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Final report

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1 Acknowledgments

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2 Executive summary

The ACIAR project '*Strategies Using Floriculture to Improve Livelihoods in Indigenous Australian and Pacific Island Communities*' utilised value chain analyses as a unifying framework in and across participating countries. The overall **aim** of this multifaceted project was to identify constraints and opportunities for indigenous enterprise development through floriculture. The potentially enabling approach was through studies within production-to-market supply chain systems in each of the Northern Territory of Australia (NT), Papua New Guinea (PNG), Fiji, and Solomon Islands (SI).

The project addressed the following **objectives**:

1. To identify and analyse floriculture value chain arrangements and opportunities.
2. To provide new and improved products and practices to floriculture enterprises.
3. To strengthen floriculture enterprises by building horticultural and business skills and fostering a positive environment.

In view of the multifaceted nature of the project, this final report addresses progress on activities on a sub-project basis.

Papua New Guinea:

Through NARI, FRI and PNGWiA, the project provided a platform for research initiation and engaged stakeholders in the emerging floriculture industry in PNG. It enabled understanding of potential floriculture enterprises and of how research interventions contribute towards improving the livelihoods for smallholder growers. Floriculture opportunities were highlighted for growers, particularly women, both in the lowlands and highlands. Various approaches were employed in regard to opportunities and constraints. They included workshops in which growers and researchers collectively identified constraints and research interventions and solutions. Technical solutions included the use of a low cost and easy to access non-mist propagator (NMP) and participatory research using mother-and-baby trials to increase access to quality planting materials. Supply chain studies identified different strategies including floriculture product lines, local versus cross-regional channels, and market segments. Training workshops provided critical capacity building for growers, florists, researchers and extension agents in floriculture and floristry, including best management practices in production, postharvest and marketing of flowers. A high humidity (air wash) cold container was constructed in Australia and shipped to Lae to underpin ongoing postharvest floriculture quality endeavours, including realising longer shelf life and strategic marketing.

Fiji and Solomon Islands:

Nursery based production of Fiji's native species for aesthetic and functional (e.g. land stabilisation) purposes was targeted for promotion and expansion. In addition to demonstrations of propagation in a purpose built plant nursery unit, an associated display garden and off site display plantings were developed. Moreover, the project team at Koko Siga facilitated South Sea Orchids (SSO) advancement of floriculture, including the publication of a '*Fiji Floriculture Handbook*' that was disseminated across the project and used in training activities.

Community awareness of the potential benefits of floriculture was raised in SI. The project aligned with a floriculture initiative of Gold Ridge Mining Ltd. Spin-offs included enhanced economic empowerment of some successful women growers and florists. Visiting tropical floriculture consultant Mrs Jan Hintze delivered a workshop on quality, post-harvest treatment, and marketing of tropical cut flowers. Awareness was raised among growers and other stakeholders in SI floriculture. Germplasm distribution has provided impetus to grow the industry.

Northern Territory:

The NT DPIF team maintained technical activities in the areas of plant propagation (e.g. ginger allies), evaluation of cut flower potential ('top end' native species), and plant nutrition (K^+ for gingers). Importantly, a tissue culture facility was established to provide novel and / or elite floriculture germplasm to project partners and stakeholders in PNG, Fiji and SI. Also, researchers based at CDU, in collaboration with value chain specialist Prof. Sherrie Wei, completed a review on *'Factors Influencing the Growth Potential of the Floriculture Industry in the Monsoonal Tropics of the Northern Territory, Australia*'. Until its demise due to funding issues, ABT provided training and guidance in floriculture and floristry to indigenous players in the Darwin region. This group, in collaboration with other project partners, focused on bush-harvested cycad fronds for local and interstate markets. Value chain analysis for trial shipments of cycad fronds to Sydney and Brisbane markets indicated conditional opportunities IF the Indigenous communities can bulk-up supplies to achieve economies of scale for production and freight.

Value Chains:

Value chain analyses enabled better understanding of floriculture value chains in each region (i.e. Aus, PNG, Fiji, SI) and explored chain partner relationships, governance structures, margins of chain partners, information flow, and financial arrangements. Market research discussions considered supply and demand characteristics in each of the regions. Strategic considerations, such as differentiated / new products, competitive prices, and relationship building for value chains were discussed in the light of their respective comparative advantages.

Queensland:

The project was managed from UQ. Being research active agency, intensive study was conducted into the vase life of Acacia. Three PhD students were graduated, Dr K. Ratnayake, Dr M. Che Husin, and Dr N. Rafdi, and one visiting scientist was supported, Dr S. Gantait). Vase life was effectively doubled and underlying mechanisms elucidated. Technical and scientific publications were produced. Also, the Crawford fund sponsored a floriculture train-the-trainer workshop at UQ Gatton.

Overall, the economic feasibility of floriculture in Fiji, SI, PNG and the 'Top End' (NT) was evidenced in industry value chains as well as at individual player level. In Fiji, industry wide economic feasibility was shown in sustained involvement in floriculture by the wholesaler SSO. Chain wide economic feasibility was shown in the SSO-Koroipita and SSO-HART (Housing Assistance Relief Trust) chains of less disadvantaged communities. These value chains were initially established through third party intervention. They have continued to generate profits for both the wholesaler and the growers in the Koroipita and HART settlements. In SI, industry-wide economic feasibility of floriculture was illustrated in an ever increasing number of florists and growers among women from both middle class and lower income families alike. Although there was no floriculture wholesaler in the SI context, many mini floriculture supply clusters have functioned with reasonable profits for florists and growers in the same network. In PNG, the economic feasibility of floriculture can be seen from macroeconomic development and industry levels. At the macroeconomic level, as PNG imports temperate floriculture products, enhancement in temperate floriculture value chains could potentially yield an import substitution effect. Industry-wide economic feasibility was illustrated in the many value chains of tropical and subtropical floriculture products in Lae, Port Moresby, and Goroka. It was also evident in the nascent cross-region Goroka/Port Moresby value chains of subtropical and temperate flowers. In the NT, there were several key constraints to the economic viability of floriculture. However, some growers managed to sell with adequate profits through various outlets into local markets (e.g., weekend markets, online, petrol stations, and food shops) and even managed to compete in southern Australian markets. One sector within the floriculture industry with

greater potential is native seed collection. Another is whole plant rescue harvesting for landscape gardening.

Economic benefits for growers and florists in Fiji, SI and PNG were estimated to be close to AUD0.8million in the final year of this project and projected to double three years after the life of this project. Further economic benefits would be expected as growers and florists fine tune their skills as well as more women participate in floriculture. Social benefits flowed from economic benefits earned by women growers and florists in Fiji, SI and PNG. Case studies showed enhancement of women's empowerment as evidenced in acquirement of more life skills (e.g., driving), improved communication and negotiation skills and better self image.

3 Background

Indigenous communities in Northern Australia, Papua New Guinea, and Pacific Islands have limited opportunities for generating income and developing enterprises that are economically viable and that preserve or enhance their natural resource base. Constraints include lack of various resources, technical knowledge, access to markets, and knowledge of how to benefit from them, as well as limited business skills in general. Additionally, gender inequalities and exclusions of various kinds based on ethnicity may exacerbate these problems. Women rarely have access to financial and other resources that enable them to fully contribute to the finances of a family or community. Nonetheless, they play a significant role in household food and crop production and also in the marketing of horticultural products.

One resource to which such communities have access is a rich biodiversity in native plant species, often supported with a rich tradition of indigenous knowledge. This is a resource that, if carefully managed and developed, may confer a unique comparative advantage on such communities, offering opportunities for income generation that are compatible with cultural norms and build on traditional knowledge. Moreover, floriculture is one of a relatively few income generating activities that is widely regarded as 'women's business'. Such communities may not, in general, have a comparative advantage in competing with established producers of familiar floriculture species in domestic or export markets. However, given that the floriculture trade places a high value on novelty, the rich native floral diversity to which they have access could possibly provide an entry point to the floriculture trade and, in adding value to local biodiversity, might also encourage its conservation.

Floriculture is broadly defined to include the wild harvest of decorative foliage and plant products as well as the culture of decorative plants for sale as live plants in pots or for landscaping, or for the cut-flower or -foliage market. Floriculture offers potentially valuable opportunities to generate incomes by supplying a range of high value products to growing domestic markets, particularly among urban populations enjoying increasing prosperity, and to the tourism sector. These local high-value markets might also serve as a platform to build up enterprises to tackle specialised export markets.

The multi-billion dollar world trade in ornamental plants offers diverse opportunities for improving the livelihoods of otherwise disadvantaged communities in tropical countries and regions. There are potential opportunities for indigenous Australian communities to develop floriculture enterprises based on novel products, such as those identified in a Rural Industries Research and Development Corporation (RIRDC) report on '*Identifying export potential for North Australian wildflower*s'. Also, the ACIAR funded Scoping Study HORT/2006/055 on '*Developing the Ornamentals Industry in the Pacific: An Opportunity for Income Generation*' identified unrealised opportunities for floriculture products in the Pacific countries. Indeed, it was suggested at the time that there was a significant trade deficit in floriculture products.

There have been various preliminary efforts to help women's groups in Northern Australia, PNG, Fiji, and SI to establish floriculture businesses. However, anecdotal reports suggest that such efforts have been under resourced and / or lacked key technical support and a coherent model of partnership and engagement of indigenous communities. Inadequate business skills, lack of proper market research and weak links between producers and markets were identified as common constraints. Meanwhile, commercially successful models in other tropical developing countries have tended to depend heavily on infusions of capital and expertise from outsiders, often multinational companies, and may not have maximised livelihood benefits to participating communities. The present project recognised these experiences and models that required relatively low levels of investment and were well founded in local knowledge and experience.

In 2009, ACIAR funded a second Small Research Activity, PC/2009/029 on '*Understanding constraints and opportunities in the use of native floriculture to improve the livelihoods of indigenous communities in Australia, Papua New Guinea and the Pacific Islands*'. The primary objective was to identify the more promising models for engaging indigenous communities in income generating floriculture activities based on the preliminary experiences in this region. A secondary objective was to clarify any constraints that might be imposed on the use of native plant species in commercial floriculture by local legislation implementing the Convention in International Trade in Endangered Species (CITES). The present project also learned from these recommendations and took into account the livelihood and community impacts of value chain relationships.

The activities proposed in the project were well aligned with the '*Indigenous economic development strategy – 2009-2012*' (Indigenous Economic Development, Department of Regional Development, Primary Industry, Fisheries and Resources, Darwin, 46 pp.). Similarly, they were complementary to activities of the NT Government's Department of Regional Development, Primary Industry, Fisheries and Resources, the Queensland Government's Department of Employment, Economic Development and Innovation, and the Northern Australian Indigenous Land and Sea Management Alliance. Moreover, floriculture was identified as a priority for research and development in support of improved livelihoods by the National Agricultural Research Institute (NARI) of PNG, and by the Fiji Ministry of Agriculture (MoA), Department of Extension.

Based on the previous experience and analysis, the multifaceted project was placed to research novel strategies for improving livelihoods of marginalised communities through the establishment of various kinds of floriculture enterprises. This project was in line with ACIAR's position on the Pacific Islands that many target beneficiaries "*live in isolated rural community's dependent on household food production and intermittent crop, fish and livestock sales*". Improving and transforming these systems into sustainable income-generating activities was proposed to "*enhance self-reliance and reduce poverty over time, as diversification into new activities*". Similarly, ACIAR's position on PNG proposed that "*there is particular need to develop the informal sector (including those involved in village level production and marketing of root and horticultural crops…)*". The proposed activities were to contribute to ACIAR's Pacific Islands program Subprogram 1 (household incomes); specifically to "*identification, development and adoption of new market driven opportunities for horticultural crops*"; and, for PNG program Subprogram 1 (social, cultural and policy constraints); specifically to "*the role of cottage industries in contribution to livelihoods, household cash flow, and complementing engagement in formal markets and the national economy*".

The strategy of the project partners in these relatively ambitious multifaceted undertakings was: a) to strengthen existing supply chains that are currently supplying local or national markets with well known, often exotic, species, b) to use these as a platform for introducing further innovations in terms of the species, especially natives, used and in production, handling and value-adding methods and in value chain relationships, and c) to diversify and increase the sophistication of local markets towards development of export products and markets. In the case of bush-harvested decorative plants where there was no existing market chain, the project built on the precedent of bush-harvested food products (e.g. bush tomatoes) sold into conventional markets.

In this initiative, capacity building in floriculture built on and complemented various other initiatives funded in Fiji and SI by AusAID and implemented by Koko Siga and South Sea Orchids (Fiji) and the Community Sector Program and Agriculture Livelihoods Program (SI). AusAID previously invested in a pilot development of floriculture in Fiji under its Rural Enterprise Development (RED) Initiative. In PNG, the project worked co-operatively with the ACIAR project ASEM/2009/042, '*Improving women's business acumen in Papua New Guinea: Working with women smallholders in horticulture*'. This project focused on helping smallholder producers in PNG to develop their business skills.

Through a feasibility study of the Floriculture Industry in PNG, it was identified that an appropriate route for delivering training is through the existing Women in Agriculture (WiA) groups. Also, technical training for both NARI and FRI staff in the areas of germplasm collection, breeding and selection, tissue culture and postharvest were identified as possible priority areas. It was also considered that 'Train-the-Trainer' would be a cost-effective way of upgrading skills in the technical and social aspects of floriculture.

The project also sought to strengthen linkages between researchers, extension workers and growers, plus between public sector and private sector actors. Innovations in terms of new products (i.e. plant species and varieties) and practices (viz. production and postharvest) originating mainly from public sector research were to be communicated through formal workshops and participatory training processes involving both public- and private-sector trainers. Innovative whole chain processes coupled with development and / or revisitation of micro-business plans may potentially be used to strengthen links between smallholder and community growers / harvesters and market chain actors in the private sector. Actions to advocate changes or build capacity in the public policy area were considered pertinent in PNG, with particular regard to CITES legislation, and in Fiji, with particular consideration as to use of plants in landscaping and planning.

It was considered important to explore a model or series of models for engagement of indigenous communities responsive to local needs and opportunities and which ensures that benefits flow back into the livelihoods of indigenous communities. Such models are potentially useful for possible future investment in dietary diversification for improved nutrition and health in indigenous communities and a range of other horticulture- and livelihoods-related research and development initiatives.

4 Objectives

The project had three general objectives,

1. To identify and analyse floriculture value-chain arrangements and opportunities.
2. To provide new and improved products and practices to floriculture enterprises.
3. To strengthen floriculture enterprises by building horticultural and business skills and fostering a positive operating environment.

5 Methodology

The project's general objectives were addressed through and across a series of five multifaceted studies involving different partners in different locations, value chain relationships and floriculture foci, each with its own study level objectives.

5.1 Summary of research methodology

Objective 1. Characterising floriculture businesses: Market studies and value chain analysis
Is there a viable market for the available product(s)?
How is value added along the chain and shared among the actors? (Quantify livelihood benefits)

Objective 2. New products and practices
(researchable issues specific to each study)

Bush-harvested cycad foliage	Other decorative plants and foliage	Tropical cut-flowers	Native plant landscaping	Native plant development
Australia (Top End)	Fiji, PNG	Fiji, SI	Fiji	PNG
Harvest and post-harvest handling. Seasonality. Community-market chain relations.	Production and harvest techniques.	Suitable cultivars. Propagation and production issues (incl. soil fertility and red ginger decline). Post-harvest handling.	Selection of species. Propagation and production techniques. Growing media Information dissemination.	Selection of species. CITES issues. Upgrade facilities. Trial crosses and evaluation. Out-grower, enterprise, market relations.

Increasing floricultural/technical complexity

Objective 3. Capacity building
Building floriculture and business skills at the micro-enterprise level within and across all case studies.

Objective 1. Characterise under realised and novel floriculture business potential, analysing enterprise and associated value chain arrangements and opportunities for improving livelihoods

This objective was to guide the development of high value ornamental plant products in each case study.

A market demand driven approach rather than a production push or hard selling approach was promoted in the course of understanding and encouraging development of floriculture industries involving Australian and Pacific Island communities. This involves gaining a better understanding of customer needs, wants and preferences even before production and selling take place, with marketing becoming facilitative. Customers buy the product with a clear perspective as to the benefits that it brings to them. An appreciation of why people buy certain cut flowers, pot flowers, with certain colours, lengths, sizes and their willingness to pay are essential market information for all floriculture enterprises and supporting research organisations. 'Flip side' knowledge as to why people don't buy certain floriculture products is equally important, and thus was also a genre of investigation within this project.

