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Final report

project

Improving silvicultural and economic outcomes for community timber plantations in Solomon Islands by interplanting with *Flueggea flexuosa* and other Pacific agroforestry species

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1 Acknowledgments

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Finally, the people of Solomon Islands who have welcomed us into their villages, tolerated our mistakes and worked with us to achieve our goals, to them a very special Thank You.

2 Executive summary

Solomon Islands villagers have been encouraged to plant high value timber trees, mainly teak (*Tectona grandis*) and to a lesser extent mahogany (*Swietenia macrophylla*). In order to grow commercially valuable trees, they must be planted at a high initial stocking density so that the competition for sunlight promotes rapid height gain and slim straight stems. However, as the trees grow the demand for water and nutrients from the soil grows as well and the trees start to compete with each other for the available resources. Growth slows and at this point it is necessary to start removing some of the trees (thinning) to allow the remaining trees to grow. In Solomon Islands, as elsewhere, thinning is very unpopular, growers cannot understand the need to remove trees they have spent years growing and cannot sell.

The project was commissioned to find a solution to this problem that is typical wherever trees are grown. Part of the problem is that each teak tree is perceived as being valuable and there is no history of local use. Thinning the trees has therefore no practical advantage to the grower. The project has developed an alternative system for growing high value trees that mixes the high value species with an indigenous tree (*Flueggea flexuosa*) that is widely used in villages for housing and construction. Growers plant two of these local trees for every teak tree but progressively harvest the local tree for their own use, effectively thinning the stand and allowing the high value timber to reach mature size.

Research into the silvicultural management of this novel system for growing teak was needed before it could be introduced to community growers. The project developed a series of trials designed to look at the effects of different ratios of teak and flueggea and the impact of spacing on growth and form. These trials were established in April 2009 and by the end of the project in April 2012 were showing that the trees are compatible in a mixed species system and giving confidence that this is a workable system that can be introduced into communities. Further research on the growth characteristics of both species has been undertaken through the establishment of higher density planting trials established in April 2010 and a comprehensive spacing trial involving a Nelder design that was established in January 2011.

These research trials do not help growers with established plantations to overcome their reluctance to thin their trees and a series of 5 thinning trials, designed to demonstrate the effect of thinning on the growth of the remaining trees, have been established in Western Province, Malaita and Guadalcanal. These trials have shown a response to thinning, though probably due to the age of the plantations, it was not as immediate as would be expected. Further trials with a more aggressive thinning regime are required to fully understand the implications of the results. One of the problems facing such trials in a country with poor transport infrastructure is that the impact is localised with few growers aware of the results beyond the immediate vicinity.

This problem of communicating results and ideas prompted the involvement of the Solomon Islands Association of Rural Training Centres (SIARTC) in the project. Rural Training Centres (RTCs) are situated throughout Solomon Islands and draw their students from across the Islands. Demonstration trials at RTCs expose students to the mixed species system and they take the ideas with them when they return home. The mixed species system was also well suited to utilising the traditional practice of agroforestry, where food or cash crops and trees are grown on the same land at the same time. The RTCs have been the ideal place to demonstrate this with students involved in growing a variety of crops within the demonstration trials. The project has produced booklets in both English and Solomon Islands Pijin for the students to use.

Solomon Island teak must compete in the global market and there is a general perception that plantation grown teak is inferior to ‘natural’ teak. The project commissioned a series

of tests to examine the qualities of the Solomon Islands timber of 3 age classes and to compare with young Queensland teak of a similar age. The flueggea was put through a smaller series of tests to examine its commercial potential. Results showed that older age class SI teak compared favourably to natural teak and verified the suitability of SI plantation-grown teak in all traditional applications. Flueggea also performed well and has potential for flooring and cabinetry though it would benefit from careful tree selection to breed out a tendency for shrinkage.

Social research into the interactions within villages where Teak is grown and the potential social and economic impacts of harvesting a potentially valuable resource has been undertaken in parallel with the silvicultural research. This has provided valuable insights into the power sharing and decision making processes within widely varying village communities and the insights gained will guide the next project as it moves from the system development phase into introducing the agroforestry systems into the communities.

3 Background

For many years, Solomon Islands (S.I.) has been financially dependent upon logging with the export of timber harvested from native forests accounting for up to 70% of the country's GDP. There are limited opportunities to replace this income source as these revenues inevitably decline with the over-exploitation of the forest resource (Allen, 2011). The only other major income generating activities are tuna fishing (also in decline) and mineral resources, with mining exploration burgeoning throughout the provinces. Commercial production forestry is limited to 2 plantation operations in Western Province, Eagon Pacific and Kolombangara Forest Products Limited (KFPL), but these are very small in scale, amounting to around 24,000 ha in total, compared to the total plantation estate in Australia of over 2 million ha. These activities provide limited opportunity for the 85% of the S.I. population who live in rural areas to partake in income generation and to lift themselves beyond the level of subsistence farming.

Smallholder forestry has the potential to provide substantial foreign income earnings to S.I. while providing a regular and sustainable livelihood for the rural population. Teak in particular is a highly sought after timber that has maintained its value throughout the global economic downturn. Current prices quoted on an on-line trading site (http://www.alibaba.com): for round logs – US$500-800 per cu m., and for square stock – US$ 1600-3800 per cu m. However, these prices are for logs of larger diameter (60-100 cm). The size of the total smallholder plantation estate in S.I. is not known but was estimated at around 4500 ha in 2006 with an expectation that the estate would expand by 500 ha annually. If harvesting of mature plantations were at the same rate of 500 ha per year there would be a potential of around 250,000 cu m. of teak for export with a value in excess of US$ 125 million per year.

Individuals and communities scattered throughout S.I. have been establishing high value timber plantings over the past 15 years. The species planted is predominantly Teak *(Tectona grandis*) though Mahogany (*Swietenia macrophylla*) is also planted, especially in areas with shallow, coralline soils. These plantings range in area from a few trees to several hectares. In general they were planted at a 4m x 3m spacing, standard plantation practice that forces the trees to compete with each other for light and therefore produces straight, commercially desirable stems. However, this system requires a systematic thinning regime to remove poorer quality stems and remove competition pressure from the best 250 stems, allowing them to grow through to a size that commands a premium price. Growers in S.I. have been reluctant to thin any of the trees from their plantings believing that they will lose money as each tree has a potentially high value. As a result, plantings have become overstocked with trees competing against each other for nutrients, water and light with growth reduced to a minimum. These unmanaged plantings can never achieve their true potential, the growers will never attain the economic return they expect and in many cases will find it very difficult to find a market for the trees they have.

The project was established to find a viable alternative to this planting system that would allow growers to plant high value timbers such as Teak in a way that would encourage thinning and that would also lead to better management of the land allowing for continuous cropping or income generation throughout the life of the plantation. The focus of the research became a mixed species planting system whereby the Teak was planted at close to the final stocking rate with a local tree, *Flueggea flexuosa*, planted between the rows to force the Teak to adopt the straight form needed. As the trees grew and competition for resources slowed the growth of the Teak, the Flueggea would be progressively thinned to be used locally for construction and fencing or to be traded to neighbouring communities. Planting of food and cash crops in the inter-row would allow for the continuous generation of food or income from land.

The project also had to address the problems faced by growers who had established and overstocked plantations by demonstrating the improvements in growth that could be achieved through adopting a thinning regime. We established thinning trials at various locations on Guadalcanal, Malaita and Western Provinces so that we could measure the response of the trees to thinning and to develop the data into growth models to give growers a reasonable estimation of the expected returns, based on the silvicultural management of their plantings.

The value of the S.I. Teak is also dependent upon the quality of the timber. Long rotation (70 years) timber commands the premium price while shorter rotation timber, typical of the Solomon Islands, is considered not to have the same quality (Coillte Consult. 2006). We therefore commissioned a comprehensive timber testing program for three age classes of S.I. Teak in order to establish the comparative quality of what has become a separate provenance of *Tectona grandis*. We also tested three size classes of Flueggea to assess its suitability as an export timber and one age class (6 years) of Teak grown in far north Queensland for comparison with S.I. Teak.

In order to gain a full understanding of the potential economic impacts of the project, it was necessary to locate the economic effects within a social context, which analysed the social relationships amongst community members, and identified patterns of authority over decision-making, and where the rights over the distribution of benefits were located. A social research team was established involving researchers from Griffith University and the University of Queensland, aided by a married couple from S.I. who acted as guides and translators. The team established relationships with communities on Guadalcanal and in Western Province in order to gain an understanding of the community dynamics under differing social contexts and leadership structures.

In 2009, an addition (Objective 6) was made to the project to promote adoption of similar agroforestry systems in an aboriginal community in northern Queensland as a training and income-generating exercise. We established relationships with the indigenous community of Hopevale located approx. 200 kms north of Cairns in Queensland with the plan to establish a similar mixed species trial using Teak inter-rowed with *Eucalyptus pellita.* The trial was to be used as a demonstration activity but also, in conjunction with the Australian Agricultural College at Mareeba, was to be used as a training ground for younger community members interested in learning silvicultural management to gain jobs with the establishing Teak plantation industry in the area.

The project related directly to two priorities identified for Pacific Island countries in ACIAR's 2006-07 Annual Operational Plan:

- Domestication of multipurpose trees for forestry and agroforestry, including selection of suitable germplasm and silvicultural management
- Value-adding processing of forest products

4 Objectives

The broad aim of the project was to enhance the economic contribution that the emerging timber plantation industry will make to the Solomon Islands economy, whilst increasing smallholder income security, by the use of silvicultural systems incorporating inter-row plantings with shorter rotation species. To achieve this aim the project had six specific objectives:

Objective 1: To design silvicultural regimes, involving interplanting with *Flueggea flexuosa* and other Pacific agroforestry species, that are likely to deliver a high quality furniture-grade timber log while also providing an early return from the associated crop.

Objective 2 To support the educational and extension activities of the Forestry Division, SICHE and SIARTC through the promotion of an agroforestry-based system of community timber planting involving optimal silvicultural regimes

Objective 3 In collaboration with industry partners, to examine the potential of furniture-grade timber and agroforestry species for the production of solid timber products that are in demand in significant international markets, e.g. Australia and India, and which may be capable of being produced in small local processing facilities;

Objective 4: Investigate and promote local applications for *Flueggea flexuosa* and other agroforestry species, and enhance awareness of the product potential of these species, especially in Pacific and Australian markets, thus increasing 'market pull' for the greater use of these species in productive silvicultural systems. Examine the economic rationale behind reducing the plantation age of furniture-grade timbers such as teak or rosewood.

Objective 5: Conduct socio-economic analysis of the effects of the adoption of these systems on smallholder and community economies with particular reference to effects on resource exploitation, social outcomes and poverty alleviation.

Objective 6: To test and promote the use of mixed species, agroforestry systems to increase community welfare through the provision of training and employment opportunities within indigenous communities in Northern Queensland.

5 Methodology

The choice of trial sites has been determined by 2 major factors. The first was land-ownership which can be a source of considerable friction in Melanesian society. We therefore chose to establish trials on un-encumbered land with clear ownership by either the S.I. Government, Schools (either state or church owned), Rural Training Centre's (RTCs) (usually church owned) and land belonging to KFPL. The second consideration was access to the labour and expertise required to establish and maintain the trials. In particular, the larger mixed- and mono- species spacing trials required a knowledgeable and skilled workforce. For this reason Kolombangara was the ideal choice for these trials and RTCs ideal for the demonstration trials.

5.1 Silvicultural trials

5.1.1 Mixed species spacing trials

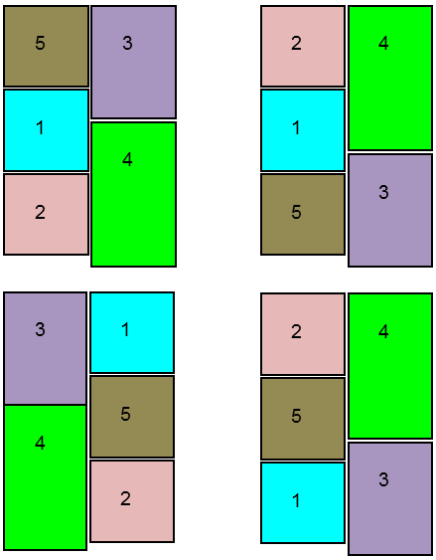

Figure 1: Trial Layout

Fully replicated mixed species spacing trials were established at Ringi and Poitete on Kolombangara and at Tenaru, Guadalcanal. Trials sites on Kolombangara were chosen because of the availability of land and expertise for the establishment and maintenance of the trials. The locations at Ringi and Poitete reflected two different soil types for direct comparison and also the Poitete site was near the site of the Forestry Training institute, run by the S.I. College of Higher Education, School of Natural Resources and therefore easily available to the trainees. The Ringi site was on land owned by KFPL and set aside for scientific trials. The site at Tenaru was chosen because of the different climatic conditions on Guadalcanal, which has much more distinct wet and dry seasons than Western Province, and because the Forestry Training Institute at Poitete was closed due to building failure and the trainees moved to Honiara, Guadalcanal. Providing the same mixed species trial at Tenaru was an opportunity for the Forestry trainees to continue to have access to one of these trials.

The trials were laid out as 4 replications of 5 treatments (Figure 1):

- Treatment 1: Teak planted at 4 x 3 m spacing (833 stems per hectare)
- Treatment 2: Teak inter-planted with 2 rows of Flueggea at 4 x 3 m spacing
- Treatment 3: Teak inter-planted with 2 rows of Flueggea at 4 x 4 m spacing (625 sph)
- Treatment 4: Teak inter-planted with 2 rows of Flueggea at 4 x 6 m spacing (416 sph)
- Treatment 5: Teak inter-planted with 1 row of Flueggea at 4 x 3 m spacing

The trials at Poitete and Ringi were established by KFPL staff under the guidance of Vaeno Vigulu (Forest Manager) and Figert Roger (Mensuration Manager) and with the assistance of the Forestry officers based at Munda. All measurements of the trials are undertaken on a 6-monthly basis by the KFPL forest measurement teams, paid for by the project. Litterfall samples have been collected for 18 months on a monthly basis.

The trial site at Tenaru is in the grounds of St Joseph's Catholic High School with the intention of involving the students in some of the activities related to the management and

measurement of the site. The site preparation work was carried out be private contractor while the planting and initial maintenance was by school students and forestry trainees.

5.1.2 Mono-species spacing trials

The mono species trials were established in the KFPL scientific area at Ringi on Kolombangara and at Tetere Prison Farm on Guadalcanal. We chose the KFPL site because of access to a skilled labour force and proximity to the other scientific trials. Our involvement with the Prison Farm stemmed originally from an idea to establish a working mixed species agroforestry trial there which would be maintained by the prisoners and used as an educational and rehabilitation resource. It since transpired that the lack of suitable prisoners for an open farm was such that there was not enough labour force to go around and we decided to use the land for a low maintenance, mono species spacing trial for Teak and Flueggea which would be accessible to Forestry trainees in Honiara.

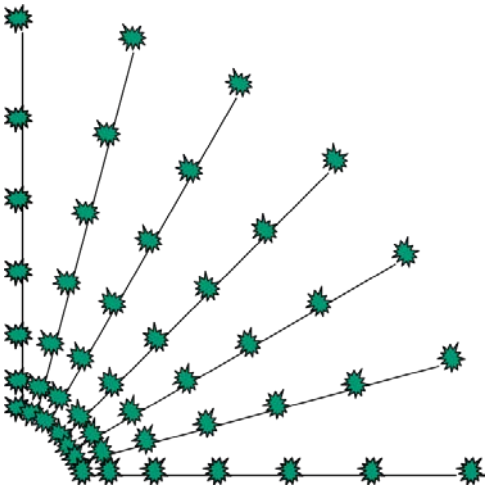

Figure 2: Nelder Fan Design

The design used was based on the work of JA Nelder (1962) who described an experimental layout in which trees are planted at the point where linear spokes intersect with the concentric arcs in a wheel or fan design (Figure 2). Using this system it is possible to plant trees at many differing densities within the same experimental area. For the sake of the KFPL experiment the planting densities along the arcs of the fans ranged from 6233 sph in the centre to 78 sph at the outer arc with a total of 15 different densities represented. The experiment was laid out as a complete circle with alternating quadrants of Teak and Flueggea. In half of the circle we encouraged the growth of a locally occurring legume, *Centrosemas pubescens*, in the other half the legume was excluded. This therefore allowed us to examine the effect of biological nitrogen fixation on both species. The experimental set up at Tetere was different with a half circle of Flueggea and 2 quarter circles of Teak. Spacing densities ranges from 1110 sph in the centre to 7 sph at the outer ring.

The KFPL trial was established as part of the research into intra- and inter- specific competition in agroforestry systems being undertaken by Vaeno Vigulu, a John Allwright Fellow, for his PhD. Vaeno is studying at Griffith University under the project coordinator Dr Tim Blumfield. The trial is measured by Vaeno during his field visits and by the KFPL staff when Vaeno is absent. Foliar litterfall has been collected and stored by KFPL staff on a monthly basis for the first 18 months of the trial. It is then sorted, weighed and sub-sampled by Vaeno during his field work periods.

5.1.3 Community-based mixed species spacing trial

Initial results from the mixed species trials at Poitete and Ringi suggested that Flueggea did not keep up with the height growth of the Teak and a possible answer to this may be in planting the Flueggea at a higher density. The villagers of Saika in Vonavona lagoon, Western Province were keen to be involved and cleared a one hectare site for us to establish a trial where Teak was planted at the density of the other trials but Flueggea was planted at twice the density (2m x 3m spacing) giving an initial stocking rate of 1666 sph. The trial was split to allow for 2 thinning regimes to examine the effect of thinning on such a high density planting.

The area was laid out by the Munda Forestry officers who were there to assist in the planting. The trial is measured on a 6-monthly basis by Munda Forestry and half of the

trial has been thinned after 18 months by removing the Flueggea rows that were on either side of the Teak row, effectively bringing the Teak back to the normal 4m x 3m spacing. In the other half of the trial the thinning will be held back until 3 years after establishment to examine the effects of prolonged competition on the form and growth of the developing teak.

5.1.4 Agroforestry demonstration trials

In a country with very poor infrastructure, few roads and limited transportation it is very difficult for any demonstration trials to have an impact beyond the immediate locality, yet establishing trials over the entire archipelago is not an option. We therefore chose to work with the S.I. Rural Training Centre (RTC) network which is a mixture of church and community based vocational training centres and to establish demonstration trials on their land to be established and maintained by their students. This had several advantages; the centres had a wide geographical spread; the land was not subject to conflicting ownership claims; the students would be involved from the outset and the trials would be established as full agroforestry trials with Teak and Flueggea planted on a 1:2, 4m x 3m spacing (treatment 2 above) with crops to be grown in the inter-row; and students returning home to their villages would carry the idea with them.

Three trials were established to test the idea.

- The first was at Airahu RTC situated about 26 km west of Auki. Staff and students cleared the land which was abandoned farm land, and the trees were planted with the assistance of Shane Tutua, project in-country coordinator, and Forestry officers from the Auki forestry office. The trials have been maintained by the staff and students with the support of the Auki Forestry team. Trials are measured on a 6 monthly basis by the Forestry team.
- The second trial was established at Tambaka RTC in Western Province, about 30 minutes boat ride from Munda. Tambaka was chosen as it had thin coralline soils, typical of many coastal areas in S.I. but a soil type that had thus far not been represented in the trials we had established. On advice from the Forestry Office we established both Teak and Mahogany as the high value crop, inter-planted with Flueggea. Mahogany is reputed to flourish better on the coralline soils due to the shallower, buttressed rooting system, particularly important in cyclone-prone areas. The trial was established by staff and students of the RTC with the assistance of Munda Forestry. The trial is measured on a 6-monthly basis by the Forestry team.The trial has been interplanted with crops such as sweet potato, cassava, cow beans, snake beans, dryland rice, tomatoes and capsicum.
- The third trial was established at St Dominics RTC on Kolombangara. The RTC is located at the northern tip of Kolombangara, about two and a half hours by truck from Ringi. St Dominic's is also home to the Vanga RTC Teacher Training College and was therefore considered essential in the wider dissemination of the agroforestry idea throughout the RTC network. This trial was also established with the assistance of the Munda Forestry team.

5.1.5 High intensity agroforestry trial

The RTC agroforestry demonstration trials have never been intended as scientific trials other than through the regular measurement of tree growth. However, the competition between food crops and trees for the same nutrient and water resources has an inevitable consequence for the growth of both. The RTC trials revealed evidence of nutrient deficiency in Flueggea when grown with sweet potato in the very early stages of site

establishment. It was therefore decided to establish a more formal agroforestry trial with intensive food crop production that would be continuous for the length of the trial.

