies introduced to grower cooperatives for the purposes of harvesting and timber marketing under FSC guidelines	January 2013	<p>Preliminary discussions held with growers about certification and the requirements for group-based action. It became obvious that only certain groupings would be feasible, often family or tribe based but also community or church. The prohibitive cost of gaining certification was such that it became obvious that none of the villagers identified had the resources to take this step.</p>
		A resource inventory with a centralised database of timber resources	March 2013	<p>The project undertook mapping and inventory exercises. These proved to be extremely difficult and time consuming.</p> <p>It was decided to involve the communities themselves and inventory workshops were held with over 80 participants from 40 communities attending at various locations.</p> <p>Having visited the GIS station at the Ministry of Forestry Head Office in Honiara, it became obvious that establishing a further workstation to store data would be impractical. The project shifted to a cloud-based system that is still being used and developed.</p>
		Identify market drivers and other mechanisms for adding value to teak thinnings, thereby promoting appropriate silvicultural management	December 2014	
		A pilot programme for the collection and purchase of community grown timber within Western Province and to demonstrate other uses for timber not suitable for thinning	December 2014	<p>While there was some sympathy with the plight of the smallholder growers at KFPL, there were no resources to assist in getting smallholder timber to Kolombangara.</p> <p>An exercise was undertaken using KFPL resources to harvest and transport out-grower teak to Kolombangara following a request from a buyer and using a ship that was on a scheduled stop to collect timber. Prices ranged from USD100 to USD300 per m³ for round logs, depending on quality.</p> <p>The development of a pilot programme for the collection and</p>

				<p>purchase of community timber was always dependent upon outside funding being made available and it became rapidly evident that the major donor agencies do not support this form of infrastructure development. Meetings held at the Asian Development Bank and with Australian Aid made it clear that there was no possibility of attaining funding. Infrastructure was clearly understood to be roads and bridges and DFAT declared no intention of supporting any forestry-related activities in the near future.</p> <p>The only feasible route identified will be through private enterprise and this will not happen until it is proven that the harvesting, processing, transport and export of plantation teak is an economically viable prospect.</p>
3.3	PRA/2012/03: Improving processing and marketing to improve the tamarind value chain in Vanuatu (project leader: Helen Wallace, USC)	Consumer and customer research to understand the markets and potential products for tamarind in Vanuatu	June 2013	<p>In collaboration with the Vanuatu Department of Industry the value chain map and process flow diagrams were initially developed and then subsequently updated as the industry has grown.</p> <p>Surveys were undertaken and market and new product opportunities were shared and discussed at the tamarind stakeholder workshop. Since then, the private sector, in collaboration with the research team, has used these insights to develop new tamarind products.</p>
		Refine processing methods for tamarind	December 2014	<p>Shelf life testing of dried tamarind and commercial tamarind products was carried out. Processing research including drying times and temperatures was conducted and analysed.</p> <p>Different drying methods (sun and solar drying) using peeled and unpeeled fruit were also tested. Drying tamarind in the solar dryer was an efficient way to stabilise the product. Tamarind contains a natural preservative (tartaric acid) and once dried to a water activity of 0.6 or below is a very stable product.</p> <p>Microbiological load tests were conducted on primary and secondary tamarind products. All samples were acceptable for Australian food standards.</p>
		Provide training, awareness raising, planting materials and capacity building for tamarind production and	Dec 2014	<p>Two training workshops were conducted by Charles Long Wah on Efate Island and participants are now supplying tamarind to him. Four solar dryers were supplied</p>

		processing		<p>(two from the tamarind project), to Epau, Lelepa, Moso and Nguna Nangai Farmers' Associations. Participants learned to dry many products including tamarind, canarium nuts, mango, fish, peanuts, natapoa and paw paw and some are now selling in Port Vila markets.</p> <p>The Department of Industry collaborated with the GIZ Climate Change Department and Shefa Provincial Government to organise a solar food drying and preservation training event for women in Taloa Village, Nguna island.</p> <p>The Department of Forestry ran canarium nut and tamarind awareness training discussions in various communities throughout Vanuatu in support of PARDI activities. A tamarind silviculture manual is currently in draft form, being prepared by Joseph Tungon Department of Forests.</p> <p>As part of the joint collaboration with GIZ Climate Change Department for the solar food drying and preservation training, a manual for drying fruit in the solar dryer has been produced in Bislama.</p> <p>A tamarind inception workshop held in August 2013 identified demand for sweetened tamarind products exceeds supply in Port Vila; major supermarket was selling 58 kg of tamarind candies each week; there is unmet demand from restaurants for unsweetened tamarind to use as an ingredient.</p> <p>Growers were keen to activate an association and nominated representatives from each village. The association will concentrate on growers in Efate initially.</p>
3.4	Development and delivery of additional targeted small research projects that address key knowledge or skill gaps	Key knowledge gaps identified and the development of SRAs	December 2014	There have been a series of additional research activities in support of the forestry component undertaken by Adelaide university (outlined in objective 1.1.5)
3.5	Ensure effective coordination and knowledge sharing between commissioned PARDI forestry projects	Coordination meetings, workshops with project stakeholders	December 2014	Forestry team met in Adelaide in May 2012 and Brisbane in June 2013 to review analysis of market segments and discuss next steps.
		Undertake or support PIC government communications	December 2014	Forestry briefing meetings were held with the Vanuatu Government in December 2012.

Objective 4: Strengthen value chains for selected high-value horticulture and agriculture products (led by QDAF)

No.	Activity	Output/Milestone	Due date	Comments
4.1	Identify, prioritise and develop interventions to strengthen horticulture value chains in the Pacific	Horticulture chain reviews completed	December 2011	All the chain reviews have been completed.
		Four horticulture chain reports	July 2012	Completed and uploaded onto the SPC Land Resources Division website. A series of additional household and consumer surveys and postharvest chain analyses were also completed during 2013. These are reported under PRA/2011/03 and PRA/2012/02.
4.2	PRA/2010/05: Developing commercial breadfruit production systems for the Pacific islands (project leader: Andrew McGregor, Kokosiga Fiji)	Identify varieties for year-round production and develop propagation systems	December 2013	Twenty (20) characterisation sheets for breadfruit were developed for varieties located in Natewa Bay, Vanua Levu. Characterisation work was carried out in agreement and in line with the FAO-IPGRI multi-crop passport descriptors. A total of eighteen (18) characterisation sheets were developed for breadfruit varieties on three Ministry of Agriculture research stations. From these characterisation sheets a fruiting pattern calendar has been derived. A breadfruit planting material supply system from source to private nurseries was established. Logistics of bringing material was shortened to 3 days from 7 days. This has seen an increase in the strike rate during propagation. Distribution of planting material to supply emerging industry: a total of 3,000 root suckers were supplied to a private nurseries. Large orders were sourced from other project partners for breadfruit planting material (IKSA and MPI).
		Develop orchard management systems		Formal field trials have been established to evaluate performance of breadfruit trees under different soil types around Nadi, Fiji – 12 months of data were collected. A total of 2,002 trees were planted in pilot orchards by 36 participating farmers, on a total of 30 acres (12.19 ha). Data were collected on the cost of production and cost of maintaining a commercial breadfruit orchard. Data

				<p>were also collected for various intercropping options. Staff were trained in financial and economic analysis</p> <p>A farmer-orientated manual for growing pineapples as an intercrop with breadfruit was produced.</p> <p>Three papers on breadfruit nurseries and orchards were presented at the International Horticulture Congress Conference in Brisbane in 2014.</p> <p>Observational trials evaluated different pruning and training techniques.</p>
		Establish post-harvest systems for export		<p>The first commercial breadfruit exports since the beginning of the project took place in January 2014 in close collaboration with Pacific Breadfruit Project (PBP). A supply chain analysis was carried out from harvesting through to airfreight in order map the current process working from wild harvested fruit. Based on this supply chain analysis a formal trial was designed to quantify physical damage and sap flow at various stages of the supply chain.</p>
4.3	PRA/2011/01: Facilitating improved livelihoods for Pacific cocoa producer networks through premium market access (project leader: Tevita Kete, SPC)	Identify premium market opportunities for each of the farmer networks through market intelligence linked to specific chocolate retailers; facilitate private sector partnerships	December 2013	<p>Established private sector partnerships continued with Vanuatu (Bahen and Co) and Solomon Islands (Zokoko).</p> <p>ACTIV visit to Bahen & Co, Western Australia (March 2013) – presentation by Bahen from roasting to the moulding using antique chocolate-making equipment.</p> <p>Buyer/supplier exchanges (visits) continued and construction of/adjustment to fermentation boxes and solar drying methods and practices tried out.</p> <p>Samples of beans shipped to buyers for testing and results documented against processing methods.</p> <p>Provision of PGS awareness meetings/workshops to SolKom.</p> <p>Provision of market awareness training/meetings/workshops.</p> <p>Facilitated PGS partnerships.</p> <p>Shipment of 40 kg of solar dried beans for factory run and facilitating planning sessions for SolKom.</p>
		Improve the capacity of cocoa producers to access niche market opportunities through better quality control incentives, product		<p>Organisation of workshops in March and May/June 2013 (plantations visit and best agricultural practices in Epi, Vanuatu)</p> <p>Preparation of database of cocoa producers for certification.</p>

		traceability training and management skills customised to premium markets		<p>(FTAANZ), producers registration and GPS plots (Vanuatu)</p> <p>Work with the selected producers to better manage their plantations (pruning) and awareness on best processing practises (Vanuatu)</p> <p>Capacity building for SolKom and its network of suppliers.</p> <p>Demonstration workshop on cocoa processing methods and quality control practices.</p> <p>Developing trial for fermentation and drying.</p>
		Progress the capacity of the domestic cocoa industry to add value to cocoa products, investigating opportunities for local manufacturing, branding and retailing		<p>Carried out by ACTIV:</p> <p>April to September: development of chocolate formula (70% dark); adjustments of fermentation and drying technique.</p> <p>Creation of the Alean Chocolate Makers business and research for alternative funding.</p> <p>Deliver first batch of commercial chocolate for the local ice cream maker.</p> <p>Start building shed.</p> <p>Order of second hand processing equipment.</p> <p>Development of branding and packaging.</p>
4.4	PRA/2011/03: Developing an integrated participatory guarantee scheme in the Pacific islands in support of sustainable production of high-value vegetable crops (project leader: Jen Carter USC)	Identify local consumer trends by market and consumer analyses	January 2013	<p>Completed. The PGS project sourced this information from the PARDI Fiji retail transformation project.</p> <p>Semi-structured interviews were conducted with hotel/resort managers, buyers, purchasing managers and chefs across Suva, Nadi and the Coral Coast between August and October 2012. Detailed market, consumer trends and purchasing behaviour information was collected for each hotel and analysed to provide an overview of opportunities for local high-value vegetable crops. The most viable hotel/resort partners for the PGS pilot in Fiji are the Warwick Resort and the Shangri-La Fijian Resort.</p>
		Improve coordination and collaboration of vegetable growers in Fiji and Solomon Islands	January 2014	<p>The first commercial shipment was achieved in 2013, however plans for additional early season harvesting were impacted by flood in the Sigatoka Valley in March 2014. Business training was undertaken throughout 2013 and early 2014, with grower groups now forming companies to administer contracts and funds. New agreements were in place for 2014 in the Solomon Islands and</p>

				<p>anticipated for Fiji. Postharvest chain analysis was completed in east and west bank Sigatoka, Nausori (Fiji) and Honiara (Solomon Island); three postharvest training workshops were undertaken and technical results submitted to journals.</p>
		Strengthen key support services for growers to enhance long-term PGS adoption	January 2015	<p>Government and micro-loan credit programmes has been reviewed (report finalised December 2013).</p> <p>A review of seed/seedling was undertaken and an action plan for 2014 developed.</p> <p>The strategy to date has been to focus on student participation in this project. At present, four higher research degree students are enrolled and supporting this project. A new USP student is about to commence a Master program to assess the existing supply chains in terms of food safety risks.</p>
4.5	PRA/2011/04: Developing a clean seed system for market-ready taro cultivars in Samoa (project leader: Valerie Saena-Tuia, SPC)	Screen taro varieties for defined market opportunities	December 2013	<p>A PARDI steering committee (eight members from partners (MAF, SROS, SFA, exporter, farmers and SPC) was established to steer direction of activities of the project.</p> <p>SROS completed evaluation and identified four cycle 8 lines that outperformed existing export varieties (Samoa 1 and 2 and Tausala ni Samoa) in terms of taste and consumer acceptance. These four lines were released to Samoa MAF for multi-locational trials.</p> <p>Report produced and uploaded on SPC, SROS and ACIAR websites.</p> <p>Two taro varieties (Samoa 1 and 2) were selected to support current export markets excluding the other three varieties (Samoa 3, 4 and 5).</p> <p>Three new pink taro varieties (Talo Fusi, Talo Lani, Talo Tanu) were evaluated and taste-tested and were preferred over Samoa 1, one of the current exported varieties. Government and MAF have decided to officially launch these new varieties 13 October 2015 during the Samoa AgrosHOW. Over 20,000-30,000 planting materials have been produced in tunnel multiplication houses ready for distribution to all participants during the launching. Samoa MAF recently received a special award from the Public Service Commission for outstanding achievement to support food and livelihood security. Talo Maagiagi and few other lines were removed from the list of varieties to be launched due to increased susceptibility to taro leaf blight in</p>

				wet areas.
		Improved multiplication of disease- and pest-free planting material	<p>January 2015</p> <p>May 2014</p> <p>July 2015</p>	<p>Micropropagation protocol on taro has been developed and presented at PARDI Outcome Workshop, Lami, Fiji in June 2015. Protocol by U. Lutu and V.S. Tuia. will be presented at the International Society of Tropical Root Crops Conference in February 2016 in China. Five methods were evaluated and the bioreactor system improved the field-planting readiness of taro plantlets by 20 weeks in contrast to 28 weeks using the conventional method. The bioreactor-treated plantlets achieved 100% survival rate as compared to 94% for glass-treated plantlets in the screen house. The protocol has potential to produce 48,000 to 768,000 plantlets annually (combination of static and bioreactor treated plants).</p> <p>Two tissue culture staff from Samoa MAF trained on micropropagation methods at SPC CePaCT that could assist with mass production of new varieties in Samoa for distribution to farmers. New tissue culture laboratory will be built in 2015–2016 and will include a bioreactor production room. Further training of new MAF staff will be carried out in 2016 and MAF staff attachment with SPC CePaCT is in the pipeline in time for the completion of the new tissue culture lab funded by World Bank.</p> <p>Further preliminary research has indicated that two field propagation methods optimised for non-suckering lines at MAF, Samoa included the use of spraying corms with gibberellic acid (500 ppm) and mini-corm setts/slicing. These two methods are being used on two current export varieties (Samoa 1 and 2) and on the three new taro varieties (Talo Fusi, Talo Salani and Talo Tanu).</p> <p>Two virus elimination systems (meristem culture and heat therapy) optimal for elimination of viruses at CePaCT for production of clean material</p>
		Establish viable private-sector nurseries for commercial multiplication and dissemination of new market preferred varieties	July 2015	<p>Cost–benefit analysis (CBA) indicated that establishment of private sector nurseries is not economically viable ('Preliminary cost benefit analysis of private sector nurseries for multiplication and dissemination of clean taro leaf blight planting materials' by Anna Fink, SPC economist). Even if no maintenance costs existed, the nurseries still make a large net loss</p>