Conducting stakeholder consultations and supply chain analysis, including market, research for floriculture products produced in the region and / or evaluating opportunities and constraints associated with potential market segments facilitated focusing and planning of research interventions, was embodied within each study (objective 2) along with capacity building activities (objective 3). Value chain analysis allowed the project to assess how

value is added in different models and where livelihood benefits accrue, permitting eventual comparative analysis and drawing of lessons across the project.

Objective 2. Provide new and improved products and practices to nascent floriculture enterprises, fostering their evaluation and adoption

Activities under this objective were specific to each study and to some extent were determined, or at least prioritised and fine-tuned, by initial characterisation work and stakeholder consultations. The main methodology for value chain analysis was qualitative inquiry, consisting of series of interviews with stakeholders, focus group discussions with growers, florists and consumers, and workshops.

i. Bush-harvested decorative foliage of cycads (Northern Australia)

Establishment of sustainable, culturally appropriate and economically viable supply and market chain arrangements between Indigenous Australian communities and market intermediaries; also, considering development of standards and of harvest and postharvest handling procedures. Value chain walk by ABT for cycad fronds to the Sydney market.

ii. Other decorative foliage (Fiji, PNG, stakeholder consultation and market studies)

Establishment of appropriate community-harvest and managed production of foliage species; also, considering development of harvest and postharvest handling procedures (viz., shelf life, disinfestation, devitalisation, etc.) and establishment of export market relationships.

iii. Production and sale of tropical cut flowers (e.g. *Alpinia*, *Curcuma*, *Heliconia*, etc. based on market studies) for domestic and tourist markets (Solomon Islands and Fiji)

Establishment of germplasm exchange, exchange arrangement, propagation and distribution, production issues (e.g. ginger decline, soil fertility, and production technologies), post-harvest handling, and market links.

iv. Nursery production of native plant species for landscaping (Fiji and Australia)

Identify appropriate species, document characteristics and develop propagation and production techniques; also, considering development of protocols for their use in landscaping.

v. Production of new plant products derived from native species (PNG)

Identify, collect and / or curate candidate species of PNG native ginger and allies that have potential to introduce superior traits into the tropical cut flower breeding program being conducted by the NT DoR; also, considering value chain walking for Goroka to Port Moresby with representative growers from the Eastern Highlands province and with NARI and FRI staff.

- Field trials to test selected native species and new and existing hybrid cultivars as floriculture production lines.
- Participatory on-farm trialling of selected existing and novel floriculture cultivars to refine agronomic practices with regard to commercial productivity, seasonal variability in production, pest and disease constraints, and local plus further afield marketability.

Objective 3. Strengthen floriculture enterprises by building horticultural and business skills and fostering a positive environment for their development.

Skills in horticulture development and strengthening by establishing and maintaining mother-and-baby trials for new products and allied practices with associated participatory learning and capability development activities also, business skills and acumen enhancement through participatory training workshops. Resilient businesses and

sustainable improvement in indigenous livelihoods through business skills embedded, transferred and / or transmitted to other members of the community. Institutional capacity building in effective implementation and planning for use of native species in landscaping through stakeholder workshops and exchange visits for learning.

Through the forum of collaborative on-farm trialling and in conjunction with PNG grower's groups, short duration workshops to empower growers in key technical aspects of production and post-production practices, including marketing, of tropical ornamentals.

The above three multifaceted objectives were realised through co-ordinated involvement of project partners in the areas of operational project management, social business and production skills development, and technical new products and practices.

6 Achievements against activities and outputs/milestones

Objective 1. To identify and analyse floriculture value-chain arrangements and opportunities.

Activity	Outputs/ milestones	Completion date	Comments
Activity 1.01 (A*) Value chain analysis: NT.			
Supply chain: 'Whole-of-value-systems' approach to analyse the value chain of a floricultural enterprise in NT.	Analyse selected NT floricultural supply chain partner (e.g., ABT and collectors/members) relationships. Identify drivers of selected supply chains in the NT. Assess value distribution among selected NT floricultural supply chain partners.	Yr2 Yr3 Yr4 Yr2 Yr3 Yr4	In the first two years of this project, value chain analysis was carried out by the ABT collaborating with Sherrie Wei regarding the viability of cycad frond value chains. Both local and interstate value chains were examined. A 'whole of value chain systems' approach was employed to analyse several potential interstate value chains for wild-harvested cycad (*Cycas armstrongii*) fronds from the NT. The analysis was based on data collected from field work conducted by Sherrie Wei and ABT in collaboration with Minbeni rangers. A test chain of wild harvesters to local consolidator to interstate wholesalers to florists was found to have a 40% margin factored into the selling price by the local consolidator and another 40% by the interstate wholesaler, with a further 100% margin being added by the florists. In this situation, a cycad frond sold for $0.30 by the wild harvester would retail for approximately $1.70. A test chain of wild harvesters to florists (Adelaide, Brisbane and Toowoomba) was trialled to investigate postharvest handling effects on product quality and to gauge the level of interest in the product from interstate florists. Postal parcels were employed to ship vacuum packed product for this trial. Mechanical damage was evident on fronds after transit where packaging had been bent and / or where fronds had been pressed against the hard thick stems of large fronds in the same pack. Due to the withdrawal of project partner Aboriginal Bush Traders, Value chain analysis was conducted in the format of two reviews, Review 1: assessment of cultivation and / or other form of potential value adding activities in the context of impacting economic and social issues, particularly in the context of floriculture; Review 2: strategies using floriculture to improve livelihoods in Indigenous Australian communities. See Appendix A for the report.
Activity 1.01 (PC) Value chain analysis: PNG, Fiji, and SI.			
Supply chain: 'Whole-of-value-systems' approach to analyse the value chain of selected floricultural enterprises in PNG, SI and Fiji.	Analyse selected PICs floricultural supply chain partner (e.g., wholesaler out-grower in Fiji) relationships.	PNG: Yr2M5 Yr3M5	Local value chains in Lae, Goroka and Port Morseby, and cross regional chains of Goroka à Port Moresby and Lae à Port Moresby were analysed. Given the cooler climatic conditions in Goroka and premium prices paid for subtropical and temperate flowers, such as arum lilies and roses, Goroka à Port Moresby value chains have greater potential to expand. However, local value chains are still viable in meeting local demand. In July 2013, the Goroka à Port Moresby value chain for subtropical flowers was walked through with two grower representatives from the Eastern

Identify opportunities within the supply chains. Compare results from different regions to identify the micro business development associated with the floricultural activities of similar value chains.	Value distribution among selected PICs floricultural supply chain partners. Identify drivers of supply chain in PNG, SI and Fiji.		Highlands province, two NARI team members and one FRI team member. The growers had a deeper understanding of market requirements and established supply contacts with the Port Moresby florist buyer network. Value distribution between supply chain players varies greatly depending on the type of flowers and size of arrangements. In general, florists' margins, with their floristry value adding skills, are more than growers' (Appendix B).
		Fiji: Nadi-9/2010 Suva-9/2011	In Fiji, value chain analysis focused on SSO's two chains in Nadi and Suva. In Nadi, SSO focuses on *Dendrobiums*, but in Suva, SSO focuses on Anthuriums. Grower default on contracts is more of an issue in Suva. In the Nadi area, SSO's out-grower scheme with women for *Dendrobium* in Koroipita and HART (Housing Assistance Relief Trust) settlements were examined. For value distribution, florists have the largest share. All chain partners have greater margins for larger flowers than for smaller flowers, an indication of a common interest for chain partners to work together. In 2013, with the involvement of Fiji Rotahomes Project, both Koroipita and HART women have progressed to grow a new cut flower, Heliconia. As SSO was not collecting their flowers, there was no guaranteed market for the flowers. However, it is a sign that out-growers are taking some initiatives. (cross referenced in 3.2 Capacity impact.) Key value chain considerations include insufficient supply of flowers to meet market demands, the issue of break-away growers in the SSO supply chain from among non-project growers, insufficient knowledge and skills relating to growing flowers, particularly among small out-growers, lack of quality specification and the need to introduce new cultivars (Appendix C). The recommendations for the Fijian floricultural sector are workshop on floricultural skills, introducing new cultivars, a strategic alliance with tourism industries, marketing and promotion of floricultural products by local and national governments, and capacity building workshop on supply chain management.
		Solomon Islands: Yr3M 9 Yr 4M3	The floricultural industry around the Honiara area in SI is centred around two communities, Kakabona and Betikama. The industry is characterised by many *supply clusters* or *mini supply chains* around florists' personal alliances, such as Mary Bojia's and Anne Maedia's mini supply chains. Value distribution was around 50-60% for growers, 25-30% for florists, 10-15% for material suppliers and 5-10% for delivery. Florists can handle larger quantities and are the drivers of their individual mini supply chains. A potential floriculture value chain involving a new growing group in the Gold Ridge Mining area of the Guadalcanal province was emerging around 2013. The driver for this potential value chain is the Community Relations office of Gold Ridge Mining Limited (GRML). The group has received some new bright-coloured Zingiber planting material from Darwin. One hands-on technical workshop and one value chain workshop were conducted for this group. The women's perception of their strengths, weaknesses,

			opportunities and threats was discussed in the value chain workshop. Value distribution between supply chain players for the new GRML chain is yet to be determined. If these growers can supply to local offices, such as the various offices of GRML, then returns to growers are likely to be comparable to other value chains in SI, such as the Kakabona and Betikama ones (Appendix D).
Activity 1.02 (A) Identify opportunities within the supply chains: NT.			
Identify the micro business development associated with the floricultural activities. Document potential social issues that impact on Indigenous commcercial bush harvesting. Document the economic and social impact of potential value adding activities to identify and overcome barriers to future investment in floriculture in the North.	Review NT value chains after 12 months and 24 months. Understanding of the viability of new value chains. Capacity building business skills workshop conducted. Literature review Final version of review Review of project activities and literature review. Final version of review and draft journal paper.	Yr3 M3 Yr4 M3 Y4M6 Y4M9 Y4M6 Y4M12	Some growers of exotic tropical species in northern Australia have managed to compete in southern Australian markets. Among them they were diversifying their value chains by selling what they can through local markets, food chains and hotels, and florists. Indigenous participation in this industry was compromised by a complex array of cultural, logistical and social factors that limit their involvement in conventional floriculture. These also influence the economic feasibility of wild harvested products. Another sector within the floricultural industry is native seed collection and whole plant harvest for rehabilitation and landscape gardening. Mining and development are likely to continue to expand in the NT. It will be important that this sector continues to grow and involve local people, especially Indigenous people who own large tracts of land in the provenances of these activities. Opportunities exist in the NT for small enterprise development in the floricultural industry. However, profitability is likely to be low and largely governed by freight costs. Air freight, for example, requires large shipment volumes (e.g. 1250-2000 cycad fronds) and high prices ($1.25/stem) to break even. In the same situation, road transport provides a slight profit (e.g. hundreds of dollars) beyond the minimum salary. Moderate profits of >$1000 may be realised if larger quantities (e.g. >2500 fronds) are shipped by refrigerated road transport. In the NT, the researchers based at Charles Darwin University (CDU) in collaboration with value chain specialist Prof. Sherrie Wei completed a review report "*Factors Influencing the Growth Potential of the Floriculture Industry in the Monsoonal Tropics of the Northern Territory, Australia*" (Appendix A). The review paper was submitted to Acta Hortic for publication (Appendix E).
Activity 1.02 (PC) Identify opportunities within the supply chains in PNG, Fiji, and SI.			
Identify the micro business development associated with the floricultural activities in Fiji, PNG and SI.	Review value chains after 12 months. Understanding of the viability of new value chains (e.g., including tourism bodies).	PNG: 03/2013	The Goroka à Port Moresby value chain has the potential to expand due to the climatic endowment that Goroka growers have. The drivers for the Goroka à Port Moresby value chain are the florists in Port Moresby. After walking the value chain, the representative growers were made aware of some issues at the grower level, such as harvest time, preferred flowers to grow for the Port Moresby market. One consistent observation in PNG, Fiji and SI floricultural values chain is that growers are the weakest link in the chain in the context of limiting growing techniques, access to information and knowledge, and business skills. Training at the grower level on all aspects of modern supply chains, including

	Capacity building business skills workshop conducted. Compare results from different regions		growing, postharvest handling, quality standards, communication and business skills, is needed for growers to offer value in the Goroka à Port Moresby value chain. Only when growers are skilled, will florists be ready and willing to partner with them and build trustworthy commercial relationships. Recommendations include new germplasm, flower agronomy training, improved business management skills, an information centre, and capacity building for floricultural science. One highlight among the recommendations is for Goroka growers to consider establishing a co-operative. The prospect of setting up a cross-group co-operative in Goroka is positively embraced by the representative growers who walked the Goroka à Port Moresby value chain. The benefits for a Goroka floricultural co-op would likely include joint purchasing of farm inputs, profit sharing incentives, access to floristry accessories from Port Moresby, bulking up of quantity, centralised grading and packaging, improved logistical co-ordination for sending products to Port Moresby, and access to training workshops by qualified pre- and postharvest floricultural professionals. Microbusiness development opportunities in PNG could be illustrated by a few mini value chains driven by some committed women; e.g., the grower Rose Gendua who brought a larger block of land in 2013 to grow Anthurium in Lae, and the florist Mary Saun in Port Moresby. Fiji: Yr2 M3 Towards the end of the first year of this project, the out-growers in the SSO value chain were starting to take some ownership of their products through performing more functions, like book keeping and paying for transport. This change was from joint efforts by several aid projects. It is envisaged that providing new planting material, through the SSO supply chain, will bring improved profits for SSO and out-growers. The main opportunity for the industry in both Nadi and Suva lies in supplying to offices, hotels and building industry. With some effort, opportunities exist for departing tourists, planning and organising weddings for the international market, retailing through consignment, flower shows and carnivals, supply to hotels, and expanding the cut foliage markets. SI: Yr3 M5 Micro business development in SI could be illustrated by two mini value chains, one driven by a successful grower and the other by a successful florist. The florist Anne Maedia, being listed under Department of Commerce's webpage, has received overseas orders to deliver arrangements in the Honiara area. The grower Mary Bojia, while expanding production in cut flowers, was now venturing into ecotourism by using her income and entrepreneurial experiences learned from floriculture.
Activity 1.03 (A) Market research: NT.			
Analyse demand side of floricultural products in NT.	Survey local market requirements and preferences for floricultural products through	Yr2 M3 Yr3 M3	Market research for cycad fronds indicated that the bendable characteristics of the product are desirable by florists. The longer ones (over 70 cm) are more desirable than shorter ones. There are other leaves as greenery in flower arrangements, such as koala fern, umbrella fern and Gymea foliage; although each type of foliage has its own features.