A 2ha site was cleared at the Ringi, KFPL scientific area adjacent to the Nelder fan site. Teak and Flueggea were planted in alternate rows at a 4m x 3 m spacing (Treatment 5 above). This site was chosen as it had the same soil type and conditions as the other trials for a direct comparison of growth effects. It was also close enough to Ringi for the gardeners to have ease of access. The area was divided into quarters with the villagers involved in growing the food crops requested to grow legumes, (snake beans, peanuts, cow beans etc) only in 2 of the quarters in order to help evaluate the effects of biological nitrogen fixation on the long term sustainability of the system. The site was cleared and planted by KFPL staff under the guidance of JAF Vaeno Vigulu. Gardening was undertaken by family of KFPL staff who were asked to keep a record of the weight of the different crops that have been harvested. Tree growth is measured at 6-monthly intervals by the KFPL measurement team.

5.1.6 Flueggea improvement trial

While not part of the original project design, we were able to assist Dr Shane Tutua in obtaining money from the EU Stabex Funds to establish a Flueggea improvement trial at Poitete. When the second round of funding for the long term maintenance and selection activities failed to materialise, we incorporated the project into our own and have taken on responsibility for its continuance.

While Flueggea has been widely cultivated in countries such as Samoa (Thomson, 2006) where its value in construction of traditional housing is widely recognised, it has never been through any form of selection or improvement in S.I. While we succeeded in sourcing some of the 'improved' seed from Samoa, it proved to have low viability. We have since discovered that Flueggea seed does not retain its viability for very long under the storage conditions available in S.I. Seeds were collected from wild populations in all of the provinces in S.I. with the exception of Isabel (trees were not in seed at the time the collection team arrived). A 2ha site was established next to the Poitete mixed species trial with the seedlings planted in line plots of 8 trees, replicated 6 times. The trees are measured on a 6-monthly basis by the Munda Forestry team, site maintenance is by KFPL staff

5.1.7 Thinning trials

While the major focus of the project has been on developing an alternative to plantation style silvicultural systems for growing high value timber, we were aware of the problems faced by potentially thousands of community growers who already have planted Teak and Mahogany using the plantation system and who are faced with overstocked and under-performing woodlots. However, no data is available on thinning regimes, especially the response of overstocked plantations to thinning though there has been some anecdotal evidence that Teak is not a

Image 1: Sign Board for Thinning Trial, Harasita, Malaita

species that responds well to thinning once growth has been halted through overstocking.

In order to assess the response to thinning of these established plantations we devised a split plot system whereby a half hectare of the woodlot was chosen and divided in half with roughly similar mixtures of trees (size and form) in both halves. In one half we physically removed 3 out of every 8 trees. This is the first of a two stage thinning regime normally practiced in plantation forestry. In the other half we marked the trees that would have been left behind had we physically thinned the trees as we had in the other half. The marked trees and the remaining trees in the other half are then measured for height and diameter at breast height (dbh) on a 6 monthly basis

Thinning trials have been established in the following locations:

- Ughele Village, Rendova Island, Western province
- St Dominics RTC, Kolombangara Island, Western province
- Saikile Village, Roviana Lagoon, Western province
- Nubu, Guadalcanal
- Harasita, Malaita

In each case local forestry office staff have been involved in the establishment of the trials and in the ongoing measurements that occur on a 6-monthly basis.

5.2 Additional research conducted by John Allwright Fellow – Vaeno Vigulu

5.2.1 Interspecific competition

Competition between species is inevitable within a mixed species system and it is important to understand how that competition affects the growth and productivity of all the species involved. This research is therefore using the mixed species trials described above at Ringi and Poitete to model the interactions between the species at different densities and planting mixtures. The community trial at Saika is also part of this research. These plots are also able to provide data on the nutrient status of both plants and soil as a result of competition and regular litterfall, foliar and soil samples have been taken for nutrient analysis.

5.2.2 Root architecture

The way that the roots of species of trees occupy the soil volume is an important consideration in designing mixed species systems. The preferable mixture is to have differing root architecture between the species so that water and nutrients are drawn from different parts of the soil, reducing competition pressure. As part of the research into interspecific competition, the root architecture of both Teak and Flueggea at 3 years has been investigated, a process that involves digging the soil away from the roots and tracing or mapping the major root networks.

5.2.3 Stable isotope tracer experiment

The use of the stable isotope of nitrogen (N), 15N as a tracer gives a clearer understanding of the way that nutrients (particularly nitrogen) are partitioned within a complex system. While 15N occurs naturally in nature, it forms only 0.3663% of N derived

from the air. Using a N source such as ammonium sulphate, a commonly used fertiliser, that has had the 15N component enriched to 10% of the available N allows the researcher to follow the pathways that the N takes when it is assimilated by the various components of the system such as the trees, weeds, soil and microbes. The amount applied is within the natural variation of N in the soil and therefore does not have a fertilisation affect upon the system. In order to ensure that the 15N is not taken up by other plants, it is necessary to isolate the trees using an impermeable plastic barrier to a depth of 60 cm.

A total of 8 isolation plots have been established with 4 each in the mixed species trial and the high intensity agroforestry trial. Each isolation plot contains one Teak tree and one Flueggea. In the mixed species trials weeds are allowed to grow within the isolation plots in the same manner as outside the plots. In the agroforestry trial two of the isolation plots have legumes and two have non-leguminous food crops. Leaf, vegetation and litterfall samples are collected monthly. A mass balance will be undertaken on half of the plots at the end of the experiment.

5.2.4 Biological nitrogen fixation:

Fertiliser is expensive, hard to transport and hard to store in good condition. For long term crops such as trees it makes no economic sense to community growers. There is however a need to maintain the long term sustainability of a mixed species system, especially where food crops are being grown continuously and in the longer term over the span of multiple rotations on the same land. Investigations into the efficiency of biological nitrogen fixation through the use of leguminous food crops in the agroforestry plots or using a locally occurring leguminous groundcover is part of this research program.

5.2.5 Intra-specific competition

Competition between plants of the same species is a driving force behind current silvicultural practices and one of the main reasons that this project came into being. While the main thrust of the project has been to develop a mixed species system, there is a strong recognition of the need to understand the effects of intra-specific competition and to use that understanding to educate growers. The data from both the Nelder fan and the thinning trials will be used to model the intraspecific competition between both teak and Flueggea.

5.2.6 Thinning trials

Results from the thinning trials will be used to model the response of teak to late stage thinning.

5.2.7 Nelder fan

Measurements are taken on a 6-monthly basis looking at diameter at breast height, height and leaf area. Litterfall is also being collected on a monthly basis until 18-months samples have been collected. The litter will be used to monitor the nutritional status of the trees.

5.3 Social research program

The social science research team conducted three field visits between 2008 and 2012.

- In 2008, Professor David Burch and Dr Kristen Lyons (and alongside Dr Tim Blumfield) visited Takaburo (Guadalcanal), Baraulu and Saika (Western Province) for a preliminary visit and pilot study. This included interviews with local government officials, spiritual leaders and community representatives.
- In 2010, Dr Kristen Lyons and Mr Henry Boer (and along with Gideon and Rose Bouro, as translators), conducted interviews, focus groups, resource mapping and transect walks in Baraulu and Saika (Western Province) and a new site on the Guadalcanal Plains. Resource mapping involved community members mapping their village so as to identify infrastructure, natural and other resources, and access and ownership of these resources. Transect walks with community member's enabled in-depth discussion of resource and land ownership, land management and other issues.
- In 2012, Dr Kristen Lyons, Dr Peter Walters and Ms Erin Riddell (and with Gideon and Rose Bouro, as translators) completed a final phase of interviews and focus groups at Baraulu, Saika and the Guadalcanal Plains. Ms Riddell also undertook resource mapping and focus groups in Saika as part of her Masters of Development Practice research at the University of Queensland. Upon completion (December 2012), this thesis will also be submitted to ACIAR.

Research and analysis focused on five themes:

- Patterns of land use and resource access;
- Village level social structure and decision-making patterns;
- Social and economic dynamics;
- Workload impacts associated with system uptake, including the gendered impacts; and
- Processes of learning and education related to land management and use.

This report focused on these themes across the selected sites included in this research: Baraulu; Saika; Guadalcanal Plains; and Takaburo.

6 Achievements against activities and outputs/milestones

Objective 1: To design silvicultural regimes, involving interplanting with Flueggea flexuosa and other Pacific agroforestry species, that are likely to deliver a high quality furniture-grade timber log while also providing an early return from the associated crop

No.	Activity	Outputs/ milestones	Completion date	Comments
1.1	Silvicultural characteristics of agroforestry species	Database of commonly used species, characteristics, usage	2012	We have kept the focus of the operations of this project on Flueggea though other timbers such as Terminalia species are under consideration, particularly in wetter areas.
1.2	Identification of high quality planting material	Stock of viable seed for agroforestry species and access to best available teak material for trial plantings	2012	The Flueggea improvement trial at Poitete is developing well and the first phase of roguing operations is underway to remove all trees with poor growth and form. Measurement data indicates that the Santa Cruz provenance has the greatest potential Teak seed available through the Forestry Dept has proven to be of consistently high quality in terms of growth and form.
1.3	Scientific area establishment, SICHE.	Replicated randomised complete block trials involving species, stocking rates and thinning regimes	Aruligo: dropped following flooding Tenaru established late 2010 Kolombangara Trials at Poitete and Ringii established April 2009	Drought and bushfires have rendered the Tenaru trial ineffective for data gathering though it still exists for use by the students for practical demonstrations of silvicultural operations. It has also been widely cultivated for gardens by the families of school staff and remains a good example of agroforestry Trials at Poitete and Ringii on Kolombangara are well established and are yielding valuable data

1.4	Demonstration area establishment, Rural Training Centres, and Tetere Prison Farm	Establishment of demonstration plots at 3 RTCs	St Dominics established Dec. 2008 Tambaka established Dec. 2008 Airahu established Nov. 2008	The trial at St Dominic's has been completed we have planted additional SI flueggea to make up for the poor performance of the Samoan The trial at Airahu is flourishing with good growth response from the Flueggea after an initial slow start Tabaka RTC has planted Teak, Mahogany and *Gmelina mollucana* as part of their mixed species trial with inter row plantings of a variety of food crops.
		Tetere Prison Farm	2 x quarter circle Nelder fans of Teak and 1 x half circle Nelder fan of Flueggea established at Tetere	Site had to be re-planted due to the effect of drought following initial establishment. A subsequent fire in 2010 removed most of the trees and rendered the data from the site as useless
		Establishment of village based silivicultural trial	Saika Village established May 2010	A one hectare trial has been established at Saika village using a higher density of Flueggea
1.5	Establish thinning trials	Paired plots of thinned/un-thinned teak	2012	Thinning trials have been established at: Ughelle Village, Western Province Saikele Village, Western Province Nubu Village, Guadalcanal Harasita village, Malaita Trials have also been established at: St Dominics RTC, Western Province
1.6	Modelling	Silvicultural prescriptions and yield projections	2012	Silvicultural prescriptions for managing mixed species systems have been incorporated into the agroforestry booklet produced by the project and will continue to be refined as the trials mature. 3 years of data is not sufficient to model the development of a novel approach to growing teak within a mixed species system. Data collected from all trials will be analysed and modelled as part of the PhD of the John Allwright Fellow Vaeno Vigulu.

PC = partner country, A = Australia

Objective 2: To support the educational and extension activities of the Forestry Division, SICHE and SIARTC through the promotion of an agroforestry-based system of community timber planting involving optimal silvicultural regimes

No.	Activity	Outputs/ milestones	Completion date	Comments
2.1	Workshops involving SICHE and Forestry Division staff and trainees for the planning and execution of trial areas	Well designed and replicated scientific experiment with good understanding of principles and outcomes by staff concerned	2012	Initial planning meetings held at SICHE and MoF Involvement of SICHE trainees at Tenaru and Tetere in the establishment and maintenance of scientific trials and thinning trials.
2.2	curriculum development	Curriculum units for use by both RTC trainees and extension workers	2012	Workshops were held with RTC and SICHE staff to develop the content of the units. An internal disagreement in SICHE over the disbursement of EU funding led to the withholding of the curriculum materials that had been developed
2.3	Training workshops for smallholders and community extension workers	Workshops Field Days	2011-2012	The lack of curricular material has reduced the opportunity for the workshops, which were to use this material as a focus for the activities.
	Design and production of training materials	Training manuals in English and SI Pidgin	2011-2012	Agroforestry booklets have been produced in both English and pidgin following a series of workshops involving Ministry of Forestry staff, SPC Land Resources division, N&S Consulting , SIARTC and Griffith University, Included as Appendix 1 and Appendix 2
	End of project workshop	Discussion on the successes and failures of the project	2012	Meetings have been held with SIARTC, Ministry of Forestry HQ staff and Ministry of Forestry staff (Munda)

PC = partner country A = Australia

Objective 3: In collaboration with industry partners, to examine the potential of furniture-grade timber and agroforestry species for the production of solid timber products that are in demand in significant international markets, e.g. Australia and India, and which may be capable of being produced in small local processing facilities;

No.	Activity	Outputs/ milestones	Completion date	Comments
3.1	Source *Flueggea flexuosa* material for testing	Local Flueggea obtained from growers,	2010	Age classes not available as this material is taken from wild populations, material therefore divided into size classes for testing
3.2	Source teak of known provenance and age classes for testing	3 age classes of Solomon Island provenence teak acquired from local growers	2010/11	Teak of different age classes of the Solomon Islands provenance has been sourced from out-growers

3.3	Assessment of teak chemical, physical and mechanical properties	Material tests undertaken	2010/11	The assessment process is completed and the report is included herewith in Appendix 3 of this report
3.4	Assessment of the timber properties of Flueggea and other agroforestry species	Material tests undertaken	2011	Final report published and included as Appendix 3 to this report

PC = partner country, A = Australia

Objective 4: Conduct product market analysis, investigate and promote local applications for Flueggea flexuosa and other agroforestry species, and enhance awareness of the product potential of these species, especially in Pacific and Australian markets, thus increasing 'market pull' for the greater use of these species in productive silvicultural systems.

No.	Activity	Outputs/ milestones	Completion date	Comments
4.1	Analysis of potential market for product based on the results of testing and processing	Undertake research into possible markets for timber based on the results of the testing program	2012	A report on the potential market for Teak thinnings based on the results of the wood testing is included as Appendix 4
4.2	Discussions with Solomon Island and Australian processors market chains for appropriate agroforestry and furniture-grade timber species	Based on Activity 1 enter into discussions with processors regarding suitable end uses for timber	2012/3	The final version of the timber assessment was not handed over until November 2011, 5 months before the finish of the project; it was therefore not possible to engage local or overseas processors with regard to suitable end uses. However, the testing process did involve Australian processors and the results are contained within the report.
4.3	Development of a range of sample products demonstrating the variety of uses in both Australia and the Solomon Islands for the timber	Use timber that has been identified as suitable to manufacture test pieces to demonstrate timber qualities	2012	This has been undertaken at the Salisbury test centre with samples of furniture and flooring for all age classes of teak and for flooring for the flueggea Pictures of test products can be seen in the Wood Properties report in Appendix 3. Furniture made from Teak thinnings has also been produced in the Solomon Islands by a local craftsman to demonstrate that even timber with a large proportion of Juvenile wood is both usable and attractive. Pictures of his furniture are in the Report on potential markets for Teak found in Appendix 4.
4.4	Preparation and distribution of relevant information through trade displays and personal contact	Attend trade displays in Australia and SI with demonstration pieces and information leaflets	2012	While this was not possible due to timing of the release of the report, the final report on the teak and Flueggea is now available and is being used as the basis of an information leaflet which is undergoing production through the Secretariat of the Pacific Community

PC = partner country, A = Australia

Objective 5: Conduct socio-economic analysis of the effects of the adoption of these systems on smallholder and community economies with particular reference to effects on resource exploitation, social outcomes and poverty alleviation.

No.	Activity	Outputs/ milestones	Completion date	Comments
5.1	Initial selection and socio-economic profiling of 3 distinct communities	3 villages selected for inclusion in programmme	Completed June 2008	Takaboru, one of the initial villages was nearly destroyed by flooding in 2009 and the members of the community have scattered to other villages. A replacement village in Guadalcanal has been identified and initial visit taken place Two villages in the Western Province were also selected, Bara'ulu which is a Christian Fellowship Church village, and Saika, an independent village with its own spiritual leader and no established church connections. In total, two visits were made to the Guadalcanal site, and three visits, including overnight stays, were undertaken at both Bara'ulu and Saika villages.
5.2	open-ended, informal discussions and interviews	Information regarding: 1. Current patterns of land use, ownership and control. 2. Changes in land use and the impacts of such changes. 3. Land use development and planning. 4. The analysis of gender issues. 5. Alleviation of problems related to resource limitation.	October 2008	Interviews, focus groups, resource mapping and transect walks, as well as participant observation were all utilised to collect data on these key themes.
5.3	Report to mid-term review	Recommendations regarding the appropriateness of operational procedures	April 2010	A review of progress was presented – both as a presentation and in written format – to the Mid Term review
5.4	Follow up interviews	Identification of changes in previously identified norms	2010-2012	On-going data collection, including interviews, focus groups, transect walks and participant observation at selected sites. A Masters of Development Practice student also completed an additional 4 weeks of fieldwork at one study site – Saika village – and completed a separate report.

5.5	Preparation of socio-economic analysis of the effects of system uptake	Report and journal articles on SI communities and the effects of change	2012	Final report writing completed, and journal articles currently underway.

Objective 6: To establish a mixed species, demonstration planting on land within the Hopevale Community

No.	Activity	Outputs/ milestones	Completion date	Comments
6.1	Nursery	Planting stock for the trial to be established at Hopevale Training towards RTF230103 and RTD20102	2010	The nursery building was completed and handed over to the market gardening operation on the understanding that it would be available for forestry needs
6.2	Establish mixed species trials	Properly prepared and managed mixed species trials and block plantings on Hopevale community land	2010/2011	The area was planted immediately prior to the wet season. Access to the site was limited by the wet season but reports indicate there was substantial flooding. A site visit in March 2011 showed few plants remained viable due to weed infestation but mainly because cattle had been allowed through the gate Enough plants were left to replant on the higher ground but despite assurances this was not undertaken
6.3	Agroforestry systems	Interplanting with food and cash crops Community demonstration and training in principles of agroforestry		The market gardening operation in Hopevale closed down in March 2011 due to a disagreement between the foreman and the CDEP. The failure of the plot to establish also meant that demonstration of mixed tree/vegetable production was not possible
6.4	Training Modules	Training provided by AACC – Mareeba towards RTF230103 and RTD20102		The CDEP program were approached to identify trainees and training requirements but this has never been achieved.
6.5	Promote employment opportunities	Additional opportunities for training in an industry relevant setting		Required successful completion of 6.4

6.6	Collaboration and cultural exchange with Solomon Islands	Exchange visits between Hopevale trainees and Solomon Island training institutions Attendance at Year 4 evaluation workshop		Required completion of 6.4

7 Key results and discussion

As with all forestry research, these are long term experiments, particularly when it comes to developing growth models and predictions of interactions. The nature of this project is such that many of the results will not be fully realised for some time though the work of the John Allwright Fellow, Vaeno Vigulu will have started the process of teasing out the implications of the research. The results presented here are therefore preliminary and will be more fully expounded in the 5 peer-reviewed journal articles and the thesis that will be produced over the next 18 months.

7.1 Mixed species spacing trials

Tenaru trial

This trial was subjected to a prolonged dry period following establishment, necessitating re-planting of the trees that had died. We continued with site maintenance and had started to allow limited gardening by school staff as a means of controlling weeds and maintaining the site but unfortunately a grass fire down the middle section of the site destroyed the integrity of the experiment and we will be able to draw no meaningful data from it. We therefore approached the school and suggested that the area be taken over for staff gardens but that the trees should be left to develop. The last visit to the site in September 2012 has shown that the trees that are left are thriving, especially in the areas being actively gardened. We did notice that pruning is required and approached the forestry section at SICHE and have offered to pay costs of getting the students to the site to prune and spot weed around the remaining trees. We have also determined that we will continue to monitor the site as it is still an active agroforestry site though no longer useful as a mixed species research trial.

It will also be a site where we can undertake future research into the longer term effects of agroforestry on soil microbiological functioning in different climatic conditions than those that exist in Western Province.