				<p>if the selling price is set at \$0.30 per sucker which is the affordable and acceptable price by farmers. A workshop was carried out to present findings of the CBA to the steering committee to understand the logistics and dynamics of the study. Based on results of the preliminary CBA, MAF Nu'u took over the establishment of the nurseries in their premises and formed multiplication demo nurseries for production of planting materials prior to the official taro launching of the three new taro lines (Tanu, Fusi and Salani).</p>
		Improved information flow along the taro supply chain	July 2015	<p>Posters, pull-up banners, pamphlets and brochures have been produced to promote the PARDI work.</p> <p>Information on the new taro will be made available during the taro launching and for the Minister of Agriculture to officiate the opening.</p> <p>Workshops held with PARDI members to discuss results of the CBA and also results of the project were presented during the ACIAR Impact Workshop in June 2015, Lami, Fiji.</p> <p>Dissemination and uploading of reports, materials, posters, articles on SPC website and networks (SPC PAPGREN, PAFNET).</p> <p>Banner displays in Samoa during the Samoa Agricultural shows held in both Upolu and Savaii islands.</p>
4.6	PRA/2012/05: Developing protected cropping systems for production of high-value vegetables in the South Pacific Islands (Fiji and Samoa) and Australia (project leader: Elio Jovicich, DAF)	Identify market opportunity for high value vegetables	July 2013	<p>Demand for high-value vegetables was identified from supply chain reviews and studies conducted by PARDI. Collaboration was established with key commercial growers, agricultural input suppliers/importers, regional and government R&D institutions (Fiji MoA, Samoa MAF and SPC), and current PARDI and ACIAR projects in the Pacific. Environmental constraints for producing high-value vegetables outdoors were reviewed, as well as limitations of currently used protected cropping technology in the main islands of Fiji and Samoa. Demonstration sites with different environmental conditions were selected: three in Fiji (MoA at Sigatoka and Koronivia, and commercial farm in Tavua) and two in Samoa (MAF at Nu'u and commercial farm in Tapatapao).</p>
		Screen vegetables in protected cropping system	July 2014	<p>A structure design concept for a tall, passively ventilated tunnel structure was proposed for vegetable production under tropical conditions. Improved design plans were</p>

				<p>completed for 360 m² units with an overseas greenhouse factory. Local importer Marco Polo assisted with the logistics of importing five structures from China. Combined project funds (PARDI PRA/2012/05 and ACIAR PC/2010/090) were used to fund structures and start demonstration activities and collaborative research.</p> <p>Fijian collaborators received and built structures. Arrival was delayed in Samoa. Collaborator farmer in Samoa built the two structures sourced by the project.</p> <p>Additional greenhouses (similar to project design but of lower quality and cost) were subsidised to growers by the government in Fiji. Farm visits provided advice to additional farmers who start building structures with wood in Sigatoka valley (three).</p> <p>Design for gravity and pump-operated irrigation systems were completed and parts sourced. With local input supplier, the project continued to identify agriculture inputs that would need to be available to farmers.</p> <p>Three main high-value crops, tomato, capsicum, and cucumber, were selected based on surveys conducted by PARDI projects and growers' advice. Cultivars for trials were suggested and imported from four seed companies. ACIAR PC/2010/090 includes AVRDC tomato lines in Sigatoka. Test crops commenced first in Tavua and later in Samoa sites and Sigatoka.</p> <p>Crop plantings continued from August 2014 to March 2015. Demonstration site managers agreed to focus on learning how to grow crops under new systems. Project focused on demonstration and capacity building for drip irrigation and crop management. Face-to-face training delivered to 160 farmers (Fiji: 7 days in Nov 2014 (Sigatoka and Tavua) and 10 days in June 2015 (Sigatoka and Tavua); and Samoa 12 days Feb and Nov 2014. Growers managing demonstration sites further provided training to other farmers. Training activities in June 2015 (4 days) conducted in conjunction with SPC-led projects, PIFON and Sigatoka PGS farmers.</p>
		<p>Improved supply chain for high value vegetables</p>	<p>January 2015</p>	<p>High attendance and participation in training activities indicated increased interest in protected cropping (and demand on capacity</p>

			<p>building) and appears to be linked to the increased number of structures set up since 2012. Provided advice on wood structures under construction in Fiji (2014). Samoan farmer commenced local commercial fabrication of high tunnels (2015). An additional 6th demonstration site was identified on a commercial farm in Lautoka. A wood structure was constructed at demonstration site in Tavua in September 2015.</p> <p>Collaborator growers in Fiji and Samoa demonstrated increased yields of superior quality in vegetable commodities. Farmers have examples of new systems for pruning and vertically supporting capsicum, tomatoes and cucumbers to extend the harvesting season under protective cropping. Summer crops provided insights for managing ventilation, shading, pollination and plant density. Some crops finished in August 2015 with others ongoing. In Tavua, capsicums are also being grown under shade tunnel during the 2015 dry season. Capsicums planted in June 2015 had first red fruit harvested in September. Amaranth, cilantro, and other leafy vegetables tested as short-term easy-to-grow cash crops that can be grown after investing in a structure. Commercial demonstrations harvested good yields and quality and produce sold in local supermarkets and restaurants.</p> <p>Pest and disease management issues in trials in North Queensland (Australia) helped develop recommendations for managing the same pest issues in Fiji and Samoa where broad-spectrum and/or ineffective pesticides were used in greenhouse crops. Assisted recommending a miticide that is introduced to Fiji through ACIAR PC/2010/090. Import permits for applications submitted for products abamectin and micronized sulphur in Samoa. Linked Samoan importer with Australian distributor.</p> <p>Project organised a visit of Samoan collaborator farmer to Fiji demonstration and commercial sites. Farmers benefited from exchanging experiences using protected cropping. Two collaborating farmers participated in PARDI Impact Workshop and Market Day.</p> <p>After June 2015, partial support on initiated activities is maintained</p>
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				while a further project proposal is being developed. New appointed SPC officer at Sigatoka (Fiji) is committed to work on protected cropping. Discussions initiated with PGS project team to adapt and test low-cost structures for farmer groups.
4.7	PRA/2012/02: The implications of evolving food retail markets on small producers livelihoods (project leader: Gurmeet, USP)	Value chain review of retail markets	July 2013	<p>Surveys on 1,000 urban Fijian households were completed and analysis has begun.</p> <p>All major Fiji food retailers, processors and hotels/resorts were interviewed to understand current constraints and future opportunities.</p> <p>The availability of Ministry of Agriculture staff and flooding across Viti Levu delayed the start date, but the survey of 600 local producers across Viti Levu began in March 2014. Trader survey began in April 2014.</p> <p>As of July 2015, research surveys are analysed and final report not yet provided.</p>
		Facilitation of information flows to small producers	July 2014	Capacity building and information sharing has occurred throughout the project with all of our research partners and plans are in place to share project insights with a wider audience of government agencies, key members of the private sector and farmers once the information has been fully collated.
		Improved supply chain for small producers	January 2015	Outcome presented in the project specific impact sections (above)
4.8	Development and delivery of additional targeted small research projects that address key knowledge or skill gaps, or provide support for ongoing projects	Identify supply chain interventions by value chain analysis	July 2015	<p>A series of small research activities were undertaken to address key knowledge gaps. These include:</p> <ul style="list-style-type: none"> • Red Papaya marketing study. • Sweet potato supply chain review
		Project opportunity for intervention identified	December 2013	Following value chain analysis undertaken by UQ in 2010, seven research projects were commissioned. A hort value chain review workshop was also undertaken in 2011 led by UQ.
		Crops value chain improvement	January 2015	Crop value chain improvement information is reported in sections 7 and 8 of this report.
4.9	Ensure effective coordination and knowledge sharing between commissioned PARDI	Identify networks of appropriate skills to conduct identified value chain interventions and capacity building	December 2012	<p>Horticulture coordinator undertook travel to Fiji, and Samoa to support project delivery and meet with key stakeholders.</p> <p>Most Hort project researchers attended the IHC 2014 congress</p>

	horticultural projects and synthesise lessons relating to strengthening horticulture value chains		where key findings were presented and shared.
		Organise annual meeting of crops and horticulture project leaders	Due to the diversity of projects in a range of Pacific countries this activity was replaced by additional component leader travel and meetings with PARDI collaborators to discuss project activities, which has developed the communication and partnerships required for successful project outcomes. This collaboration has led to the involvement of private enterprise in PARDI projects in Fiji and Samoa.
		Provide project reports to PARDI component leaders' annual meeting and ACIAR RPMs	<p>Annual Hort Project updates presented to ACIAR and PARDI project leaders (Dec 2012, 2013, 2014).</p> <p>End of project reports for hort projects have been provided to ACIAR</p> <p>A number of project video clips that display the impacts of the PARDI horticulture project activities were co-ordinated through travel with the PARDI Communications Officer to Fiji.</p>

Objective 5: Develop and apply appropriate methodologies to evaluate how PARDI activities and interventions: (i) contribute to sustainable and efficient supply chains; (ii) improve livelihoods; and (iii) increase our understanding of the factors underpinning competitiveness in Pacific Island supply chains (led by UQ-QAAFI)

No.	Activity	Output/Milestone	Due date	Comments
5.1	Establish and apply a framework for monitoring, comparison and evaluation of project progress and guide project management	PARDI advisory group (PAG) established	June 2010	<p>The PAG and its associated ToRs were established in June 2010, under the chairmanship of Dr Richard Beyer. Templates for PRA were developed. For each PRA project there was a full project document, detailed milestones, and budget. PAG was based around a blind review process to afford a greater capacity to critically assess applications.</p> <p>Of the total of 40 project concepts presented for review, 25 (63%) were eventually commissioned: 14 major contractual projects and 11 supporting non-contractual activities. Of the major projects, 42% were developed and led by PIC project leaders</p>
		<p>Documented protocol for project review</p> <p>Reviews of commissioned project performance</p>	<p>September 2010</p> <p>December 2012</p> <p>December 2013</p> <p>December 2014</p>	<p>Once operational, either the PARDI project leader or the relevant component leader monitored the project performance which involved: 6-monthly milestone reports, updates, contributions to PARDI annual report, presentation at PARDI-ACIAR review meeting, and project-specific workshops.</p> <p>The PARDI management team was in constant dialogue with project leaders and well as with relevant ACIAR RPMs.</p> <p>Some projects had additional external technical advisory committees, meetings of which the component leader, PARDI project leader or PAG chairman attended.</p>

No.	Activity	Output/Milestone	Due date	Comments
5.2	Identify opportunities for new partnerships to strengthen or grow chains	Joint stakeholder meetings and workshops with PHAMA and other PIC initiatives	Ongoing	<p><u>PARDI + PHAMA</u></p> <p>Support for cocoa industry strategic workshop (led by PHAMA).</p> <p>Co-funding of Andrew Sale by PHAMA and PARDI re Solomon Island activities (cocoa and PGS projects).</p> <p><u>PARDI + other PIC initiatives</u></p> <p>PARDI established collaboration with UNWomen in 2013, which has continued with research and capacity building activities. A total of four studies were completed with UNWomen staff and local government staff to assess opportunities for improving livelihood outcomes with female traders working in wet markets and road-side stalls in Fiji and Vanuatu.</p> <ul style="list-style-type: none"> • Training UNWomen staff on value chain analysis, survey design and survey implementation. • Designing market analysis studies for ring road development in Vanuatu. • Analysis and business plan development for the Marobe Livestock market. • PARDI appointed to the UNWomen Consultative Group for the Australian Aid-funded Markets for Change project and Partners Improving Markets project (PIM). PARDI is collaborating with UNWomen on the value chain research and consumer research activities for Markets for Change.