	consumer survey.		Given the prices that interstate wholesalers were willing to pay ($0.70-0.75/frond) and based on sensitivity analysis, wild harvest of cycad fronds alone is unlikely to become a viable business. This underscores the desirability of alternative strategies for Indigenous women, such as wild harvest of native seeds together with cycad fronds and wild harvest of whole cycad plants for the landscaping and mining industries for rehabilitation. In the NT, demand for cycad fronds is driven by price. Ideally this should be no more than $1/stem. In regard to marketing cycad fronds as a differentiated product, an initial survey of informed florists indicated through conjoint analysis that they attribute 89% importance to social justice aspect of the product, 5.5% to conservation, and 5.5% to price aspects
Activity 1.03 (PC) Market research: PNG, Fiji, and SI.			
Analyse demand side of floricultural products in Fiji, PNG and SI.	Local market requirements and preferences for floricultural products understood. Compare market requirements from different regions.	Fiji: Yr2 M3 PNG: Yr3 M3 SI: Yr3 M5	In general, there is lack of a 'flower culture' among South Pacific countries. Market segments among the three countries are similar: expats, offices and businesses (local and interstate) and the general public (occasions and calendar events). Subtropical / temperate flowers as well as non-common pink Anthuriums are sought after in all the three countries. Market information was obtained from five florists. It included quantity and quality specifications, indication of buying prices, and levels of demand for different products in their individual value chains. It was evident that there are distinct market segments for floricultural products in PNG; these being expats, business houses and office segments, and the general public. Currently sought-after cut flowers in PNG are orchids and subtropical to temperate flowers, like rose, tuberose, and arum lily. There exists in PNG a high demand for floricultural products, particularly for floral arrangements and potted plants. Florists eager to capitalise on this demand organised a self-funded study tour to SSO of Fiji in October 2012 to enhance their flower arrangement skills. Market segments in SI were similar to those in PNG. Currently sought-after cut flowers in SI are also subtropical to temperate species, as well as non-common pink Anthuriums. Both *Dendrobiums* and Anthuriums are sought after and highly priced in SI. Less commonly seen flowers incorporated in flower arrangements are highly desired by up-market hotels. Providing suitable new planting material (e.g., Anthurium, Curcuma) could expand the opportunity of the SI floricultural industry.
Activity 1.04 – All regions			
Agree on methodologies for assessing livelihood impacts (based on value	Gather end of project data. Assessed relative success of	Yr4 M6	Cut flower growers in general: A strategy that growers in the NT have used to stay competitive is through the production and cultivation of new varieties of exotic tropical flowers with assistance from the Department of Primary Industry. Some growers of exotic tropical species in northern Australia have managed to

chain analysis and other sources).	models in adding value and improving livelihoods among value chain actors. Key research and product development issues identified for Fiji, PNG and SI.		compete in southern Australian markets, many diversifying their value chains by selling what they can through local markets, food chains and hotels and florists. Indigenous community: One sector within the floricultural industry is native seed collection and whole plant harvest for rehabilitation and landscape gardening. Mining and development are likely to continue to expand in the NT and it will be important that this sector continues to grow and involve local people, especially Indigenous people who own large tracts of land in the provenances of these activities. For native seed collection to incorporate into flower arrangements, floristry and marketing skills for local and online selling are important. Strategic considerations (e.g. differentiated/new products, competitive prices and relationship building) for different types of value chains are outlined depending on their comparative advantages. Comparative advantage refers to resources, skills and processes that a firm or value chain possesses which are significant and not easy to duplicate by competitors. Recommendations are based on the criteria of relative efficiency, invested energy, and estimated time span to achieve results. The findings suggested that each value chain should consider a main strategy to reap the market advantage. These strategies involve offering: i. unique or differentiated products, ii. competitive prices through operational efficiency, and iii. good services through relationship building with niche market segments. The floricultural value chains across the three countries share similar production, logistical and marketing constraints and business cultures. In the three countries, women involved in floriculture have earned extra income, especially among florists who form and drive their mini value chains, add value through understanding markets, and upgrade their floristry skills over time. This phenomenon is more obvious in SI (e.g., Anne Maedia) and PNG (e.g., Mary Saun) than Fiji, where the prime established wholesaler co-ordinates and manages their value chains in Nadi and Suva. For women growers, they earned extra income through supplying florists or road side selling. Some growers have, over time, become florists and have improved their livelihoods further (e.g., Rose Genta from PNG, Mary Bojia from SI). These outcomes are jointly made possible by individual motivation, this ACIAR floricultural project, and other external assistance, such as Rotahomes in Fiji, PHAMA (Pacific Horticulture and Agricultural Marketing Access) in SI, Bris Kanda Incorporated (of New Zealand), and other ACIAR projects in PNG that have offered and reinforced general technical and marketing trainings to the communities involved in this project. Potential R&D issues among South Pacific countries are opportunities to up-scale the weakest link in the floricultural value chain, i.e., growers and bulk-up production through some kind of a co-op arrangement. These issues require a deeper understanding of grower motivations and aspirations, their preference of life styles, family issues, and feasible governance structures to collaborate horizontally with other growers and vertically with wholesalers or florists in the value chain.

Conduct 'end of project' review and workshop to present project findings.	Findings of project activities conducted in each of the partner countries will be presented at a workshop in August 2014.	Y5M2	An end of project (EoP) review and workshop was conducted from 13 to 15 August 2014 in conjunction with the International Horticultural Congress (IHC) 2014 in Brisbane, Australia. Project collaborators from UQ, NT, PNG and Fiji made oral and poster presentations at the conference.
	Project papers/posters presented at the ISHS Congress in August 2014.		The project team presented seven papers at IHC 2014 (Appendix E).

* PC = partner country, A = Australia, SSO = South Seas Orchids

Objective 2. To provide new and improved products and practices to floriculture enterprises.

Activity	Outputs/ milestones	Completion date	Comments
Activity 2.01 Bush-harvested decorative foliage of cycads (NT)			
Develop a model for the harvest, post-harvest handling and market arrangements of a bush harvested product in agreement with communities and market chain actors. Develop harvest and post-harvest techniques for cycads, appropriate for community use Investigate opportunities and methods for extending harvest season or supply to market. Develop training packages for bush harvesters. Identify and provide training opportunities for bush harvesters in different locations. Identify other bush harvested products	Agreement on value chain arrangements. Development & implementation of a working model. Protocols for handling cycads available. Protocols for holding cycads or processing into more durable products available. Associated training packages available for use.	06/2012 Yr 2 m 12 Yr 3 m 12	This process was delayed by negotiations with NT Parks & Wildlife. However, permits were issued in April 2011. Investigation of harvest, postharvest and market arrangements was effected through a visit to Sydney's Flemington Market. Analysing the value chains for cycad fronds highlighted a number of common issues with other sectors in the floriculture industry in the NT. Cycad fronds, along with cut flowers, require refrigerated transport to southern markets. This can only be done by airfreight, as road transport predominantly carries stock that needs to be kept colder. Other restrictive factors include high costs of production, lack of skilled labour, economy of scale and distance from market as being the factors contributing to very low profit margins. There is a need for growers to have more cohesion through Professional Associations in order to be better able to negotiate lower freight prices when sending products to market and bringing products up from down south (e.g. fertiliser). Cooperation and government support (e.g. perhaps reduced rates for airfreight, designated road transport) may allow these niche sectors of floriculture to remain viable. Initial feed-back showed that there needs to be more work on postharvest handling, freight and market leverage. Therefore, the initial focus was made to local market opportunities. Development of small enterprise by indigenous individuals in NT will need to address the issue of high freight costs. One alternative option is to initially focus on better supplying the Darwin market with a 'bundle' of wild harvested products. Also, access to interstate markets might be

that have commercial potential.			established through online services, such as Interflora and Teleflora.
2.02 Other decorative foliage (PNG and Fiji)			
Identify and develop supply arrangements (harvest in community, management of stocks, etc.).	Identify suitable species and viable value chain.	PNG Fiji	Establishment of germplasm collections for cordyline, gingers, heliconias, anthuriums, and reidelia has initiated at NARI and FRI. Project partner, SSO conducted an extensive survey of ginger, heliconia and cucurma varieties present in Fiji. This survey focused on those species that were identified to have commercial potential. SSO and Koko Siga worked together to collect, multiply and distribute some of the more rare varieties amongst the grower networks.
2.03 Production and sale of tropical cut flowers for domestic and tourist markets (PNG and Fiji)			
Partner planning and prioritisation meetings (PC).	Agreed priorities and program of research.	PNG Fiji	Planning meetings were conducted periodically for the project team and the commercial stakeholders of the industry. Comprehensive consultations were conducted with the landscaping industry on the commercial potential of native plants in development projects and commercial based enterprises. These consultations provided the basis for a preliminary list of plants to be investigated. During consultations, further interest was shown from reforestation and landscape restoration programmes in the country that are seeking large volumes of native trees.
Catalogue existing materials in use by growers (PC) and available for exchange (A & PC).	Lists and or illustrated 'manual'.	NT 11/2011	A list of ginger and allies (*Zingiber, Alpinia, Etlingera & Curcuma*) accessions bred and developed by the NTDoR New Ornamental Crops program wascompiled.
Exchange new germplasm and improved cultivars of cut flowers (A & PC); propagate locally and make available to local microenterprises (PC).	Existing materials that are novel to growers in PICs and adapted to their needs disseminated. New varieties available for trial by growers.	12/2012 Yr3	Bulking-up of NT DoR's germplasm material was ongoing. Opportunity to source germplasm of selected native gingers and heliconias from SI was discussed with the new project partner there. Similarly, the opportunity to source germplasm from the ginger collection at the Lae Botanical gardens (PNG) to introduce into NT DoR ornamental ginger breeding program was discussed with FRI. Collection trips were made to some major cordyline growing areas in PNG: the Highlands, Momase, and the New Guinea Island regions. A total of 60 accessions were assembled in Lae within a field gene bank at FRI. The collection was also duplicated at NARI. The *Zingiber* field trial in NT encountered pest and disease issues. A borer that usually attacks ornamental *Alpinia* and *Etlingera* gingers was identified. A spray regime developed for *Alpinia* was successful in controlling the borer. A number of *Zingiber* plants exhibited symptoms of leaf yellowing and wilting, followed by collapse of the entire shoot. As judged by a foul smell emitted from the affected shoot, the disease was evidently bacterial. A shipment of 10 new Zingiber cut flower cultivars from NT DPIF ginger breeding program was sent to the collaborating partner in Honiara, SI. Negotiations were progressed with collaborating partners in Fiji to organise a small shipment of plants of some of NT DPIF new Zingiber cut flower cultivars to be sent to Fiji in August 2014. The tissue culture

			facility at NT DPIF became operational and work started on initiating some curcuma accessions into culture for project partners in Fiji, PNG and SI. This initial tissue culturing was to be followed by culture of Darzing cultivars and a few other zingiber cut flower varieties to send to project partners in PNG. Due to the delay in getting the lab established tissue culture plant material was not readied for distribution to collaborators.
Develop practices in management of ginger production (A). Develop and trial new management strategies in participation with growers (PC)	Research reports and report to planning meeting. Annual progress reports.	06/2012 06/2013	The recovery and propagation of ginger hybrids bred and developed by the NTDoR New Ornamental Crops program was progressed with most germplasm was recovered and propagated. Research work on ginger production issues of rhizome decline, soil fertility and appropriate production technologies was commenced with land preparation for field trials in Darwin and progressed. Review of cut-flower ginger and key findings from previous NTDoR research was implemented. This formed the foundation for appropriate management strategies for improved ornamental ginger production in PC. The ornamental ginger nutritional trial in the NT on zingibers to determine potassium inputs and effects on cut flower production and plant vigour was completed. Data from the trial were collated for analysis. A pot trial to determine baseline nutrient requirements for growing curcuma as a potted plant was conducted over the 2013/14 flowering season. The controlled-released fertiliser (CRF) Osmocote® was applied at different rates to a selection of hybrids. The rate of release of the CRF was monitored by measuring the chemical properties of the growing media in the pots along with measurements on growth and flowering. A field trial of a number of promising curcuma cut-flower accessions was planted at Berrimah Research Farm during the 2013/14 flowering season to investigate two growing systems: full-sun conditions or a tunnel house under 50% shade.
Procurement and Installation of a cold container for demonstrations on cold chain establishment**.**	A moveable cold container installed at NARI for research and demonstrations	12/2014	A reefer container modified into an air-wash cold container in Australia was installed at NARI PNG. This facility is to be used for training and research on postharvest quality management of cut flowers. It would also be potentially useful for commercial cut flower and foliage aggregation and marketing.
Postharvest training workshops on better produce handling practices.	Trained human resource will perform better produce handling practices.	06/2014	A training workshop on postharvest quality improvement and supply chain management was conducted by project leader (Prof Daryl Joyce) and project officer (M. Sohail Mazhar).
2.04 Nursery production of native plant species for landscaping (Fiji and Australia)			
Survey and analysis of Fiji's native plants suited for landscaping and nursery based enterprises. (PC) Production of information sheets for selected plant	Native spp. with commercial potential are identified.	03/2013	i. Compiled a preliminary list of native plants with commercial potential. ii. Plant profiles developed. Technical specialist Don Burness and landscape architect Kalara McGregor provided inputs into the content and layout of these profiles.

species and identification of information gaps/ researchable issues. (PC)			
Establishment of nursery facilities to propagate and evaluate selected native plant species.	Native spp. with commercial potential are trialled. Agronomic information on propagation & cultivation data collected.	NT Fiji	Rapid vase-life screening in the NT of a number of 'Top End' native species for their longevity as a cut-flower, foliage and filler resulted in a number of promising species (*Corymbia* sp., *Acacia simsii*, *Verticordia cunninghamii)* that warrant of further investigations. Several propagation trials were completed. This work formed a simple template for identify a number from earlier prioritising of potential species. Key areas of influence with regard to commercialising were identified and broadly encompassed some sexual and asexual propagation methods with underlying propagation media development specific to requirements of individual species. Two flood events in early 2012 caused major damage to the nursery and primary demonstration site in Fiji. Both were repaired and reopened with additional support from ACIAR. Currently, the nursery had between 5000 and 8000 plants. A total of nine demonstration gardens were established at sites including a town centre, an eco-tourism retreat, two eroded riverbanks, a village-based school, a marina, a village, an urban high-rise development, and a tourism site.
Planting of native landscape gardens at selected locations [Suva city (USP) and Nadi] for evaluation of the characteristics of candidate species, and to serve as a platform for demonstration and training. (PC) Repair and reinstate nursery facilities damaged as a result of flooding in January 2012.	Trial / demonstration gardens are established.	Yr 3M6	In Fiji, a total of 12 native demonstration gardens were established under the project. These sites include 1 town center, 1 eco-tourism retreat, 2 eroded riverbanks, 2 village-based schools, 1 village, 1 marina, 1 urban high rise development, and 3 tourism sites. Additional interest was shown for other potential sites, including Nadi International Airport, Nadi town, Lautoka City, expanded marina planting, and two more tourism sites. A nursery facility was established in the first 6 months of the project and was utilised for the mass propagation and trialling of native plant species. This nursery was completely destroyed by the unprecedented floods in January 2012. A new nursery was constructed on higher ground within the vicinity of the old nursery and demonstration garden. That nursery continued to supply plants for the demonstration plots as well serving as a model to the landscaping industry. The project collaborated with 3 commercial nurseries that invested in native plants as part of their product offering.
Work with town planners to develop planning guidelines on the use of ecologically adapted species in new developments and infrastructure projects, including exchange visits and other capacity building for town planners. (PC)	A landscape species list developed that takes into account the landscape requirements of urban developers and town planners.	Yr 2 M2	A first step towards incorporating native plants in the urban landscape was made through a joint landscaping project of a major apartment complex in Suva comprising of almost entirely native plants. The project was a success and the landscape was fully established. Preliminary meetings were held with Lautoka and Ba town planners and project staff worked to build up the necessary plant stocks to establish collaborative joint demonstration plots.