Ringgi and Poitete

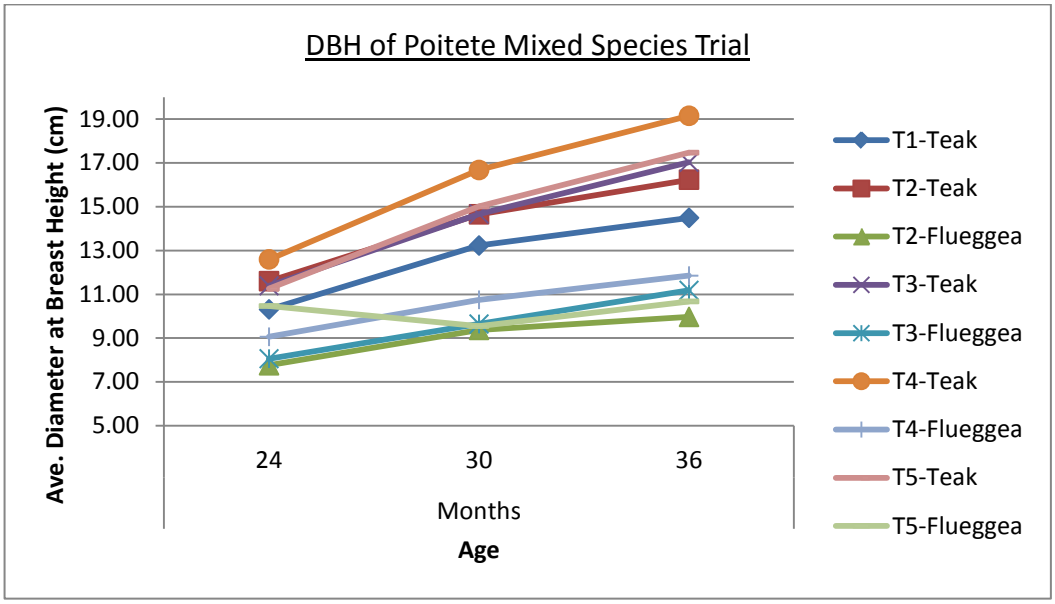

Figure 1: Diameter at Breast Height for Poitete Mixed Species Trial

Both of these trials are well established though there have been some problems with wind-throw in the Flueggea growing in wetter areas. The causes of this may be fungal, may be a consequence of the root architecture or may be as a result of the development of a heavy crown in the relatively open areas of the mixed species trials causing the trees to be top heavy and therefore susceptible in high winds. This will be investigated as part of the examination of root architecture during the supplementary PhD research. As a consequence we are also examining alternate species to Flueggea for growing in water susceptible areas.

Image 2 Ringgi Trial 42 months following establishment

Other than the problem mentioned above, both sites have established well (Image 2) and must be considered to be successful examples of a mixed species system. The trials were established to examine both combinations of Teak and Flueggea (alternating rows or two rows of Flueggea and one row of Teak) and spacing (4m x 3m, 4m x 4m and 4m x 6m). One of the more interesting initial findings was that Teak grown as a monoculture at standard 4m x 3m spacing had the lowest diameter at breast height (dbh) of all the Teak while Teak grown with Flueggea was uniformly higher (Figure 1). Teak and Flueggea grown at the lowest stocking density at the same spacing had the highest dbh, clearly reflecting competition pressure at higher stockings. These results suggest that the two species are complementary in a mixed species trial and also suggests that intra-specific competition in pure Teak stands is significant at the young age of 36 months. A similar result was seen at Ringgi, Figure 2 shows basal area for the Ringgi trial, again there is the clear separation of the 4m x 6m spacing and though less clear than the Poitete trial, the basal area for the pure Teak stand is the poorest performing treatment at 38 months.

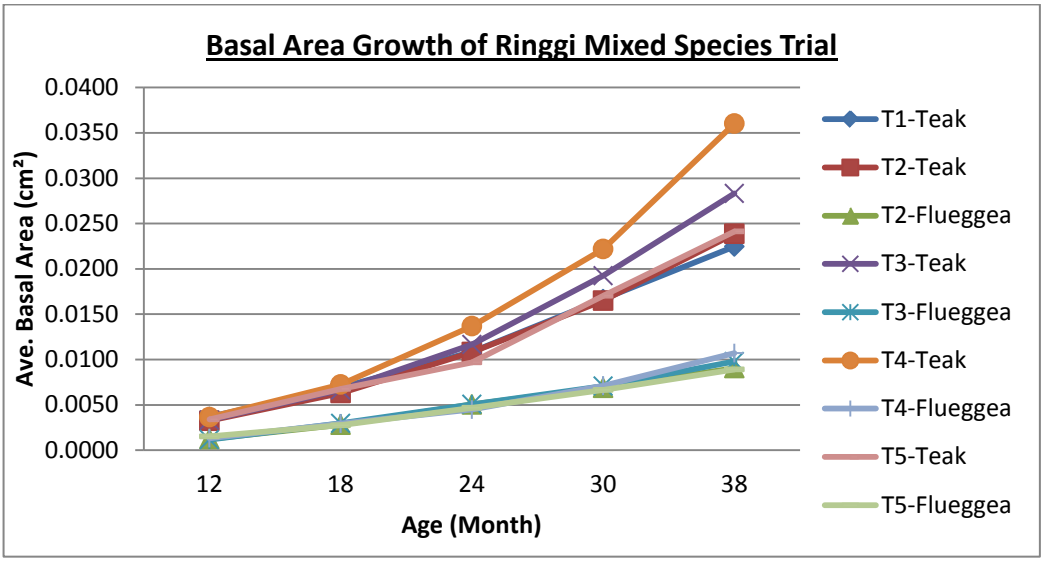

Figure 2: Basal Area at Ringi Mixed Species Trial

Community-based high density trials, Saika Village, western province

Image 3: High Density Trial at Saika

The trial at Saika was established as a response to a perception that it may be possible to plant Flueggea at a higher density in the inter-rows, boosting the growth in height of the Flueggea and thereby improving the form of the Teak which seemed to consistently outgrow the Flueggea at the earlier stages of the other mixed species trials.

Half of this trial has received the first thinning as the competition pressure from the higher density is greater. Initial data suggests reduced growth in both height and dbh compared to either Ringgii or Poitete but as Image 3 suggests, the form of both Teak and Flueggea is good and careful and timely thinning should be able to manage the effects of competition. One of the advantages of using Flueggea in a high density trial is that it is useful as a building material at all stages of growth with the thin saplings used for roofing while the more mature poles are able to be used as the posts to support houses and the major structural elements of the walls.

High intensity agroforestry trials

While much of the research effort has been on the interaction between the 2 timber species being grown, there was an awareness that this system also had to be practical from the farmer's perspective. The demonstration trials within the Rural Training Centres of Tabaka and Airahu have been used to grow food crops in the inter-row during the term time. Cassava, sweet potato, rice, tomatoes, capsicum and beans were all being grown successfully. We also wanted to examine how the system performed under more intensive pressure and planted a 2ha plot with alternating rows of Teak and Flueggea at 4m x 3m spacing with staff from KFPL at Ringgi invited to establish gardens between the trees. Initial cropping has been good (Image 4) and we have asked the staff involved to monitor yields as the trees mature.

Image 4: First Harvest, Agroforestry Trial Ringgi

Isolation plots have also been established in the gardens and the stable isotope ^{15}N is being used as a tracer to examine how the nutrients are partitioned between the various components of the agroforestry system

Rural training centre demonstration trials

Image 5: Flueggea seedling grown amongst sweet potato

While these trials were not designed for scientific evaluation, they nevertheless have provided some key insights into the practical application of agroforestry within this system.

One of the earliest findings was the recognition of competition between species. Image 5 is of a Flueggea seedling being grown in close proximity to sweet potato.

Image 6 was taken some months later, with the same plant after the sweet potato had been harvested and showing obvious signs of nutrient deficiency. It was this that drove the development of the research proposal for the John Allwright Fellowship looking at competition within the system.

Image 6: The same plant some months later

Image 7: Airahu Agroforestry Trial, Malaita

However, the RTC trials also demonstrated how well the system could work as shown by Image 7 of the agroforestry trial at Airahu RTC, Malaita. This picture shows Flueggea on the right with teak to the left with sweet potato being grown between the trees and trellising with beans growing toward the rear of the plot. Other trials have successfully grown a variety of vegetables including taro, corn, dry land rice, beans, capsicum and tomatoes.

7.2 Mono-species trials

Nelder design

This is recently (18 months) established though is already demonstrating the effect of spacing on height, dbh and form, particularly in the Teak. The Nelder design teases out the complex interactions occurring due to competition for available resources. The effects of competition can be clearly seen at the different stocking densities for height (Figure 3) and for basal area (Figure 4).

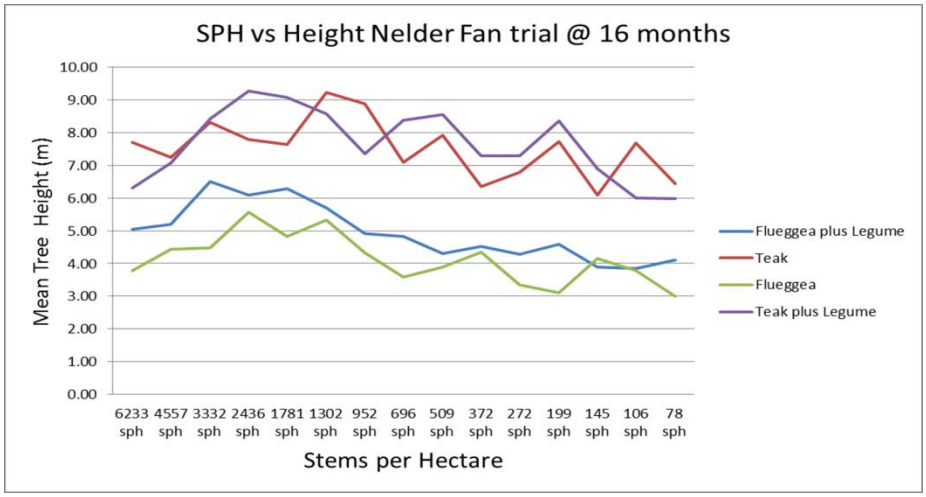

Figure 3: Height against stocking density at 16 months in the Nelder trial

Interestingly the Nelder design clearly demonstrates that the optimum density is not the same for height as it is for basal area and it is this fact that is the basis for the silvicultural management of plantations. The optimal density for height gain in Flueggea is apparently between 1700 sph and 3,300 sph and seems to confirm our own observations which prompted us to establish the higher density trial at Saika to gain greater height in the Flueggea. The stocking density for teak is much broader, ranging from around 1,000 sph to around 3,000 sph. (Figure 3).

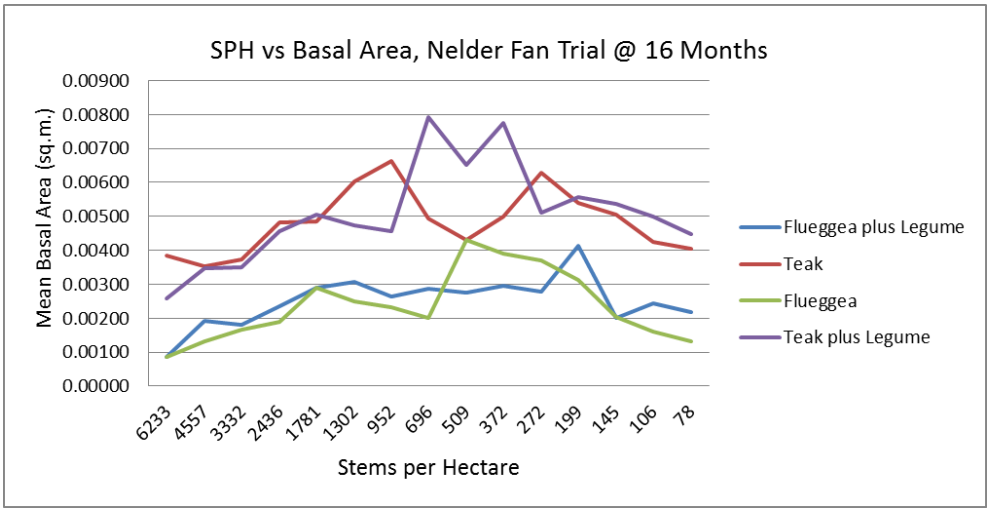

Figure 4: Basal area against stocking density at 16 months in the Nelder trial

The best stocking density for basal area in flueggea is in a very broad range from around 200 sph – 1300 sph and from around 300 sph – 1,000 sph in teak. There is an apparently significant effect with teak from the understorey legume that was allowed to flourish in one

half of the trial area. It will be interesting to continue with the monitoring of this site as the trees mature.

Image 8: Young teak trees showing good early form due to spacing

Image 9: Teak with heavy low branches at the lowest stocking density

One of the other major reasons for establishing a Nelder trial is to monitor the effect of spacing on the form of the trees. High stocking densities generally give a more commercially desirable form as the trees are forced to grow tall and straight as they compete for light. This is particularly noticeable in teak, which forms a straight stem with the large leaves alternating along the stem when it is densely planted (Image 8).

Eventually the competition for nutrients and water in the soil becomes the limiting factor for growth and that is the point where thinning becomes necessary, but the desirable form for the stem should have been achieved by then.

Trees that are planted at a low stocking density have the benefit of both sunlight and soil based resources. While this can translate into higher basal area as was seen in Figure 4, it often also causes problems with heavy low branching which requires high levels of maintenance to prune the tree to the desirable shape but which more often than not results in a tree which can develop multiple stems and of very little commercial value. This is the case of the teak shown in Image 9. This picture was taken on the outer ring of the Nelder trial.

Flueggea improvement trial

While not part of the original proposal, the need for an improved strain of Flueggea has always been evident. Most of the trees grow well in plantation style conditions and the mixture of Teak and Flueggea has proven to be a good one. However, taking seeds from the wild gives rise to high levels of variability in the growth and form of the trees. Seeds were collected from each of the provinces of Solomon Islands with the exception of Isabel (not seeding at time of visit) and in November 2011 were planted in line plots of 8 trees with 5 replications (Image 10).

As Figure 5 demonstrates, there was no real difference in the average height of the provenances with similar results for diameter at breast height. The trees can therefore be chosen on form rather than geographical origin. Badly formed and underperforming trees will be rogued in early 2013 and seeds collected will be used to establish a seed production area on another part of Kolombangara.

Image 10: Flueggea Improvement Trial

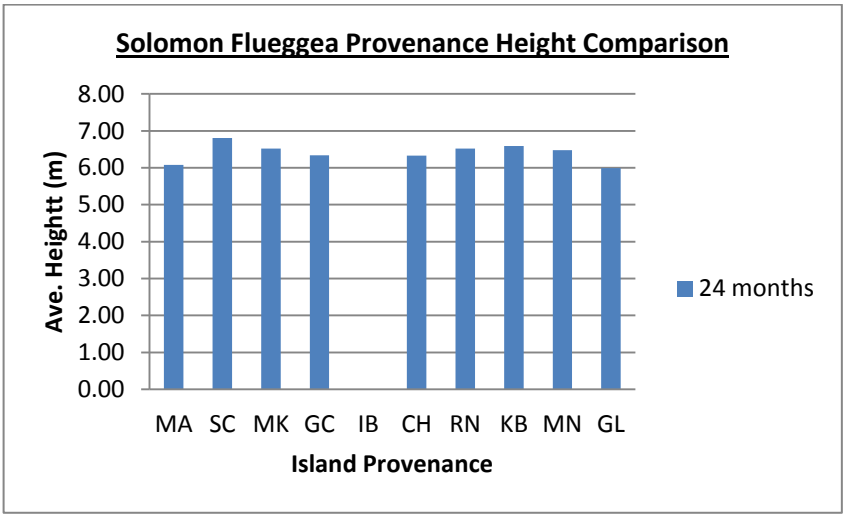

Figure 5: Flueggea Improvement Trial Height Data at 24 Months

Thinning trials

The trials that probably have the most profound implications in the short term are the thinning trials that have been established in Western Province and Malaita. Virtually all of the Teak that has been planted over the previous 10-15 years in Solomon Islands has not been thinned. The reasons for not doing so are many and complex but the most common is the lack of an economic incentive to do so. We prepared a table to demonstrate the economic benefit of thinning that would allow growers to see the relative value of a thinned and an unthinned stand at the end of a 20 year rotation (Table 1), this is included in the agroforestry booklet.

Table 1: Relative prices for logs based on 'at the gate' pricing in Honiara

Diameter	Height (m)	Volume (cu m)	Solomon $ for a cu m	How much you would get
10 cms	10	0.08	$365	$29
20 cms	10	0.31	$525	$165
30 cms	10	0.71	$982	$694
40 cms	10	1.26	$1,050	$1,320
50 cms	10	1.96	$1,120	$2,199

However, it was also clear that demonstration trials were required that would show the response to thinning for established Teak stands. Results have been variable, Figure 6 shows incremental gains basal area for a thinned stand at Harasita, Malaita. The steady gains in basal area for the thinned stand are clear indication of a thinning response while the decline in incremental gains for the unthinned stand equally clearly is a sign that the unthinned area is in suppression. The marked difference between the two treatments with the thinned stand having nearly double the incremental growth of the unthinned stand, has been enough to prompt the grower to start to thin the rest of his stand.

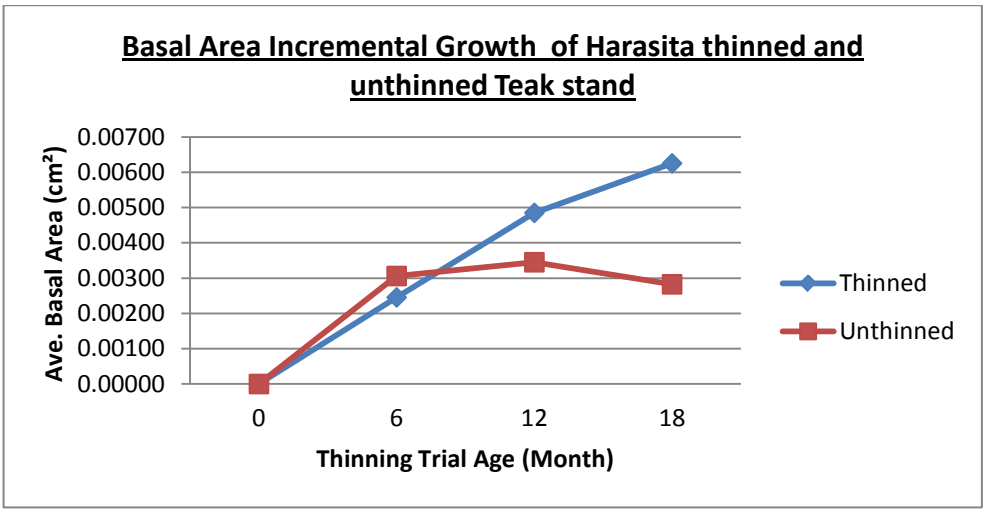

Figure 6: Incremental gains in basal area, Harasita, Malaita Province

A similar trend can be seen from the data collected at Mauru, in Western Province (Figure 7) with a gradual gain in growth increments in the thinned stand, though the separation between the two is not as pronounced.

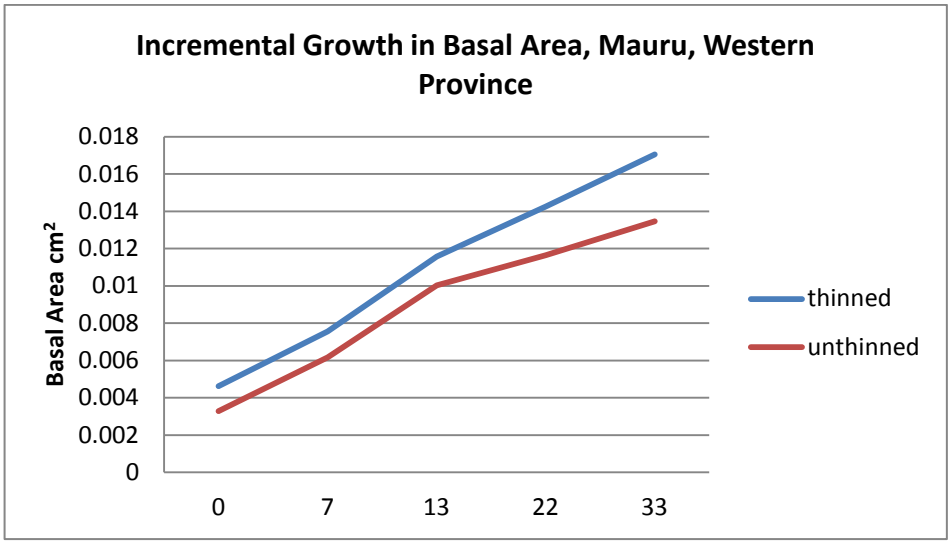

Figure 7: Incremental Growth in Basal Area Mauru, Western Province

Other trials have shown a less pronounced response which may be due to the age of the trees at the time of thinning. Unfortunately, precise data about plot establishment is hard to obtain as few written records were kept by the growers. If age of the stand is a factor, the problem will become more severe over time as the stands continue to be suppressed.