No.	Activity	Output/Milestone	Due date	Comments
5.3	Develop effective communication tools and products to disseminate PARDI outputs and ensure long-terms information accessibility	<p>Communication strategy developed</p> <p>6-monthly project newsletter</p> <p>PARDI reports, documents and associated written outputs posted on the SPC website portal</p>	<p>December 2010</p> <p>July 2015</p>	<p>PARDI produced technical newsletters every 6 months, which were circulated widely throughout the Pacific, New Zealand and Australia. The project team also prepared a series of project factsheets for major projects and distributed to external stakeholders. An activity map outlining PARDI project activities was released in March 2012.</p> <p>PARDI negotiated a web presence on the SPC Land Resources Division (LRD) website, where most of the project reports and newsletter were uploaded (http://www.spc.int/lrd/pardi-projects).</p> <p>In 2014, PARDI launched a series of YouTube clips to promote and highlight stakeholder engagement and capacity building. A 30-page PARDI capacity building booklet was also released in March 2014.</p> <p>In addition PARDI produced news alerts and ACIAR blog contributions. It is important to note that PARDI communications was run on a very limited budget.</p>
		PARDI component leader meetings	6 monthly throughout	The PARDI component leaders met every 6 months, and an annual PARDI–ACIAR forum was held in early December since 2012.
5.4	Document and analyse the key learnings from PARDI, including effective supply chain and agribusiness development strategies, stakeholder engagement, and enduring impact	Supply chain review documents	July 2014	All the supply chain reviews have been completed and posted on the SPC-LRD (PARDI) website.

No.	Activity	Output/Milestone	Due date	Comments
		Report on the overall impact of PARDI, including case studies	December 2014	<p>PARDI completed an external end-of-project performance assessment between November 2013 and May 2014. This review provided an in-depth and independent assessment of PARDI impact and achievements.</p> <p>A report outlining key learnings and key recommendations was supplied to ACIAR in 2014, as part of the end-of-project review.</p> <p>PARDI presented a series of presentations to ACIAR (December 2014) on impact of project activities. PARDI products and impacts were also the key theme of the PARDI end-of-project workshop held in Fiji in June 2015. The economic, social and community impacts for each the PARDI research projects is further described below and in the individual end-of-project reports.</p>

8 Key results and discussion

PARDI research interventions were undertaken across six Pacific Island nations, and involved a portfolio of 14 major research projects and a further 11 small research activities. The geographical spread of the research undertaken is shown in the figure below, and the key research findings by project are presented below.



Pearls

- The Tongan pearl industry and the non-export sector of the Fijian pearl industry now have development plans that provide a realistic blueprint for sustainable industry development. Plans were developed with extensive stakeholder and government consultation.
- Seventeen coastal communities in Fiji are now involved in spat collection. The national spat collection program was developed and implemented collaboratively with the Fiji Fisheries Department and spreads spat collection effort to minimise potential impacts of storms (e.g. Cyclone Thomas had a major impact on the major pearl-growing area of Savusavu). Increased oyster supply from the program provides a sustainable basis for industry development, and pearl production in Fiji is no longer limited by oyster supply. Spat collection provides livelihood opportunities for communities through sales of spat to pearl farms, and potentially from mother-of-pearl (MOP), half-pearl (mabé) and MOP handicraft production.
- Three successful hatchery runs were conducted in Tonga to maintain oyster supply to Tongan pearl farmers. They were conducted with collaborative technical input from J Hunter Pearls (Fiji).
- Half-pearls (mabé) are a new export product for the Fijian pearl industry. This development was a direct result of trial mabé production conducted by John Allwright Fellow Pranseh Kishore from Fiji.



Collection of juvenile pearl oysters (spat) at Namarai, Viti Levi, Fiji.

- Half-pearl production workshops that focused on training pearl farmers and community members to improve pearl yield and quality were held in Fiji in 2013, 2014 and 2015, and in Tonga in 2014 and 2015. These workshops built on previous training held during 2012. To support capacity building outcomes, new extension material was prepared and translated into local languages.
- Research undertaken by Pranesh Kishore to determine factors affecting the quality of round pearls resulted in modification to farming practices by the Fijian pearl industry to maximise pearl quality and crop value. The largest pearl farm in Fiji estimated that this change to culture methodology has resulted in an increase in the value of the pearl crop of ~30% and increased the proportion of export quality pearls.
- Business planning workshops were held for pearl farmers in Fiji in 2012, 2013 and 2015, and in Tonga in 2014 and 2015. Economic modelling and risk assessments were undertaken for individual farms and generic business skills training was provided to farmers. Outputs included industry-wide economic models for the major pearl farming activities spat collection, mabé farming and round pearl farming.

Mother-of-pearl handicrafts

- Led by USP in collaboration with JCU and UoA, this project assisted the Fiji handicraft sector through targeted community-based training in design and manufacture of MOP jewellery and inlay handicrafts.
- An initial survey of the MOP handicraft industry in Fiji showed that this sector had an annual value of more than F\$10 million, of which more than 85% was based on MOP items imported from Asia.
- A series of training programs was held in Fiji with women's groups. The program was run in partnership with the Ba Women's Forum (BWF) and Ba Town Council and training was undertaken in the council-owned 'women's bure' in Ba town centre. The graduation of trainees was attended by the Attorney-General and senior representatives from a number of government ministries including the Ministry of



Ba women's group MOP training workshop

Agriculture, Fisheries and Forests and the Ministry of Social Welfare, Women and Poverty Alleviation.

- Working closely with local communities, 20 variations of ‘fashion wear’ items and 14



variations of ‘everyday wear’ items were developed. Design and product innovation was principally undertaken by Marie Erl (contemporary and traditional jewellery designer and trainer from New Zealand), with direction from Robert Kennedy, a Fiji-based fashion designer and handicrafts buyer from Tappoo.

- A high-profile commercial launch of the MOP handicraft took place in 2014, and products are available at Tappoo retail outlets in Fiji.

Showing the final packed MOP designer jewellery.

Value-added fisheries

- This USP-led project aimed to research potential supply chain enhancements and value-adding of selected aquaculture and fisheries commodities (tilapia, and the seaweed *Caulerpa*) in Fiji, Samoa and Tonga.
- Marketing strategy supply and market chains have been developed and tested for tilapia in Fiji and Samoa, and for *Caulerpa* (locally known as sea grapes) in Fiji, Samoa and Tonga. In Fiji there is a need for a cold-chain hazard analysis and critical control points (HACCP) analysis of the *Caulerpa* supply chain. Biomass surveys of key harvesting sites in Fiji have shown how the crop is vulnerable to cyclones and coastal development.
- Value-adding of *Caulerpa* has led to extension of shelf-life for up to 12 days, and for a much longer preservation period (up to 12 months). Public tastings indicated acceptability of the 12-day old samples. A research partnership with the private sector (Pacific Seaweeds Limited) is assessing the incorporation of shelf-life extension into the supply chain (for the export market) for *Caulerpa*. Two public tasting events have also been held for tilapia (in Samoa and Fiji) and showed preference for smoked fillets and smoked whole fish, and the preservation method has been refined over the past several months. ACIAR Masters student Janice Natasha has completed her thesis on value-adding of tilapia.

Sea cucumber

- The project team conducted questionnaire-based interviews with 84 sea cucumber fishers and 21 processors in Kiribati, 134 sea cucumber fishers and 13 processors in Tonga, and four processors in Fiji. The surveys were carried out over five atolls in Kiribati and four island groups in Tonga. Findings on fishing and processing by 86 sea cucumber fishers from three island groups in Fiji, carried out for an MSc thesis by Ram (2008), were used to describe the situation in Fiji.
- Practically all of the sea cucumber fishers in Kiribati were men, averaging 36 years old. In Tonga, many sea cucumber fishers interviewed were women (19%), and the average age of fishers was 40 years. In Fiji, women comprised 32–66% of fishers surveyed by Ram (2008).

- Women play a more important role in processing than previously understood. Although 99% of the fishers in Kiribati were men, their spouses carried out or helped in the post-harvest processing of the catch in 66% of cases.
- Based on the number of sea cucumber fishers in villages visited and the number of fishing villages in the countries, we estimate that there are 3,000–5,000 sea cucumber fishers in Kiribati, around 1,500 in Tonga, and about 3,000–5,000 in Fiji.
- Beche-de-mer from Tonga, Kiribati and Fiji is almost always exported dried and the majority goes to Hong Kong. Processors did not believe there would be much potential for other product forms, such as vacuum-packed or frozen sea cucumbers, because of the long shipment routes from Pacific islands. Although there was evidence of new products in China from sophisticated fisheries in developed countries, our investigations indicate that such opportunities may have little potential in the Pacific.
- Details of the China market study and specific post-harvest processing techniques are presented in the end-of-project report.

Canarium nut

- This USC-led project (project leader Helen Wallace) supported the expansion and commercialisation of the canarium nut industry in Vanuatu and Solomon Islands. Over the last 12 months, the industry has continued to grow in Vanuatu with five processors and value-adders and increased production of value-added product. We have identified new market opportunities, developed marketing plans and protocols for new products, and examined food safety.
- A canarium nut consumer preference survey was conducted, and showed that 67% of companies believed canarium nuts have commercial appeal in the Australian market. The most suitable market segments suggested were health stores, gourmet food, boutique stores, bakery and confectionary. The best value-adding option was thought to be roasted and salted product, which brings out the flavour. Other market opportunities in the export market have been identified, with samples provided to Haigh's Chocolates, and also canarium oil to Jurlique for possible inclusion as an ingredient in their skin care range.
- A draft canarium nut marketing strategy for the direct business-to-consumer market has been prepared and presented to the proprietors of Lapita Café.
- Microbial testing highlighted the need for improved food safety standards during processing.
- Interest among farmers in Vanuatu is strong with recent activities by Vanuatu Department of Forestry staff on Malekula, Malampa province. Interest in the canarium nut industry in Solomon Islands is also expanding. The Nut Grower's Association Solomon Islands (NGASI) now has 500 members and is led by Richard Pauku (Maraghoto Holdings).
- Collaborative market research undertaken by UoA is supporting industry expansion by identifying and translating agribusiness and value-adding opportunities. The key target market consumer and buyer insights and value-adding strategies were shared and discussed at a canarium nut workshop held in Honiara which was attended by private and public sector industry stakeholders from Solomon Islands, Vanuatu and Papua New Guinea.

Teak

- This GU-led project (project leader Tim Blumfield) investigated the development of market access for smallholder teak growers in the Western Province of Solomon Islands. The project highlighted the willingness of all communities to participate, itself

a sign of the desperation felt by virtually all of the growers when it comes to finding a market for their timber.

- The use of certification for gaining access to markets requiring proof of sustainability is beyond the scope of all of the communities, with the probable exception of the Christian Fellowship Church. The costs of establishment are prohibitive, and are required upfront before any benefit is either proved or felt. It rapidly became apparent that this was effectively a non-starter with the communities and the project started discussions with PHAMA around the legality assurance provisions that would gain access to Australian and New Zealand markets. These are far less onerous and mainly require care and diligence.
- Development of protocols for legality assurance has been incorporated into ACIAR project FST/2014/066 and will be field-tested before the guidelines are developed.
- The work towards obtaining a resource inventory highlighted the difficulty of getting reliable data from such a fractured resource. In many ways the problems faced by the project have been mirrored by the Ministry of Forestry's attempts to undertake a nationwide survey that has been stalled for the past 3 years. The work completed has shown that: the plantations are small, generally less than 1 ha in size and many below 0.5 ha; they are clustered by communities (which may be helpful in gaining cooperation for harvesting); they are often placed with no regard for the logistical difficulties of getting the timber to a place of loading; and they are generally in poor condition being overstocked with timber and having had little to no maintenance.
- Workshops to show growers how to assess their own timber were held partly to develop an alternative to Ministry of Forestry undertaking the work, but also in response to the establishment of a Malaysian sawmilling operation in Noro. While the attendance at the workshops was good, most growers were shocked when faced with the reality of having to assess their plantations against the grading rules currently in force. Probably less than 40% of trees in all of the plantations would pass the grading system. This would not have been a problem in well-managed plantations as it would have been that 40% that would have been grown through to final harvest, but for the growers it was a very poor outcome as even the trees that were of an acceptable standard were of relatively low girth.
- This work is still in progress as it has been absorbed into another ACIAR project (FST/1012/043) but is still problematic. The two main thrusts currently are the development of a rapid assessment system for plantations, which will reduce the amount of time that has to be spent, and the use of remote sensing technologies for assessing area of plantations.
- Supporting research by UoA has undertaken a global analysis of markets for plantation teak from Solomon Islands and a comprehensive report has been prepared which investigates and compares the market requirements and opportunities for teak in India, China, Vietnam and Thailand.
- The development of a pilot program for the collection and purchase of community timber was dependent upon outside funding being made available and it became evident that the major donor agencies do not support this form of infrastructure development.
- The success of the KFPL intervention with the Kolombangara teak outgrowers has demonstrated that there is a lucrative market for Solomon Island teak and the prices paid for even poor grade logs was a surprise. However, the situation on Kolombangara is exceptional in Solomon Islands with roads, wharves and equipment for harvesting, snigging, transporting and loading of logs. Other growers operating outside of urban areas do not have these facilities and overcoming the logistics of getting Solomon Islands timber to an export market is the single greatest challenge facing the growers.
- Social research confirmed the disillusionment of many growers who feel abandoned by the government who they feel should be providing active support. Many growers

expressed a desire to clear all the trees and start growing another crop with greater chances of success.