Preparation and printing of a Gardeners Guide to Fiji's Native Plants. (PC)	Manuals developed and distributed to potential users.	Yr 4M6	The guide is at designing and printing phase (Appendix F).
Survey and identify Northern Australian native landscape spp. with commercial potential. (A) Identify and resolve commercialisation issues (tolerances, propagation methods etc.).	Native spp with commercial potential are identified. Native spp with commercial potential are trialled.	06/2012 Yr4-2	A standardised selection protocol was developed for prioritising key genera with potential for development at the primary level of cut flower (CF) use or general ornamental product (GOP) use. Some species/genera embrace both end product uses; eg: *Lithomyrtus*. Priority genera identified were: CF – *Acacia, Corymbia, Grevillea*, *Boronia* and selected Myrtaceae - viz. *Lithomyrtus, Verticordia,* and *Calytrix*; and, GOP – *Polycarpaea, Gomphrena, Syzygium, Allosyncarpia*, *Lithomyrtus, Grevillea.* Via a matrix approach integrating plant selection methodology and previous NTDoR RIRDC funded findings on Northern Australian flora, genera and / or species with commercial potential were identified and prioritised for development. Permits were obtained from the Department of Parks and Wildlife for the wild harvest of Cycad fronds. Seven value chains were reviewed to identify the feasibility of different options and to identify the most appropriate working model. Data gathered at 3 field sites to identify issues associated with seasonality and quality of fronds in Darwin area. An initial storage and vase-life trial on bush-harvested *Cycas armstrongii* fronds undertaken. The information from this work was used to develop harvest and postharvest quality specifications for *C. armstrongii* fronds appropriate for Community use. Market research was conducted in the form of placing arrangements containing native plants at various functions and events.
Identify and resolve commercialisation issues (tolerances, propagation methods etc.). (A)	Agronomic information on propagation & cultivation data collected.	06/2013	A propagation and potted culture selection and assessment template was developed to allow for a consistent treatment, evaluation, and data collection overlay for all studies undertaken. Studies were conducted on selected species of *Haemodorum*, *Lithomyrtus*, *Gomphrena,* and *Syzygium* genera. Data collection on germination and influence of propagation media and environment, seed treatments and / or root inducting hormonal treatments continued. An issue with the sexual propagation and early growth of *Haemodorum* seedlings was addressed. Pathology investigations indicated that fungi were present as the likely primary cause. Symptoms were similar to the closely related Kangaroo Paw *Anigozanthos* diseases "ink spot and blotch". Pathology diagnostics and some screening of fungicides continued to resolve the syndrome that may be a major impediment in the full development of this species. Concurrent to this research was the selection of promising compact / dwarf forms from open pollinated (OP) seedling populations of *Syzigium*. One 1 very dwarf form of *S. suborbiculare* and 60 unique seedlings of *S. fibrosum* were identified and grown on for further evaluation. Several screening trials were undertaken on seed germination of nominated Northern Australian native genera / species with quantification of %

			germination over time. Several species of interest were difficult to germinate. Also, propagation / growing media were screened. An investigation of appropriate propagation media was implemented. Evaluated were the effects of basic physical and chemical substrate properties on germination and early growth of 3 targeted genera, *Acacia*, *Grevillea* and *Corymbia*. These genera are representative of a diverse range of northern species of interest. Concurrent with media development, seed viability determinations and treatment evaluations to overcome dormancy were conducted. Vase life assessment for species of interest was undertaken. Much of the material for this investigation was collected by necessity from road side verges and amenity plantings. Although not optimum harvest quality material, this approach allowed the project team to ascertain key quality defects. Their causes were typically pathogens or insects. A cultivated block of native floriculture species of interest was established at Berrimah Research Farm.
2.05 Production of new plant products derived from native species (PNG)			
Stakeholder consultation and planning workshop. (PC) With CITES and IP workshop. (PC)	Priorities identified and resources allocated by consensus Agreed procedures for local implementation of CITES-related regulations	09/10 04/11	A consultation and planning workshop was held in Lae in September 2010. A conclusion from this workshop was that a Feasibility Study should be conducted to clarify the issues relating to the floriculture industry in PNG and to identify the researchable issues. A stakeholder workshop was facilitated in Lae in March 2012 in which participatory approaches were employed to identify constraints and opportunities, thus allowing stakeholder contribution to developing R&D agenda in floriculture. In addition, different actors in floriculture were identified and networks established. Understanding farmer reality relating to smallholder flower production was also achieved through surveys. Preliminary results suggested heliconia, cordyline, croton, and orchid as floriculture products for cultivation within easy access to Lae. Comments elicited from respondents indicated postharvest and market access as important issues confronting farmers.
Survey of facilities available and assessment of needs of Lae Botanic Gardens in order to support selection, breeding and production activities. Upgrading of facilities and training of staff (Obj 3) to satisfy	Facilities and capacity upgraded to enable FRI to play its designated role under CITES and local legislation in support of floriculture development. Parent material for orchid commercialization program assembled and securely maintained.	Yr1-2 Yr3-1 Yr2-2 Yr2-2	Improved nursery facilities were established at NARI and FRI. They allow maintenance of already collected species and propagation of identified and collected prospective floriculture species. They can also play a role in the introduction, multiplication, and distribution of exotic species; e.g. from NT DPIF, Bali Orchid Garden. NARI and FRI staff completed training to improve skills in nursery management, non-mist propagation, field collections, and focus group workshops. The Tissue Culture Unit at NARI Aiyura Research Centre conducted training for Lae based staff from NARI and FRI. Workshops on practises of propagating lowland cut flowers were conducted in Lae and NCD in Port Moresby by Dr David and Dorothy Dowd. There were 22 participants in Lae and 16 participants in NCD. Follow-up on the Trainers Of Trainers (TOT) revealed that the information was passed as knowledge to primary school children by the TOTs

identified needs. (PC)			that had teaching profession. A women's group leader invited the group members to her yard and conducted the training resulting in rehabilitating her back-yard heliconia and orchid garden. More than 400 people were made aware of floriculture activity and its relevance. Flower arrangement and potting and proper orchid propagation training was conducted at four household back yards. The village councillor of Wagau village indicated interest to NARI to set up a resource centre that would address the need to set a nursery house for educational purpose as well as for researchers.
Survey, identify and assemble candidate spp. Develop protocols for commercialization of candidate species. (PC).			Field collections of native plant and foliage species established at FRI.
Collection and exchange of information on propagation and breeding methods for relevant species. Identification of candidate species, collection of starter material and establishment in culture. Supply of plants to breeding programme (for hybrids). Supply of plantlets for growing on by enterprises (domestic market, native species).	Methods made available for multiplying and growing on native species. Intermediate materials for hybrid program are available to breeder (i.e. through rapid production of plants from seed). Low-cost, high-quality plantlets of native species available.	Yr2-2 Yr3-2 Yr4-2	This work was integrated in the work described immediately above.
2.06 Collect & curate indigenous ginger and allied species			
Develop a list of current cut flower cultivars.	Nominate staff responsible. Produce document collating tropical cut flower ginger cultivars.	Y2M2	The outcome from this process is described immediately below.
Survey, identify and assemble candidate spp.	Desk top research to identify probable search areas. Field trips to collect samples.	Y2M3 Y2M4 Y2M10 Y3M3	Variety collections of cordylines, gingers, heliconias, and anthurims were assembled at the FRI Lae Botanic Gardens. The genetic resources were obtained from local farmers and growers. The collection were comprised of 33 cordyline varieties, 8 ginger varieties, 6 heliconia varieties, 1 anthurium variety, and 39 aroid varieties. The plantings were also used to demonstrate how to improve village plots.

	Identify species. Characterise species in conjunction with project parameters.		
Communicate finding with project partners.	Provide regular project reports on plant collection activities.	Y2M6 Y2M12 Y3M6 Y3M12 Y4M6 Y4M12	Progress was regularly reported at project meetings and workshops.
Arrange for samples to be trialled by NARI.	Plant material introduced into trial at NARI.	Y2MM10 Y3M10 Y4M10	A demonstration site of best bet popular floriculture selections was established at NARI.
2.07 Trial new and existing tropical ginger and allied cut flower species through 'mother & baby' trials.			
Identify grower consultative and trialling group.	Nominate technical officer to manage activities. Convene meeting to discuss proposed trial with growers.	Y2M1	A cordyline field trial was established at FRI to investigate the growth responses of 3 types of cordyline to 4 sources of nitrogen. This two-factor experiment employed a randomised complete block design on a 400 m^2 site. Soil analyses were conducted. Project staff gained competencies in conducting field trials, non-mist propagation, and pest and disease identification.Meetings with growers were undertaken as guided on-site field walks.
Identify existing and potential cultivars to be trialled.	Local growers surveyed to identify current cultivars being grown.	Y2M1	Information was gathered from stakeholders during workshops and through surveys to identify priority foliage. Cordyline and croton were ranked 2nd and 3rd as most important decorative foliage.
Plan and develop trials.	Select cultivars to be trialled. Develop trial plan. Collect samples. Plant out trial. Monitor and record data from trial site.	PNG Y2M1 Y2M4 Y2M4 M5/M11 p.a.	For this work, six cultivars of *A. andreanum* and *A. scherzerianum* were acquired. Anthurium propagation using a non-mist propagator was contrasted with tissue culture.
Assist selected growers to set up on-farm trials.	Assist growers to plan and plant on-farm trials.	Y3M1	Two grower groups at Munum and Nasuapum village near Lae were identified to participate in on-farm trials. The trials explored mass propagation technique of anthurium using the non-mist propagator. The participatory research approach

	Develop on-farm trial data recording template. Regular visits with growers to assist with data collection.		employed in the study allowed growers to understand research and as well as learn new skills in flower production in these communities.
Conduct regular trial walks with grower group.			Various grower meetings at NARI and through the participatory on-farm studies allowed growers and researchers to interact and exchange information on flower production and floriculture enterprise.
Collate data to provide recommendations to growers and project partners.	Document containing recommendation for 'best bet' new and existing cultivars.	Y3M10	The data collected on the mother-baby trails were used to provide information on low costs propagation techniques on anthurium in PNG.
2.08 Use participative on-farm trials to identify 'best practice' management practices for small-holder flower farmers.			
Set up process to facilitate participative on-farm research.	Nominate technical officer to manage activity. Develop grower network of interested growers. Identify issues to be trialled.	Y1M11	A researcher at NARI and a technician at FRI were employed to facilitate on-farm mother-baby trials at Munum and Nasuapum communities. The activities included soliciting growers to identify research needs and developing solutions to address through the mother-baby trial.
Plan and plant on-farm trials.	Assist identified growers to plan and prepare trial. Distribute required consumables.	Y2 M2	Anthurium trials were conducted in two grower's villages, Munum and Nasuapum. The trial in Munum resulted in anthurium shoots germinating with roots as well in about 50% of the rhizome cuttings. There was a positive response from the grower's perspective because it became obvious that the Non-Mist Propagator (NMP) enhanced faster healthy growth from anthurium rhizome stem cuttings as compared to without NMP.
Regularly monitor trial sites.	Regular site meetings to assist growers in monitoring their trials.	Monthly	Regular field visits to trails sites provided the space for both growers and researchers to monitor and collect data on the performances of anthurium using the non-mist propagator as a mass propagation technique.
Collect and collate trial data.	Produce trial notes to be distributed to growers.		The participatory approach employed in the study allowed growers and researchers to collectively collect data. This was important as growers observed the visual differences in the treatments used in the trial.

PC = partner country, A = Australia

Objective 3. To strengthen floriculture enterprises by building horticultural and business skills and fostering a positive environment.

Activity	Outputs/ milestones	Completion date	Comments
3.01 Bush-harvested decorative foliage of cycads (Northern Australia)			
Production/supply chain development (Nth Aust.). Identify potential species to be bush harvested. Postharvest training. Incorporate 'Value add' components to products. (A)	Local producers will be able to identify, develop and market new bush-harvested floricultural products. Yearly training results compiled & documented.	06/2012 06/2013	Training of Indigenous participants commenced with initial workshops about access to plants, permit and legislative requirements, processing and commercial use of floricultural products, and business skills development. Results of these workshops were compiled. ABT developed linkages with a local grower who will conduct postharvest training and workshops. ABT staff became increasingly skilled at identifying native plants with floricultural industry potential. Potential products were 'road tested' in workshops and arrangements for events and functions. ABT investigated options for value adding with local producers in the process of developing business and marketing plans. Seven supply chains were identified by ABT and were reviewed by local producers, mainly Indigenous women.
Business skills development: Nth Aust. Training in business management. Training in marketing. (A)	Local producers will be able to develop business & marketing plans for floricultural products. Reports on training activities.	Yr 1M10 Yr2M10 Yr3M10 Yr4M10	A preliminary list of candidate species was compiled.

Conduct supply chain capacity building activities with indigenous women involved in bush harvesting. Conduct training activities to develop appropriate skills to conduct *Do our own Research* (DOOR) activities.	Through participative activities such as "walk the Chain" - Local Producers will develop links with established supply chains. - Producers will identify opportunities and obstacles in the value chain to improve their competitive advantage through improved production and/or marketing. Through training activities Local producers will be able to conduct R & D in the style of DOOR to identify and resolve production and marketing issues.	Yr 1M10 Yr2M10	Project staff of ABT in the NT supported individuals in developing business plans and guided an indigenous person through establishing her floriculture business in Darwin. Support was also provided to local Larrakia and Darwin women in harvesting, value adding, and marketing of local species; notably, cycad fronds (Appendix G). Staff also worked with Bagot Community, Pudakul Cultural Tours, and Wadeye Women's Centre groups with the aim of incorporating floriculture into their activities. Twenty indigenous participants attended a floristry workshop on cycads, tropical flowers, and dried flowers.

3.02 Other decorative foliage (Fiji; with PNG, depending on initial stakeholder consultation and market studies)			
Participatory research and training in harvest-production and post-harvest handling of decorative foliage Provide business skills training for micro-enterprises (PC)	Training workshops conducted; training materials Training workshops conducted; training materials	Yr 2 & 3 Yr 3 & 3	Growers gained various skills in floristry and business skills through training workshops facilitated by Mary Shaun, David and Dorothy Dowd, Sherrie Wei and both Daryl Joyce and Muhammad Mazhar. The Fiji budget only provided funds for work on native plants. A request was submitted for additional funds to work on decorative foliage, but such were not available. While the Fiji budget was sufficient for work on native plants, some savings were contributed towards the '*Fiji Floriculture Handbook*' and some work on ginger and heliconias. Through the handbook and supporting workshops, extensive business skills training with micro enterprises was carried out in Fiji with over 100 growers/marketers trained.
3.03 Production and sale of tropical cut flowers for domestic and tourist markets (Solomon Islands, PNG and Fiji)			
i. Establish mother-and-baby sites for evaluation and participatory training for new products and practices. ii. Conduct participatory evaluation and training. iii. Assemble training materials and document results in a form suitable for use of participants and for scaling up to other groups.	Floriculture producers empowered in production and post-harvest skills, in business skills, in planning and prioritisation processes, and in gaining access to further information and future innovations. Reports of training activities.	Yr2 -1 Yr 2 & 3 Yr 4-1	Field work conducted in July 2012 identified local value chains in Lae, Goroka and Port Moresby as having unrealised potential. Cross regional chains were also identified, these being the Lae to Port Moresby chain for cordyline leaves and the Goroka to Port Moresby chain for subtropical flowers, such as arum lily, tuberose and dahlia. Future collaboration with the chain drivers could enhance chain performance. There was a tendency for florists in PNG to grow cut flowers and to provide training to other growers that supply their business. Florists generally mark-up their cut flower/foliage purchase prices by 2-fold. A value chain and business skills workshop conducted by Prof Sherrie Wei with facilitation from NARI for some 30 participants in Lae and some 20 participants in Port Moresby in July 2013. A floriculture training workshop was delivered in January 2014 in Honiara, SI by visiting tropical floriculture consultant, Mrs Jan Hintze. The floriculture workshop was on quality, post-harvest treatment, and marketing of tropical cut flowers.

3.04 Nursery production of native plant species for landscaping (Fiji and Australia)			
Awareness raising and training workshops for Fiji developers and planners - using printed manual and demonstration gardens to promote use of native plants in urban planning, landscaping and nursery-based enterprises. (PC)	Developers & planners and plant nursery industry are made aware of possible role of native plants in landscaping, and provided with skills to incorporate these options in their work.	NT	With the assistance of an advisory group, trial plantings of several native plant species with floricultural potential were grown at the Coastal Plains Research Farm.
Training workshop for local nursery micro-enterprises - using printed manual and demonstration garden to advise them of new species, sales opportunities and production techniques (PC)	Nursery microenterprises informed of new opportunities	06/2014	A demonstration garden was established near the nursery to trial and showcase candidate species. Native plant species were incorporated into a landscaping project for a new apartment complex in Suva.
3.05 Production of new plant products derived from native species (PNG)			
Individual or small-group training of partner organization staff in specialist skills as identified in the feasibility study)	Trained project staff, training materials	Yr 1	A preliminary list of candidate species was compiled. Field collections were made to bring additional varieties of each of the plant groups. On the job training for for staff was ongoing, encompassing skills training to enable development of new products.
Participatory training for women's groups (e.g. PNG-WiA) who will act as out-growers and basic business skills (PC)	Trained group members, training materials	Yr 3 & Yr 4	A hands-on technical workshop for 30 women was conducted by Dr David and Dorothy Dowd in Lae in August 2014.
3.06 Improving small-holders' horticultural skills with a focus on tropical cut flower production (PNG)			
Nominate technical officer to manage activity.	Technical Officer nominated.		An officer was recruited and developed collections of cordyline, ginger and ixora at the Lae Botanic Gardens of FRI.

Upgrade women smallholder horticultural skills.	Technical Officer works in liaison with women's grower groups to facilitate grower group activities focused on up-grading horticultural skills. Series of classes with visiting industry specialists in topics relating to pre and postharvest management of cut flowers.	Y 1M10 Y2M10 Y3M10	A researcher was employed at NARI to implement research activities and as well as liaise with grower groups to facilitate training in floristry. This activity contributed to increased networking with many grower groups and as well as research and NGO's involved in floriculture in PNG.
Upgrade skills to deliver technical support in trialling activities.	Attend 'train the trainer' short course with selected growers at UQ Gatton.	Y2M7	Training was conducted on postharvest quality and supply chain management of cut flowers.
Develop a training manual.	Using information collected from trial work and training activities, collate a training manual for use by smallholder flower growers.	Y4M6	Various training notes were made available based on the workshops facilitated by Mary Shaun, David & Dorothy Dowd, Sherrie Wei, and Daryl Joyce & Muhammad Mazhar. This documentation will be used as a resource for future training workshops in PNG.