The thinning that was undertaken was equivalent to a first pass pre-commercial thin, with 3 out of 8 trees being removed. Future trials should look at thinning to the final stocking rate of 200-250 sph or removing 5 out of 8 trees. This more radical intervention may be what is required to stimulate a reasonable thinning response in older plantations.

7.3 Social research

Introduction

In order to maximise the positive community, economic and environmental outcomes associated with this plantation forestry project, it is first necessary to understand the social, cultural and political dynamics of communities in which the project is being introduced. Increased understandings of these broader dynamics will assist to ensure the cultural and political sensitivity of project implementation and the conduct of team members, and with outcomes that are likely to more closely resonate with local communities' needs and aspirations. Here we provide a brief summary of some of these dynamics across three sites in the Solomon Islands: Bara'ulu and Saika villages in the Western Province, and the Guadalcanal Plains. Our full report is detailed in Appendices 5 and 6.

The social science research team has conducted three field visits between 2008 and 2012. This included interviews with local government officials, spiritual leaders and community representatives. It has also included interviews, focus groups, resource mapping, transect walks and participant observation with women and men from each of the selected communities.

Key Findings

Decision-making (including related to land use, plantation management etc) is often informed via a system of community and/or spiritual governance. In Bara'ulu, for example, the Spiritual Authority of the Christian Fellowship Church plays a central role in local level decision making. Decision making at both Bara'ulu and Saika also occurs at committee meetings, and with certain individuals and committees demonstrating considerable leverage and authority. Mapping these dynamics is a necessary pre-requisite to understand the extent to which communities have adopted plantation management practices, including thinning and pruning. In some instances, information and advice disseminated via Rural Training Centres and ACIAR staff appears to be inconsistent with broader community development agendas, local governing authorities and spiritual beliefs. Women were also frequently under-represented in these decision making processes.

The introduction and management of teak plantations has workload implications, as well as implications for the division of labour amongst households and communities. Weeding and pruning, for example, were frequently described as time consuming activities, and as such were often avoided, with community members explaining they prioritised their work elsewhere (including in activities related to subsistence and cash food crop production). Teak was also described as not able to deliver in economic terms, circumstances that further reduced community members' motivations to direct their labour in their maintenance.

The demonstration plot at Saika village was also described as being limited in terms of its integration within the broader community; with many community members indicating they had little knowledge of, or engagement in, decision-making related to its management. Many community members also questioned the economic return on this, and other communal teak plantations; citing minimal or no return from the sale of teak.

Key Recommendations

The expansion of mixed species plantation and agro-forestry plantings has the potential to deliver social, economic and ecological benefits to communities in the Solomon Islands. Indeed, many community members in the villages we conducted social research demonstrated early enthusiasm for the ACIAR project – and tree planting more generally – on the basis of such positive impacts. Yet at the same time, the introduction of teak (alongside other tree species) has introduced a new forest management system, new labour and workload requirements, the outcome of which has introduced new challenges and issues for community members, including in some instances driving changes in land tenure systems. As such, many of the communities we spoke with had lost interest in teak as a pathway for community economic development.

In the context of our findings, we conclude that it is imperative to understand the broader socio-cultural contexts in which this ACIAR project is being introduced, to ensure that staff and management systems are cognisant of local level needs and aspirations, as well as being sensitive to the cultural, including religious and gendered practices, of the communities in which this project is being introduced.

We conclude with a number of recommendations to inform on-going work on this ACIAR project:

- Recognise and work with local level governance and decision-making processes to actively enrol community members in the ACIAR project, including demonstration plots.
- Recognise the power brokers in the community (eg. Spiritual Leader and Ministers at Bara'ulu and Spiritual Leader, Community Director, Marama and the Senior Pastor at Saika), that shape decision making related to land management and community labour, and work with these to enrol communities in the project – including related to thinning and pruning activities.
- On-going maintenance of current demonstration plots, and expansion in the number of demonstration plots elsewhere, to provide visible evidence of the outcomes of forest management practices, including thinning.
- Support the expansion of reliable and trustworthy information sources on forest management practices, including their benefits.
- Recognise the value of experiential learning, and find innovative ways to integrate local community members in demonstration plots and other activities related to the project.
- Improvements in the supply of equipment. This includes equipment related to forest management (pruning tools, chainsaws etc) as well as that required to support Forestry staff, the ACIAR research team and other visitor needs. Women identified the need for crockery, thermos and other kitchen equipment to cater for the increased visitors.
- Active inclusion of women and young people in extension activities.
- Acknowledge the diverse needs and aspirations community members articulated – including related to service provision, infrastructure, education, employment etc. Part of the medium and long term monitoring and evaluation of the agro-forestry development project will require assessment of the extent to which these identified community needs might be met via the income generated from the sale of teak and how the project might be altered to assist in delivering on these needs.
- On-going support for the expansion of short and medium-term income generating activities (including thinning); given community members cannot wait 15-20 years before they begin to generate an income through the sale of teak.

7.4 Hopevale agroforestry trial

Hopevale Aboriginal Community is situated north of Cooktown in Northern Queensland. The area is subjected to monsoonal weather patterns with distinct wet and dry seasons that affect access to the community and to field sites. It is an area where teak (*Tectona grandis*) has been grown with established plantations at the Starkey Mission property that adjoins the Hopevale Deed of Grant in Trust land (DOGIT) and at Lakeland 60 kms to the south-west. The project had an established relationship with ITC Forestry, a managed investment scheme company, who had agreed to provide the Queensland teak for comparative testing with Solomon Island teak and who operated both the Starkey and Lakeland teak plantations. It therefore seemed a suitable area to establish an agroforestry trial that would also provide training and employment opportunities for Hopevale youth. We worked closely with Mr Paul Tracey from the Australian Agricultural College Corporation (AACC), Mareeba Campus, who were to provide the training and certification for the trainees.

In consultation with the Hopevale Council, we were given a 3 ha site situated to the east of the township, about 250 m southwest of the end of the airstrip. (Image 10) This area

had previously had a small mixed species planting of teak and mahogany established which would also provide training opportunities in thinning and pruning. AACC provided a draft training plan (Appendix 8) but negotiations were stalled by the Community Development Employment Projects (CDEP) provider, who ultimately held the responsibility for releasing the young people employed by the scheme so that they could participate in the training program. Negotiations surrounding this issue continued for over a year without resolve.

Image 11: Hopevale Trial Site in May 2009

In order to provide some local input and the on-going supervision that we were unable to provide because of the distances involved, we employed a local community member to act as coordinator and follow up the progress of the site. This was similar to the in-country coordination that we used in Solomon Islands. Mr Gerald Hammett, a former forestry worker, was employed on a casual basis to look after the site and keep communications open with the CDEP provider. We also had a great deal of support from the Hopevale CEO, Mr Lee Robinson, who saw this as an opportunity to help provide training relevant to the banana industry which was due to be established within the DOGIT in the near future. Mr Hammett was able to have the site cleared of sickle pod weeds and the fence line cleared with firebreaks to protect the planting. We bought the material for the shade house which was to be used as a nursery for the tree seedlings and then would be given to the community to support the market garden operation into the future.

A change in the personnel in the CDEP office saw a far more promising outlook for the success of the project and the stalled negotiations were re-opened between AACC and CDEP for provision of training. The shade house was assembled by CDEP employees and, with the imminent onset of the wet season which would have delayed planting for a further 3 months, it was decided to plant out the site using a mixture of teak and Eucalyptus pellita which were provided free by ITC, which by then had been taken over by Elders Forestry. Planting took place in December 2010.

Image 11: Hopevale Trial Site May 2011

Site access was not possible until March 2011 due to extreme weather conditions. The visit revealed that flooding had occurred across the central portion of the site and the trees that survived had been destroyed by cattle that had been allowed in. Sickle pod weed had again re-colonised the site (Image 11). It was agreed with the CDEP that the site be slashed and the higher areas of ground should be re-planted with the trees that had been left over and remained in the shadehouse.

A follow-up visit in May showed this had not happened and all attempts to contact the CDEP providers failed. A conversation with AACC, Mareeba revealed a similar story with a breakdown of communication. It was therefore decided to abandon any further attempts to establish a trial at Hopevale as there was less than a year to run in the project and the possibility of success was very low.

8 Impacts

8.1 Scientific impacts – now and in 5 years

8.1.1 Silvicultural trials

The immediate impact of the project has been the development of a novel system for growing high value timber trees. Not all of the silvicultural trials previously reported have survived intact with those on Guadalcanal at Tetere and Tenaru being heavily impacted by drought and bushfire to the point where they will not yield valid data. These trials have been left to the prison farm and school to take care of as the trees left will still have demonstration and potentially commercial values. In the case of St Joseph's School at Tenaru, large areas of the plot have been used as gardens by staff families and we will therefore continue to monitor the plots for interactions between trees and crops.

The revised list of silvicultural trials is as below:

Replicated Spacing Trials:

- Ringii, Western province (established April 2009)
- Poitete, Western Province (established April 2009)

Nelder Design Spacing Trials

- Ringii, Western province (teak, flueggea) (established January 2011)

Community-based Spacing trial

- Saika Village, Western province (high density teak/flueggea trial) (established April 2010)

High Intensity Agroforestry trial (involves community members growing gardens in a teak/flueggea trial)

- Ringii, Western Province (established May 2010)

Thinning Trials

- Ughele Village, Rendova Island, Western province (established January 2009)
- St Dominics RTC, Kolombangara Island, Western province (established September 2009)
- Saikile Village, Roviana Lagoon, Western province (established March 2009)
- Nubu, Guadalcanal (established March 2009)
- Harasita, Malaita (established October 2010)

Rural Training Centre Demonstration Trials

- Tabaka RTC, Western Province (established December 2008)
- Airahu RTC, Malaita (established November 2008)
- St Dominics RTC, Western province (established March 2009)

Flueggea Improvement trial – Poitete (established November 2010)

All trials are measured on a 6-monthly basis (in the follow on project – FST/2012/043) and the data will be used for modelling growth in pure and mixed species stands. These trials also examine the effect of Biological Nitrogen Fixation as an alternative to using fertiliser and in sustaining the long term viability of high intensity agroforestry activity. We have also established a high intensity agroforestry trial at Poitete with families of KFPL staff

growing vegetables among the trees. Some of the results are given in the previous section but, as is the case with most forestry trials, these trials will continue to yield valuable data for many years to come as the trials mature and the effect of spacing and competition for light, nutrients and water increases.

Results from all of these trials will form the basis of the 5 peer reviewed journal articles, 2 conference papers and PhD thesis from the John Allwright Fellowship recipient, Vaeno Vigulu, who will be completing his PhD in early 2014.

8.1.2 Timber testing program

The timber testing program examined a comprehensive series of properties for 3 age classes of Solomon Island Teak, one of Teak sourced from Far North Queensland and 3 size classes of Flueggea. The report is attached as Appendix 3 of this document. This report has also been used in the generation of a fact sheet that was being produced by the SPC – FACT program (Appendix 7) and will be further developed in the next project. Probably the most significant use of this report will happen over the next 5 years as it will form the basis for informational material that will be developed to educate community growers on the real value of the timber resource they control and to promote the quality of Solomon Island Teak to international buyers.

8.1.3 Social research program

The nature of social research is such that it is important to establish baseline data in advance of any impacts that the project may have in the future and also important to document the normal social interactions occurring within the village. There are many differing types of communities and family groupings operating within Solomon Islands and we therefore attempted to have a cross section of community types choosing a village close to Guadalcanal (Takaboru) with an established history of involvement with Forestry and very family oriented. In Western province we established contact with a village that was within the community of the Christian Fellowship Church (CFC), situated in Roviana Lagoon (Bara'ulu) and another village in Vonavona Lagoon (Saika) that had a spiritual leader but was not under the centralised control of the CFC.

The social research team have gained a great deal of insight into some of the very complex relationships that impact upon the uptake of novel agroforestry systems and the decision making that affect sometimes all aspects of the silvicultural management of planted trees. The real benefit of this research will be seen during the implementation of FST/2012/043 as the outputs from the silvicultural research are used to facilitate enhanced uptake of mixed agroforestry systems by the communities. Understanding the relationships and power balance within the communities we will be working with will be a very real advantage and the continued involvement of the social research program will ensure that approaches to the communities are made with the sensitivity needed to affect a good outcome.

8.2 Capacity impacts – now and in 5 years

There have been several ways in which capacity has been impacted by this project. We have worked closely with the Forestry Officers in Malaita and Western Provinces and the staff of Kolombangara Forest Products Limited (KFPL) and they have been included in every aspect of the planning, coordination, establishment, maintenance and measurement of the trials. One direct result of this was the successful application of one of the KFPL employees, Vaeno Vigulu, for a John Allwright Fellowship. Vaeno has one year left until the completion of his PhD when he will return to Solomon Islands and will be a great asset to the Solomon Island Scientific Community.

The project has developed agroforestry booklets in both English and Pijin and we are currently in discussion with Rotary International with a view to getting these produced on a

scale large enough that they can be supplied to all RTCs for use as curriculum aids and to all of the Community-Based Forestry Extension Officers CBFEOs for use in their extension activities. We are also developing a series of posters based on the booklet material that will be used to spread the message of agroforestry to a wider audience by being distributed through the Ministries of Forestry, Agriculture and Rural Development. It is expected that these materials will have an on-going and lasting impact on the uptake of Agroforestry and on the silvicultural management of forestry stands.

The development of the involvement of the Rural Training Centres, discussed below, also increases the capacity of the non-formal and vocational educational system through expansion of the curriculum and a broadening of the agricultural systems that are currently being taught. A recent agreement reached as part of the negotiations for FST/2012/043 included the Community Based Forestry Extension Officers working with the RTCs in community based agroforestry systems. This is a new development for 2 previously separate community based operations and will increase the capacity for the CBFEOs through providing them with access to Demonstration trials and other RTC resources while they in turn will be actively engaged with students including giving lectures on Forestry and Agroforestry systems, particularly in RTCs where there is no Forestry teacher.

8.3 Community impacts – now and in 5 years

Currently, community impacts are limited as the project has worked on the development of the agroforestry system and the scientific validation of the process before it was introduced into the community. However, there has been considerable interest and awareness of the project in areas close to where our activities have been based with the sale of *Flueggea flexuosa* seedlings from the Munda Forestry office a prime indicator that people may be experimenting with similar mixed species plantings.

The spread of the demonstration trial areas through the Rural Training Centres network is also a guide to the uptake of the system. Our original goal had been to introduce the demonstration trials into 3 RTCs to evaluate how well this worked. The enthusiasm to put in these mixed species plantings was such that we were able to help the RTCs approach the EU to fund an expansion of the project. When, in common with all EU projects funded at that time, the second funding round did not eventuate, this project had to be prematurely terminated but the RTCs continued to adopt mixed species trials and the last estimate was that 16 RTCs had trials in place with students involved in all aspects of the establishment and maintenance.

A meeting held in November 2012 between the project staff and the RTC Executive confirmed their continued commitment to developing agroforestry based on the ACIAR model within the entire RTC network and to strengthen that commitment by working with Community Based Training Centres (CBTCs), local landowners and the network of Community Based Forestry Extension Officers (CBFEOs) to introduce the system into the local communities surrounding the RTCs. This will be trialled in 5 hubs as part of FST/2012/043 and should result in a significant uptake of agroforestry within those areas. Further to that there was an acknowledgement of the need for a greater role and involvement of women within these projects and a commitment to involve community women at all stages of the project development. This is a significant commitment on behalf of the RTCs and will provide the pilot for expansion throughout the network.

The work undertaken through this project has also provided the basis for outreach into communities through the next project and the data arising from the scientific trials will form the basis for advice and educational materials that will be used in the next phase,

8.3.1 Economic impacts

The economic impact of any intervention in the Solomon Islands must be viewed in relation to the economic status of the majority of the population. The GDP per capita of the Solomon Islands is estimated at US$ 3300 (CIA World Fact Book, 2011). With a population estimated at around 600,000, only one third are considered to be in the labour force, of which 75% work in agriculture where SBD 25 (approximately AUD 3.40) is considered to be a good hourly wage. 80-85% of the population live in rural areas on subsistence incomes.

Preliminary agroforestry trials with high intensity vegetable farming on Kolombangara have given impressive yields for the first food harvests that indicate that families with access to the local markets will be able to both grow their own food and to achieve a reasonable level of supplementary income through sales of their produce. Marketing of excess produce is an important economic activity, especially for the rural women and is often the only source of cash. Solomon Island women often undertake 5-6 hour journeys, in the dark, in overloaded wooden dugout canoes just to be able to claim a good spot for the Friday market. At the end of the market they paddle back, again in the dark. The importance of vegetable growing to the subsistence economy of rural Solomon Islanders should not be underestimated and though the returns may be small in monetary terms, it has a disproportionately large effect on the ability of villagers to meet school and medical fees and purchase essential non-food items.

Flueggea grown in the trial areas are useful, and saleable, at virtually every stage of their growth cycle with saplings used for rafters and mature trees for durable house stumps. High density trials will yield > 1200 stems of Flueggea per ha with local sales between SBD5 and SBD30 per stem, depending on girth and length. This estimated income of approximately SBD15,000 per ha, will be available for the first 10 years and is again valuable supplementary income for subsistence farmers. There is also potential for Flueggea to be sold to the export market once the improvement and coring program yields results.

One ha of land planted under the agroforestry system will contain approximately 250 mature teak trees at the end of the 20 year rotation. Based on very conservative estimates of a merchantable stem of 15m length with a diameter of 40cm, this would give a stem yielding around 2 m^3 of timber or 500 m^3 per ha. Current pricing at Lagoon Eco Timbers in Honiara (one of the few active teak buyers) would yield approximately SBD2100 per stem or SBD525,000 per ha to the grower and considerably greater returns to the buyer. While these prices are considered very low this is a developing market with little competition.

As the market develops and competition among buyers increases it is reasonable to expect returns closer to international standards. Based on the predicted establishment rate of 1,000 ha per year, the resource would yield 500,000 m^3 of timber per year which at current prices (see below) would be worth USD190 million per annum to the Solomon Islands. Improvements in germplasm and wood quality should see further improvements on yield with an increase in stem diameter of an extra 10 cm increasing the yield to 750,000 m^3 or USD 285 million annually.

The problems of lack of infrastructure limiting market access is, and will remain, one of the biggest challenges to community based timber growing operations in Solomon Islands. This affects existing plantations and colours grower's attitudes to adopting other systems because no matter what system is used, if market access is unavailable, it is considered to be effort wasted. There are changes happening, most noticeably with the development of a saw milling and veneering operation at Noro in Western Province, due to open in February 2013. This operation will provide an outlet for plantation grown teak though grower education now becomes a high priority to prevent exploitation. There are also signs of other buyers coming in to Western Province providing much needed competition. However, other Provinces in Solomon Islands will continue to face this difficulty and

therefore a range of growing options from plantation style and agroforestry through to sustainable native forest management will be needed.

8.3.2 Social impacts

The Social Impact of the current work is, by its very nature limited as the project has had little interaction with village groups beyond the establishment of thinning trials and the high density trial at Saika village. It is not unreasonable to expect that the next phase of the project, which will have a greater focus on the involvement of communities will have a far greater potential to impact on the communities involved. The object of the social research program so far has been to gain an understanding of the problems and power structures within villages and has highlighted the misunderstandings that can happen through even the most modest approach to villages. The most common experience to date has been that in village settings, when meetings are called to discuss some aspect of work that we wish to do involving villagers, it is invariably the men that are at the forefront. When similar meetings are called that are on a smaller, family level, the women take an active role in the discussions.

8.3.3 Environmental impacts

The Solomon Islands continues to suffer severe environmental degradation through the actions of the logging companies which continue to remove timber at a non-sustainable rate and with a complete disregard for harvesting best practice which would limit the damage to the remaining bush. This has led to polluted waterways from erosion in harvested areas which tend to be overrun by the vine Merrimia peltata which shades out and strangles re-establishing vegetation.

Resource limitation is another threat to the environment as the growth of population on islands such as Malaita limits the space available for agriculture and community forestry. We are demonstrating the utility of agroforestry as a multiple land use option in both the RTCs and in the high intensity trial.