Tamarind

- This USC-led project (project leader Helen Wallace) focused on supporting a potential tamarind industry in Vanuatu by undertaking consumer research to better understand the market and identify potential products for tamarind in Vanuatu, refine processing methods, and provide training and capacity building in tamarind production and processing.
- The project had major success with training farmers in processing techniques and the emergence of a new tamarind processor, Lapita Café, and a new product line, tamarind chutney, which is soon to be launched in the Vanuatu market. This has resulted in growth in the tamarind industry, and more opportunity for farmers to sell tamarind products.
- Value chain interviews and grower surveys led by UoA identified new market opportunities in Vanuatu. It was found that:
 - Most of the tamarind trees were in residential areas and used for their shade (64%); 29% were growing as a wild population and only 7% as small-scale immature production crops.
 - The most common factors holding back the growth of the tamarind industry in Vanuatu were lack of market information, lack of awareness by relevant government institutions, a lack of recommended silvicultural practices, with lack of proper processing skills to meet the required standards found to be the greatest challenge.
 - There is unfulfilled domestic demand for tamarind products.
 - Retailers want more tamarind products and year-round supply and are willing to support local farmers and processors.
 - Opportunities exist to target locals and tourists (especially from New Caledonia who are more familiar with tamarind).
 - Currently tamarind candies are targeting children through sales in supermarkets and stores close to schools, but opportunities are wider in terms of types of products, target consumers and market lines and channels (e.g. tamarind paste and chutney for retail and food service applications).
- A tamarind stakeholder workshop was held to share value chain analysis and market survey results, including market opportunities. As a result, the private sector, in collaboration with the research team, have used these insights to develop new tamarind products. The initial tamarind training workshops provided by the project will be scaled up and out with additional funding from GIZ.
- Scientific experiments in drying and processing have resulted in enhanced knowledge of methods for drying tamarind to a level suitable for long-term storage. Four training activities including solar drying workshops were attended by approximately 100 people, and a stakeholder workshop was attended by 45 participants.
- Overall production of tamarind products has increased since the start of the project. Local media associated with the project has also generated major interest from farmers.



Official launching of tamarind chutney, sweet tamarind chilli and dried tamarind: (Photo by Alcina Charlie, VTO 2014)

- At the beginning of the project, only Pacific Nuts produced and sold commercial tamarind products, but as a result of the market and processing research and the training workshops the private sector have been motivated to enter the industry, and at the end of 2014 Lapita Café launched a new tamarind chutney into the market. This has increased the overall production in the industry since the start of the project and provided more opportunities for tamarind farmers.

Breadfruit

- This Pacific-led project (project leader Andrew McGregor of Kokosiga Fiji) supported the commercial expansion of the Fiji breadfruit industry, through the development of propagation techniques, varietal evaluation, and community engagement to promote smallholder farmer production.
- Characterisation/information sheets have been created for the following material: Natewa collection – 20 varieties; Sigatoka Research Station – 2 varieties; Legalega Research Station (Vanua Levu) – 10 varieties; Seaqqa Research Station – 8 varieties. With this information, provisional fruit calendars were developed for identified preferred Fiji varieties. From the 20 promising Natewa Bay varieties identified, five marcotts have been brought to Nadi for orchard establishment and evaluation. From the information available it was decided by the Pacific Breadfruit Project (PBP) team that *Balekana* (*Balekana dina* and *Balekana ni Samoa*) should be the initial focus of breadfruit orchard development in western Viti Levu.
- Orchard field trials have been established to evaluate performance of breadfruit trees under different soil types and management systems – 24 months of data have been collected. A paper was presented at the Brisbane International Horticulture Congress (IHC) on the economic returns from developing breadfruit orchards. Trials have been completed on three propagation techniques, and a paper was presented at the Brisbane IHC on evaluating marcotting techniques for improved multiplication of breadfruit planting material.
- In January/February 2015 a technical officer visited Palau, Republic of the Marshall Islands, Federated States of Micronesia (Pohnpei and Chuuk), Guam, Commonwealth of Northern Mariana Islands, American Samoa and Hawaii at the invitation of the University of Hawaii, Breadfruit Initiative. The focus of this exchange was training on breadfruit orchard development and management.
- As a result of this project, there are 42 participating farmers in Fiji's Western Division who have planted 2,240 breadfruit trees on 18 hectares of land. Farmer-owned demonstration orchards are coming into production some 18 months ahead of expectations, greatly improving the expected viability of breadfruit as a commercial crop.

Cocoa

- This project was led by SPC, and aimed to identify premium market opportunities, improve the capacity of cocoa producers to access niche market opportunities through better quality control incentives, and build capacity in the domestic cocoa industry to add value to cocoa products.
- Commercial business links have been established between cocoa value chain stakeholders in Vanuatu and Solomon islands and high quality chocolate makers, such as Haigh's Chocolates in Adelaide, Bahen & Co in Western Australia, Zokoko in New South Wales and Guittard's in the United States.
- ACTIV delivered its first batch of commercial chocolate to the local ice cream maker.
- Solar drying strategies were developed with Vanuatu stakeholders (Cocoa Growers Association, ACTIV and Department of Trade and Industry) to address smokiness of the beans.

- A chocolate factory has been built and equipped in Port Vila, under the management of ACTIV.
- A chocolate competition was held in Vanuatu in October 2014.
- SolKom delivered 200 kg of high quality beans to Zokoko and received double the price farmers used to receive. Vanuatu Cocoa Growers Association also received a higher price for the first shipment of 15 tonnes of solar dried cocoa.
- A database of cocoa producers for certification has been started in Vanuatu.

Participatory guarantee scheme/Vegetables

- This project sought to improve smallholder farmer access to high-value domestic markets (resorts and hotels) in Fiji, Samoa and Solomon Islands so as to improve smallholder farmer profits. To overcome challenges associated with consistent supply volume and product quality, the project established a series of pilot-scale farmer participatory guarantee schemes (PGS) in Fiji and the Solomon Islands. As of July 2015, three PGS groups were registered as companies: Nawamagi, Qereqere and Narata, which are also registered under the umbrella company the Sigatoka Valley PGS Farmers Company, and another PGS group at Koronivia has been registered. All have market access agreements for the supply of tomatoes with hotels including the Intercontinental and Fijian Shangri La Resorts on the Coral Coast, and the Grand Pacific Hotel and the Holiday Inn in Suva.
- Support was also provided to the Areatakiki and Aruligo, and Sasa PGS groups in the Guadalcanal province of Solomon Islands, established in 2009 under Australian Aid's Agriculture Livelihood Program (ALP). These PGS groups have secured agreements with the Heritage Hotel in Honiara. Growers were provided with training in production, organisational and business structure and operation, appropriate post-harvest handling, and seedling production.
- The World Vegetable Center (AVRDC) undertook a survey of 80 farmers in the Sigatoka Valley, Coral Coast and Koronivia in the Suva area to identify key production, post-harvest and marketing practices and analyse key constraints. This was used to prioritise supplementary technical assistance provided to farmers.
- This project also allowed AVRDC, in collaboration with the Solomon Islands Ministry of Agriculture and Livestock (MAL), to continue evaluation of improved vegetable lines or cultivars in Solomon Islands. In February 2014, an AVRDC tomato line, CLN2585D, was officially recommended and launched by MAL. MAL named the line as MAL-SI/LE/01/14, and it has become commonly known as Rose's Choice by farmers. About 200 seed packets were provided to individual farmers (about 100 seeds per packet) during and after the launch ceremony.
- At the beginning of the project, PGS tomato farmers in Fiji were experiencing around 25–30% on-farm postharvest wastage, much of which was due to poor ripening practices and limited understanding of management of field heat. These losses have been reduced to around 10% following application of improved practices introduced through the various training workshops.
- To further examine smallholder farmer post-harvest needs, USP PhD student Mr Salesh Kumar undertook post-harvest handling surveys across Fiji, building on the wider survey conducted by AVRDC in 2013. He found that:



- Farmers are aware of the current level of wastage, Sigatoka farmers estimating around 26% wastage and central farmers around 28%, with losses during on-farm grading the perceived key point along the chain;
- Farmer and family unit (not hired labourers) played the major role in on-farm product grading and sorting, so future training should target this group;
- 60% of farmers (whole industry) are still using poor on-farm ripening, suggesting outside of the PGS groups post-harvest handling of tomato remains poor;
- Intra-farm transport had no significant effect on post-harvest wastage.
- A large municipal market post-harvest wastage study was conducted at Suva, Sigatoka and Nausori (Fiji), providing an important baseline study. While tomato supply chains were shown to have comparative high levels of post-harvest wastage (supporting our focus on smallholder tomato growers), post-harvest wastage across a range of fruit crops was also high.

Taro

- Led by SPC's LRD in Fiji (project leader Valerie Saena-Tuia), this project sought to develop a clean seed system for market-ready taro cultivars in Samoa.
- PARDI and staff from the Scientific Research Organisation of Samoa (SROS) undertook a large market-based consumer-acceptance study of selected varieties of taro with Samoans living in Auckland, New Zealand. Assessing consumer acceptance and taste preferences of new varietal taro lines was essential information to support the ongoing Samoan taro breeding program. To create added capacity building outcomes, training in product sensory evaluation was provided to SROS staff.
- Shelf-life testing at MAF premises demonstrated that taro corm varieties can be stored at 10°C for more than 28 days, as compared to storage at normal room temperature which resulted in 40–50% of corms becoming rotten.
- SPC's Centre for Pacific Crops and Trees (CePaCT) has been successful in optimising tissue culture production rates using the bioreactor system, which has resulted in improved field readiness to 20 weeks instead of 28 weeks in two Samoan breeding lines (Nuu 20 (BL/SM/201) and Talo meamata (BL/SM/202)). CePaCT has evaluated five different methods and compared two types of tissue culture systems: the culturing of plantlets in glass an/or polycarbonate culture vessels containing normal static semi-solid artificial nutrient medium versus plantlets cultured in bioreactor system. Results of the protocol have the potential to produce 48,000 to 768,000 plantlets annually.
- The project successfully identified three new taro lines to satisfy market demand for pink taro, similar to Fiji Tausala ni Samoa. Official launching will take place on 13 October 2015 of the three new taro varieties (Talo Tanu, Talo Fusi and Talo Lani (cycle 6)) during Samoa Agro Show/FAO World Food Day. The Samoan Cabinet, ministry CEOs, development partners, private sector and farmers are invited and approximately 20,000–30,000 sets of planting material have been produced for



Taro consumer taste panel evaluation



Exported taro varieties Samoa 1 & 2 (photo Tolo Losefa)

distribution during the launch. The new taro lines were identified by farmers during MAF and SPC farmer consultation and tasted better than the current export varieties. Multi-locational trials reflected consistent performance of the three varieties in terms of yield and good eating quality in four locations in Savaii (Falealupo and Vaiafai) and Upolu (Sapunaoa and Fasitootua). Four taro lines selected to serve the export markets in this transitional period are Samoa 2 (current export variety) and three new lines (Talo Fusi, Talo Lani and Talo Tanu). Samoa 1 will be dropped from the list of export varieties.

- SROS has evaluated varieties for the future export market, and four genotypes of cycle 8 cross (C7-102 x C7-083 crosses) have been identified and released to SPC and MAF for planting material propagation and performance evaluation under different agro-climatic conditions in Samoa. The four new cycle 8 phenotypic lines outperformed existing export varieties (Samoa 1 and 2) and Fiji Tausala ni Samoa in terms of taste and consumer acceptance. The three phenotypic lines (cycle 8) had higher carbohydrate and protein content, with other nutritional composition comparable to other cycle 8 lines.
- Preliminary analysis of the establishment of private-sector nurseries is that they are not economically viable (*Preliminary cost benefit analysis of private sector nurseries for multiplication and dissemination of clean taro leaf blight planting materials*, by Anna Fink, SPC economist). Even if no maintenance costs existed, the nurseries would still make a large net loss if the selling price was set at \$0.30 per sucker which is the affordable and acceptable price by farmers.
- Out of five export varieties (Samoa 1, 2, 3, 4 and 5) selected earlier, two taro lines (Samoa 1 and 2, cycle 5) have been selected as the main current export varieties to serve US and New Zealand markets based on taste and consistency in performance. Increase in taro exports (Samoa 1 and 2) from June 2014 to June 2015 was approximately 1.5 million taro exported (81,808 x 20 kg bags, 137 4ft consignments) using figures from MAF packhouse. A recent increase from four to sixteen containers a month to New Zealand and US markets has been recorded by MAF and is expected to increase. Samoan taro export is becoming very competitive with Fiji and other exporters of taro from the region.
- These two varieties can be stored at 10°C to prolong shelf life to 28 days. Export of frozen taro is being investigated in collaboration with PHAMA, SROS and MAF and preliminary trials already underway to New Zealand.