PC = partner country, A = Australia

7 Key results and discussion

Papua New Guinea:

A broad range of activities were undertaken in PNG through close collaboration between NARI and FRI. Notable among them were:

- Establishment of base germplasm collections in demonstration plots of cordyline, gingers, heliconias, and anthuriums at both FRI and NARI sites in Lae. These collections were provided for further and future work on variety selection and supply of quality planting materials for growers.
- Species of *Riedelia* were collected from wild populations and propagated at FRI and NARI for development and multiplication for further research. *Riedelia* species are native to New Guinea and plant improvement should yield novel plants for markets.
- Hardy species, such as *Cynometra katikii* and *Lamiodendron brassii*, were identified as having potential as ornamentals and landscaping plant because of their physiognomic characteristics. However, initial trialling with cuttings determined that they generally did not perform well and were slow in growth development.
- A checklist of the current species currently used by the growers and florist was developed. In the case of some genera, identification of species was difficult due to the many cultivars currently in use; e.g. cordylines, heliconias, and gingers. Most of these are only known in the industry by common names.
- A postharvest workshop for training of trainers imparted broad understanding about the processes and technologies used to deliver quality floriculture products to markets. The workshop brought home a realization that floriculture practices in PNG have a way to go prior to entry into competitive international markets enjoyed by established flower exporting countries, such as Thailand and Kenya.
- Multiplication of materials by vegetative cuttings was established to be the best general option for use at FRI and NARI. A focus on improving potting media would provide better quality healthy planting materials for the growers.
- The introduction of species currently in the public domain, such as some more productive varieties of orchids, gingers from Bali Orchid Garden and *Curcuma* from Northern Australia, was highlighted as priority. However, this could not happen due to technical requirements and other issues that will take time to address. It is, nonetheless, anticipated the prospect will be followed through so they can be brought into the country.

Fiji:

The cut flower aspect of floriculture was captured in Fiji by Koko Siga encouraging germplasm introduction and capacity building by South Sea Orchids. However, the novel focus was on introduction and use of native species for the landscape and land care aspects of floriculture. Key activities included:

- Germplasm collection, propagation, maintenance and promotion for the commercialisation provision of native floriculture plants.
- A plant nursery facility was established and utilised for the mass propagation and trialling of native plant species. The nursery supplied ornamental plants for demonstration plots to the landscaping industry. This aspect of the work project was collaborative with three commercial nurseries that chose to invest in native plants as part of their product range offerings.
- A total of 12 native demonstration gardens were established under the project: 1 town center, 1 eco-tourism retreat, 2 eroded riverbanks, 2 village-based schools, 1 village, 1 marina, 1 urban high rise development, and 3 tourism sites. Additional

interest was generated at other potential sites, including Nadi International Airport, Nadi town, and Lautoka City, plus an expanded marina planting and two more tourism sites.

Solomon Islands:

Work in the SI was a minor activity with no formal project partner there. However, synergism was anticipate through information flow from other parts of the floriculture project. A highlight was:

- A floriculture value chain involving a group in the Gold Ridge area of Guadalcanal Province was visited and a focus group discussion conducted. The growers can potentially supply to local offices, including and importantly the offices of Gold Ridge Mining Limited (GRML). The potential returns to growers were anticipated to be comparable to other value chains in SI, such as the Kakabona and Betikama chains.

Northern Territory:

Upon the financial demise of ABT as a partner organisation, CDU consulted widely as to the status and future of floriculture in the NT, including Indigenous floriculture. Key findings of this review were:

- The general areas of floriculture most active in the NT included cultivation of exotic tropical species for the cut-flower industry, cultivation of native and exotic plants in nurseries for commercial and retail sale, harvest of grass seed and native plant seed for revegetation projects, and cultivation and wild harvest of different native plant products for a variety of commercial purposes through to cultivation and wild harvest of whole plants (e.g. cycad, bamboo) for local, national and international sale.
- The NT DPIF has provided a modest floriculture R&D program since the late 1980s (NTG 2014). It has included development of new varieties of cut-flowers, research into cost benefits of different transport options, and an extension role in providing production advice and market trends towards encouraging industry growth. In more recent time the R&D focus has been in topical exotics, such as *Heliconia*, *Etlingera*, *Alpinia*, *Zingiber*, *Curcuma* and various orchids in the monsoonal tropics of the NT. In more arid southern NT, the focus has been on developing commercial production of well-known Western Australian native species, such as *Anigozanthos* (kangaroo paw). The capacity of NT DPIF to provide R&D for the cut-flower industry has waxed and waned over the years depending on different NT Government priorities. There is now only a small team that provides limited research, extension and industry development.
- A major category of floriculture in the NT is the sale of native plants and seeds for landscaping and rehabilitation. Greening Australia (GA) plays a big part in sourcing, supplying and growing a variety of native plants and grasses, as well as providing outreach on best practice land-care (GA 2014). They have been involved in the harvesting, distribution and re-establishment of native grasses in the semi-arid sub-tropical region of the NT since 1993. GA supplies seed from a large range of grass species native to northern Australia for use in re-establishment of native pasture, mined site vegetation, roadside vegetation, erosion control/bank stabilisation, dust suppression, weed suppression, conservation and biodiversity enhancement, habitat restoration, landscaping, nurseries and research. GA endeavours to involve remote Indigenous Ranger groups and others in this business, and provides them with equipment and support to collect seed of provenance. GA also contributes to Florabank, which stores seed from a variety of provenances. GA has nurseries in both Darwin and Katherine and supplies a wide range of local native plants to the general public, professional landscapers, local council, other nurseries, Landcare groups, mining companies, and others carrying on revegetation or native landscaping works.

- Another supplier of seeds is Top End Seeds, which has been operating in Darwin since the early 1990s and is now located in Katherine (Top End Seeds 2014). They supply seed for revegetation projects, host a provenance specific seed collection, and provide seed cleaning and treatment as well as training in seed harvesting, processing, storage and sowing.
- There are a number of commercial nurseries throughout the Darwin and Katherine region which retail and / or wholesale a variety of plants and other floriculture products. They produce a range of native and exotics plants for residential properties, retail stores, and landscape gardeners. Additionally there are other businesses which supply the interior plants market along with several smaller growers who supply product for a number of weekend markets in the major town centres.
- Feedback from participants involved in surveys, a workshop and on-site interviews provided a fairly consistent interpretation of the history, current state and future of mainly the cut-flower industry.
- Two growers supplied local and interstate markets and reported transport costs having reduced profit margins of interstate produce considerably and resulting in a shift towards local markets. Growers interviewed observed that the average age of growers was advanced (mostly 50-60 years), with few younger people entering this industry. Also, they indicated little co-operation between growers to collectively address key constraints, such as high freight costs.
- An Aboriginal community visited was found to have had a number of different floriculture or horticulture type projects in the past. These included cycad whole plant harvesting, cycad frond harvesting for local markets and vegetable and fruit crops for local community supply. The continuation of these projects seemed to have been related to the changes in the supporting welfare funded program and the associated coordinators' role. It is likely that their purpose may have been training orientated in many cases. Many Aboriginal communities are now looking for wildlife based enterprise to generate income, and there is interest in floriculture projects. There is a clear need for better engagement, mentoring and support to assisting these communities in choosing and developing the most appropriate type of enterprise.

Prior to its demise, ABT co-ordinated work with and by interested Indigenous parties. Key aspects of this seminal work were:

- In the first interstate floriculture 'walking the chain' study, ABT gained valuable knowledge and recorded the operating practices for selecting, collecting, washing, grading and packaging cycad fronds. A total of 650 cycad fronds were collected and 480 were marketable at close to a 75% marketable rate. The trial shipment was sent by air freight costing AUD557 (AUD7.15/kg). This rate was too high to make a profit, although the purpose of the trial was quantifying logistics rather than quantifying profitability. It was evident that an alternative method of delivery, such as road freight, must be considered by potential Indigenous suppliers. This means there would be longer time of shipment. Accordingly, further postharvest research would be needed to determine relationships between product quality, vase life and shipping conditions, such as temperature and humidity. From the initial work it was recommended that cycad fronds be packaged with plastic sleeves and shipped under an ambient temperature of 4^0C. Another important finding through "walking the chain" was the relative mark-up along the way with interstate wholesalers requiring 25-40% margin to have reasonable profits and florists needing around 100% margin.
- A positive aspect from this trial was that there was interest from interstate wholesalers in establishing business relationships with potential suppliers of NT cycad fronds. Countering this potential demand is the finding that there are other

large supplies of native foliage lines, such as *Sticherus* (umbrella fern) and *Caustis blakei* (koala fern) available in state capital cities. These products, along with imported products (e.g. leatherleaf fern) would compete with cycad fronds. They are sold for ~ AUD1.00 per stem at the wholesale market.

- After the Sydney market trial, an alternative interstate value chain was 'walked' which sold through a large local flower grower and consolidator of NT floricultural products. The consolidator had established businesses connections with several interstate floricultural wholesalers in Sydney, Adelaide and Melbourne. The consolidator was able to handle larger quantities of fronds of 500 bunches / week (2,500 fronds / week) and to negotiate very competitive air freight rates. Significantly for Indigenous suppliers of the product, this meant joining an existing efficient value chain which can handle more quantity and had established business linkages through the supply chain. However, it did add one more intermediary between Indigenous suppliers and interstate wholesalers which would erode potential profits.
- Given the margins for the two traced interstate value chains, it was evident that there is not enough profit for any potential Indigenous cycad frond harvester within a small scale enterprise development. Nonetheless, the main purposes of the two trials were to collect baseline data from both demand and supply sides and to initiate some relationship with value chain partners. In a follow-up interview, the interstate wholesaler indicated that a better situation in the future is for them to pay ~ AUD0.70-0.75/frond to sell at ~ AUD1.00/frond, rather than at AUD1.30/frond as in the trial, at the wholesale market (C. Scott, pers. commun., 2012). This information was all helpful for cost / profit analysis to determine whether it was worth pursuing wild harvest of cycad fronds by the Indigenous communities in and around Darwin area.
- In addition to the value chain work, ABT also co-ordinated floristry training, management of plants for bush harvesting trials, and trial plantings of native species for floriculture, including pot culture (e.g. *Haemodorum coccinea* [Scarlet Blood Root] among other activities not documented before the economic demise of the Company.

Cycad fronds vaselife studies

- A preliminary storage and vase-life trial was carried out on bush-harvested *Cycas armstrongii* fronds at the end of 2011 (Appendix H, figure 1). The overall quality of the fronds were satisfactory to poor due to a number of problems in relation to defects and disorders such as uneven leaflets, kinked or twisted fronds, spotting (fungal) and thrips damage (Appendix H, figure 2). Some of the problems were attributed to the bush-harvested cycad plants being at the end of a vegetative growth cycle. Furthermore, in December when the trial was run the weather was hot and humid ideal conditions for pest and disease problems.
- Key findings from the simulated storage temperature and packaging method trial found fronds that were stored at 4^0C and covered with plastic sleeves, and stored for 3 days to simulate fronds being transported by truck from Darwin to Brisbane were still acceptable in a vase for up to 10 days from harvest (Appendix H, figure 3). Fronds that were stored at 13^0C and at extreme temperatures (non-refrigerated truck) with and without plastic sleeves for 3 days only had an acceptable vase-life of 7 and 3 days from harvest, respectively. The main symptoms associated with end of vase life quality for the cycad fronds were (1) browning at tips of leaflets due to desiccation; (2) shrivel midrib due to desiccation and gradually browning of frond; (3) bending and twisting of frond due to desiccation; and (4) loss of lustre, paleness in colour affecting overall appearance of frond (Appendix H, figure 4).

Cut flower ginger agronomy studies

Zingiber

- For *Alpinia* (Fiji and NT) and *Zingiber* (NT), poor plant health manifested in flower shoot collapse and rhizome decline, is an emerging issue. Investigations were undertaken with *Zingiber* to identify if potassium played a role in this condition. (Appendix I, figure 2).
- Luxury levels of potash did not alleviate *Zingiber* rhizome decline. General agronomy including baseline leaf tissue nutrient levels and macro element inputs have been established for some of the important genera of ornamental gingers. Implications for PI partners in the cultivation of cut-flower gingers are the maintenance of good soil structure and appropriate organic matter and cation levels. This can be achieved through crop yield and growth monitoring and regular organic additions such as composted manures and mulches.
- Three cultivars, “Choc Delight”, Singapore Gold hybrid “HYB” and “Pine lime” had yield depression with the high treatment over the medium to low inputs. Treatments did affect leaf potassium levels marginally with low inputs having around 3% potassium and medium and high inputs reaching levels of 3.5% (Appendix I, figure 1 & figure 3). These levels reflect the suggested range for the related edible ginger species *Zingiber officinale* (Asher and Lee, 1975) which serves as a useful basis for developing nutrition standards for ornamental *Zingibers*
- The flower yield reduction of several *Zingiber* cultivars may also have been a response to high chloride levels as the potassium form used was muriate of potash which has significant chloride levels. More suitable forms of potassium without chloride were not available locally during the trial period. Composite leaf analysis from low, medium and high input plots indicated a doubling of leaf chloride levels for the medium and high treatments (1.0-1.6 % Cl) compared to the low treatment (0.6-0.8 % Cl) and this could contribute to a yield depression at extreme levels (Appendix I, table 1).

Curcuma

- Preliminary *Curcuma* field production technology has been established for a new germplasm of advanced selections of *Curcuma*. This was achieved through a field trial quantifying the effects of light levels and nutrient inputs on yield and quality. Baseline nutrient inputs and leaf tissue levels were also established. Significant increase in growth and yield of both flowers and rhizomes was achieved with the following fertigation schedule. During the first ten weeks of growth a high nitrogen soluble fertiliser was applied. Later potassium (K) inputs were significantly increased at the rate of 60 Kg/Ha/week and nitrogen reduced to 20Kg/Ha/week during the flowering period (Appendix I, table 2). Preliminary data from the leaf tissue analysis show high K levels in all three clones (Appendix I, figure 3). This is indicative of gingers being high K feeding plants, as has been shown in previous nutrition studies on *Zingibers*. This preliminary work on nutrition for cut flower production provides some suggested levels for fertiliser inputs which is currently lacking on in-field growing of *Curcumas* (Appendix I, table 2).
- Light levels had a significant effect on flower yield and stem length on two particular Curcuma clones. Clone 1 plants growing under 50% shade had an average number of 16 flowers/plant, compared to plants growing in full sun of 9 flowers/plants. Clone 2 plants growing in full sun showed a significant increase in yield producing an average of 16 flowers/plant, compared to only 6 flowers/plant under 50% shade (Appendix I, figure4). Clone 2 flowers produced longer stems of over 700mm under 50% shade, compared to flowers growing in full sun with stem length of about 400mm. Slightly longer stems of over 250mm were produced on Clone 1 flowers growing under 50% compared to flowers growing in full sun (Appendix I, figure 5).

- A number of new advanced selections of Curcumas in the germplasm collection evaluated in this field trial have shown excellent potential as a cut-flower. This research work has demonstrated by providing some shade stem length can be greatly increased in some clones. A better understanding of *Curcuma* nutritional requirements for in-field production of cut flowers was obtained from preliminary leaf tissue levels which support the current knowledge that gingers have high requirements for potash inputs, particularly during flowering. The following preliminary field trial resulted in the development of large healthy rhizomes in the three clones we investigated in this nutritional study. Finally, for the bulking-up of rhizomes for planting material both for cut flower and nursery the nutritional inputs used in this field trial shown to produce large healthy rhizomes in the three clones investigated (Appendix I, figure 7). Suggesting that propagation of rhizomes is best achieved by in-field production.
- Several pot trials were undertaken to quantify nutrient requirements for container production of *Curcuma*. Nutrient inputs were through commercial controlled-released fertiliser (CRF) applied at different rates and incorporated in growing media to a selection of hybrids. Nutrient availability over time was monitored by measuring leachate conductivities and subsequent impacts on growth and flowering.
- Initial results found top fresh weight significantly increased in Clone 3 supplied with 6 and 8g/L CRF due to an increase in plant height, number of shoots per plant, and size of leaves. In contrast, top fresh weight increased slightly for Clone 1 at 8g/L CRF and Clone 2 there was no increase (Appendix I, figure 9 and figure 10). In regards to rhizome fresh weight, the growth of Clone 3 rhizomes did not significantly increase in size at the higher CRF rates. This may have been due to the growth being restricted by the small pot size used. Suggesting that a bigger pot maybe more suitable for this particular clone for containerise (pot) production. In regards to Clones 1 and 2, these were more suited to a small pot. Inspection of Clones 1 and 2 at the end of the trial found a number of well-developed storage roots on rhizomes treated at 8g/L CRF (Appendix I, figure8).
- Preliminary results of the electrical conductivity (EC) in leachates collected from pots using the pour-thru extraction method (Yeager et al, 1983) found that the bulk of the fertiliser was released within the first half of the production phase, before 60 days after planting (DAP) in all treatments (Appendix I, figure 11). The pH reading of the potting medium taken at the end of the experiment for all three clones showed a decline in pH with increasing CRF rates (Appendix I, figure 12). The pH of the potting media at the lowest CRF rate of 2g/L was still quite high above pH 6 for all three clones. Even at 4g/L the pH of the potting media was close to 6 for all three clones. This high pH may be a possible reason why Clone 1 did not perform well and Clone 2 did poorly as it may have suppressed the growth of these plants. Suggesting that Clone 1 and 2 may prefer a lower pH of around 5.0
- The following preliminary pot trial shows that *Curcuma* can be grown in pots. However, growing and nutritional requirements will differ between *Curcuma* hybrids as a result of the parents used in the crossing, particularly in regards to pH.