While the project cannot be said to have a direct impact on the environmental problems faced by the Solomon Islands, there are indications that benefits will accrue in the longer-term:

- The introduction of mixed species planting using *Flueggea flexuosa* as the intermediate species provides building materials that are recognised and accepted by the local community from the first thinning. Current practice sees the trees that are felled as part of this pre-commercial thin being left to rot on the ground.
- The introduction of the agroforestry model for teak production demonstrates the concept of multiple land use with a succession of crops being grown as an inter-crop in the plantation area. This relieves some of the pressure on land and resource availability in high density areas.
- Carving is an important source of revenue, particularly in Western Province where carvers traditionally come from. One problem has been the dwindling quantity of suitable trees, mainly rosewood, kerosene wood and ebony which are not replaced once cut down. Teak is a very suitable replacement for both Rosewood and Kerosene wood and the commercially unsuitable teak trees that would be otherwise thinned to waste are well suited to small carvings. We have often alluded to this to growers and most have not tried Teak as an alternative stock material. We will be commissioning carvings from teak thinnings and carry these into villages to promote the use of teak and reduce pressure on the traditional species.

8.4 Communication and dissemination activities

The agroforestry booklet (included as Appendices 1 and 2) in both English and Pidgin is a major tool for communicating the lessons that have been learned in the development of the agroforestry system for growing high value timber species. It had been developed to deal with issues surrounding spacing and thinning, silvicultural management of the trees; suitability of crops for growing in the inter-row in response to varying light conditions and to act as a general guide and reference tool for both extension officers and teachers. This booklet is currently being evaluated by the Ministry of Forestry and the Rural Training Centres and will be updated according to the response we receive. We are currently in discussion with Rotary International to underwrite the publication costs.

Our work with the Rural Training Centres is one of the principal methods of communication and disseminating the agroforestry principles. Anecdotal evidence is good with regard to pupil uptake once they have returned home and the expansion of the demonstration plots in to other RTCs beyond the scope of the original project also suggests a positive uptake. These plots have been a practical demonstration to pupils of multiple cropping on one piece of land and the RTCs have, in general tried a wide variety of crops including dry land rice, tomatoes, capsicum, sweet potato, cassava, sweetcorn, cow peas and various local bean crops.

The high intensity agroforestry trial at Ringii also involves local families who are growing a variety of vegetables for own consumption and sale. The involvement of local communities in these activities is one of the best methods of ensuring information from these activities trickles down into communities.

We have undertaken seminars for the Ministry of Forestry staff in Honiara to present the work of John Allwright Fellow Vaeno Vigulu and to highlight the trials that have been put in place and the general recommendations arising from the studies. We have also involved Ministry staff in the planning of future activities. Seminar presentations have been given at various intervals to the management committee of the RTCs and this is an important venue for discussing with head teachers and agriculture staff the direction of the program and the lessons that are being learnt.

Similar presentations have been given to the staff of Munda Forestry who are the key elements in the establishment, maintenance and mensuration of the western province trials. These are also very important communication activities and provide invaluable feedback on the acceptability and impact of the trials.

9 Conclusions and recommendations

9.1 Conclusions

The project has demonstrated that teak and flueggea can be successfully grown together in a mixed species system and the evidence suggests that they are complementary with greater growth from the teak than would occur in pure teak stands planted at the same stocking density. These findings give greater confidence as the next project commences that will introduce this system into community settings. However, this is not a one size fits all system and there must be a degree of flexibility to suit soils, climate and the preference of the grower. The spacing trials will reveal at which stocking density the Teak and flueggea are most productive. The results to date (at 3 years) 4m x 6m spacing is showing promising growth and provided the form remains good is a better spacing for agroforestry as it allows more light interception for the inter-row crops.

The project found that all the SI provinces of flueggea have reasonably similar growth characteristics with no real difference in the average height and diameter of the provenances grown in trials but there were differences in form of the trees within the provenances. The flueggea improvement program will soon start to make better quality germplasm available to growers, while the ongoing teak improvement program by Ministry of Forestry, KFPL and Eagon will continue to improve what is already excellent genetic material for that species. Both these programs are currently based on growth and form. The timber testing program clearly indicated that some traits such as a high sapwood to heartwood ratio in younger teak and a sloping grain in flueggea were heritable and could be therefore be selected out of the germplasm pool but this would require a simpler testing program, appropriate to Solomon Islands.

Work with the Rural Training Centres has been very successful with a greater than expected uptake of agroforestry systems. The RTC network is growing with current numbers (November 2012) at 45 RTCs with 55 Community Based Training Centres. This remains one of the better means of communicating information regarding the agroforestry system as well as being a test bed for different crops to be grown within the system.

Thinning trials are beginning to demonstrate a response to thinning in later age Teak stands, but the results are quite variable, possibly due to the different ages of the teak stands involved. The best of the thinning trials has shown a doubling in the periodic increment for basal area as a response to thinning and the result has prompted that particular grower to thin the rest of his plantation.However, the results are not reaching a wide audience. This is partly a matter of poor communications and there is a need for more of these trials, preferably with a more radical thinning regime to final stocking rate, and greater involvement of the community based forestry extension officers to bring the community growers to view the trials and results.

The Social Research Program has delivered a sound basis for developing an understanding of the effects of the economic impacts from a forestry based intervention on social structure and cohesion in rural areas. However, this is just the start of the process as the most radical effects from gaining income through thinning existing plantations will only happen over the next few years. This in turn will provide some indication of the impact of eventually being able to harvest mature and commercially valuable trees at the end of the rotation.

The overall failure of the Hopevale project was the result of many factors and it would be unreasonable to lay blame on any one group. The CDEP provider was bound by the complex set of rules governing number of hours worked and funding and there was a great deal of confusion as to what was and was not allowed under the provisions of the CDEP. The market gardening operation, which was a basis for incorporating vegetables

and trees into an agroforestry system, fell apart when one motivated individual left and the site remained locked during the last visit to Hopevale. It was also very hard to interest people in training, despite the fact that we had an agreement from local forestry operations that they would be interested and willing to take on suitably trained forestry gangs to undertake silvicultural operations. Hopevale is awash with people with certificates and diplomas that do not translate into employment opportunities, in large part this is due to the reluctance of community members to travel away from their community and families and the lack of real employment opportunities in such a remote area.

Finally, unlike Solomon Islands, the community of Hopevale do not have the need to utilise the land and forests that surround them. In Solomon Islands people grow their food or die of starvation, they use the forest for construction material, food, fibre and medicine on a daily basis and they plant trees as a means of earning desperately needed income and security. These imperatives do not exist within the Hopevale community, not that the individual group members do not feel a real affinity to their land and place, but there is no incentive to actively manage the resource and therefore development of an agroforestry system has little real meaning.

9.2 Recommendations

The agroforestry system that has been developed in this project now needs to be tested in a community setting to assess how well crops grow, how well the Flueggea is utilised when thinned and how acceptable the system is to growers. In areas where access to buyers is increasing, it may be that a mixed species system has less importance or that a different planting regime such as alternating rows of Teak and Flueggea is better suited to the increased market access. There are large areas of Solomon Islands that remain remote and disconnected from easy market access and for these areas, the mixed species system remains valid. This system is also suited to areas such as Malaita where access to land is severely limited and a system that allows intercropping is the only viable option for people wishing to grow high value timber trees. The next project must remain flexible to the changing needs and situation of the growers. As part of this it is important to evaluate other tree species which may be grown as either the main crop or the interplanted species. Rosewood (*Pterocarpus indicus)* is a possible candidate for the high value timber while *Terminalia brassii* may be a good inter planted species, especially in wetter areas.

The continued improvement of the Teak and Flueggea, as well as any other species that may be included in the mixed species system, needs to go beyond simply looking at growth and form and should take into account the wood properties. The destructive sampling of trees which was undertaken in the project was expensive and difficult, requiring fumigation before the timber was allowed in to Australia for wood properties testing. A non-destructive wood testing program through the use of transverse coring would give much of the same information, but would enable some of the tests to be done in country and sending 25mm diameter cores to Australia for more complex tests would be relatively cheap and simple.

Work with the Rural Training Centres should be extended to include some of the CBTCs and to involve the community based forestry extension officers who work within the RTC areas. The booklet developed during this project should be incorporated into the teaching program and improved in the light of use as a teaching aid. Further educational material, based on the booklet should be developed for use with community growers.

Long-term sustainability is an issue with any system that requires repeated rotations, even when they are as long as 20-25 years. If a small number of other tree species (20 – 25 trees per hectare) that are slower growing or have alternative uses than timber, such as the ngali nut (*Canarium indicum*) or trees that are valued for handicrafts such as kerosene wood (*Cordia subcordata*) or ebony (*Diospyros spp.)* were to be planted mixed in with the other trees, they would be left following harvest, already mature trees, and form the basis

for the re-establishment of the forest in that area. The next rotation of Teak could be planted in to another logged area.

The long-term involvement of the experienced social research team is a vital element to these projects and with the impending economic slump that is forecast in Solomon Islands through declining timber revenues the role played by this research will be of great importance in documenting the rapidly changing social and economic environment and informing the actions of the rest of the project team.

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Tutua S, Blumfield TJ., Bacon GJ, Vigulu V., Haines RJ., Roger F, 2012 The effect of spacing on Solomon Islands Teak accepted as poster presentation for The World Teak Conference, Bangkok, Thailand, 25-30 March 2013

11 Appendixes

11.1 Appendix 1: Attached as separate PDF file

Australian Centre for International Agricultural Research

SPC Land Resources Division, Honiara

Solomon Islands Ministry of Forestry

Solomon Islands Association of Rural Training Centres

Agroforestry - A Better Way to Grow Teak

1

11.2 **Appendix 2:** Attached as separate PDF file

Australian Centre for International Agricultural Research

SPC Land Resources Division, Honiara

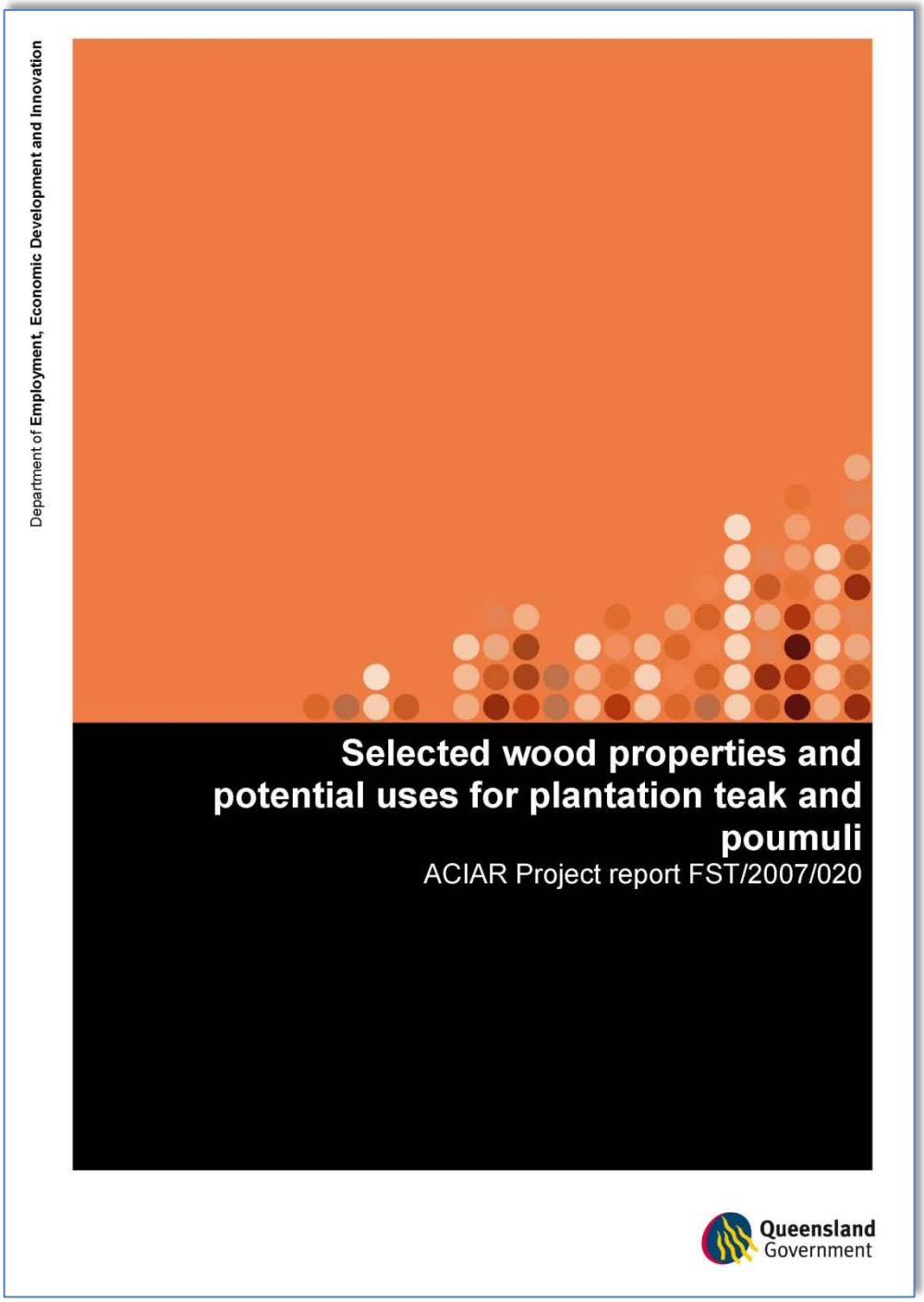
Solomon Islands Ministry of Forestry

Solomon Islands Association of Rural Training Centres

Agroforestry – Gud Wei Fo Grom Tree

1

11.3 **Appendix 3:** Attached as separate PDF file



11.4 Appendix 4: Attached as separate PDF file.

Analysis of potential market for product based on the results of testing and processing

Report by Tim Blumfield

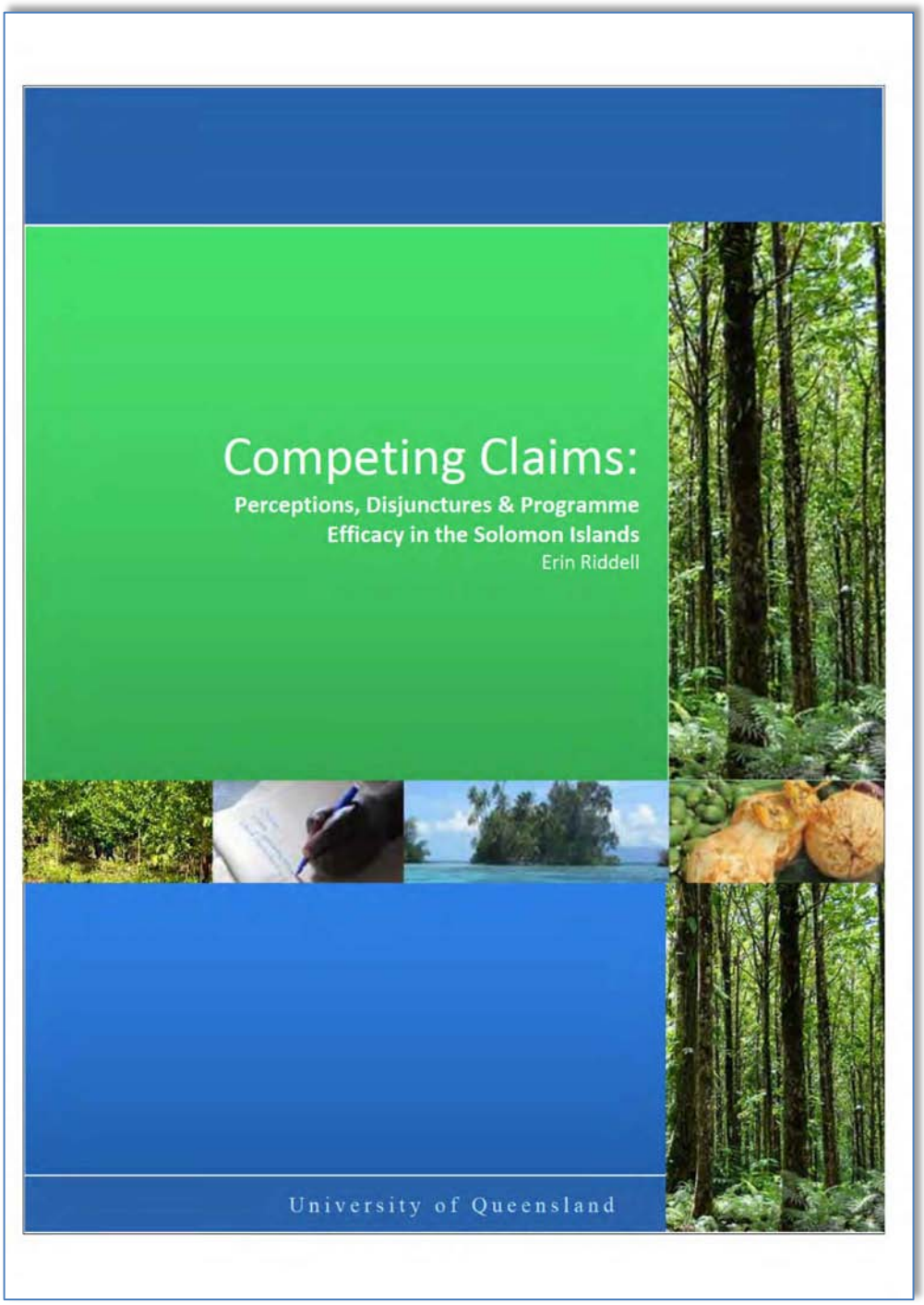
11.5 Appendix 5: Attached as separate PDF file.

Agro-forestry and its Social Impacts
Social Science Research Final Report – 2012

Dr Kristen Lyons[1], Dr Peter Walters, Erin Riddell,
Prof David Burch and Henry Boer

[1] Authors Lyons, Walters, Riddell and Burch are all located in the School of Social Sciences at the University of Queensland, while author Boer is located in the Centre for Governance and Public Policy at Griffith University.

11.6 **Appendix 6:** Attached as separate PDF file



11.7 **Appendix 7:** Attached as separate PDF file

11.8 Appendix 8: Australian Agricultural College Corporation, Mareeba campus – Draft training plan, Hopevale community

Re: Draft Proposal ACIAR/GU Hopevale Agroforestry Project

Training Modules

The AACC is registered to deliver training from the RTF03 Amenity Horticulture training package and the RTD02 Conservation and Land Management training package. In the table below I have endeavoured to identify units of competency which align with the training modules listed in the draft proposal.

RTF20103 Certificate II in Horticulture	**RTD20102 Certificate II in Conservation and Land Management (General Land Management)**
RTC2701A Follow OHS procedures RTC2702A Observe environmental work practices RTC2012A Plant trees and shrubs RTC2016A Recognise plants RTC2026A Undertake propagation activities RTC2209A Install, maintain and repair fencing RTC2401A Treat weeds RTC2706A Apply chemicals under supervision RTE2607A Install a micro-irrigation system RTE2909A Collect and record production data RTF2001A Apply a range of treatments to trees RTF2009A Perform above ground pruning RTF2013A Pot-on plants RTF2017A Prune shrubs and small trees RTF2024A Tend nursery plants RTF2025A Transplant small trees	RTC2701A Follow OHS procedures RTC2702A Observe environmental work practices RTC2012A Plant trees and shrubs RTC2016A Recognise plants RTC2026A Undertake propagation activities RTC2209A Install, maintain and repair fencing RTC2401A Treat weeds RTC2706A Apply chemicals under supervision

Funding Arrangements

The AACC is able to access funding from the Cape York Training and Employment Strategy to deliver recognised training to the participants from Hope Vale. This funding would cover most aspects of the training, but the employer would incur Tuition Fees charged by the AACC.

Costs to be covered by the participants employer includes the Tuition Fees calculated at $1.05 for each nominal hour of training. Please note indigenous students receive a 75% exemption to pay fees so for these students the actual cost would be calculated at $0.26 for each nominal hour of training.

For the AACC to access funding from the Cape York Training and Employment Strategy the employer is required to submit a Community Training Application (CTA) to the Cape York Employment and Training Strategy Prioritisation Group (CYETSPG). The CTA needs to be approved prior to a training agreement being reached between the AACC and the employer.

AACC Project Scope

The AACC is able to provide training against an agreed training plan. Typical aspects provided by the AACC to projects in the Cape include

- Qualified trainers
- Mentoring to support the students and workplace trainers/supervisors Management of training
- Quality training materials – learning resources
- Assessment of training outcomes
- Provision of statements of attainment

Please note the AACC will not provide physical resources required for the workplace projects. The physical resources for the workplace projects are the responsibility of the employer.

Prepared by:

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Australian Centre for International Agricultural Research

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Solomon Islands Ministry of Forestry

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Agroforestry - A Better Way to Grow Teak

use this page to make notes

What is Agroforestry?

The word agroforestry is a combination of agriculture, or growing of food, and forestry for the growing of trees. Which may be for many purposes including; timber, fruit, fuel or firewood, carving, fibre medicine and traditional clothing such as tapa cloth.

Agroforestry is growing trees and food crops together; your traditional gardens are a form of agroforestry. As is the Temotu improved agriculture system which includes growing breadfruit, gnali nuts, alite, yams, mamafua and taro within one garden system.