Protected cropping/Vegetables

- This project aims to help Fijian and Samoan vegetable farmers to better adopt protected cropping systems (production systems that mitigate environmental conditions that constrain production) to increase access to the hospitality industry and urban markets, particularly during the off-season. The project set up demonstration sites in Fiji (Sigatoka, Tavua, Koronivia and Lautoka) and Samoa (Nu'u and Tapatapao). To increase success and impact, the project combined ACIAR/PARDI-funded research, local industry and business support (All Seasons Nursery, Soil Health Pacific, Marco Polo), and efforts from regional and in-country government (SPC, MoA-Fiji, and MAF-Samoa) as well as relevant projects (ACIAR PC/2010/090 and IKSA (Improving Key Services to Agriculture)). More recently, the Pacific Island Farmers Organisation Network (PIFON) contributed to training activities with participants from several Pacific communities.
- The project designed, negotiated with an overseas company to construct, sourced, and set up a series of high ventilated poly-tunnels that were then planted using improved cropping practices. Five 360 m² steel structures were built incorporating design principles (height and ventilation) suitable for warm conditions. Importantly, structure design was also applicable to lower cost construction with wood. Since 2014, a few farmers in Fiji have built wooden structures. With the 4 m high structure

built at demonstration sites, extreme air temperatures can be mitigated as warmer air escapes through roof vents, pulling cooler air into the structure from the open or screened side walls. This is particularly beneficial for vertically trellised crops (tomatoes, capsicums and cucumbers). This crop environment is an improvement compared to environments under popular low arched-roof poly-tunnels (generally adopted because of their low cost). The project suggested that low structures are raised to optimise crop environments (e.g. poly-tunnels in Samoa and some recently built low wooden structures without roof vents in Fiji). Two cyclone warnings for north-west Fiji successfully tested the possibility of detaching and reattaching structure cover materials at the demonstration site in Tavua.

- Drip irrigation systems operated by gravity and electric pump were designed and set up at the five demonstration sites to demonstrate water use efficiency and labour reduction. Farmers valued the hands-on training activities (22 days in total) on this new technology. In Fiji, farmers commented on the potential for irrigating field crops in years of extreme drought such as in 2014/2015. It is anticipated that suppliers such as Marco Polo Intl. will increase the availability of low-cost irrigation components.
- At the start of the project, local farmers and project participants had little or no previous experience with protected cropping cultivation. With the structures set up in early 2014, the project team focused on commencing test crops, identifying production challenges and providing solutions, and training activities. Encouraging first yields and produce quality were obtained with selected crops (e.g. tomato 6.8 kg/m²; capsicum 5 kg/m², cucumber 8.3 kg/m²) as well as some other high-value crops (cilantro, amaranth, bitter gourd, Chinese and red cabbages). Lebanese cucumber, introduced to Samoa by the project at Tapatapao and Nu'u demonstration sites, has become a specialty vegetable in demand by local hotels and restaurants. Farmers in Fiji and Samoa have seen the production of mature coloured capsicums under protected cultivation, which PARDI market surveys had identified as a 100%-imported high-value commodity.
- A total of 160 farmers attended training activities and gained knowledge on specific plant pruning and trellising techniques to keep crops in production for longer periods and therefore extend supply. In June 2015, a week of training was delivered in Fiji under an off-season vegetable production tour/workshop organised by PIFON, PAPP and SPC, and had participants from regional PARDI/ACIAR projects, local farmers (including some from PGS groups) and representatives from Samoa, Papua New Guinea, Tonga, Solomon Islands and Vanuatu. Farmers managing demonstration sites in both countries continue to provide advice to visiting farmers interested in the technology.
- Training days included discussions on recognition and management of key pests (e.g. broad mites, *Polyphagotarsonemus latus*) and diseases (e.g. powdery mildew caused by *Leveillula taurica*). Farmers were either using ineffective pesticides or the pests were not managed at all, leading to total crop loss in both scenarios. Through collaboration with ACIAR project PC/2010/090, the introduction of specific pesticides



Protected cultivation used to produce capsicum

was promoted. Abamectin is now commercially available for managing broad mites in Fiji, and there are intentions to make micronised sulphur available, which can assist in suppressing both broad mites and powdery mildew. In Samoa, applications for import and use have been submitted to Pesticide Committee authorities by a collaborating farmer. When insect exclusion screens were attached all around the structure (e.g. in Tavua), crops were protected from larger insect pests; however, in other locations the removal of screens to improve ventilation allowed entrance of Lepidoptera and *Liriomyza* spp. Farmers will need further recommendations on crop rotation and practices that promote soil health to minimise impacts of soil-borne diseases and plant parasitic nematodes.

Fiji consumer market survey

- Supermarkets have now taken over 54% of urban food expenditure with the municipal market retaining 28%. The remaining 18% of food expenditure is split between roadside stalls (6%), corner shops/butchers/bakeries (6%) and the fish market (4%). The majority of the local population never purchases food from restaurants, fast food or service stations with less than 2% of total urban food expenditure, indicating these outlets are more likely servicing tourists.
- Supermarkets and the municipal market were patronised by 100% and 97% of households surveyed respectively.
- Supermarkets dominate the processed food category while the municipal market is preferred for fresh produce.
- Public transport is the favoured mode of transport to most food outlets, except for roadside stalls and corner shops where travelling by foot is preferred.
- The four most important characteristics when choosing where to shop are food safety (91%), freshness (89%), quality (81%) and price (80%).
- The key determinant of food shopping behaviour is ethnicity with iTaukei being least likely to shop at supermarkets.
- The most popular crops adopted by farmers in the last 5 years were zucchini (23%) ginger (13%), capsicum (8%), cucumber (6%), taro (6%) and tomatoes (6%)
- Only 1.58% of producers sell through supermarkets, instead preferring to sell through the main municipal market (87.22%).
- Key challenges for traders included maintaining consistent supply, fluctuating market price, maintaining consistent quality, and finding a market to sell products.

Red papaya

- This project sought to value-add to recent ACIAR projects supporting the Fiji papaya industry by identifying the domestic and export market constraints in the red papaya supply chain in Fiji and Australia. Papaya is one of the main export fruits of Fiji.
- Simulations of supply chain interventions demonstrated the value of pre-conditioning and sorting fruit in Fiji before dispatch. These advantages were demonstrated to supply chain participants, as was the use of lower cost packaging. Hot water trials did not demonstrate a significant difference in disease control, because the winter harvested fruit had low disease incidence. The effect of hot water treatment on ripening was demonstrated.
- The pre-ripening/grading demonstration trial clearly indicated the value of this activity in helping to produce a more even and clean final product (photograph below). Discussions with importers regarding their ripening practices indicated the value of pre-ripening which meant that a product could be marketed soon after it landed, or stored in the cooler for sale later in the week. Two of the three collaborating importers did not have ripening facilities which meant that they had to wait up to 5 days for fruit to ripen in the winter months.

- The New Zealand market survey element of this project identified that consumers have positive feelings towards Fiji and its fresh produce. They considered the Fijian ‘traditional’ agricultural practices and its unspoiled tropical environment would contribute to good quality fruit. Although in the blind sensory tests Fijian Red was the preferred papaya line in terms of flavour and sweetness, when intention to purchase was asked, the Australian Skybury variety was preferred. The small size of the Fijian papaya was disliked by most consumers. Philippine papayas, the only papaya widely sold in major supermarkets, were considered inferior to both Fijian and Australian product lines.



Kava

- This project was carried out in collaboration with Fiji-based South Pacific Elixirs (SPE) Limited, and has been continued through direct private sector funding. The project is supporting SPE and the wider Fiji kava market by seeking to develop a rapid propagation system for clean planting material. Lack of an adequate and continuous volume of disease-free, good quality planting material is a significant constraint in establishing any commercial kava enterprise. Kava dieback is a problem in many countries in the Pacific, and has been known to wipe out production. Virus testing can be used to detect those kava stems not infected with cucumber mosaic virus (CMV, which has been shown to be associated with dieback; Davis et al., 2005), which can then be used to initiate tissue cultures for further propagation.
- The project collected planting material of four varieties (44 stems) from five sites in Levuka. RT-PCR and IC-RT-PCR techniques were used to test leaf tissue of the 22 samples collected; 10 tested positive for CMV. IC-RT PCR proved to be more sensitive in detecting CMV than RT-PCR. Soil samples were also taken from the kava collecting sites for analysis (minerals and pH). The pH of the soil from the sites where CMV-positive kava material was collected was 5.5 and less, and it was between pH 5.7 and 6.5 where the CMV-negative material was collected.
- Tissue culturing of CMV-free material has achieved an overall 41% success rate, which is acceptable. Kava is one of the most difficult plants to establish in tissue culture because of the level of endogenous contamination. While there has been insufficient time to establish the protocol for the bioreactor (temporary immersion technology), this research is continuing through funding provided by SPE.
- This project made a significant contribution to the private sector through strengthening the nursery production of planting material for SPE. Trials were established to identify which propagation protocol (nodal cutting length and soil substrate) delivered the optimum multiplication rate of quality planting material. The significant improvement in multiplication rates achieved in the nursery has resulted in commercial growers contracted to SPE adopting the improved technique.
- The project has been instrumental in supporting the development of a tissue culture facility at USP and highlighting the important contribution that tissue culture (micro-propagation) can make to improve the availability of quality planting material. This is an important area for plant biology students to be aware of. USP provided funding for the new facility, with PARDI funds resourcing some equipment and consumables for use in the kava research.

9 Impacts

9.1 Scientific impacts – now and in 5 years

PARDI research resulted in 19 published academic journal articles, with a further five papers currently under review; four completed masters and PhD theses; and 51 conference or technical papers (see Section 10.2).

Project-specific research impacts are described below.

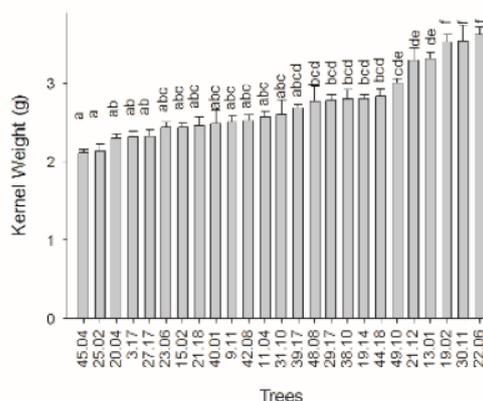
Pearls

Many aspects of this project were novel, and the scientific impacts of this research include the following.

- Productive and sustainable pearl culture systems: This project further developed culture systems for pearl oysters that facilitate uptake by pearl farmers: (1) development of appropriate spat collection methods and information on recruitment of pearl oysters in Fiji and temporal influences; (2) influence of culture method on growth rates and survival of oysters and on resulting pearl quality; (3) development and on-going refining of hatchery culture methods for *Pteria penguin*; and (4) development of culture methodology supporting maximum pearl yield and quality. Outputs are likely to be broadly applied by scientists within the fields of mollusc and pearl oyster aquaculture.
- Publications and application: Eight publications in international journals and a book chapter resulted from this project. These will improve perceptions of research and research needs in the region and bring focus to the work of ACIAR and project partners.
- Research student training: A number of postgraduate research students worked within this project including a John Allwright Fellow (Pranesh Kishore, JCU, PhD) and two ACIAR-USP scholarship holders (MSc); all are from partner countries. Pranesh Kishore completed his PhD during the PARDI project and published six papers in international journals prior to thesis submission. Involvement of post-graduate research students in the project builds significant scientific impact of regional relevance and provides industry- and community-relevant capacity building within partner countries.

Canarium nut

- This project has generated scientific data on tree growth, early flowering, early fruiting and nut quality characteristics for canarium nut on Kolombangara Island, Solomon Islands over a 3-year period, in conjunction with staff from the Solomon Islands Ministry of Forests. Preliminary analysis shows that the best trees produce kernels that weigh twice as much as the poorest trees. Selecting the right trees could lead to double the production of kernels by weight. Kernel recovery and total nut



The difference in mean kernel weight in 5 year old, *Canarium* trees in Kolombangara Island, Solomon Islands. N=25-30 nuts per tree.

- weight was also much higher in the best selections compared to the worst selections.
- Shelf-life experiments on canarium nut-in-shell and kernel have shown that kernels can be stored successfully for 6 months at 30°C and for 9 months at 25°C when vacuum packed. Increases in free fatty acids of nuts while stored may limit further storage potential at ambient temperature. Our experiments have shown that the risk of pre-harvest microbial contamination is low. There is a risk of contamination where cracking is done in the village. Nut-in-testa is supplied to processors in Vanuatu, which affords some protection from contamination. There is a risk that mycotoxins could develop during prolonged on-farm storage. Safe moisture content needs to be achieved as soon as possible after harvest.

Teak

Following training of Solomon Islands Ministry of Forestry staff in the use of GPS handheld units for forestry inventory purposes, a cloud-based storage system for all GPS data has been established and will continue to be supported by current ACIAR projects.

Tamarind

The project has produced new scientific knowledge on processing of tamarind and a draft scientific publication has been produced. Shelf-life quality testing is completed. Initially drying of tamarind pulp to a water activity level of 0.6 will allow the product to be safely stored for 12 months in ambient conditions.

We also found that:

- The solar dryer was more efficient at drying tamarind than sun drying.
- Peeled and whole tamarind fruit dries to a commercially acceptable water activity level after 2 days of fine weather in the solar dryer.
- Temperatures of over 50°C were reached by 08:30 in the solar dryer in sunny conditions. This indicates that during clear weather tamarind should be placed in the solar dryer early in the morning to maximise effectiveness. On day two of drying the fruit can be taken out of the solar dryer at 14:00.
- There is potential to sun-dry tamarind whole (unpeeled in shell) to protect against pests and contaminants during drying. After 3 days of drying whole, unpeeled fruit on black plastic in the sun, the tamarind pulp reached commercially acceptable levels of a_w .
- 75% of the moisture content was lost after 5 h of drying fresh tamarind fruit at 65°C.
- Drying at temperatures of 65°C and above for 5 h produces commercially acceptable water activity levels in tamarind fruit. At 80°C, peeled tamarind reaches an acceptable a_w level after 2 h of drying. However, at higher temperatures (80°C) the quality of the product deteriorates in terms of colour and firmness.
- Oven drying peeled fruit for 6 h at 60°C and above reduces a_w to an acceptable level (below 0.6).