NT Native plant species development

- For the monsoonal flora of the NT there are good candidate species for ornamental product development for certain genera. We initially selected 22 genera that showed potential for effort into cut flower development (Appendix J, table 1). Of these genera, we further refined this to some key species for project activities after consulting local organisations such as Greening Australia, Top End Native Plant Society and the NT Herbarium along with members of the NT Nursery and Garden

Industry Association who collectively had extensive experience with the horticultural constraints to developing the flora (appendix J, table 2).

- Project activities centred on *Acacia, Banksia, Corymbia, Eucalyptus*, *Lithomyrtus, Verticordia, Haemodorum* and *Calytrix* were selected for vase life determination and/or propagation studies. The basic applied horticultural methods used in this initial studies are readily applicable for those of limited experience Much of the vase life screening with selected species linked with the more extensive *Cycad armstrongii* cut-foliage development jointly investigated with ABT. Unfortunately with ABT's demise a key linkage with capacity building and product diversity for local indigenous woman, via ABT workshops, was lost to the NT native plant study component of the project.
- The vase life protocol allowed us to screen a number of species efficiently and with little demand on resources. Several species have since been rejected for further development as cut flower. Some, given good vase life, warrant further effort such as *Acacia* (several species for flower and/or foliage), *Banksia dentata* and *Corymbia ptychocarpa.* However for the latter two species the selection of improved forms and resultant clonal propagation will be critical, (Appendix J, table 3). Rapid vase life screening is a key determinant for further development of potential species and is a resource efficient, simple method.
- Efficient propagation impacts on the commercial viability of new potential species and is a core element to ensure uptake of new product is achieved. Appropriate propagation media both the physical and chemical components, is essential in the development of new crops. Selected species varied in their response to propagation media chemical and physical parameters and we have developed a simple template of different media components that allows the identification of "best bet" media composition reflecting key chemical and physical properties, for identifying the most appropriate media for a given species (Appendix J, table 4; figure 1-3).
- Our preliminary efforts in propagation have been based on seed and asexual methods. With a number of seed treatment and basic rooting hormone options, we have been able to achieve some level of propagule generation across a number of species. For *Lithomyrtus retusa*, a highly ornamental species yet to be cultivated, asexual cutting propagation is important as seed propagation is unsuccessful. Also there is good scope for selection of unique forms thus necessitating a need for clonal propagation. Initial screening trial of root induction hormones suggest clonal propagation will be feasible and warrants further investigation (Appendix J, Figure 5).
- *Haemodorum* was identified as a key species for development and investigations by ABT and NT DPIF focused on propagation and field establishment (Appendix J, figure 4). Despite much effort *Haemodorum* cultivation has yet to be realised. Seed propagation is relatively easy and large numbers of seedlings can be obtained. Subsequent nursery growth of containerised seedlings and early field establishment is far more challenging. We have yet to resolve seedling decline and plant death in field plantings. Pathologically no consistent causal organism has been identified although *Pythiums* and *Alternaria* may be implicated. The few establish plantings have also been very slow for time to first flowering.
- We have been able to initiate studies on a flora that has had very little horticultural development. A core element of this investigation was identifying which species had good prospects for development and what technical constraints could hinder those prospects. This was achieved through "desk top" studies using a matrix and a prioritising approach. With clarity on potential species, we initiated basic horticultural studies which addressed the main horticultural constraints identified for the selected species. Key components of these studies were vase life screening and subsequent

propagation media development and appropriate propagation methods for the selected species.

Value chain activities:

- In summary, value chain activities across the four countries included identifying and working with drivers of selected supply chains, and analysing relationships among chain actors and their respective profit margins. Value chain interventions included workshops on value chain management (especially feeding back market research results) and walking through floriculture value chains with selected growers. Estimated total economic benefits due to this project, under reasonable assumptions, across three South Pacific countries were close to AUD0.8 million at the final year of this project (refer to Methodology section).
- In the NT, test shipment of cycad fronds from Darwin to the Sydney market enabled estimation of margins for supply chain actors profitable enough to stay in business, viz., about 40% for local consolidator, 40% for interstate wholesaler and 100% for retailing florist. In this situation and adding other costs, a cycad frond sold for $0.3 by the wild harvester would retail for approximately $1.7. This is in contrast with the price that interstate wholesalers would hope to get, less than $1. The general conclusion is that for Indigenous communities to engage in small enterprise development for cycad fronds, efficiency has to be achieved through bulking up. A further test shipment through Australian Post to Brisbane enabled packaging requirements to be established for cycad fronds.
- In Fiji, this project had worked with two of SSO's supply chains established by previous aid related projects involving squatter populations in Nandi, viz., the least advantaged population with little knowledge and skills in general and in growing flowers in particular. *Dendrobium* cut flowers were considered easier to start with. Margin analysis indicated that growers on average earned significant income (around FJD40/month) from SSO's out-growing scheme. Estimated tangible economic benefits flowing from *Dendrobium* cut flowers (excluding other intangible environmental and social benefits) in these two SSO value chains under this project for Fiji is about AUD8,000 (See 8.3.1 Economic impacts).
- In SI, activities focused on collaborating with successful florists in the Solomon Islands Floricultural Association (SIFA). In general, value distribution for cut flowers was around 50-60% for growers, 25-30% for florists, 10-15% for material suppliers and 5-10% for delivery. In 2013, this project started working with Gold Ridge Mining whose management was interested in assisting relocated residents in its catchment area to grow cut flowers for extra household income. The group has received some new bright-coloured Zingiber planting material from NT DPIF Darwin. Estimated tangible economic benefits flowing from cut flowers under this project for SI is about AUD9,200 (See 8.3.1 Economic impacts).
- In PNG, local value chains in Lae, Goroka and Port Moresby and cross regional chains of Lae to Port Moresby and Goroka to Port Moresby were analysed. Value chain margins were similar to those of SI, although they varied greatly depending on the type of flowers and size of arrangements. The Goroka to Port Moresby value chain for subtropical and temperate flowers have great potential to expand. This cross regional value chain has been 'walked through' by two representative growers (from WiA and Goroka Floricultural Association) together with NARI and FRI staff. Estimated tangible economic benefits flowing from cut flowers under this project for PNG is by far the highest among the three countries, in excess of AUD778,000 (See 8.3.1 Economic impacts).
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Acacia vase life research:

- In the context of utilising novel native plant species of Australia and the Pacific islands in floriculture, research in Queensland at UQ focused on enhancing postharvest longevity. *Acacia holosericea* (velvet leaf wattle) was adopted as the test species because of its reputed short vase life and it being representative of hundreds of acacias with unrealised commercial potential as cut flower and / or foliage lines. *A holosericea* is native to the Top End as was identified by the NT DPIF project partner as a potential cut foliage line. The Acacia vase life work involved RHD students and visiting researchers. It was discovered that physiological wound-induced stem plugging was primarily vase life limiting for *A. holosericea*. Pulsing and vase solutions based on Cu^{2+} and H^{+} were identified and optimised to a least double the vase life of this cut species; e.g. from ≤1 week to an acceptable duration of ~2 weeks.

8 Impacts

8.1 Scientific impacts – now and in 5 years

Papua New Guinea:

- Germplasm collection and trials were established for ginger family, cordyline, and other ornamental plant species (FRI, NARI, NT DPIF).
- Scientific floriculture skills sets were realised by 7 researchers from FRI and NARI in collection, germplasm management, plant ID, and research planning, implementation, piloting, and up-scaling.
- Propagation trials were conducted using a non-mist propagator and tissue culture for anthurium (NARI). In association, 2 NARI and 1 FRI researchers acquired new skills and knowledge on propagation of cordyline and anthurium. The use of the NMP by the growers to multiply materials in sterile conditions may become the norm in the future. So far it has shown some promising trend in the 'mother – baby' trial, especially the one set up at Munum village in the Morobe Province.
- Agronomy trials were undertaken for ginger and allied families (FRI, NARI). For example, 3 NARI and FRI researchers participated and successfully implemented a cordyline agronomy trial.
- Vase life studies were initiated on selected materials, such as cordyline foliage. This work should continue to identify solutions that are easily accessible to the florists and give maximum benefit to the customers.

Fiji and Solomon Islands:

- Germplasm collection and trials were undertaken for native landscape species and for members of the ginger family (Koko Siga, SSO).
- Propagation trials in a demonstration nursery facility were completed for native landscape species (Koko Siga).
- Agronomy trials at demonstration sites in urban and peri-urban areas, including coastal, were undertaken (Koko Siga).
- With nearly 4 years of collecting and trialling native plants, the project has developed a broad information base that is being developed into a manual on landscaping with Fiji's native plants. It is envisioned that the manual will be released by June 2015 and made available to landscapers, researchers and anyone interested in Fiji's native plants. Senior author, Kyle Stice presented a scientific paper entitled: "*Increasing demand for native plants in Fiji's ornamental horticulture sector*" at the International Conference on Germplasm of Ornamentals (Appendix E). The paper has generated considerable interest amongst the horticultural community. However, the main impacts of the project are expected to follow the launch of this manual. These are expected to be in the application of the various techniques developed under the project. These will include:
    - mass propagation techniques for Fiji's native plants to be used in hotel development and urban beautification;
    - use of native plants in river bed stabilisation and sea shore restoration; and,
    - an understanding of the incentives required to encourage small scale tourism operators and communities to invest in landscape rehabilitation activities, using native and naturalised plants.

Northern Territory (Top End) and Queensland:

- Germplasm collection and trials were undertaken on research stations for the ginger family and for native Australian species (NT DPIF). They defined limiting factors and addressed limitations to the commercial cultivation of potential novel floriculture species; e.g. genotype selection and plant nutrition.
- A cycad field monitoring protocol was developed for documenting / recording baseline information on phenology, such as vegetative flush over time and the incidence of pest, diseases or physiological disorders that affect the quality of the cycad frond (2 ABT project partners). Whilst previous population and recruitment studies have been undertaken for Cycas in traditional ecological studies, this is one of the first monitoring attempts with a specific horticulture overlay embracing key commercial aspects such as frond flush / availability and defects (e.g. insect damage) by season and with on-site monitoring.
- Insect and pathogen pests on cycad fronds were identified by NT DPIF Entomology and Pathology sections (3 NT DPIF non-project people).
- Propagation trials were conducted, for ginger family and native Australian species. *Zingiber* selections were bulked up for distribution to partner countries. (NT DPIF).
- A selection and development model was evolved for commercialising NT endemic flora. This flora has had no concerted approach to realising amenity potentials. Commercialisation constraints were identified for selected genera. Technical studies for 7 genera with potential were commenced and reported in an oral presentation at the ISHS congress, Aug 2014 (NT DPIF).
- Zingiber and Curcuma selections were bulked up for distribution to partner countries. They were initiated into tissue culture for efficient and hygenic distribution. This involved the first *in vitro* propagation of several species and hybrids. One NT DPIF technician was trained.
- Agronomy trials were conducted with members of the ginger family (NT DPIF). A protocol for nutritional studies for determining the impact of key nutrients on ginger rhizome health and longevity was developed. They involved quantified standard tissue sampling and leaf tissue nutrient levels for ornamental gingers which had not previously been developed. Knowledge was transferred to NT ginger growers (8 growers) and partner country members (4 people).
- Scientific impacts also include management strategies developed for 3 new *Lepidoptera* pests in gingers by the Entomology group of NT DPIF (2 people).
- Postharvest trials were conducted on cycad fronds (ABT, NT DPIF, UQ). Post-harvest methodologies for cut foliage / flower studies involved ABT members with bush-harvested *Cycas armstrongii* frond studies. A template for quality specification was delivered for the first application to Top End endemic flora. ABT partners implemented improved horticulture in vase life screening, post-harvest handling, and alternate storage and transport methods and their monitoring for bush-harvested *Cycas armstrongii* fronds (5 project partners).
- The mechanism of short vase life in *A. holosericea* was elucidated and treatments to extend vase life to commercially acceptable durations were developed (UQ). This research focus activity potentially opens up the prospect of using others of the hundreds of native Australian Acacia species in floriculture.

University of Queensland:

- Three PhD graduates (Dr K. Ratnayake, Dr M. Che Husin, Dr N. Rafdi) and four visiting scientists (Dr J. Liu, Dr I. Ahmed, Prof. F. Celikel, Dr S. Gantait) undertook research aligned with the project research.

Technical and scientific work by all collaborators were published in international journals and proceedings, including scientific papers (Appendix E) presented at the IHC 2014 and submitted for publishing in Acta Hort.

8.2 Capacity impacts – now and in 5 years

Papua New Guinea:

- Training undertaken in floristry and business, including supply chains (NARI, PNGWiA, Jan Hintze, Sherrie Wei). Over 200 growers, florists, and researchers participated in training in floristry and business management in floriculture.
- Training in propagation, agronomy and postharvest (NARI, FRI, UQ, David and Dorothy Dowd). Over 100 growers, florists and researchers participated in training in propagation, agronomy and postharvest during the project life.
- Enhanced capacity (e.g. staff, infrastructure) of research partners, including in conducting market and postharvest research (NARI, FRI, PNGWiA).
- Enhanced research capacity through availability of propagation and nursery facilities at FRI and NARI, and a cool room at NARI.
- Germplasm advice, selection and distribution by experts to project partners and stakeholders (NARI, FRI, PNGWiA, NT DPIF, David and Dorothy Dowd). Support and establishment of floriculture germplasm at FRI and NARI. Through this project 3 officers had first-hand experiences working on floriculture related activities and attended training and workshops organized by the project. A field assistant from FRI was seconded to the project and he too learned a great deal during this period. One of these officers has taken up a full time job with FRI and he will continue to support floriculture activities within the organization. The other two officers will use the knowledge and experience they have gained in their new career paths after the project life. These officers could become champions in providing technical information to the growers and florists.
    - The officers engaged under the project learnt new skills such as nursery techniques, material selection and preparation, conducting vast life test and postharvest training.

Postharvest training workshop participants learning to set-up a vase life experiment with low cost inputs (Left). The workshop participants celebrate the completion of three days workshop at NARI, PNG.

    - The growers that have been trained under the project have improved and started their own farms. Some growers are slower learners and will required time to put what they have learned into practise.
    - One of the faster learners is a lady named Martha Sapien, who has taken the lead to organize 9 other women in her village to work together as a group. The women have done their plots and are waiting materials. The group planned to specialise on orchids for future markets locally.

  - New knowledge was acquired in the last project train-the-trainer workshop on Postharvest. Those who attended generally agreed that the knowledge gained has open up new doors for them to explore in the future. Although the supply chain is limited and yet to be fully developed, the knowledge gained will enhance their ability to deliver quality products to the market in the future.

- A field collection expedition to Wagau in the Morobe Province collected *Riedelia* species and also exposed to the potential of floriculture a community who have access to a diverse flora. The team demonstrated basic floral arrangement techniques and encouraged the local stakeholders to practice them in celebrations and local events. The community requested more training in the future.
- For the value chain component, capacity impacts are more obvious for PNG partner members through substantive interactions and exchanges. A value chain walk from Goroka to Port Moresby enhanced the market research capacity of participants including one from NARI and one from FRI. In addition, 2 growers also walked the Goroka – Port Moresby value chain in which relevant experiences were gained in understanding market demands. At the end of value chain walk, they conducted consumer surveys independently.