This booklet is about growing high value timber such as teak and mahogany using agroforestry. This is not the way you

might have seen it done before where an area is covered only with Teak trees and nothing else is grown there.

Why is Agroforestry Important?

The population of the Solomon Islands is increasing which means there is less land to go around for people to do all the things they want to do, to grow food to eat and to sell on the market and to grow trees for their houses or to sell

Agroforestry is a way of doing both and it has many benefits:

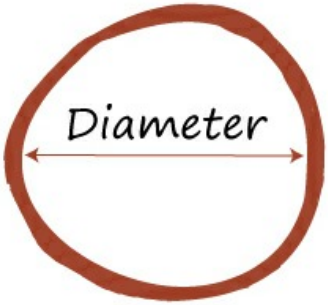
- Increases soil fertility as trees bring up nutrients from deep underground and recycle them as the leaves fall
- Some tree and plants can make nitrogen which helps all the other plants to grow.
- You can earn money from more than one crop and at different times when you harvest all the different crops and fruits and when you sell the timber.
- Growing trees also helps increase the diversity of the area, captures carbon in the trees and soil and may gain funding from government programmes that are looking at climate change adaptation strategies

Why Use Agroforestry?

We use agroforestry to grow high value trees such as Teak and Mahogany.

People are having problems with their trees because they do not like to take out the thinner trees. Many people in the Solomon Islands have planted Teak trees, often with up to 830 trees in one hectare of land. These trees grow very well for the first 3 or 4 years but then growth slows down so much you might think it has stopped.

If you have trees planted like this you will notice that they are tall and straight but they never get any fatter, no matter how long you wait. The fatter a tree is, the more money you will get for it.



Trees are measured by the diameter, how far it is across at a height of 1.3m above the ground, about chest height, usually in centimetres, and by the length of the stem before the branches start.

If you had a tree that had a clear stem (no branches) for 10 meters and was 10 centimetres in diameter it would contain less than one tenth of a cubic meter of timber (0.1 cu m),

trees this size only fetch Solomon $ 365 for a cubic meter so you would only be paid $29 for the tree.

If you had thinned the trees and let this same tree grow to 40 cm diameter (about as big as you can get your arms round), it would contain nearly 2 cubic meters of timber and they buy this size timber at over $1,100 for a cubic meter. You would get $2199 for this tree. Have a look at the table below and you can see the current (2011) market price for teak.

Diameter	Height (m)	Volume (cu m)	Solomon $ for a cu m	How much you would get
10 cms	10	0.08	$365	$29
20 cms	10	0.31	$525	$165
30 cms	10	0.71	$982	$694
40 cms	10	1.26	$1,050	$1,320
50 cms	10	1.96	$1,120	$2,199

Some people think that all their trees are worth a lot of money. and do not want to thin them but if you look at the table you can see that small trees are not worth much and it is better to cut them down and let the other trees grow big.

If you had 1 ha of trees that were not thinned you might have 830 trees worth $165 each or about $136,950

If you had thinned the trees you might have 300 trees worth $2199 each or about $659,700

Our Agroforestry System is for growing high value trees like Teak or Mahogany

To overcome the problem that people have with thinning (if you do not know about this, look at page 21 now) we use an agroforestry system where we grow teak as the long term crop.

We also grow Flueggea (you might know it as: mamafua, mawana, mavua, voraka, mafuna or mamaghuana) as a useful medium term crop and food crops or even cash crops such as vanilla and cocoa.

These are all grown on the same piece of land as in the picture above so that land is productive all the time.

We will tell you how to do this in this booklet.

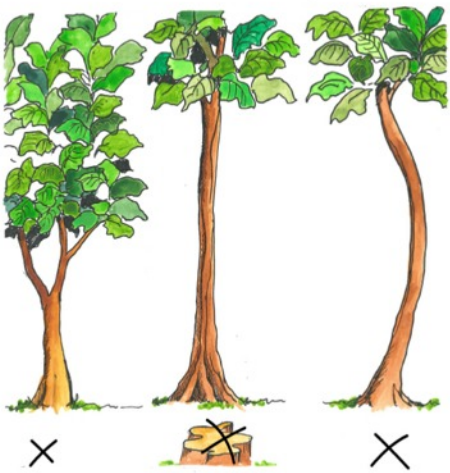
Your local forestry office can help you in choosing the trees, marking out for planting and all the other work that is in this booklet. If you have questions, go and talk to them.

Starting with the seeds

If you want good quality (tall, straight, round) trees, you have to get your seed from tall, straight, round trees.

Where to get the seed

1. Go to your local forestry office for seeds and seedlings, they have the best quality2. If there is not a forestry office near you can collect your own, make sure you only collect seeds from the best trees, the ones that grow tall and straight



3. You might try and buy your seeds and seedlings from someone else. If you do this you have to be careful, make sure they have got their seeds from only the best trees. If you are not sure

it is better to get some from forestry or collect your own.

Don't get seeds from bent or low branched trees or ones that are heavily fluted like the ones in the picture.

Remember, Forestry have the best seeds and seedlings!

What to do with the seeds -Mamafua

Collect your seeds June/July and October/December. Collect only ripe fruit that is black, soft and juicy.

Separate the seeds from the skin and flesh by mashing them in a bucket of water, let the seeds air dry on paper in the shade, not in the sun.

Making Coir

Don't try and keep them for more than 2 weeks as they do not grow well after they are kept

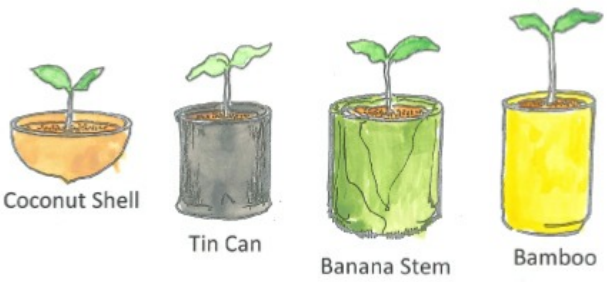
You will need to germinate them on a tray of good soil or you can grate rotten coconut husks (coir) and use that mixed with the same amount of soil, or you can use river sand. Water the tray and leave

them to germinate for about 14 days, remember to keep them watered.

Seedlings ready for pots

Let them grow until they have got 2 leaves and are as big as the first joint on your finger, you will then need to transplant them into a pot of their own so they have room to grow.

Keep the seedlings that are in the trays and pots out of the sun and off the ground. You can use many different things as pots put some holes in the bottom so that water drains through



You can make a nursery from bush materials with palm leaves as a roof.

As your seedlings get bigger you can take some of the leaves off the shade house roof and let the seedlings get used to the sun.

Making a Nursery from Bush Materials

When the seedlings are strong you can let them stand in the sun until you are ready to plant them. Don't forget to water them if it does not rain.

Mamafua seedling will have to be taken to be planted in their pots.

What to do with the seeds – Teak

You will need to pre-treat the teak seeds to get them ready for germination

1. Soak the seeds in water for 24 hours
2. Dry in the sun for 12 hours

Germinate teak seeds in the same mixture you would use for mamafua. They need to be kept in the shade house along with the other seedlings until they have 3 leaves when they

need to be planted into a stand out bed. This is a prepared bed where the soil has been cultivated and then covered with good quality top soil. This allows the roots to penetrate the soil and a good stump to develop.

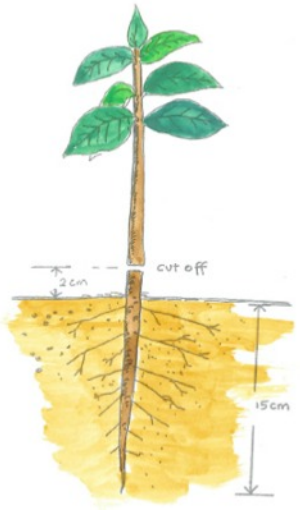
Stand Out Bed

After 3 months, when the top of the stump is as thick as a mans thumb, the trees are ready for planting out. Teak seedlings can be made into stumps for planting, they are easier to carry.

Do it like this:

- Pull the plant out of the ground
- Cut off the stem about 2cm above where the plant stuck out of the ground
- Cut off the other end of the stump at about 15cm long
- Clean off all the roots

They will last up to 2 weeks like this before you have to plant them but keep them in a hessian sack in the shade and water daily



Getting the land ready for planting

While your seedlings are growing, you can be getting the land ready for the trees. You need to make sure the site is good for the crops you want to grow:

- that it does not get waterlogged.
- If the soil is coral soil you should get advice from the Forestry office about which trees to grow, mahogany might be a better choice than teak

You need to clear all the weeds away from where you will be planting, weeds will steal the food in the ground that your plants will need to grow big and they can shade your plants from the sun, making them weak. When you clear the weeds put them in the middle between 2 rows, they will rot down and give food to the plants.

Do not burn the weeds and rubbish, this is bad for the soil and wastes the plant food in the weeds.

If there are food plants growing on your land or some fruit trees that you want to keep that is OK.

Use some sticks to mark where you are going to plant the trees

How far Apart Should You Plant the Trees?

If you are planting trees to sell the timber you need to make sure that your trees have long straight stems without any branches.

To make trees grow tall and straight you have to plant them close together, that makes them grow straight and stops them from putting on big branches.

The standard spacing is 4 metres x 3 metres which takes 830 trees for each hectare. Flueggea can be planted closer at 2m x 3 m spacing, but this will need more seedlings as you will have 1660 trees to plant.

It is easiest to plant in straight lines with the lines 4 metres apart and the trees 3 metres from the next tree in the line. If you do not have a ruler, 4 big strides between the rows and 3 big strides between the trees will do fine.

Your local Forestry office will help you to do this, just ask them.

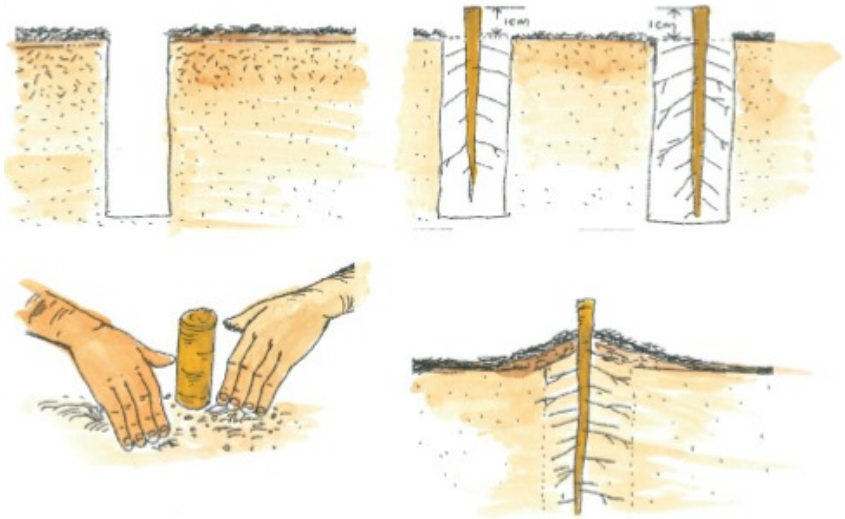
Planting Your seedlings

Flueggea is planted straight from the pot:

- make a hole in the ground,
- take the flueggea from the pot and plant in the hole so that the tree is at the same level in the soil as it was in the pot
- Press the soil in round the plant so that there are no air pockets.

Teak is planted as stumps:

- Make a hole that is deep enough for the stump
- Leave 1 cm of the stump above ground level
- Press the soil around the stump so that there are no air pockets
- Do not leave a depression around the stump where the water can collect.



The Agroforestry Way to Grow Teak

Nobody wants to go to all of the trouble of planting 800 Teak trees and then cutting down more than half of them before they are ready. That is why we think the agroforestry way is better

The agroforestry way is to plant teak mixed in with another tree that you can use yourself for fencing and building houses. Flueggea (mamafua) is a good tree for this but there may be a local tree that you think is better. Mamafua is good because it grows quickly, is a durable timber useful for housing and you can start to use it within a few years.

Whichever tree you choose, this is the way to plant so that you end up with big teak trees.

Make sure your lines of trees face the direction of the rising sun (East – West) so that your food crops get plenty of sunlight

Mark out your land at the same spacing we talked about before, 4 metres between the rows and 3 metres between the trees within the row. Plant 1 row with Teak, then 2 rows with mamafua then repeat along the rest of the land. As the trees get older and need thinning, you can use the mamafua for your fences or houses and leave the teak to get bigger.

After 3 years when the canopy closes (when the leaves from one tree starts touching the leaves from another tree) you will need to harvest 1 row of flueggea between every 2 rows of teak

After another 3 years you need to harvest the last row of flueggea between the rows of teak so that you are left with just rows of teak at about 280 -300 trees per hectare which is the recommended final stocking rate.

By the end of the rotation (15-20 years) the teak will have grown tall and fat. Then it is time to sell the teak.

Keeping Your Trees Healthy

You will need to control the weeds near your trees, especially while the trees are young. Weeds take the food from the soil that your trees need to grow and they shade your trees from the sun and make them weak.

There should be a weed clear area as long as your arm around the trees as it shows in the picture.

Another good way to keep weeds under control is to grow your food crops between the trees, just remember to keep them away from the trees themselves, just the same as for weeds.

What Food Crops Can I grow?

The food you grow will change as the trees cast more shade, here are some of the crops you can grow:

Sunshine	Part Shade	Shade
Sweet potato, Cassava, Tomatoes, Peppers, Beans, Corn, Pumpkin, Pawpaw, Rock Melon, Tobacco, Lettuce, Chinese Cabbage, Peanuts, Tsoi Sum, Cucumber, Chilli, Egg Plant, Pineapple, Water Melon,Parsley	Taro Slippery Cabbage Vanilla Pawpaw Coriander Passion Fruit, Ball Bean	Taro Fern Ginger Kava Bush Yam King Tree Parsley

Of course, as you thin out your trees there will be more light so the list of things you can grow will change.

Some plants like sweet potato are very aggressive, keep the vines away from your young trees

Remember to change the types of crops you grow in each area so that the soil and plants stay healthy.

You should grow legumes such as peanuts or beans every second or third crop, they will help to put food or nutrients back into the soil. This will feed your next crop and will even help your trees to grow bigger.

This is called **crop rotation.**

Not all crops might grow well under the trees, it is up to you to try different crops that will suit the trees and the soil conditions in your garden.

If you want to know more about crop rotation, ask at your local Agriculture Extension Officers, they will be happy to help you.

Beating Up

Beating up is replacing trees that have not survived in the early stages of establishing your woodlot.

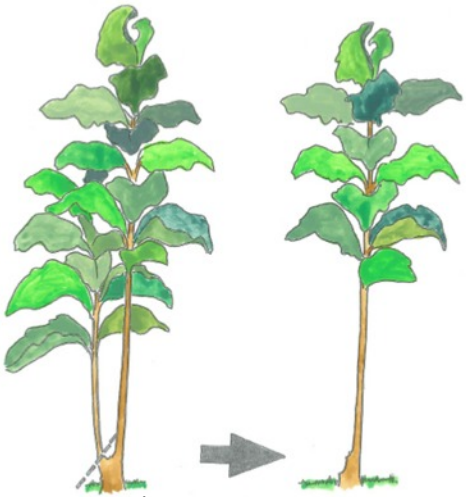
You should always grow extra seedlings so that you can replace any that have died, if you do not need them you may be able to sell them or give them away to a friend.

Do a survival survey, this is where you count how many trees have died, about one month after planting.

Replace any dead trees

Keep checking your trees for the first 3 months and replace any that have died or look as though they will not survive.

Form Pruning (Singling)



Singling to remove the extra stem

Sometimes trees develop two stems instead of one, form pruning is when you cut away one of the stems so that all of the energy from the tree goes into one stem, making it bigger.

You need to choose which stem to keep, look for the straightest, thickest of the two stems and keep that.

One month after planting is the time for singling. Make the cut as clean as possible to stop any disease getting in to the base of your tree.

If you cut at an angle it stops water from staying on the cut which might make the cut go rotten and damage your tree.

Green Crown Pruning

Green crown pruning is when you cut off some of the lower branches away from your trees, there are 3 reasons to do this:

1. If you take away the branches the stem grows without any knots and the wood is worth a lot more money.
2. When trees have a lot of branches they blow over more easily in the strong wind
3. They are easier to work under.

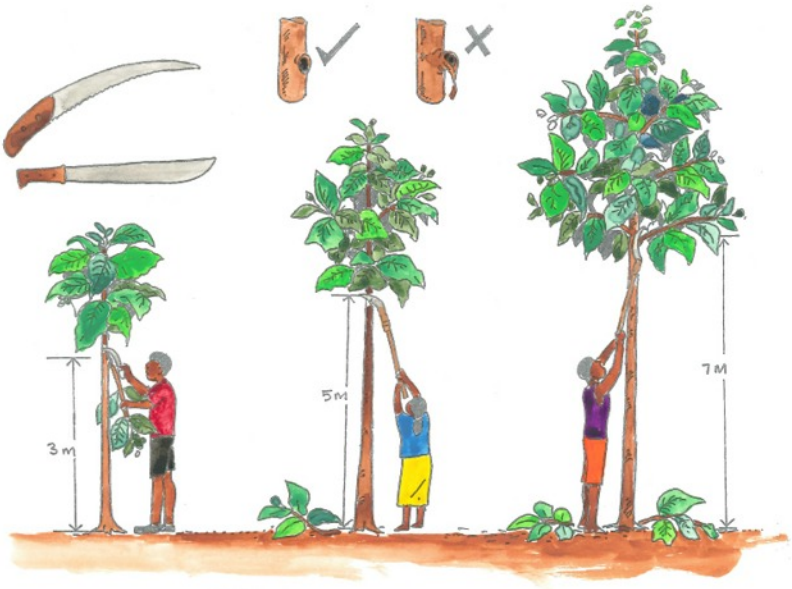
When to Prune?

Flueggea 18 - -24 months

Teak Follow the ministry of forestry protocol.

How to Prune?

If you use a bush knife make sure it is very sharp, make the first cut upwards at the bottom of the branch, make the second cut downwards to remove the branch.



Better if you can use a clean hand saw or pruning saw or cutters.

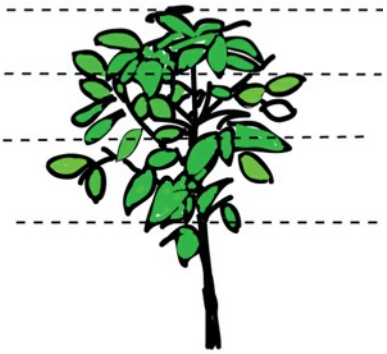
Very Important

- Cut close to the stem
- Don't leave a 'coathanger' as it will heal slowly

Late pruning (big branches) leaves big scars and bumps on the stem of the tree.

How Much to Prune – Flueggea

Don't take too much off, divide the branches into 3 sections and take away the branches in the lower section



Before Pruning

After Pruning

Your local forestry office can help you and show you how to prune.

Thinning

With the agroforestry system you do not have to thin your teak, you just harvest the flueggea for your own use and this will increase the space for your teak to grow.

You should still take out any teak trees that are bent or poorly shaped.

Before thinning

If you have planted some teak trees using the single species plantation style way, you will have to think about thinning.

If you planted your trees 5 years ago they will probably look like the first picture, some of them will be tall and straight, but some will be too thin, bent or with more than one stem.

You need to take these trees out.

In a 1 hectare block (100 m x 100 m) you will plant about 830 trees at the start.

If you want big trees that are worth a lot of money you will have to remove or thin about 540 of the trees to let the others grow.

Have a look at page 5 and what the difference is for the price of thin trees and fat trees.

Some of these trees you may be able to sell, if you live near a place where you can get them to market.

After thinning

Your local Forestry office can help you with thinning, they will be happy to help

Getting Ready for Harvesting - pre-harvest inventory

If you are about to harvest some of your trees for the market you need to have a good idea how much timber you have.

Someone needs to measure the diameter of the trees and the length of the stem. That way you can see what price you will get for each tree.

Your local forestry office will be glad to help with measuring your trees.

use this page to make notes

Acknowledgements:

This booklet was funded by the Australian Centre for Agricultural Research Project FST/2007/020 "Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands"

Authors: Tim Blumfield, Shane Tutua, Gideon Bouro, Philip Zekele, Larren Gomese, Benol Ngiloaia

Illustrations: Nelson Horipua, Frank Sauni, Brian Feni & Tim Blumfield

Australian Centre for International Agricultural Research

SPC Land Resources Division, Honiara

Solomon Islands Ministry of Forestry

Solomon Islands Association of Rural Training Centres

Agroforestry – Gud Wei Fo Grom Tree

use this page to make notes

Wat Nao Agroforestry?