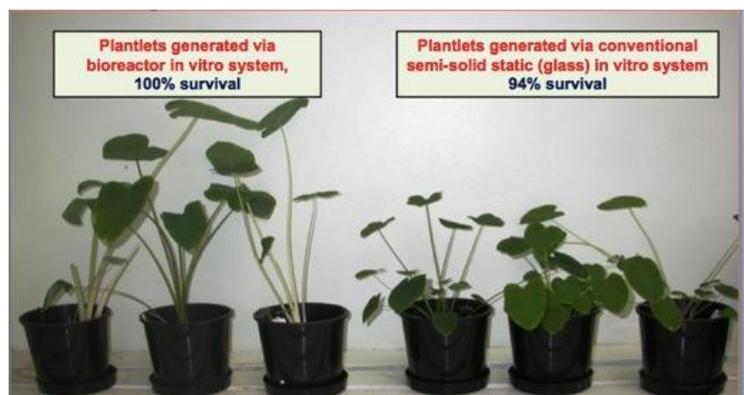
Participatory guarantee scheme/Vegetables

Postharvest research aimed at improving smallholder farmer harvesting and storage practices trialled a range of novel diagnostic tools including the use of hand-held infrared thermal imagery. Thermal imagery was found to be particularly useful identifying and demonstrating poor postharvest handling practices. Smallholder farmers were keen to use this equipment to explore their handling practices and storage infrastructure. The highly visual and the easily interpretative nature of thermal imagery allowed farmers to better appreciate temperature and the associated concepts of field heat.



Taro

SPC's CePaCT has been successful in optimising tissue culture production rates using the bioreactor system. This has improved field readiness to 20 weeks instead of 28 weeks in two Samoan breeding lines (Nuu 20 (BL/SM/201) and Talo meamata (BL/SM/202)). This work also involved evaluating five different methods and comparing two types of tissue culture systems: the culturing of plantlets in glass and/or polycarbonate culture vessels containing normal static semi-solid artificial nutrient medium versus plantlets cultured in the bioreactor system. The protocol has the potential to produce 48,000 to 768,000 plantlets annually.



Protected cropping/Vegetables.

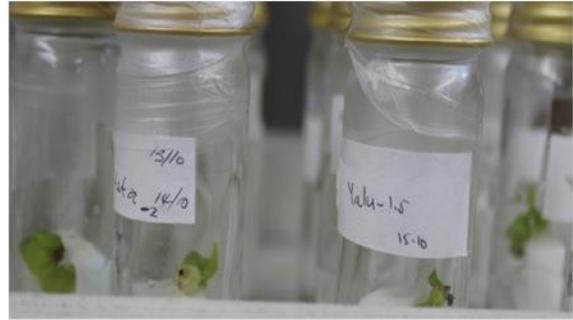
Demonstration and adaptive research (that included cultivar trials and agronomy evaluations) undertaken in Sigatoka, Tavua and Tapatapao have provided local farmers with proof of concept examples of capsicum, tomato and cucumber crops grown under protective cropping structures. Hands-on participatory activities were used in training to highlight the benefits of the new production systems. Commercial farmers managing demonstration sites continue to have visits from farmers and to pass on their knowledge from success and failure experiences. Research on protected cropping has been resumed at the MoA research station with additional support from an SPC officer.



Tomato plants pruned and trellised vertically were grown as a first test crop in 2014 by farmer Munsami Naicker at the protective cropping demonstration site in Tavua, Fiji.

Kava

Kava tissue culturing and plant virus testing capacity has been established at USP, through capacity building of Abhineswar Prasad. As Abhinesh is a permanent member of USP staff, these skills can be transferred to other staff and to students. In support of this work USP has funded a new tissue culture laboratory. Plant nursery staff at South Pacific Elixirs Limited now have expertise in kava propagation methods and the use of CMV immunostrips. In 5 years time it is expected that staff at USP will have skills and experience in working with bioreactors for mass propagation of kava, and possibly other plants. It is also likely that the skills of the commercial nursery staff and growers in propagation and CMV detection will have improved.



Kava tissue culture meristems – 8 weeks old

9.2 Capacity impacts – now and in 5 years

Through extensive higher research degree (HRD) student participation in the value chain assessments and research projects, 25 Pacific island and Australian students directly assisted in project delivery and received technical support for their studies.

HRD students are listed below:

1. Abhineswar Prasad: USP masters student supporting the kava tissue culture and virus testing project.
2. Karishma Devi: USP PhD student supporting work on the retail transformation project.
3. Kritika Devi: USP PhD student supporting work on the retail transformation project.
4. Anna Finizio: UoA PhD student supporting work on the retail transformation project.
5. Sam Fargher: UoA economics graduate supporting work on the retail transformation project.
6. Laura Bateman: UoA PhD student supporting work on the Fiji marine and canarium nut PRA activities.
7. Maria Raza: UoA masters student supporting work on the cocoa PRA.
8. Etonam Kosi Anku: UoA masters student working on the cocoa PRA.
9. Stephanie Hajaj: UoA masters student supporting work on canarium nut.
10. Camilo Esparza: UoA PhD student supporting work on canarium nut.
11. Amit Sukal: CePaCT, PhD at QUT, acquired his MSc on taro virus indexing, now doing PhD on developing yam virus indexing protocols which will be applicable for eliminating viruses in taro.
12. Pranesh Kishore: John Allwright Fellow/JCU PhD student supporting work on the pearl project.
13. Emanuel Ram: USP MSc student supporting work on the pearl project.
14. Monal Lal: JCU PhD student supporting work on the pearl project.
15. Kaione Loumoli: ACIAR/USP postgraduate scholarship for masters degree supporting the value-added fisheries project.
16. Laisene Tuioti-Mariner: sadly deceased.
17. Salesh Kumar: USP PhD student working on the PGS vegetable project.
18. Tara Mckenzie: USC Honours student supporting the PGS vegetable project.
19. Rubilyn Vaai: USP masters student supporting the PGS vegetable project.
20. Mereia F. Lomavatu: John Allwright Fellow/USC studying postharvest plant pathology.
21. Janice Natasha: completed her USP masters project on post harvest processing of aquacultured tilapia (*Oreochromis nilotica*) for potential commercialisation in Fiji in April 2014.
22. Binesh Prasad: USP MSc project supporting the PGS vegetable project has been submitted.
23. Jerome Taio: USP MSc student supporting work on the pearl project. His results have helped develop more productive hatchery culture methods for pearl oysters.

24. Leikitah Tamanalevu: USP MSc prospective student; submitted a proposal in 2015 to research pest management options under protected cropping.
25. Yumeng Chen: UoA masters student supporting work on canarium nut.

PARDI provided capacity building support to the following Pacific government and NGO agencies (numbers of individuals in brackets):

- Vanuatu Department of Industry staff (5): Jimmy Rantes, Noel Kalo, Wensie Wesley and two new staff Christine Kapalu and Julienne have actively participated and gain technical skills in the agribusiness supply/value chain review methodology.
- Epli Waqavonovono (1), Head of the Fiji Bureau of Statistics: survey development and enumerator training for the household consumer survey as part of the retail transformation project.
- Vanuatu Bureau of Statistics team (5): survey development and enumerator training for the cocoa and canarium nut producer and tourist surveys.
- Mr Ilimeleki Kaiyanuyan, Chief Economist and Tevita Natasiwai, team leader at the Fiji Department of Agriculture, Fisheries and Forests (2): survey development and enumerator training for the producer and trader surveys as part of the retail transformation project.
- Sandrine Wallez, ACTIV (1): involvement in co-delivery of the cocoa project.
- Basile Malily, Cocoa Growers Association of Vanuatu (1): gained skills in agribusiness development.
- Lapita Café staff (3): received training in improve canarium nut processing based on drying, moisture loss and shelf life (temperature data loggers to monitor the temperature during the drying procedures).
- Staff at the Solomon Islands Ministry of Forests (4): trained in assessing early fruiting and flowering in support of the canarium nut project.
- Salesh Kumar (1): intense training in post-harvest horticulture through funded attendance to the University of California at Davis post-harvest short course.
- Leeroy Joshu (1) and students at Solomon Island National University (35): received training in post-harvest supply chain assessment methodology.
- Amena Banuve, MPI, Fiji (1): training in post-harvest supply chain evaluation techniques.
- Tissue culture staff from Samoa MAF (2): trained on micro-propagation methods at SPC CePaCT that could assist with mass production of new varieties of taro in Samoa for distribution to farmers.
- Solomon Islands Ministry of Forestry staff: trained in the use of GPS handheld units for teak forestry inventory purposes.
- Aloesi Hickes, SPC (1): project team member on ACIAR project PC/2010/090, received training on protected cropping cultivation in Sigatoka and Tavua (Nov 2014: 6 days; June 2015: 6 days) and through email and phone discussions.
- Mua Mani, SPC (1): recently appointed research support in Sigatoka by ACIAR PC/2010/090, receiving training to support protected cropping activities.
- Field staff, MoA Fiji (4): construction of protected cropping structures in Sigatoka and Koronivia and management of crops.

- UN WOMEN staff from Fiji, Vanuatu and Solomon Islands (5): training on survey development/implementation and value chain analysis as part of UoA capacity building activities within projects.
- Irene Singh, MoA Fiji, researcher at Koronivia (1): training in protected cropping.

The following targeted industry capacity building was undertaken (numbers of individuals in brackets):

- Votausi Mackenzie-Reur (1): Lapita Café in Vanuatu involvement in the canarium nut and tamarind projects.
- Richard Pauku (1): Maraghoto Holdings in Solomon Islands involvement in the canarium nut project.
- Larren Gomese (1): involvement in the industry mapping and value chain analysis activities for the teak project.
- Municipal market vendors (10): trained in management by UNWomen and UoA.
- Six (6) participants from PARDI breadfruit project and private sector trained at SPC CePaCT on handling, transfer and management of breadfruit tissue culture plantlets in the greenhouse.
- Munsami and Anjini Naicker (commercial farmer and daughter) (2): training on protected cropping cultivation, book-keeping and data collection onsite (Nov 2014: 6 days; June 2015: 12 days) and through email and phone discussions. Munsami manages a commercial demonstration site and also provides training to regional farmers.
- Atish and Kaushik Chand (commercial farmer and son) (2): training on protected cropping cultivation since June 2015. His farm in Lautoka is now an additional demonstration site that farmers can visit to discuss and learn about protected cropping.
- Edwin Tamasese, Director of Soil Health Pacific (1): training on protected cropping cultivation and is involved in discussions about inputs for farmers in Samoa. Edwin manages two commercial demonstration sites and also provides training to regional farmers.
- Staff from South Pacific Elixirs Ltd in Levuka (5): trained by Abhineshwar Prasad in kava propagation techniques. At the same time a demonstration was given in the use of CMV immunostrips – an on-site tool to quickly identify CMV-infected plants with or without external disease symptoms.

PARDI sponsored the following Pacific industry collaborators to attend major conferences and present project findings:

2011

- Dr Anand Chand (USP Fiji): attendance at Horticulture for the Future conference in Lorne, Victoria, in September.
- Suwastika Naidu (USP): attendance at Horticulture for the Future conference in Lorne, Victoria, in September.
- Luseane Taufa (Tonga): attendance at Horticulture for the Future conference in Lorne, Victoria, in September.
- Kyle Stice (Fiji): attendance at Horticulture for the Future conference in Lorne, Victoria, in September.

- Livia Tora (Fiji): attendance at Horticulture for the Future conference in Lorne, Victoria, in September.
- Takena Redfern (Fiji): attendance at Horticulture for the Future conference in Lorne, Victoria, in September.

2013

- Salesh Kumar (University of the South Pacific PhD student): attendance at UC Davis post-harvest short course.

2014

- Kuinimeri Asora Finau (SROS): attendance at the International Horticulture Congress 2014 (IHC-2014) in Brisbane in August.
- Noel Kalo (Ministry of Agriculture, Vanuatu): attendance at IHC-2014 in Brisbane in August.
- Mereia F. Lomavatu (Department of Agriculture, Fiji): attendance at IHC-2014 in Brisbane in August.
- Leroy Joshua (Solomon Island National University): attendance at IHC-2014 in Brisbane in August.
- Salesh Kumar (USP PhD student): attendance at IHC-2014 in Brisbane in August.
- Arshni S. Shandil (SPC CePaCT): attendance at IHC-2014 in Brisbane in August.
- Valerie Saena-Tuia (SPC Centre for Pacific Crops and Trees): attendance at IHC-2014 in Brisbane in August.
- Kaitu Erasito (SPC CePaCT): attendance at IHC-2014 in Brisbane in August.

The following PARDI technical training workshops were undertaken:

- June 2011: Tutu Rural Training Centre training staff on breadfruit best practice marcotting and best practice root sucker collection, Fiji.
- Jan 2012: Training on breadfruit best practice root sucker selection and collection for farmers in several villages along Natewa Bay, Fiji.
- Feb 2012: 'Protected cropping: A potential production system to address offseason supply of vegetables in the Pacific' (within ACIAR PC/2010/090 project inception workshop), at Sigatoka Research Station, Fiji.
- April 2012: Regional canarium workshop was held in Port Vila at the Department of Forests, Agricultural Training Centre.
- April 2012: Breadfruit workshop in Samoa.
- May 2012: Fisheries workshop in Fiji.
- Aug 2012: Business skills workshop for pearl farmers, Savusavu, Fiji
- Oct 2012: Half-pearl (mabé) production workshop for pearl farmers in Savusavu.
- Nov 2012: Vegetable participatory guarantee training workshop held in Sigatoka, Fiji.
- Dec 2012: Half-pearl (mabé) production workshops for farmers in Rakiraki, Fiji.
- Dec 2012: Two tamarind training workshops on Efate Island, Vanuatu. Over 100 participants were involved in the workshops, most were women.
- 2012: Half-pearl (mabé) production workshop for pearl farmers, Vava'u, Tonga.
- 2012: Training in using data loggers to monitor the temperature during the drying of canarium nuts in Vanuatu.
- Dec 2012: Two tamarind processing skills training workshops in Vanuatu.
- March 2013: Cocoa bean fermentation training with SolKom stakeholders in Honiara.