Fiji:

- Training was presented in nearly 20 florists and over a 100 flower growing enterprises. It was supported by a reference manual produced by the Project – the "*Fiji Floriculture Handbook*" (SSO, Koko Siga, Jan Hintze).
- Training was also given in plant propagation and agronomy practices to over 50 growers and nursery operations (SSO, Koko Siga).
- Enhanced capacity (e.g. staff, infrastructure) of research partners, including through a nursery facility and an allied landscaper designed demonstration garden (Koko Siga).
- Germplasm selection and distribution to currently over 50 beneficiaries, which is expected to increase over 100 (Koko Siga, SSO).
- Measurable capacity impacts were seen in the up-skilling of project staff, collaborating community nurseries, city landscapers, hosts of demo plots and commercial nurseries. The training and up-skilling was provided in a 'hands-on' manner by technical advisor, Don Burness, and landscape architect, Kalara McGregor. A total of 45 practitioners were trained under the project in various areas, including: site selection, plant identification, plant requirements, planting schemes and site management. Provision of new nursery facilities according to locational appropriate best practice construction design now allow project staff to efficiently propagate large numbers of plants in a controlled environment. The project nursery site has an average of 5,000 – 8,000 plants at any given time. Importantly, a degree of disaster resilience has been built in and demonstrated in these nurseries.
- Project staff transferred nursery and landscaping technologies to private sector partners who in turn began investing their own resources in expanding work with native plants. A total of 15 private sector partners (12 demo sites and 3 nurseries) directly benefitted from this capacity building.

- Armed with a newly launched Fiji Floriculture Handbook, over 120 women flower growers and florists were trained in Fiji on production and marketing of floriculture products.

- The new Fiji Floriculture Handbook is targeting around 500 women and men who earn some income from floriculture in Fiji.
- In Fiji, women from two poverty alleviation housing projects, Koroipita and HART, started out as *Dendrobium* out-growers relying on SSO to harvest, collect, transport, book-keep, and sell the flowers. Later during the course of the project these growers became responsible for their harvesting and book-keeping, and have been introduced to other cut flowers, such as heliconia.
- An anecdote on knowledge / attitudes / practices (KAP) by florist Anne Maedia merits noting. She participated in the project workshop in Feb 2013 and subsequently applied her new knowledge on 'Do Your Own Research' in her own vase life trialling. As the President of SI Grassroots Women in Arts, she travelled around the country to conduct workshops, albeit fee paying to cover her expenses and time, to disseminate the KAP that she learned.
- David and Dorothy Dowd conducted a hands-on growing technical workshop to some 30 women in Lae in August 2013. The two Goroka women growers who walked the Goroka à Port Moresby value chain disseminated knowledge and skills to their individual groups, the Goroka District Floricultural Group and the Eastern Highlands province WiA Group in August 2013. The women explored ways to establish a co-op among Goroka growers.
- Micro-business development in PNG was evident in a few mini-value chains driven by some highly committed women. For example, grower Rose Genta in Lae who brought a larger block of land in 2013 to grow anthurium and a car to pick cut flowers from other growers. The florist Mary Saun in Port Moresby also has a car and an employee to deliver cut flowers for her.
- Micro-business development in SI could be illustrated by two mini-value chains, one driven by a successful grower and the other by a successful florist. Florist Anne Maedia was listed under the Department of Commerce's webpage and she has received overseas orders to deliver arrangements in the Honiara area. Grower Mary Bojia, while expanding production in cut flowers, ventured into ecotourism using income and entrepreneurial experiences learned from floriculture.

Solomon Islands:

- Training was provided to women participants in floriculture in:
    - floriculture business, particularly supply chain (Sherrie Wei).
    - Training in floriculture and growing of plants (Jan Hintze).

    - Crawford fund sponsored train-the-trainer training (UQ, NT DPIF, Malcolm Hunter, Sherrie Wei).
- Some germplasm distribution was effected (NT DPIF).

Northern Territory:

- Training in floristry and in business principles and practices, including supply chain (ABT, Sherrie Wei).
- Enhanced awareness of the floriculture industry and its needs, including research and training capacity (e.g. staff, infrastructure), by research partners (ABT, NT DPIF, CDU).
- Improved skills for baseline technical vase life and storage studies linked with supply chain studies; viz., in regard to the economic viability of sending cycad fronds interstate, improved basic horticultural techniques, and supply chain linkages (ABT members along with 5 project partners).
- Improved policy development via understanding the potential for ornamental sector in improving livelihoods in partner countries (ACIAR Board NT project visit of 15 people).
- New NT DPIF tissue culture facility developed with core NT DPIF funding leveraged partly by supportive ACIAR project operations funding with a view to *in vitro* germplasm transfer to partner countries.
- Improved agronomy for native *Haemeodorum* species in plantings involving baseline leaf and soil level and (potential) pathogen diagnoses. Greater partner capacity in basic horticultural methods (Mimbeni Rangers, ABT; 7 people).
- Indigenous (i.e. native Australian species) plus some exotic (e.g. *Curcurma*) germplasm selection and distribution (NT DPIF).
- Improved capacity shared with project members in partner countries (viz., Fiji, PNG, and SI) on the broad range of endemic genera in the Zingiberaceae family with potential for development as cut flowers or flowering pot plants.
- Enabling methods as train-the-trainer for development delivered at Gatton workshops, including 1 Crawford Fund workshop, and in-country visits (10 - 15 people per time across 3 partner countries).
- Ginger germplasm sent to SI with associated technical info transfer for post-entry quarantine and culture (2 people).
- Prohibitive quarantine costs for germplasm movement to PNG severely restrict movement of live plants. Quarantine regulatory requirements restricted live plant movement to Fiji and SI. Nonetheless, zingiber germplasm movement via live plants was achieved under all quarantine requirements (several project partners, 5 people).
- A putative virus infection issue in Curcuma remains unresolved despite several pathology investigations. Tissue culture was deemed as the safest and most cost-effective approach for germplasm transfer. All project partners developed a greater capacity for negotiating germplasm transfer internationally. (several project partners; 5 people).
- Prohibitive quarantine costs for germplasm movement to PNG severely restrict movement of live plants. Quarantine regulatory requirements restricted live plant movement to Fiji and SI. (several project partners, 5 people).
- A putative virus infection issue in Curcuma remains unresolved despite several pathology investigations. Tissue culture was deemed as the safest and most cost-effective approach for germplasm transfer. All project partners developed a greater

capacity for negotiating germplasm transfer internationally. (several project partners; 5 people).

8.3 Community impacts – now and in 5 years

Papua New Guinea:

- One of the major impacts by the floriculture project in the communities has been the contribution to the mobilisation and establishment of women grower groups/associations. The project provided the platform for women to participate in the cash economy through production and sale of flowers to increase household income in communities.
- The establishment of smaller value chain groupings in a few communities, such as Munum and Nasuapum villages in the Morobe Province, demonstrated the interest the project has realised in these communities, especially after they have attended the earlier trainings and workshops.
- The results of vegetative propagation using the non-mist propagation methods were encouraging and the direct involvement of growers in their construction and set up provided them with hands-on experience on how to manage at the village level. This approach assists them deal with hardy species, especially shrubs and woody species.
- The cordyline germplasm at the FRI botanic gardens provides for planting materials to growers. The Munum growers obtained cuttings of selected cordyline varieties from the collection, something which would have not been possible without efforts made under the project.
- A local grower who had been actively involved in the floriculture in Lae purportedly ventured into using a cool storage facility for the purpose of buying from the local growers and then shipping cut flower to Port Moresby. Cool storage is important to assist growers trading between Lae and Port Moresby.

Fiji:

- Collaboration with more than a dozen village communities and several eco-tourism operators has seen a renewed interest in the native plants. Project staff were approached by numerous groups interested in landscaping with natives and willing to purchase plants from the project nursery.
- Training activities focused on up-skilling project staff, collaborating with community nurseries, city landscapers and hosts of demonstration plots. Training and up-skilling was provided in a hands-on manner by technical advisor, Don Burness, and landscape architect, Kalara McGregor. A total of 45 practitioners were trained under the project in various capacities, including: site selection, plant identification, plant requirements, planting schemes, and site management.
- The Project supported the development of a ready reference handbook on how to grow and harvest some of Fiji's cut flower and flowering potted plant varieties. The book was launched at the SSO at its premises in March 20th 2014. This new handbook is used as the basis for training programs across Fiji to enhance the viability of small floriculture businesses. It builds on earlier publications also produced by SSO with funding from CTA. Since its launch, a total of 250 growers and floriculture entrepreneurs had attended training workshops by SSO using the new handbook. Requests for the handbook have also been received from floriculture growers and marketers in Samoa, PNG and the Cook Islands. SSO have already conducted training in Samoa using the manual under the auspices of the Pacific Island Farmer Organisation Network (PIFON).

8.3.1 Economic impacts

An exemplar to quantify benefits to growers and florists was attempted. In the course of estimating economic benefits to growers and florists, some assumptions were necessary and made to the best knowledge of project team members. These assumptions include:

- Growers' and florists' incomes from floriculture were based on information from case studies
- For SI and PNG, growers' and florists' incomes were assumed to be comparable to half of unskilled workers and skilled workers respectively
- Number of growers and florists benefited from this project were based on the total number of participants attending workshops during the project period
- Income by growers and florists 'due to' this project was assumed to be one-third of their total income from floriculture

In the two Fijian SSO-Koroipita and SSO-HART value chains, on average, some 40 out-growers earned extra FJD40/month from growing *Dendrobium* cut flowers. Thus, total yearly economic benefits to out-growers were FJD40/month x 40 growers x 12 month. Economic benefits to SSO were assumed to be similar to out-growers. Follow-on benefits will be expansion into other cut flowers, such as Gusmania and ginger, but has not been included in quantification.

In SI and PNG, salaries for unskilled and skilled jobs were used as proxies for income for growers and florists respectively. Given that many florists were 'teacher-turned' in both PNG and SI. Median monthly income could be a proxy for florists in both countries. Median monthly salaries for unskilled and skilled workers in SI were about SBD120 and SBD160 respectively (Solomon Islands Chamber of Commerce and Industry, 2010). It is also assumed for SI that average grower income from floriculture is about half of unskilled worker salary. The number of grower participants attending workshops held in Honiara and Gold Ridge was about 200, hence an indication of the number of grower beneficiaries in SI.

In PNG, average monthly salary for clerical work is about PGK2,300 (Salary Survey in Papua New Guinea, http://www.salaryexplorer.com/salary-survey.php?&loctype=1&loc=168), and half of that amount, i.e., PGK1,150, could be an indication of average household income from floriculture. Based on the number of participants attending the workshops in the three cities of Port Moresby, Lae and Goroka, estimates for economic benefits for growers would be PGK1,150 x 300 growers x 12 months.

Median monthly salary in PNG was about PGK6,500. They were roughly what florists in PNG earn on average. About 10 florists believed to be benefited from this project, thus, estimates for economic benefits for florists would be PGK6,500x10 floristsx12 months.

It is assumed that benefits started to accrue during the final year of project implementation and about one third of these benefits can be accrued to this project. Based on these assumptions, estimated total economic benefits due to this project across three South Pacific countries were close to AUD0.8 million. It is envisaged that there would be follow-on economic benefits as more women engage themselves as growers or florists since

currently there are unmet demands in floriculture. It is likely that given three more years of knowledge and skills dissemination and spin-off value chain activities, economic benefits would be doubled to around AUD1.6 million. The following table summarises the economic benefit for Fiji, SI and PNG. As can be seen from the table, PNG generated most of the economic benefits. This might be due to the size of its economy, the involvement of government organisations to bring awareness of floriculture and attract more participants to workshops. Other intangible benefits, such as environmental and social benefits, were not quantified.

Summary of Economic Benefits from Floriculture in Fiji, SI and PNG

Benefits to supply chain actors in Yr 3	Fiji	SI	PNG
Yearly economic benefits – Growers	FJD 19,200 (40/mo x 40 growers x 12 months)	SBD144,000 (60/mo x 200 growers x 12 months)	PGK4,140,000 (1,150/mo x 300 growers x12 months)
Yearly economic benefits – Florists/wholesaler	FJD 19,200 SSO's benefits assumed to be similar to growers	SBD11,520 (160/mo x 6 florists x 12 months)	PGK780,000 (6,500 x 10 florists x 12 months)
Total economic benefits	FJD 38,400 ~AUD23,900	SBD155,520 ~AUD27,600	PGK4,920,000 ~AUD2,336,000
Benefits due to this project, 33% of total economic benefits	~AUD7,966	~AUD9,200	~AUD778,666
Estimated total economic benefits due to this project across 3 South Pacific countries at the final year of project implementation			~AUD795,832 (7,966+9,200+778,666)
Projected economic benefits doubled three years after this project			~AUD1.6 million (795,832x2)

Papua New Guinea:

- Identified product development and market opportunities for subtropical and temperate flowers from Eastern Highlands province.
- Identified supply chain opportunities (e.g. inter province markets, even international) and limitations (e.g. transport) (NARI, Sherrie Wei, UQ).
    - Identification of Goroka-Port Moresby and Lae-Port Moresby value chains (Sherrie Wei).
- Affirmed utility of native and naturalised flora, including redelia and cordyline foliage (ABT, NT DPIF, CDU, Sherrie Wei, UQ).
- Improved business network among supply chain partners.
- Increased household income among floricultural growers as reflected through a questionnaire with one grower earning K200.00 per day through sale of flowers at Lae market on a Saturday.

- Collected, established, and documented cordyline collections at FRI & NARI, followed by release to growers in Lae.
- Native redelia species (2) collected from the wild with plans to collect beyond the project's life. Future plans are to explore breeding to realize the commercial potential of this native plant.
- Contribution to capacity building in best management practices and thence increased household income generation through production and sales of flowers. However, an economic impact as a direct result from this project is problematic to measure for various reasons. One is that growers had started marketing their products prior to the initiation of the project. Some of the growers did so as a hobby, which had expanded over time. However, work on anthuriums under the project clearly generated interest among growers, and some committed themselves to developing the industry in Lae.
- Nursery skills taught by Dave and Dorothy Dowd in 2013 gave growers better ability to manage and use their materials wisely.
- There was a push for a better floral facility in Lae for growers to use. Suggestion has been made of setting and selling at the FRI botanic gardens on a regular basis.

Fiji:

- Supply chain opportunities were identified (Sherrie Wei, Koko Siga).
    - Enterprise creation and expansion; e.g. village-based enterprises supplying planting material, nurseries including native plants in their portfolio (Koko Siga).
    - Affirmed utility of native flora, especially landscape species (Koko Siga).
    - Enhancing the value of the Fiji tourism experience (Koko Siga; nursery industry, hotel sector).
- Livelihoods have been directly enhanced for the people involved with the 12 demonstration sites and the 3 nurseries. This has added the income generation opportunities created for the village based households that supply native plant to the nurseries. It was estimated that some 100 hundred households had been involved. The income generated and the households involved are expected to increase as this business opportunity expands as a result of the project. This has added the benefits accruing to the numerous participants in the Project's training program who have been able to apply skills learned to their own small enterprises.
- The increasing use of native plants by tourism operators is enhancing the quality of the Fijian tourism product on offer. Over time this will contribute to the number and type of tourist arrival and the overall amount spent in Fiji. While this cannot be quantified, it is expected to develop into a significant impact over time.

Solomon Islands:

- Investigated supply chain opportunities and limitations (GRML, Sherrie Wei).
- Potentially increased household income among floricultural growers, although the extent of improvement due to the project yet to be assessed.
- Women involved in project activities have reported that they are earning extra income by improving their fresh flowers handling practices through the supply chain.

Northern Territory (Top End) and Queensland:

- Identified supply chain opportunities (e.g. interstate markets) and limitations (e.g. transport) (ABT, NT DPIF, Sherrie Wei, UQ).

- Identified recommended areas where floriculture would be best focused in the NT in the future considering the constraints identified (CDU, Sherrie Wei, NT DPIF). This insight should empower NT growers seeking support for this industry in the future.
- ABT and NT DPIF facilitated visits to local consolidators (e.g. Jettner, Majestic Orchids to consider supply chain issues and project collaboration (3 consolidators / wholesalers).
- Vase life of Acacia species was trialled and enhanced at UQ.

8.3.2 Social impacts

Social benefits flowed from economic benefits earned by women growers and florists in Fiji, SI and PNG. Case studies showed enhancement of women's empowerment as evidenced in acquirement of more life skills (e.g., driving), improved communication and negotiation skills and better self image.