Disfala toktok Agroforestry hem kam from agriculture, or iu plantim kaikai en forestry, wei fo plantim tree. Hem garem staka minin, hem inkludim fo timba, fo frut, fo firewood, fo carving, fo pepa, meresin en fo kabilato.

Agroforestry hem wei fo plantim tree wetem kaikai lo garden tugeda. Bus garden hem wanfala wei fo duim agroforestry olsem kaen garden blo olketa lo Temotu. Olketa plantim bredfrut, nali nut, alite, yam, mamafua, taro, sugar cane en kumara tugeda insaet lo wan garden nomoa.

Disfala buklet hem abaotim hao iu plantim trees wea hem garem big selen olsem teak en mahogany wetem disfala kaen agroforestry. Olketa no save plantim teak olsem lo bifoa.

Dis kaen ia hem niu wei fo plantim teak.

Wae Nao Agroforesty Hem Impotent?

Populesen lo Solomon Islands hem kam ap big moa. Graon hem sot fo pipol duim waka lo hem, fo plantim kaikai fo kakaim en salem lo market en plantim tree fo mekem haus en for salem.

Agroforestry hem wanfala wei fo duim tufala samting ia tugeda en hem garem staka gud samting lo hem:

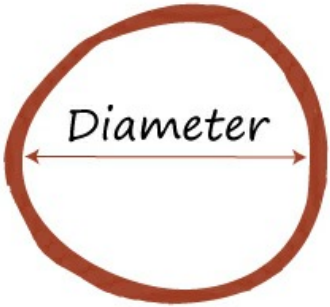
- Hem putim staka kaikai lo insaet graon fo tree en garden.
- Samfala trees en plants olketa mekem kaikai fo olketa seleva.
- Iu save tekem selen from olketa difrent kaen garden kaikai en from olketa trees lo difrent taem.
- Plantim tree hem save givim staka difrent samting lo eni ples, olsem carbon lo tree en graon en hem save tekem selen from olketa program lo gavman wea luk luk lo olketa wei iumi save adapt go lo hao climate blo iumi hem senis

Wae Nao Iumi Iusim Agroforestry?

Iumi save iusim agroforestry fo plantim trees wea garem big selen olsem Teak en Mahogany.

Pipol garem staka problem wetem trees blo olketa bikos olketa no katem olketa ravis trees lo planteisen blo olketa. Plande pipol lo Solomon Islands olketa plantim teak tree blo olketa kasem 830 trees insaet lo 1 hekta (ha). Olketa tree ia gro gud lo fest 3 or 4 yias den olketa slo fo gro moa.

Sapos iu plantim trees blo iu olsem bae lukim olketa kaen a hem toll en stret bata olketa no save gro fat no mata iu weit long taem. Sapos olketa tree ia hem fat en hem toll bae iu save tekem plande selen.



Olketa save markem olketa trees ia lo midol blo olketa iusim sentimita (cm), en long blo log start lo graon kasem andanit lo fest brans. Sapos tree ia hem no garem brans en hem 10 mita (m) long en 20 sentimita (cm) waed, hem bae kolsap kaesm 0.1 cubic mita (c.u m) nomoa. Olketa trees lo disfala saes hem save costim nomoa Solomon $365 fo 1 cubic mita (c.u m) so bae iu save salem tree ia fo Solomon $29 nomoa.

Bata sapos iu thinim (aotim samfala) trees en livim samfala trees fo olketa gro big kasem 40 sentimita (cm), (saes wea iu save putim han blo iu raonim), bae hem garem kolsap 2 cubic mita (c.u m) lo timba en olketa save baem disfala saes fo Solomon $1,100. So bae iu save tekem $2,199 fo wanfala tree. Lo tebol andanit bae iu lukim (2012) market praes blo teak.

Plande pipol ting olketa bae tekem plande selen lo trees blo

Diameter	Height (m)	Volume (cu m)	Solomon $ for a cu m	How much you would get
10 cms	10	0.08	$365	$29
20 cms	10	0.31	$525	$165
30 cms	10	0.71	$982	$694
40 cms	10	1.26	$1,050	$1,320
50 cms	10	1.96	$1,120	$2,199

olketa so olketa no laek fo thinim (aotim samfala). Lo tebol antap iu save lukim bae iu no save tekem plande selen lo olketa smol trees.

Hem gud fo iu aotim samfala tree en livim speis fo olketa gud trees save gro big.

Sapos iu garem 1 hekta (ha) lo trees wea iu no thinim (aotim samfala) iu bae garem nomoa 830 trees wea bae iu tekem nomoa Solomon $165 fo 1 tree en Solomon $136,950 nomoa fo 1 hekta (ha). Bata sapos iu thinim olketa trees go kasem 300 trees nomoa bae iu save tekem Solomon $2,199 fo 1 tree, en kolsap Solomon $659,700 fo 1 hekta (ha).

Agroforestry System Fo Plantim Tree Olsem Teak en Mahogany Wea Iu Save Tekem Big Selen Lo Hem

Sapos iu laek aotim problem wea pipol save garem taem olketa duim thinin lo olketa trees blo olketa

sapos iu no save lo dis wan luk go lo peig 21

Iumi save iusim agroforestry wea iumi harvestim olketa kaikai fastaem den iumi harvestim mamafua (olketa nara neim blo tree ia hem mawana, mavua, mafuna, voraka or mamaghuana) afta. Den finis nao iumi katem teak. Evri samting ia gro lo seim ples nomoa en hem save givim iu benefit

Disfala buk ia bae hem talem iufala hao fo duim dis kaen waka.

Go lukim olketa lokol Forestry Ofis kolsap lo iu. Olketa bae save susim gud fala tree fo iu en hao fo plantim tree en olketa nara waka wea buk ia hem talem.

Start Wetem Seeds.

Sapos iu laekem gudfala tree wea hem toll, stret en raon gud, iu mas tekem seed blo iu from olketa tree wea toll, stret en raon gud.

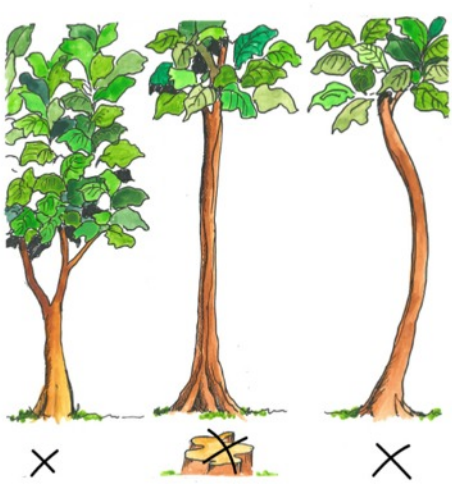
Wea fo tekem seed:

1.) Go kasem olketa lo lokol forestry ofis kolsap lo iu bikos olketa na garem gudfala seed en seedling.

2.) Sapos iu no garem eni forestry ofis kolsap, iu save kolektim seleva seeds from gudfala trees wea gro toll en stret.

3.) Iu save baem seed en seedling from nara fala man bata olketa seed ia mas kam from gud fala trees. Sapos iu no save gud, iu save go lo forestry ofis or kolektim seleva.

No tekem seed from olketa tree wea no gro stret en brans blo olketa hem lou.



No foget fo go lo Forestry Ofis fo tekem seed en seedlings

Wat Fo Duim Wetem Mamafua Seeds

Iu kolektim raep frut wea hem kala black, hem soft en hem garem staka juice.

Iu presim frut insaet lo baket wata en tanem tanem fo separetim skin wetem mit from seed. Driem seed lo antap pepa lo atsaed, andanit lo seid. No kipim seed ovam 2 wik bikos bae hem no save gro.

Making Coir

Iu nid fo plantim seed lo gud graon or rotten kokonat hask (coir) mix wetem graon or sand lo saet wata. Watarim trei en livim olketa seed ia fo gro insaet lo 14 deis en no foget fo watarim olowe.

Seedlings ready for pots

Letem olketa garem tufala lif en olketa gro kasem fest joint lo finga blo iu den iu plantim insaet lo pot.

Iu save iusim kokonat sela en bambu) en haedem from sun andanit lo seid.

Iu save mekem nesari blo iu from olketa bus metariol olsem kokonat lif.

Taem seedling big kam lelebet iu save aotim samfala lif from seid fo seedling gro gud lo sun laet.

Taem seedling hem strong gud iu save letem olketa stendap andanit lo sun go kasem taem iu redi fo plantim.

Iu no foget fo watarim olketa seedlings sapos no eni ren kam.

Wat Fo Duim Wetem Teak Seedlings

Iu mas redim olketa teak seeds bifo iu germineitim

1.) Putim seed insaet wata fo 24 hrs.

2.) Finis iu draem seed fo 12 hrs lo sun.

Iu germineitim olketa teak seeds lo sem graon iu iusim fo mamafua en kipim insaet lo seid kasem taem olketa garem trifala lif.

Bifo iu plantim lo stenaot bed, iu digim fastaem disfala bed bifo iu putim gudfala graon antap fo letem root fo go insaet gud lo graon.

Stand Out Bed

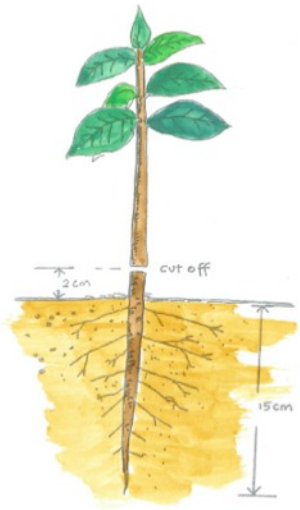
Afta tri manis, taem hem big olsem thamb blo iu, olketa seedlings redi for plantim lo field. Iu save iusim stamp from lketa teak seedlings taem iu laek plantim tree en hem isi fo karem lo bus.

Hao fo iu duim hem olsem:

- Iu pulim aot plant ia from graon.

- Iu katem het blo hem 2 sentimita (cm) antap lo root kola
- Iu aotim olketa smol root hea.
- Iu katem stamp ia 15 sentimita (cm) long.

Insaet lo 2 wiks iu mas plantim olketa stamp lo graon.



Mekem Redi Graon Fo PlantimTree

Taem seedlings gro lo nesari, iu mekem redi ples fo plantim seedlings. Graon mas garem gudfala kaikai fo seedlings:

- Graon mas no wet tumas
- Sapos graon hem garem staka korol, iu askem forestry wat kaen tree na na fit fo gro lo dea. Mahogany hem wanfala tree wea save gro gud lo graon wea garem korol. Teak no save gro gud lo korol graon.

Iu mas aotim bus lo ples wea bae iu plantim tree lo hem. Olketa bus save tekem kaikai lo graon from trees blo iu en olketa save kavam olketa plants from sun.

Iu torowe rabis lo midol lo evri tufala laen lo olketa tree, fo hem rotten en givim kaikai go lo trees blo iu.

Iu no bonem rabis bikos bae iu spoelem kaikai blo olketa tree.

Sapos iu garem kaikai lo garden blo iu wetem olketa frut trees wea iu laek kipim, iu mas putim stik fo markem ples iu laek plantim tree.

Wat Na Distens Bituin Tufala Tree Taem Iu Plant?

Sapos iu laek fo salem timba olketa tree blo iu mas garem stret stem en no eni brans. Dastawae iumi susim olketa seeds wea kam from olketa stret tree.

Tree wea hem no gro stret en bransis blo hem daon tumas, hem no save tekem big slen.

Fo mekem trees ia toll en stret iu mas plantim olketa tugeda fo stopim big brans fo gro.

Hem barava isi fo plantim trees blo iu lo stret laen 4 mita (m) bituin olketa laen en 3 mita (m) bituin olketa tree.

Sapos iu no garem rula fo markem distens, iu save iusim fofala big step bituin tufala tree en trifala big step bituin olketa tree.

Askem lokol Forestry Ofis blo iu bae olketa save helpem iu fo duim diswan.

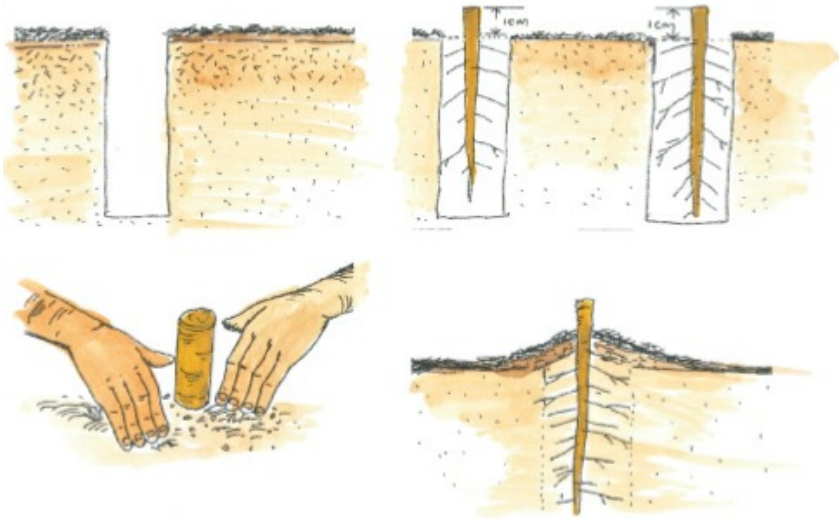
Hao Fo Plantim Seedlings Blo Iu.

Iu save plantim mamafua stret from pot:

- Mekem hol lo graon,
- Tekem mamafua from pot ia en putim lo hol.
- Iu mas plantim seedling lo seim levol olsem hao hem go insaet lo pot.

TIu save iusim stamp fo plantim teak:

- Mekem hol wea dip fitim stamp.
- Livim 1 sentimita (cm) blo stamp antap lo graon levol.
- Presim graon wea raonim teak stamp fo no eni speis fo ea.



- No livim eni drain raonim stamp wea wata save go hipi lo hem.

Wei Blo Agroforesty Fo Plantim Teak.

No eni wan laek hati waka fo plantim 800 teak trees den katem daon ovam haf blo olketa trees wea gro ia bifo olketa redi fo havest. Hem na wae agroforestry hem gud teknik.

Wei blo agroforestry hem fo plantim teak en mixim wetem nara fala tree wea iu save iusim fo fens en fo mekem haus. Mamafua hem wan fala tree wea iu save plantim wetem teak bata eni lokol tree hem bae gud nomoa. Mamafua hem gud bikos hem save gro quik taem, hem strong timba fo haus en hem no gro long taem nomoa so iu save iusim fo mekem haus.

Wat kaen tree iu susim, hem ia na wei fo plantim tree fo iu save garem big teak trees.

Olketa laen blo tree blo iu mas feis go lo ples wea sun hem kam ap (East – West) so olketa garden kaikai wea iu plantim lo midol lo olketa tree ia hem save tekem staka sun laet.

Markem lan blo iu lo sem speising wea iumi tok abaotim bifoa ia, 4 mita (m) bituin lo olketa rou en 3 mita (m) bituin olketa trees insaet lo rou.

Plantim wanfala rou lo teak, den tufala rou wetem mamafua. Iu mas duim seim samting lo ful lan blo iu wea iu laek plantim tree.

Sapos olketa tree ia gro big lelebet iu nid fo thinim, iu save iusim Mamafua fo fens or haus en livim na olketa teak fo gro big.

Afta nara fala 3 yias iu nid fo harvestim last rou blo mamafua wea stap bituin olketa rou blo teak so bae dístaem iu garem nomoa olketa rou blo teak hem stap. 280 – 300 trees bae save stap lo 1 hekta (ha) fo faenol stok blo iu. Lo end blo roteison (15 – 20 yias) bae olketa teak ia gro toll en fat tu.

Den bae iu save salem teak blo iu.

Keeping Your Trees Healthy

You will need to control the weeds near your trees, especially while the trees are young. Weeds take the food from the soil that your trees need to grow and they shade your trees from the sun and make them weak. There should be a weed clear area as long as your arm around the trees as it shows in the picture.

Another good way to keep weeds under control is to grow your food crops between the trees, just remember to keep them away from the trees themselves, just the same as for weeds.

Wat Kaen Kaikai Nao Bae Mi Save Plantim?

Kaen kaikai iu plantim bae senis taem olketa trees givim seid, hem ia nao samfala garden kaikai wea iu save plantim.

Sunshine	Part Shade	Shade
Sweet potato, Cassava, Tomatoes, Peppers, Beans, Corn, Pumpkin, Pawpaw, Rock Melon, Tobacco, Lettuce, Chinese Cabbage, Peanuts, Tsoi Sum, Cucumber, Chilli, Egg Plant, Pineapple, Water Melon,Parsley	Taro Slippery Cabbage Vanilla Pawpaw Coriander Passion Fruit, Ball Bean	Taro Fern Ginger Kava Bush Yam King Tree Parsley

Hem tru taem iu thinim trees, bae hem garem plande laet so olketa kaikai iu plantim bae senis tu.

Samfala garden kaikai olsem kumara save kavam olketa trees taem olketa trees ia smol.

No foget fo senisim olketa garden kaikai wea iu plantim fo graon en olketa garden kaikai bae save stap helti.

Iu mas senisim olketa garden kaikai blo iu wetem legumes olsem peanut en beans, bikos bae olketa putim baek nutrients wea gudfala fo plants insaet lo graon. Nutrients hem samting wea olketa legumes ia bae save givim lo garden kaikai en olketa trees blo iu.

Dis kaen wei ia olketa kolem **Crop Rotation** (muvum raon olketa garden kaikai).

Ino evri garden kaikai nao bae gro gud andanit lo trees. Iu mas traem difrent garden kaikai wea bae fitim tree en graon lo ples ia

Sapos iu laek save lo eni ting abaotim crop rotation, go lukim lokol Agriculture Extension Officer kolsap lo iu. Olketa bae save helpem iu

enisim Olketa Trees Wea Dae (Beating Up)

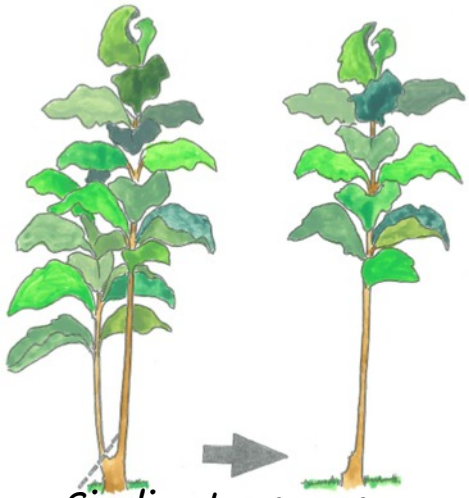
Iu bitim ap olketa trees wea dae afta iu plantim trees (Woodlot) blo iu.

Lo nesari iu mas garem extra seedlings fo senisim trees wea dae. Sapos iu no iusim olketa seedlings ia, iu save salem fo selen or givim lo olketa frens blo iu.

Afta 1 manis iu plant finis, iu go kaontim olketa trees wea dae. Iu mas ripleisim olketa trees wea dae ia.

Iu mas chek olowe fo olketa trees wea dae insaet lo fest 3 manis

Form Pruning (Singling)



Singling to remove the extra stem

Samtaems olketa trees bae divelopim tufala stem. Form Pruning hem samting olketa kolem taem iu katem aot wanfala stem fo narafala stem ia save gro gud, big en strong en stret.

Iu duim dis fala waka 1 manis afta iu plantim olketa trees blo iu.

Mek sua iu wakem klin kat fo stopim siki fo kasem bottom blo tree ia. Sapos iu kat lo angol no eni wata bae save stap lo ples iu katem ia, hem bae mekem tree blo iu rotten and bae hem dae.

Grin Kraon Pruning

Grin kraon pruning hen minim taem iu katem aot samfala lou brans.

Trifala risons fo duim diswan hem olsem:

1.) Sapos iu prunim trees blo iu bae hem no garem knot en iu save tekem staka selen lo tree blo iu.

2.) Taem olketa trees garem staka brans bae win save bloum daon quik taem nomoa.

3.) Hem isi fo waka andanit.

Wat taem fo Prune?

Mamafua hem mas 18 - 24 manis.