- March 2013: Cocoa quality control and chocolate-making training for ACTIV with Bahen and Co. in Margaret River, WA.
- March 2013: Cocoa quality control and chocolate-making training for SolKom with Zokoko in Sydney, NSW.
- April 2013: Four workshops held in Solomon Islands at Mauru and Mandali (Rendova) Tamboka (Vonavona Lagoon) and New Georgia mainland in support of the teak project.
- 2012/2013: PARDI breadfruit team have been working with the Tutu Rural Training Centre training staff on best practice marcotting and best practice root sucker collection.
- June 2013: Breadfruit propagation training for several villagers in Tunuloa, Fiji.
- June 2013: Joint cocoa workshop on best agricultural practices in Epi, Vanuatu.
- July 2013: Commercial breadfruit awareness workshop in four villages of Natewa, Fiji.
- July–Dec 2013: Half-pearl seeding training workshops for pearl farmers in Fiji.
- July 2013: PGS/vegetables (Nawamangi and Qereqere) business training (multiple workshops), Fiji.
- July 2013: PGS/vegetables (Koronivia group) business training workshop, Fiji.
- July 2013: PGS/vegetables (Narata, Nawamangi and Qereqere) joint PGS/ICM field day in production technology.
- Aug 2013: Tamarind inception workshop, Epau village, Efate, Vanuatu.
- Aug 2013: PGS/vegetables (Nawamangi, Narata), business skills and production technology training workshops, Fiji.
- Sept 2013: Greenhouse design and planning, as part of ACIAR project PC/2010/090 workshop in Tonga.
- Sept 2013: PGS/vegetables (Nawamangi, Qereqere, Narata): PGS operations, benefits and costs, company structure, production schedule workshops, Fiji.
- Sep 2013: PGS/vegetables company director's workshop (Bookkeeping 2, Business Planning), Fiji.
- Sept 2013: PGS/vegetables (Qereqere, Nawamangi, Narata) joint workshop: book keeping, off-season cropping (farmers training farmers), Fiji.
- Sep 2013: Protected cropping: Update on structures designed and sourced for the project, and collaboration activities (within ACIAR project PC/2010/090 workshop) at MAFFF Research Station, Tonga.
- Oct 2013: Regional canarium workshop, Honiara, Solomon Islands.
- Nov 2013: Business skills workshops for pearl farmers in Fiji (two workshops – one in Rakiraki and one in Savusavu).
- Dec 2013: Breadfruit planting material selection training.
- Dec 2013: PGS/vegetables (Koronivia) business planning and logistics workshop, Fiji.
- Jan 2014: Half-pearl seeding training workshops for pearl farmers in Vava'u, Tonga.
- Feb 2014: Cocoa planning and coordination workshop, St Lucia, Brisbane.
- Feb 2014: Protected cropping, part of ACIAR project PC/2010/090 workshop in Samoa.
- Feb 2014: Naqaravutu village farmers (Fiji) were trained in breadfruit propagation.
- Feb–May 2014: Mother-of-pearl handicraft training in Ba, Viti Levu, Fiji.
- March 2014: PGS/vegetables (Qereqere, Nawamangi, Narata) AVRDC good agricultural practices workshop, Fiji.
- March 2014: PGS/vegetables (Qereqere, Nawamangi, Narata and Koronivia), book-keeping, records, operations, production schedule, planning workshops, Fiji.
- April 2014: Village farmers from Rakiraki, Fiji were trained in breadfruit orchard establishment.
- April 2014: MOP handicraft jewellery training in Fiji.

- April 2014: Owners of Lapita Café, Votausi MacKenzie-Reur and Geordie MacKenzie, visited nut processing factories on the Sunshine Coast and marketing experts.
- May 2014: PGS/vegetables (Nawamangi, Qereqere, Narata) training in grading, planning workshops, Fiji.
- May 2014: CSPro data entry skills training of Fiji Ministry of Agriculture staff, SPC staff and UNWomen staff.
- May 2014: Fairtrade certification start up workshop, Port Vila, Vanuatu.
- Oct 2014: Kava nursery and propagation training at South Pacific Elixirs Ltd, Fiji.
- Nov 2014: Protected cropping: commercial and DIY structure designs, electric pump and gravity-operated drip irrigation setup and operation and crop management (at Sigatoka Research Station demonstration site, Fiji).
- Nov 2014: Protected cropping: structure designs, gravity-operated drip irrigation setup and operation and crop management (at All Season Nursery demonstration site, Tavua, Fiji).
- Nov 2015: Business skills workshop for pearl farmers, Vava'u, Tonga.
- Nov 2014: Protected cropping: project update and planning (within ACIAR project PC/2010/090 workshop) at MAF Nu'u Research Station, Samoa.
- Nov 2014: Protected cropping: structure designs, gravity-operated drip irrigation setup and operation, and crop management (at Tapatapao demonstration site, Samoa).
- Nov 2014: Vanuatu tamarind processing skills training workshops conducted by Charles Long Wah.
- June 2015: Training on protected cultivation delivered within 'Supporting offseason production of vegetables' workshop-tour organized by PIFON and SPC (Sigatoka, Nadi, Tavua, Nausori Highlands, Fiji) (participants from Fiji, Samoa, PNG, Vanuatu, Tonga, Solomon Islands).
- June 2015: Protected cropping: Samoan and Fijian collaborating farmers learning and sharing information in commercial farms and demonstration sites in Fiji (Tavua, Lautoka, Rakiraki and Sigatoka).
- June 2015: Business skills workshop for pearl farmers, Savusavu, Fiji.
- June 2015: Business skills workshop for pearl farmers, Nuku'alofa, Tonga.
- July 2015: Protected cropping: project update conducted within ACIAR project PC/2010/090 workshop in Solomon Islands.

9.3 Community impacts – now and in 5 years

9.3.1 Economic and social impacts

- **Canarium nut producers, processors and traders in Vanuatu:** The number of growers has increased from a small number in one district to over 100 farmers in four districts. The volume of production has also increased; one processor who produced 14 kg of dried kernel in 2010 increased production to over 400 kg in 2013, and an estimated 1,000 kg in 2014. Lapita Café has steadily increased the amount of dried kernel sold to retailers, and the prices paid to farmers. In 2012, Lapita Café sold approximately 16 litres (L) of oil pressed from 40 kg dried kernel. The bulk raw oil was sold to a customer for 2,500 Vatu/L (including VAT) and the pressed kernel cake was used by Lapita Café in biscuits. In 2013 Lapita Café sold 12 L of oil pressed from 20 kg of dried kernel, and planned to sell bottles of oil on the domestic market at 150–200 Vatu/30 mL (5000 Vatu/L). The Kava Store has decreased its purchase of raw product but increased the price paid to farmers due to greater on-farm value adding. In 2011 the proprietor purchased nut-in-shell for 40 Vatu/kg (approx. 200 Vatu/kg kernel) and paid 1,000 Vatu for dried kernel-in-testa. In 2014 the proprietor was encouraging his suppliers to add value on-farm and paying 1,000 Vatu/500 g kernel solar dried in glass jars.
- **Kava growers in Fiji:** 800 kava growers will benefit from access to clean planting material¹⁰. This is anticipated to increase to 1,800 over the next 5 years based on increasing manufacturing demand. Access to clean planting material to scale up and ensure continue supply was considered a key production risk factor by South Pacific Elixirs Limited.
- **Breadfruit producers in Fiji:** 240 households in the Cakaudrove Province have benefited economically from breadfruit nursery commercialisation. Efforts to develop commercial breadfruit orchards on Fiji's main island of Viti Levu have resulted in a network of farmers and villages around the islands of Taveuni and Vanua Levu to source, propagate and sell planting material. Through an extensive awareness campaign and support from the Cakaudrove Provincial Office and Tutu Rural Training Centre, the breadfruit planting material supplier network has expanded to 240 people, resulting in 25,000 root suckers being purchased from seven villages in Natewa District in the Province of Cakaudrove.
- **Mother-of-pearl handicrafts in Fiji:** 22 people in Ba province are benefiting economically from a new niche MOP handicraft enterprise supplying Tappoo retail outlets, as a direct result of PARDI MOP handicraft training, product design and commercial development support.
- **Spat collection in Fiji:** 17 communities throughout Fiji have received training in structured routine spat collection. The benefits of formalised spat collection training are flowing directly to women, their families and the Fijian pearl industry. In Novunieva village, for example, the project helped the community double their capture of spat (by providing five extra spat-collection ropes). Their first harvest of 2,000 oysters in 2013 sold for Fiji \$4,000 (about AU\$2,300). The villagers have since built a shop from these proceeds and aim to double their income next harvest and earn enough money to purchase a boat. Based on their success, another nearby village has taken up spat collection. Similarly in Nukavalabu, villagers sold their spat harvest to Fiji's largest pearl company, J. Hunter Pearls, for \$4,200. With their new spat collecting capacity, the village plans to expand into MOP handicrafts and half-pearl (mabé) production and target the local tourist trade. Novunieva and Nukavalabu villages previously relied on minimal income from fish sales, a livelihood which is inherently difficult due to the region's rugged terrain.

¹⁰ Z. Yoshida, personal communication (2015).

- Pearl farming in Fiji and Tonga: 50 active and prospective pearl farmers were trained in half-pearl seeding methods during a series of workshops conducted at a number of pearl farming sites in Fiji and the main pearl farming site of Vava'u in Tonga. The workshops were attended by equal numbers of men and women. Improved pearl seeding skills will improve both pearl yield and quality resulting in increased value of pearl crops.
- Vegetable farmers in Fiji and Solomon Islands (PGS): 48 smallholder vegetable farmers in Fiji are now members of PGS farmers' groups (Nawamagi, Qereqere and Narata¹¹; and a group in Koronivia). PGS companies now have market access agreements for the supply of tomatoes to the Intercontinental and Fijian Shangri La Resorts on the Coral Coast, and the Grand Pacific Hotel and the Holiday Inn in Suva. The project further assisted three existing PGS groups in Solomon Islands (Areatakiki and Aruligo Community Company Ltd and MK Company Ltd) supplying the Heritage Hotel in Honiara. As of July 2015, 36 tonnes of product have been traded through the established PGS groups providing participating growers with collective net smallholder profits of A\$145,000.
- Vegetable farmers in Fiji and Solomon Islands: 42 smallholder famers in Fiji have benefited from training aimed at improving the post-harvest quality of tomato as well as reducing wastage. PGS participating groups estimate post-harvest losses have been reduced from the current industry standard of 27–30% to around 10%. In addition, post-harvest training has been provided to students and staff at the Solomon Islands National University and presentations made at the Fiji National University, with the objective of raising awareness of the need for good post-harvest handling practices.
- Vegetable farmers in Fiji and Samoa (protected cropping): 160 farmers in Fiji and Samoa received protected cropping production system and drip irrigation training. There are currently an estimated 25 farmers using protected cropping in Fiji and four farmers using protected cropping in Samoa, and this capacity building will help improve adoption and reduce production risk. It is expected that a variety of protected cropping systems will be operating in the next 5 years as farmers continue to target off-season production when vegetable prices are highest.
- Tamarind producers in Vanuatu: 101 smallholder farmers have received training to enable them to better process tamarind, to help increase farmer participation in the emerging Vanuatu tamarind industry. Half the participants were women. As a result of this project Lapita Café has developed a new product line of tamarind chutney. The product has been a strong seller with demands from the food service industries, individual customers and tourists. Lapita Café is now buying tamarind stocks from Carolyn Bay, South West Malekula and North Efate.
- Charles Long Wah, trading as Pacific Nuts, said in August 2013 that he did not have enough raw material to satisfy customer demand. When interviewed in February 2014, Charles stated that he received a large quantity of dried tamarind the previous



Farmers and extension and research officers from MOA and SPC attend a hands-on training day at the protective cropping demonstration site in Tavua, Fiji.

¹¹ These enterprises are also registered under the umbrella company the Sigatoka Valley PGS Farmers Company.

season and that he now had more than enough to supply the demand. Charles is buying solar dried tamarind from people he has trained during the workshops.

- In terms of individual stories of economic benefit:
 - Helen, a farmer in Epau village, attended Charles Long Wah's solar drying workshop and received a solar dryer donated by the PARDI tamarind project. Since then her daughter has been selling sugar-coated tamarind to fellow students at her school which then pays for her bus fair and school lunch for the week.
 - Steven Atunsia, a farmer from Nguna Island, also received a solar dryer donated by the PARDI tamarind project. He now processes tamarind, natapoa and canarium nuts and sells the semi-processed product to Pacific Nuts.
- Taro farmers in Samoa: 20 commercial-scale taro farmers and four exporters have directly benefitted from PARDI work to rebuild the Samoan export taro industry¹². Research undertaken within this project has improved mass propagation of new elite taro lines that were developed through previous ACIAR investment, provided important export market demand and consumer quality expectations, as well as provided ongoing support for the Samoa taro breeding program. Between June 2014 and June 2015, taro exports increased by 1.5 million taro roots (81,808 x 20 kg bags). A recent increase from six to sixteen containers a month is recorded by MAF to New Zealand and US markets. Two new private exporters have also joined the Samoan taro export industry. Unfortunately on the basis of current price the establishment of private sector nurseries is not economically viable, impeding wider industry benefit. Current supply is limited to that provided through the Samoa Government's research station at Nuu.