Papua New Guinea:

- Raised community awareness of the potential benefits of floriculture (PNGWiA, NARI, FRI, Sherrie Wei, UQ).
- Improved social and business network across floricultural grower groups.
- Enhanced economic empowerment of some successful women growers and florists.
- Facilitated existing and new collaborations among organisations; viz. NARI, FRI, PNGWiA, Bris Kanda (NGO) Sherrie Wei, UQ, MMJV, Bulolo Women, women growers groups/associations.
- Overall, use of floriculture products increased and it is becoming more of a norm in both Lae and Port Moresby, as well as in other centres.
- A social impact is the contribution by the project to a shift in attitudes in communities to healthy lifestyle. The cultivation of flowers improves landscaping and cleanliness of village communities. In addition, floriculture enterprises engage youth and women in gainful employment.

Fiji:

- Raised community awareness of the potential benefits of native landscape plant species (Koko Siga).
- Facilitated existing and new collaborations among organisations (Koko Siga, SSO, communities, nursery industry, hotel sector).
- Further raised community awareness of the potential benefits of floriculture (SSO, Koko Siga, Sherrie Wei).
- The value of utilising Fiji's native plants in urban and village beautification is being recognised as a result of the Project. As recognition gains traction, it can be expected to lead to significant positive social impacts to both rural and urban communities. Amongst these is a contribution to this desirable cultural pride of an association with the beauty of plants that are distinctly Fijian. This is seen to be particularly important for youth and children in retaining their cultural heritage.

Solomon Islands:

- Raised community awareness of the potential benefits of floriculture (GRML, Sherrie Wei, UQ).
- Developed a new collaboration with Gold Ridge Mining Ltd. (GRML, NT DPIF, Sherrie Wei, UQ).

- Enhanced economic empowerment of some successful women growers and florists would bring social empowerment.

Northern Territory:

- Raised community awareness of the potential benefits and limitations of floriculture (ABT, NT DPIF, CDU, Sherrie Wei, UQ).
- The peak industry body for plant industry in the NT, the Northern Territory Farmers Association, was informed about the issues facing floriculture (CDU, Sherrie Wei, NT DPIF). NT Farmers hosted the NT Cut Flowers Group.
- Project presentation on the potential role of floriculture in Indigenous economic ventures, Indigenous Advancement Workshop, Darwin (30 delegates).
- Facilitated existing and new collaborations among organisations (ABT, NT DPIF, CDU, Sherrie Wei, UQ; plus, NT Herbarium, NT Botanic Gardens).
- Collaboration with NT Herbarium, Darwin Botanic Garden and Greening Australia (NT technical staff; 7 people). Activities included a project overview and regular visits re-species selection, technical advancements.
- Facilitated SI woman's group Darwin visit on cut-flower production and germplasm development (20 people).

8.3.3 Environmental impacts

Among the three South Pacific countries, environmental impacts were most obvious in Fiji where native species were adopted for soil erosion, mitigation of extreme climate and general beautification in urban and tourist sites.

Papua New Guinea:

- The Wagau community, where the last botanical collections were made, had a glimpse of what their natural plant diversity can offer. The community is known for their yam planting skills, but now they can harvest floral materials from their forests to sell in the markets. They now see a value in the forests particularly conservation of flora and fauna and will look at it from an economic perspective than before. In turn, a conservation-through-cultivation mindset will be encouraged by NARI and FRI.

Fiji:

- Demonstrated utility of native species in stabilisation and restoration situations (Koko Siga). The project demonstrates the value of native plants for soil erosion control and climate extreme mitigation. A number of other community-focused climate change orientated projects are concomitantly starting to utilise the findings of this Project. For example, SPC USAID funded "*Disaster risk management and food security: Community based approaches to manage riverbank erosion in Natalau Village*". The future environmental impacts of this ACIAR Project are expected to be considerable, but, at this stage, are problematic to quantify.

Northern Territory:

- Affirmed utility of bush managed native flora, including cycad fronds (ABT, NT DPIF, CDU, Sherrie Wei, UQ).
- Complex regulatory requirements for bush harvested cycad fronds and other native species propagule collection defined and liaison with key agency for permits and advice (NT Parks & Wildlife; 2 people).

8.4 Communication and dissemination activities

Papua New Guinea:

- The project employed participatory approaches, including workshops, mother-baby trial, and field visits, and it generated publications to disseminate information to stakeholders.
- Dissemination of information in regard to floral materials was mostly through NARI open days, Morobe Agriculture shows, and other similar events. Most of the detailed communication was on a one-to-one basis when stakeholders visited FRI and NARI project sites.
- Via its extensive network of growers, PNGWiA also communicated information to provincial and district levels on issues relating to floriculture and agro-industry in general.
- Information was also communicated through the floriculture groups, such as the Morobe Flower association and the Bulolo Floriculture networks, thereby reaching community levels.

Fiji and Solomon Islands:

- In the Fiji component of the project, major communication and dissemination activities occurred within the landscaping industry and with traditional villages.
- The project also supported 6 workshops, training over 200 growers and marketers of floriculture products.
- The '*Fiji Floriculture Handbook*' was published with project support to SSO. The '*Fiji Gardner's Guide*' was also developed.
- Findings of the project were presented at conferences in China and Brisbane; e.g. IHC 2014.
- In SI, workshops were conducted by Ms Jane Hintze on postharvest quality management and by Prof Sherrie Wei on supply chain management.

Northern Territory and Queensland [Top End]:

- ABT provided training and guidance in floriculture and floristry to indigenous players in the Darwin region.
- Brochures and activity reports were published and distributed.
- Findings of the project were presented at conferences; e.g., IHC 2014 in Brisbane.
- Overseas RHD students were advised and gained their PhDs, and visiting scientists were supported to work on improving Acacia vase life.

9 Conclusions and recommendations

9.1 Conclusions

The overall aim of this multifaceted project was to identify constraints and opportunities for indigenous enterprise development through floriculture in Indigenous Australian and Pacific Island communities. This complex project has achieved the overarching aim in the light of the three stated objectives in each of the NT, PNG, Fiji and SI. That is, it has progressed (i.) identify and analysing floriculture value-chain arrangements and opportunities, (ii.) providing (where quarantine requirements permit) new and improved products and practices to floriculture enterprises, and (iii.) strengthening floriculture enterprises by building horticultural and business skills and fostering a positive environment.

Value chain opportunities and constraints were identified through activities on (a.) working closely with the drivers of selected supply chains in individual countries, (b.) assessing value distributions and approximating profit margins among chain partners, (c.) researching market requirements (viz., local markets in Fiji and SI, interstate markets in Australia and PNG), and (d.) works on business skills by project partners and consultants.

In PNG, Fiji and SI, floriculture enterprise development has been fast growing. Opportunities are evidenced in multiple cases where many women diversified and / or changed their career, especially among teachers and government officers, into profitable floriculture to improve household income. This trend is accompanied with women's and girls' empowerment and equality among the relatively male dominant societies. Moreover, there are allied potential health benefits (Ross et al., 2015). Value chain analysis showed that informed drivers (e.g., SSO in Fiji, various florists in PNG and SI) are vital to motivate, co-ordinate and even train their grower partners. In the PNG, value chains from the Highlands to Port Moresby for temperate flowers have possibly the greatest potential once requisite handling logistics are in place. A simple cool storage set up by NARI towards the end of the project should improve cool chain management over time for those chains that make use of the facility.

In the NT, tropical floriculture enterprise development opportunities generally lie in the local market, although a few growers were able to work around the high freight issue and send to southern markets and, occasionally, to overseas markets. For wild harvest by Indigenous communities, some as yet unrealised opportunities exist for supplying wild seeds and whole plant to landscaping companies. For cycad fronds in particular, limited opportunities are there only if the communities can bulk-up supplies, which was proved difficult, to achieve economies of scale to reduce freight prices to southern markets. This finding also highlighted the fact that, despite many decades of support from the NTG, the floriculture industry in the NT was not progressing well. It relies on support from DPIF for market information and new varieties, and this support has been reducing over time. Operational costs are impacting greatly on the feasibility of supplying southern markets, and the few growers still operating need to cooperate more through the Cut Flower Association in order to be able to negotiate reduced freight prices. One recent community impact in the NT has been that growers came together to try and reinvigorate the Cut Flower Association to get information from DPIF about Fusarium wilt and market direction.

In conclusion, this project has generated economic benefits to private floriculture stakeholders (viz., wholesalers, florists and growers especially in Fiji, SI and PNG), research capacity building to public stakeholders across partners, environmental benefits (most pronounced in Fiji in the context of landscaping and conservation), as well as social benefits in terms of women's and girls' empowerment among South Pacific partner countries. Technical spin-offs that have occurred include women growers extending their skills acquired from growing flowers into vegetable crops. Economic spin-offs that have

occurred are women florists extending their business skills acquired from marketing floriculture into venturing other businesses, such as handicrafts and ecotourism.

9.2 Recommendations

Papua New Guinea:

- The current project's achievements and outputs provide a strong foundation for future research, development and capacity building in floriculture to realize the inherent potential of commercial flower production in PNG. Enabling continued support by the partners, NARI, FRI, and PNGWiA, in the present project to institutionalise floriculture and to secure further funding is critical for continuity beyond this project's life.
- FRI and NARI are demonstrably capable in terms of emerging skills and increasing infrastructure to contribute to improving germplasm for distribution to growers.
- These same organisation are skilled and empowered to address and assist with importation requirements in terms of facilitating germplasm enhancement for the industry.
- There is inherent diversity in PNG's native flora to identify novel herb, shrub and tree candidates for ornamental horticulture from floriculture to landscaping. An enabling focus on developing practical propagation techniques is important in this context.
- In a postproduction context, the project partners have need to develop new and / or promote established postharvest procedures for local germplasm on domestic markets such that they becomes standard practice.
- Largely unrealised potential for floriculture, including of temperate species, exists in cooler Highland regions of PNG. Both temperate and also sub-tropical and tropical species grown in PNG could find places on regional and distant international markets.

Fiji and Solomon Islands:

- For the Fiji and SI, a common language for quality standardisation relevant to the individual value chains could be useful.
- It would also be beneficial to explore ways for growers to better collaborate with each other building on the achievements to date by SSO in Fiji. The benefits could include joint purchasing of farm inputs, better access to new and improved floristry material, collaboration for handling and logistics, and, ultimately, improved profits and livelihoods.
- In Fiji, the largely unrealised potential to use attractive native plant species in landscape applications was clearly demonstrated and merits further exploration and realisation.

Northern Territory and Queensland [Top End]:

- Joint ventures to support Indigenous involvement in business development.
    - Aboriginal people own over 50% of the land in the NT and would benefit greatly from local, wildlife based enterprise. Joint ventures between Aboriginal groups and companies with established markets and value chains who can mentor and encourage Indigenous involvement would make a difference.
- Cooperating to compete.
    - For small scale Indigenous enterprises to compete will require development of effective branding or certification, functioning producer associations and

joint ventures; also, careful identification of long shelf life products for niche markets and the formation of cooperatives.

- Appropriate support and mentoring for Aboriginal stakeholder groups.
    - Acceptance that ontology, remoteness, language and culture will impact upon business development and connection to markets. Conventional drivers of business may not be the same in Aboriginal communities and different extension, community engagement and support mechanisms are needed to initiate business.
- A greater focus on local markets.
    - Demand for cut flowers is limited domestically as population numbers are low. Extractive industries are increasing in the NT along with development. Thus, there is likely to be demand for native seed for revegetation as well as native plants like cycads for landscaping. Greater focus on these local niche floricultural opportunities with limited transport costs could feasibly allow for greater profit.
    -
- Different models of business structure (value chains).
    - There is opportunity to learn from the way other countries structure their value chains to avoid competition (i.e. Taiwan's Orchid Supply Chain).

- Government support to negotiate joint ventures in the context of commercial partnerships.
    - Use of, in the light of the Convention on Biological Diversity (CITES), PBR registration as basis for commercial agreements with partners interested to grow Australian natives. Invest in developing new hybrids that can grow in the tropical Top End of Australia and which will find a place on world markets. Australia has great plant biodiversity, and the numerous species that could do well in monsoonal northern Australia merit further investigation.
    - Continued R&D in new varieties and disease control. Creating hybrids can allow cut flower business to be competitive. Continued investment is called for in this area accompanied by stronger government support and collaborations to share generic resources, including for research knowledge on overcoming disease (e.g *Fusarium* wilt).

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10.2 List of publications produced by project

Published Papers:

1. Che-Husin, N.M., Gupta, M.L., George, D.L., Joyce, D.C., and Irving, D.E. (2013) Gel occlusion in the xylem vessels of cut *Acacia holosericea* foliage stems. Acta Hort. 1012, 369-373. (Abstract included in Appendix E)
2. Ratnayake, K., Joyce, D.C., and Webb, R.I. (2013) Cu2+ inhibition of gel secretion in the xylem and its potential implications for water uptake of cut *Acacia holosericea* stems. Physiol. Plant. 148, 538-548. (Abstract included in Appendix E)
3. Stice, K.N., Tora, L.D. and McGregor, K. (2013) Increasing demand for native plants in Fiji's ornamental horticulture sector. Acta Hort. 977, 363-368. (Abstract included in Appendix E)
4. Wei, S. (2013) Improving livelihoods through floriculture out-growing scheme - The Koroipita Village in Fiji. Acta Hort. 1006, 405- 410. (Abstract included in Appendix E)
5. Wei, S., Joyce, D. C., Sar, S., and Singomat, N-B. (2013) Developing floricultural supply chain strategies - Papua New Guinea case study, *Socioeconomic Agricultural Research in Papua New Guinea,* ACIAR Proceedings No. 141, Canberra, Australia. Australian Center for International Agricultural Research. pp. 84-93. (Abstract included in Appendix E)

6. Rafdia, H.H.M., Joyce, D.C., Lisle, A., Li, X., Irving, D.E., and Gupta, M. (2014) A retrospective study of vase life determinants for cut *Acacia holosericea* foliage. Scientia Hortic. 180, 254-261. (Abstract included in Appendix E)

Draft Papers for Journals:

1. Husni H. M. Rafdi, Joyce, D.C., Irving, D.E., and Gantait, S.S. Citric acid improves the vase life of and hydraulic conductance in cut Acacia holosericea stems. Draft for submission to Postharvest Biology and Technology.

2. Husni H. M. Rafdi, Joyce, D.C., Irving, D.E., and Gantait, S.S. Effects of citric acid with Cu2+ and sucrose on the vase life of cut Acacia holosericea stems. Draft for submission to Postharvest Biology and Technology.

Papers Submitted for Publication in Acta Hort. Post-'IHC 2014', Brisbane:

1. Burness, D., and Stice, K. (----) Floriculture and livelihood development in Fiji.

2. Gorman, J., Cunningham, A.B., Wei, S., Marscik, D., and Hoult, M. (----) Factors influencing the growth of the floriculture industry in the wet/dry tropics of the Northern Territory, Australia. Acta Hort. (Submitted)

3. Hoult, M., Marcsik, D. and Traynor, M. (----) Developing underutilised endemic flora – A simple model for selecting potential species and overcoming key technical constraints.

4. McGregor, K., Stice, K., and Tora, L. (----) Post-cyclone coastal landscape rehabilitation using native species.

5. Ratnayake, K., and Joyce, D. (----) Xylem plugging and postharvest longevity of cut *Acacia holosericea.* Acta Hort. (Submitted)

6. Sar, S., Tomi, B., Kiapranis, R., Singomat, N-B., Poienou, M., Linibi, M., and Joyce, D. (----) Engaging stakeholders using floriculture to improve livelihoods: A Papua New Guinea perspective. Acta Hort. (Submitted)

7. Wei, S., and Joyce, D. (----) Floricultural value chain case studies from Fiji, Solomon Islands and Papua Guinea. Acta Hort. (Submitted)

11 Appendixes

Appendix A - Factors influencing the growth potential of the floriculture industry in the Monsoonal tropics of the Northern Territory, Australia.

Appendix B - Walking the Goroka to Port Moresby floricultural value chain in Papua New Guinea.

Appendix C - The Solomon Islands floricultural value chain - Comparison with Fijian floricultural value chain.

Appendix D - Floricultural value chains in the Solomon Islands revisited.

Appendix E - Abstracts of publications produced by the project.

Appendix F - Draft Gardners' guide Fiji.

Appendix G - ABT Cycad Handbook.

Appendix H - Cycad frond vase life studies

Appendix I - *Zingiber* and *Curcuma* agronomy studies

Appendix J - NT native plant studies