PARDI sought to achieve gender equity and impact, through initiatives such as the collaboration with UNWomen and research or training related activities that were specifically targeted at women and women's groups, for example:

- The Ba Women's Forum (BWF) participated in the PARDI MOP handicraft training program between February and May 2014. The program was run in partnership with the BWF and Ba Town Council and training was undertaken in the council-owned women's bure in Ba town centre, with 90% of the participants women.
- PARDI had a strong relationship with UNWomen and worked closely on initiatives to improve central and roadside markets across Fiji, Vanuatu and Solomon Islands by building the capacity of women vendors, vendor organisations and UNWomen staff.

9.3.2 Environmental impacts

PARDI aimed for sustainable environment benefits across the whole project portfolio. Some examples of positive environmental impacts are as follows.

Sea cucumber

- In surveys with Pacific island fishers, 56% (in Kiribati) and 68% (in Tonga) said that, if they could no longer fish for sea cucumbers, their main income source would be fishing for other marine resources, including shark fin, lobster and giant clam. The findings highlight that closing sea cucumber fishing would impact strongly on other fishery resources, including those in decline.

¹² Based on additional growers exporting taro between June 2014 and July 2015.

Teak (in 5 years)

- The development of timber growing as an economically viable activity will give rise to a renewed interest in growing trees and may well see a return to areas of secondary forest that have been abandoned following logging operations.
- These areas are generally considered to be of little environmental value as they are overrun by weeds or covered in dense stands of regeneration that exclude normal activities. This will dovetail with work in project FST/2012/046 to promote the regeneration of neglected secondary forest through silvicultural management.

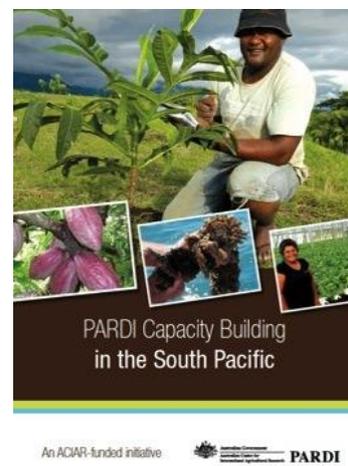
Taro

- The new taro leaf blight (TLB)-resistant varieties produced through this and associated projects do not require the use of chemicals and fungicides. The immediate response during the outbreak of TLB in 1993 in Samoa was the use of different chemicals to try and combat the disease. Now new varieties are growing well in the presence of TLB and producing very good marketable yield, supporting sustainable food security.

9.4 Communication and dissemination activities

PARDI communication outputs included scientific and technical reports, presentations at relevant conferences and workshops, the PARDI 6-monthly newsletter, resource manuals, e-news alerts, YouTube clips, radio interviews, and direct stakeholder dialogues. Through the efforts of Ms Julie Lloyd (PARDI communications manager) we were able to achieve a high international profile for the research program and for ACIAR.

As of July 2015, there have been 3,220 downloads of PARDI material from the website (which is hosted by SPC-LRD). This includes 1,195 YouTube downloads, 1,040 downloads of previous PARDI newsletters and 485 of the current newsletter, 350 downloads of the PGS vegetable farmer group package, and 150 downloads of the PARDI capacity building booklet.



Communications and meetings

- Feb 2010: Australian inception workshop, Brisbane
- June 2010: Pacific inception workshop, Nadi, Fiji
- Dec 2012: ACIAR–PARDI technical review meeting, Brisbane
- 2013–2015: Teak project quarterly newsletters – mailing list currently includes around 60 people
- 2011–2014: Breadfruit project 6-monthly project newsletter
- Dec 2013: ACIAR–PARDI technical review meeting, Brisbane
- Dec 2014: ACIAR–PARDI technical review meeting, Canberra
- June 2015: End-of-project technical workshop and market day, Lami, Fiji
- Nov 2015: End-of-project technical workshop, Port Vila, Vanuatu

Other

The teak project has a website where all its newsletters and educational material are freely available for download under the Creative Commons Licensing scheme: <https://sites.google.com/site/solomonislandsagroforestry/>

End-of-project workshop

PARDI held two regional end-of project workshops – one in Lami, Fiji on 29–30 June 2015 and the second in Port Vila, Vanuatu on 18–19 November 2015 – to showcase project impacts and, importantly, to provide an opportunity for Pacific island industry collaborators to communicate how ACIAR’s investment in PARDI has benefitted them.

Summary of the Fiji workshop feedback is listed below (extracted from a report prepared by ACIAR).



Impact Workshop – Day 1

IMPACT WORKSHOP - DAY 1		
QUESTION	RESPONSE [n=55]	
	Very Good	Exceptional
How would you rate this workshop for meeting your needs or expectations?	60%	20%
How would you rate the presentation skills of the Presenters?	69%	18%
How would you rate the quality of the information presented?	60%	24%
How would you rate the quality of the presentation materials?	65%	16%
	Agree	Strongly Agree
The Presenters communicated clearly and effectively.	64%	20%
The workshop was well-organized.	47%	53%
	Yes	
Did you feel free to ask questions?	92%	
Have your skills/knowledge increased as a result of the workshop?	98%	
Will you be able to apply what you learned to your job/field of study?	93%	
Was the venue and seating arrangement comfortable and well ventilated?	96%	
	Excellent	
How would you rate the Workshop overall?	81%	

SUMMARY/KEY FINDINGS – 113 attendees [n=55]
 More than 80% of participants agreed that the workshop met expectations with quality presentations
 100% of participants agreed that the workshop was well-organised



Impact Workshop – Day 2

IMPACT WORKSHOP - DAY 2		
QUESTION	RESPONSE [n=31]	
	Very Good	Exceptional
How would you rate this workshop for meeting your needs or expectations?	45%	26%
How would you rate the presentation skills of the Presenters?	48%	26%
How would you rate the quality of the information presented?	52%	29%
How would you rate the quality of the presentation materials?	58%	16%
	Agree	Strongly Agree
The Presenters communicated clearly and effectively.	65%	35%
The workshop was well-organized.	45%	55%
	Yes	
Did you feel free to ask questions?	94%	
Have your skills/knowledge increased as a result of the workshop?	97%	
Will you be able to apply what you learned to your job/field of study?	87%	
Was the venue and seating arrangement comfortable and well ventilated?	94%	
	Excellent	
How would you rate the Workshop overall?	74%	

SUMMARY/KEY FINDINGS – 137 attendees [n=31]
 More than 71% of participants agreed that the workshop met expectations with quality presentations, >9% from Day 1
 100% of participants agreed that the workshop was well-organised = Day 1
 97% of participants agree that attending the workshop increased their skills/knowledge base, >1% from Day 1
 Overall 74% of participants rated the workshop as excellent, >7% Day 1



Market Day

MARKET DAY		
QUESTION	RESPONSE [n=34]	
	Very Good	Exceptional
How would you rate the lunch as an innovative showcase of Pacific foods?	32%	59%
How effective was the MD at raising your awareness of PARDI activities?	50%	47%
How would you rate the quality of information provided in the MD stalls?	53%	41%
How would you rate the presentation of the Market Stalls?	50%	50%
How would you rate the organization of the Market Day?	45%	55%
How would you rate this market day overall?	52%	48%
	Yes	
Have you learned something as a result of the Market Day?	100%	
Did the MD inform you about the achievements of the PARDI projects?	100%	
Was the MD a useful opportunity for professional networking?	97%	
Was there sufficient opp. for questions & were your questions answered?	100%	
Was MD effective to understanding and identifying agribusiness dev. opp?	94%	

SUMMARY/KEY FINDINGS – 147 attendees [n=34]
 94-100% of attendees agreed that the MD effectively created awareness with innovative showcasing and quality market stalls
 100% of attendees agreed that the workshop was well-organized
 94-100% of attendees agree that attending the MD increased their skills/knowledge base, providing opportunity for networking, and an understanding of agribusiness in the Pacific
 Overall 100% of attendees rated the workshop as very good to exceptional

10 Conclusions and recommendations

10.1 Conclusions

PARDI was an ACIAR-developed concept that sought to adopt a more agribusiness-led approach to livelihood development in the Pacific. PARDI's design framework involved undertaking value chain reviews to identify new agribusiness opportunities or existing value chains with growth potential within the agricultural, forestry and fishery sectors; and then undertaking appropriate research-based interventions to unlock this potential with the overall goal of achieving livelihood outcomes. While PARDI certainly achieved considerable success in terms of the number of new agri-food products developed, new business ventures created and important long-term capacity building, this achievement was not necessarily based on effectiveness of value chains reviews. We found that the approach used to develop and support the value chains had a much more profound impact. In nearly every commissioned project within the PARDI portfolio we introduced agribusiness specialists, who worked with the project team. This partnership between technical commodity and agribusiness specialists was of pivotal importance. Not only was there an ongoing focus on achieving tangible agribusiness outcomes, but there was also commercial expertise within the project teams to help translate technical research outputs into commercial outcomes. The MOP handicrafts, PGS vegetables, tamarind, canarium nuts, and pearl industry and business development outlined in this report clearly demonstrate this point. Also significant was that agribusiness specialists worked across multiple projects. This helped create tangible linkages between projects and promoted knowledge transfer.

While PARDI developed strong partnerships with Pacific agribusinesses and NGOs, the same level of engagement was not achieved with some of the Pacific island government agencies. A relatively short project life cycle (PARDI was initially launched as 3-year initiative) and limited agribusiness expertise within Pacific government institutions made such linkages difficult. Where this was overcome, as occurred in our collaboration with the Vanuatu Department of Trade and Commerce, significant commercial and institutional impacts were achieved. Based on the success of the Vanuatu government agribusiness engagement in PARDI, we found that direct participatory engagement coupled with targeted mentor support the most effective approach.

Within each of the commissioned projects there is a series of project-specific conclusions and recommendations. Rather than re-present these here, please see the individual end-of-project reports. Below are general recommendations relating to PARDI experiences overall.

10.2 Recommendations

1. There is a need to develop agribusiness capacity within the various Pacific island government agricultural, forestry and fisheries agencies as well as to further build agribusiness capacity at the University of the South Pacific and the Secretariat of the Pacific Community.
2. Future projects undertaken in the Pacific would benefit from inclusion of agribusiness expertise in the project teams.

3. Any future agribusiness projects undertaken in the Pacific where there is an anticipated export outcome should have consultation and communication pathways with PHAMA and its associated advisory networks.
4. In the initial PARDI design there was an expectation that agribusiness supply chain reviews could be completed in a relatively short period (3–4 months). Our experience was that effective value chain and agribusiness assessments (especially those where there is a local capacity building element) are more involved and time demanding.
5. Greater engagement in agencies such as Chambers of Commerce, Departments of Trade and regional NGOs may assist in better identifying emerging agribusiness ventures and partners; and well as supporting the delivery of projects.
6. Pacific university collaboration and engagement throughout PARDI was primarily centred on the University of the South Pacific. For future projects, involvement of the smaller national university could lead to add capacity building outcomes.
7. PARDI would have been better developed as a 5-year initiative rather than a 3-year initiative with ad hoc extensions.
8. An active media and marketing component for PARDI resulted in a major regional profile for this initiative; however this may not have aligned with ACIAR views on profiling and branding. In future, more active dialogue between major new ACIAR initiatives and the ACIAR communication team at the design stage to develop a suitable communication and marketing strategy is recommended.
9. An annual ACIAR project leaders' meeting in Canberra to discuss and review project progress should be considered. While this could be modelled on the PARDI annual forums, attendance could be widened to invite all of the Pacific project leaders, and also include livelihood and agribusiness development dialogue.

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12 Appendix 1

End-of-project reports are provided for the following projects:

- PRA/2014/01: Development of a mass propagation system for elite varieties of *Piper methysticum* (kava).
- PRA/2010/005: Developing commercial breadfruit production systems for the Pacific islands.
- PRA/2013/01: Red papaya export market analysis.
- PRA/2011/03: Developing an integrated participatory guarantee scheme in the Pacific islands in support of sustainable production of high-value vegetable crops.
- PRA/2010/04: Improving the income of Pacific island fishers through better post-harvest processing of sea cucumber.
- PRA/2010/03: Developing markets and products for the Pacific island and PNG canarium nut industry.
- PRA/2011/06: Development of a market mechanism for teak and other high-value timber in the Western Province of the Solomon Islands.
- PRA/2011/07: Improving processing and marketing to improve the tamarind value chain in Vanuatu.

Reports were not yet received from the following projects at the time of report submission:

- PRA/2010/01: Supporting development of the cultured pearl industries in Fiji and Tonga.
- PRA/2010/02: Value-adding and supply chain development for fisheries products in Fiji, Samoa, and Tonga.
- PRA/2011/01: Facilitating improved livelihoods for Pacific cocoa producer networks through premium market access.
- PRA/2011/04: Developing a clean seed system for market-ready taro cultivars in Samoa.
- PRA/2012/01: Fiji retail transformation study.
- PRA/2012/05: Developing protective cropping systems for production of high-value vegetables in South Pacific (Fiji and Samoa) and Australia.