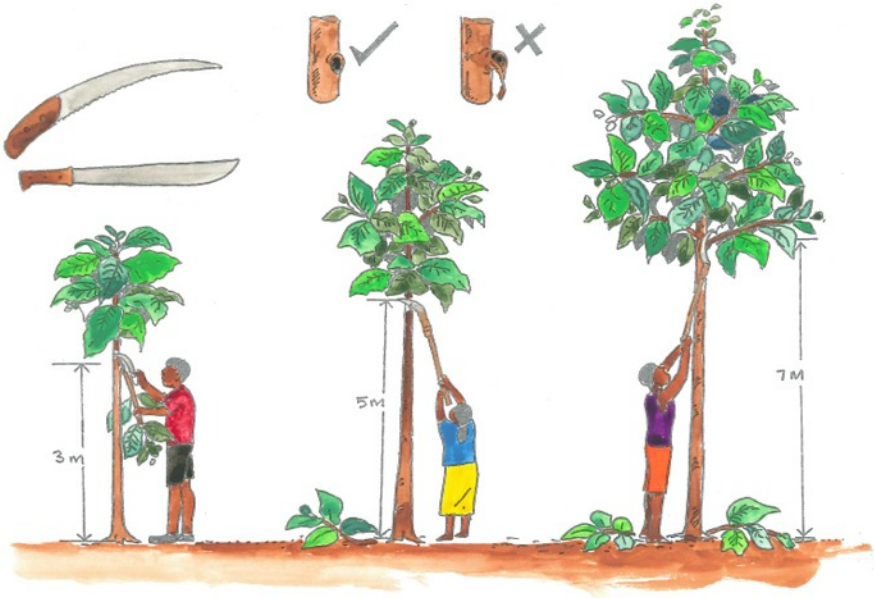
Fo teak go lo Forestry Ofis fo olketa save talem iu taem en wei fo duim pruning.

Hao fo Prune?

Iusim bus naef wea hem sap.

Fest kat mas ap en sekon kat mas go daon fo aotim brans.

Hem bae gud tumas sapos iu iusim hand saw or pruning saw or cutters.



Hem Impotent

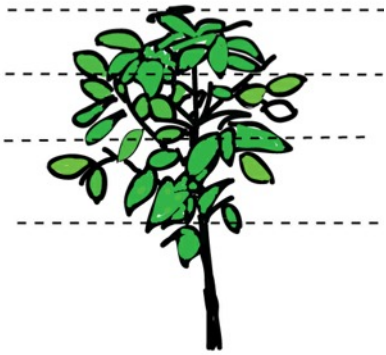
" Katem kolsap lo stem

" No livim eni brans pok aot bikos hem bae slo fo hil ap.

" Late Pruning (big brans) save livim big karakil en boela lo stem blo tree.

How Much to Prune – Flueggea

Don't take too much off, divide the branches into 3 sections and take away the branches in the lower section



Before Pruning

After Pruning

Your local forestry office can help you and show you how to prune.

Thinning (Aotim Samfala Tree)

Sapos iu folom agroforestry system bae iu no nid fo thinim teak trees blo iu. Bae iu katem aot mamafua nomoa en livim speis fo teak fo gro. Iu mas aotim eni teak trees wea smol or hem ben olobaot. Sapos iu iusim na singol spieces plenteisen teknik, iu mas ting ting fo thinning.

Before thinning

Sapos iu plantim trees blo iu 5 yias ago olketa trees blo iu bae hem luk olsem piksa lo narasait ia.

Samfala bae toll en stret, amfala bae smol, samfala bae ben en samfala bae garem tufala stem.

Iu mas aotim olketa trees wea bae iu no tekem selen lo hem. No mata iu livim lo graon long taem bae olketa ravis tree ia bae tekem kaikai en sun laet from olketa narafala gud tree.

Olketa gud trees wea iu livim bihaen bae garem staka rum fo gro big en iu save tekem staka selen lo hem.

IInsaet lo 1 hekta (ha) blok (100m x 100m) iu plantim abaot 830 trees lo speising 4m x 3m lo fest taem.

Sapos iu laekem big trees wea iu save tekem staka selen lo hem iu mas katem aot samfala kasem 540 trees lo 1 hekta (ha).

After thinning

Samfala lo olketa trees ia iu save salem lo olketa wea save baem log.

Lokol Forestry Ofis blo iu bae hapi fo helpem iu fo duim thinning.

Markem Tree Bifo Iu Katem Daon (Pre Harvesting Inventory)

Sapos iu kasem taem fo katem olketa trees blo iu en salem lo market iu mas save lo volume blo timba wea iu garem lo olketa trees blo iu.

Eni wan nomoa save markem big en long blo tree blo iu. Kaen ia nao bae iu save lo praes blo olketa trees blo iu.

Lokol Forestry Ofis

blo iu bae hapi fo helpem iu fo markem olketa trees blo iu.

use this page to make notes

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Acknowledgements:

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Illustrations: Nelson Horipua, Frank Sauni, Brian Feni & Tim Blumfield

Department of **Employment, Economic Development and Innovation**

Selected wood properties and potential uses for plantation teak and poumuli

ACIAR Project report FST/2007/020

Queensland Government

Forest Product Innovations Clarity ID 04292

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Burma (Myanmar)-This report follows ACIAR's use of the English name for Burma in lieu of Myanmar, the alternative name adopted by the military junta in 1989.

Contents

Abbreviation, acronyms, symbols

°C	degrees Celsius
ACIAR	Australian Centre for International Agricultural Research
CIE *L*a*b**	Commision Internationale d'Eclairage (CIE) *L** (white to black) *a** (red to green) *b** (yellow to blue)
DEEDI	Department of Employment, Economic Development and Innovation
EMC	equilibrium moisture content
et al.	*et alia*, and others
FAO	Food and Agriculture Organisation
FST	Forestry (program)
GPa	gigapascal
ha	hectare
kg/m^3	kilograms per cubic metre
km	kilometre
kN	kiloNewton
M	million
MC %	moisture content percent
mm	millimetre
MOE	modulus of elasticity
MOR	modulus of rupture
MPa	megapascal
Mt	Mount
MTE	Myanmar Timber Enterprise
RH	relative humidity

Executive summary

Teak and poumuli sit at opposite ends of the wood information spectrum. Teak is a household name amongst commercial timbers of the world. Teak plantations have been established in many tropical countries and it is easy to find data in the literature on a wide range of properties and uses. Poumuli on the other hand is virtually unknown outside the Pacific islands and there are limited data on total area planted, properties or uses, except for anecdotal information.

This project provided the opportunity to add to teak information through empirical testing for key properties on four different populations, one from Australia and three from the Solomon Islands. For poumuli the project presented the opportunity to determine wood properties and demonstrate the wood's potential for applications other than small poles.

Teak

Teak wood processed from plantations as young as 6-years-old has sufficient material properties to be used in typical teak products such as garden furniture and yacht decking. Older trees (15-years-old) grown in more open conditions (333 spha) attained a theoretical higher log value when graded in accordance with the current Myanmar Timber Enterprise standard and a value factor is applied to the grade classes when compared to trees harvested at younger ages and at higher stocking rates (for example 10-years-old, 1,600 spha).

The peeling and slicing trials produced predominantly C and D grade veneers. The primary grade-limiting features were knots, insect damage, discolouration and splits.

The higher stocking rate applicable to the 10-year-old plantation in the Solomon Islands may have beneficially affected physical and mechanical properties as determined in this study. The logs harvested from the 10-year-old plantation on average produced harder, heavier, stronger and higher stiffness wood material than the other plantation populations tested. Although these properties are generally considered desirable properties they don't always guarantee a higher value in many markets, where the lower threshold of a required range for a property is all that is necessary.

The shrinkage from green to air-dry and unit shrinkage rates for plantation-grown teak were lower than published data for mature teak. This is consistent with results from tests on plantation-grown eucalypts compared with mature eucalypt wood shrinkage in other studies by the authors. The high shrinkage ratios of the teak tested in this study can cause strain in board faces of rectangular sections cut using a traditional backsawn pattern, leading to cupping and surface checking degrade. Section sizes, particularly board widths need to be considered during the design stage of furniture, flooring and panelling products to ensure satisfactory performance. For example, quarter sawn stock will provide superior performance where wide cover widths are required.

The 10- and 15-year-old plantation teak wood performed relatively well in the accelerated durability indicator test. Longer term durability trials are recommended to provide more accurate estimations of plantation-grown wood durability.

Heartwood proportions for teak increased with age. By age 10 approximately half the cross-sectional area was heartwood and by age 20, two-thirds was heartwood. The extractives contents decreased with age for the Solomon Islands teak, though the results for the older material were similar to published extractives contents for mature teak. The north Queensland teak had higher levels of extractives compared with similar aged material from the Solomon Islands which may be attributed to the different climatic conditions or the influence of genetics and silviculture.

An array of products was manufactured from the plantation teak material. No problems were encountered during processing or manufacture and the resultant products were visually appealing. The wide growth rings and finer texture of the plantation teak provides a different appearance to slower grown mature teak and this may exclude plantation teak from attaining current market rates for high end yacht decking and garden furniture, however the properties as determined during this study verify the suitability of plantation-grown teak in all traditional applications.

Poumuli

The poumuli density and hardness results compare favourably with well known commercial species which have all been used successfully in applications such as parquetry, flooring, step treads and furniture.
The poumuli logs contained relatively high sloping grain (>7°) which is has a negative influence on mechanical properties. Tree breeding programs should consider selection of straight-grained material to improve the properties and performance of poumuli products.

Poumuli has medium to high tangential shrinkage, but low radial shrinkage. The high ratio between tangential to radial can lead to problems in wide backsawn boards, for example face 'cupping' in changing weather conditions.

Given the promising durability performance of poumuli, the establishment of longer-term field tests to provide quantitative service-life estimates for building products is recommended.

Heartwood development in poumuli is slow based on the measurements taken during this project with only approximately half the cross-section of 20-year-oldd poumuli measured as heartwood. Extractives contents increased slightly with age.

The physical and mechanical properties of poumuli determined during these trials indicate that the wood is suitable for a wide range of applications including flooring products, benchtops and cabinetry. Care is required to account for sloping grain and the high shrinkage ratio between tangential and radial planes.

Abstract

Australian and international standards were followed for trials to determine mechanical and physical properties including strength, stiffness, hardness, density, shrinkage, colour, extractives contents and grade quality of logs (teak and poumuli) and veneers (teak). A range of products was manufactured for evaluation.

Due to the young age of the experimental material, the logs were mainly classed as poles and posts, though peeling and slicing trials were able to be conducted on several larger logs. Due to the presence of knots, insect holes and stain the majority of the veneers were rated as C grade. Industry evaluators considered the colour and quality was good.

The density and hardness results indicated that all teak and poumuli meets the requirements for flooring applications and similar applications such as benchtops and step treads where resistance to indentation is desirable. The mechanical properties of both species across age classes allows for use in furniture manufacturing, although poumuli with sloping grain will require careful grading.

The shrinkage results place plantation teak in a low shrinkage category and poumuli in medium shrinkage. The durability indicator test results show that 10- and 15-year-old teak may have good durability, as does poumuli. The younger teak had less resistance to the fungi used in this assay. Longer term durability trials are recommended to verify the results and generate reliable data.

Introduction

This report discusses selected properties and utilisation potential of wood from plantation-grown teak *Tectona grandis* and poumuli *Flueggea flexuosa*. Teak is one of the best known commercial timbers in the world and is planted for wood production in many countries including Australia and the Solomon Islands. Poumuli is an important agroforestry candidate in the Pacific islands, however there are scant published data regarding its wood properties and the species is virtually unknown outside of the areas it is grown.

The work described in this report was undertaken by Forest Product Innovations (Department of Employment, Economic Development and Innovation DEEDI) as part of ACIAR research project No. FST/2007/020 *Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands by interplanting with* Flueggea flexuosa *and other Pacific agroforestry species.*

The broad aim of the ACIAR project is to enhance the economic contribution of the timber plantation industry to the Solomon Islands' economy, whilst increasing smallholder income security, by the use of silvicultural systems incorporating inter-row plantings (typically food crops) with shorter rotation species (for their wood).

The project examined the suitability of younger-age, plantation-grown poumuli and teak for in-country processing of products suitable for export. The component reported in this document discusses the results of trials designed to determine the characteristic wood properties of representative material from a range of plantations (six in the Solomon Islands, and one in Australia (Plate 2)) and evaluate the potential for the plantation wood to be processed and manufactured into mid- to high value products.

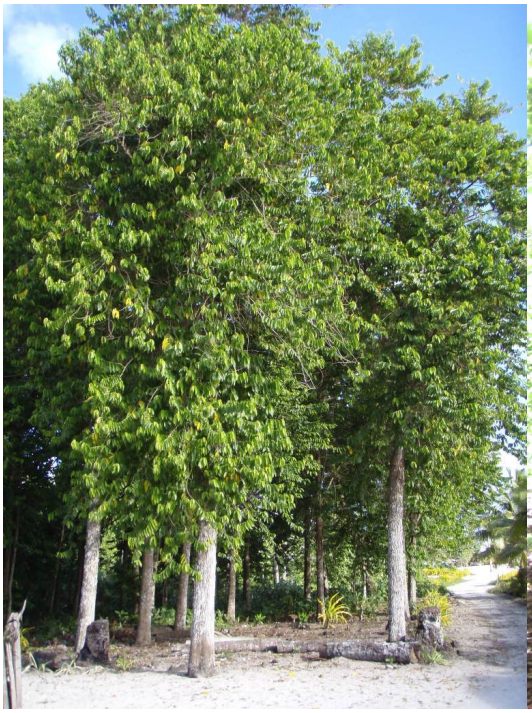

Plate 1. Poumuli stand, Samoa.

Plate 2. Teak plantation, Mt Ray Australia (Photo: Griffith University).

Background and objectives

Timber-producing trees from monoculture plantations or agroforestry systems are likely to become increasingly important sources of wood due to reduced access to natural forest resources (relevant to the Australian situation) and/or loss of resource due to harvesting rates above sustainable levels (relevant to the Solomon Island situation). Compared with short-cycle food crops, tree crops are a long-term investment, so choice of species based on potential value and utility is an important consideration requiring accurate information on which to base decisions, minimise risk and strengthen investor confidence.

In some islands in the western Pacific region, poumuli *Flueggea flexuosa* is held in high regard for important applications such as housing poles and roofing timbers due to anecdotal evidence that it is highly durable and strong, providing satisfactory performance in these construction functions in cyclone-prone regions. This reputation combined with its potential for rapid growth rates in tropical agroforestry or plantation systems has resulted in the species gaining priority for research programs.

Blumfield (2007) reported wide smallholder uptake for pole production in Samoa and Vanuatu and trials in agroforestry plots with vanilla and kava inter-cropping. This interest has developed in the absence of empirical testing and reporting of the wood properties for the species, therefore one of the aims of this report forming a component of the larger ACIAR project is to address this lack of technical data.

Determination of important wood properties allows wood technologists to compare the wood with more common commercial timbers and nominate a range of potential uses for which the wood is suitable, thus increasing awareness of the species as a useful and versatile timber, both for local applications and export markets.

Teak on the other hand is one of the best known classic timbers due to consistent high demand, particularly in garden furniture and ship building markets. The stable wood is naturally durable, weathers well, easy to work, resistant to corrosion of fasteners and acids. Corresponding with depletion of natural teak within its distribution area, plantations have been established in many countries including Australia and the Solomon Islands. In northern Australia, over 5000 ha of teak plantations have been established since 2000 (Halkett et al., 2011).

The objectives of the work described in this report were to determine the key properties and nominate suitable products from logs harvested from agroforestry plots of poumuli and to measure selected properties of plantation-grown teak at a range of ages and evaluate the suitability of this material for typical teak products.

Materials

Teak

Four batches of teak logs were provided for testing: 15 logs from a 6.5-year-old plantation near Cooktown in far north Queensland, Australia; 15 each from plantations aged 6, 10 and 15 in the Solomon Islands. Burmese teak samples were collected from two outlets in Brisbane.

Australian-grown teak

Griffith University representatives selected 15 trees for harvesting from a 6.5-year-old plantation located near Mt Ray, approximately 44 km north-west from Cooktown. No information on the germplasm was available, however the plantation site was considered fertile and had previously been utilised for beef production. The original stocking rate was 1,000 stems per hectare (spha) with 5 m between adjacent rows and 2 m between adjacent trees within a row. Residual stocking rates at the time of harvest for this trial were not provided.

Long-term average rainfall for the region is 1,700 mm per annum and the mean annual temperature is 29°C. The region experiences tropical monsoonal climatic conditions with extended drought periods from May to November and generally high rainfall during summer months. During the lifespan of the harvested trees the average annual rainfall was approximately 1,500 mm with inconsistent annual precipitation (range 715 mm in 2002 to 2,736 mm in 2006).

Solomon Island-grown teak

Two batches of 15 teak logs each were sourced from Poitete and a third batch of 15 logs from Bibiu Ringi. Site and stand information are provided in Table 1.

Table 1. Summary of Solomon Island teak source material used for tests.

Harvest age	**6**	**10**	**15**
Plantation location	Poitete	Poitete	Bibiu Ringi
Prior land use	Secondary regrowth		
Provenance	Solomon land race		
Planting spacing	4 x 3	2.5 x 2.5	10 x 3
Original stocking spha	833	1600	333
Site preparation	Fully cleared		
Thinning operations	Age 4	Age 4	Not thinned
Pruning history	Age 2.5 Age 5	Age 2.5 Age 5	Age 2.5
System	Monoculture	Monoculture	Agroforestry

Rainfall is the least uniform of climatic elements, as topographical effects cause significant variations between locations. Annual rainfall can range from 3,000 mm to 5,000 mm per annum, with February generally being the driest month.

Burmese teak

To compare the results from some of the plantation teak tests, specimens of commercial grade Burmese teak were collected from an importer's yard and a yacht builder's premises.

Poumuli

A total of nine poumuli logs were sourced from Munda on New Georgia in the Solomon Islands. Three trees from each of three age classes viz 5-years-old, 8-years-old and 20-years-old, were selected, harvested, de-barked and shipped to Brisbane Australia for testing.

The Munda region of Solomon Islands receives 3,600 mm precipitation per annum and has an average temperature of 27°C. No specific environmental data, prior land use information, original stocking or silvicultural history were available for the harvest sites.

Methods

The key properties of wood which are measured to provide an indication of the utility of a population are density, stiffness and strength, hardness, durability, colour and grade quality. Other important parameters to measure are respective proportions of heartwood and sapwood and the level of extractives contained in the wood.

Sampling

The logs were selected by the Project Leader, Griffith University, debarked on site then transported to the DEEDI Salisbury Research Facility in Brisbane Australia for sample preparation and testing.

Recovery, grading and nominal value

Log grades and nominal value

The logs were sawn to provide the necessary specimens for testing rather than to undertake a traditional grade recovery study. The logs were graded in accordance with The Myanmar Timber Enterprise Standard MTE (Anon., no date) which describes product grades for veneer logs (three grade classes), sawlogs (nine categories), poles and posts. No standard exists for poumuli, so the MTE for teak was used to grade the poumuli logs. Minimum length for all categories listed in MTE is 2.4 m however minimum diameter specifications vary from 100 mm for small poles to almost 500 mm for veneer logs.

To illustrate the comparative value of the logs, a hypothetical value factor was given to each product grade. The nominal log values increase for successive log grades which are generally based on diameter. For each batch of logs, the factor was multiplied by the number of logs in the relevant grade class to provide a total nominal batch value and mean log value of each age class for comparative purposes.

Veneer graded recovery

Veneer is used for a wide range of structural and decorative products and provides an efficient processing option for plantation resources. Decorative veneers are used in cabinetry, joinery, interior panels, marine fit-outs, furniture and overlay flooring. Demand for panels for cabinetry has declined during recent years and the key product groups for decorative veneer are overlay flooring, wall panels and furniture.

Although the logs assessed in this project were undersize according to the veneer log specifications in MTE standard, several of the larger billets were suitable for veneer production using facilities in Brisbane. Grading was undertaken in accordance with AS/NZS 2269.0:2008 *Plywood- structural Part 0: Specifications (*Note that the grade quality descriptions for interior, exterior and structural veneers are identical).

Peeling

Three logs from the Solomon Island material, one each from age 6-, 10- and 15-years-old, were selected for peeling on a spindle-less lathe at the Salisbury Research Facility. None of the north Queensland logs were large enough for peeling. The peeler logs were merchandised into two billets each to provide six billets 1.29 m in length. Target veneer thickness was 2.5 mm.

Slicing

Two 15-year-old teak logs selected for slicing were sawn round-and-round to prepare four 100 mm faces, effectively producing a boxed heart flitch. These fitches were transported to a specialist decorative veneer producer near Brisbane for slicing. One face on each flitch was notched with shallow grooves to prevent tear-out during slicing. The flitches were soaked in a gas-heated water bath for five days to a maximum temperature of 60°C to soften the wood in preparation for slicing.

Slicing angle was set to 20° and the target veneer thickness was 0.6 mm. The veneer sheets (Plate 3) were dried to 10% moisture content and stacked under concrete weights to maintain flatness.

Plate 3. Sliced Solomon Island teak veneers.

Recovery rates were calculated and selected veneer sheets were used to manufacture demonstration and evaluation panels.

Density

Wood density

Density is the mass of a material per unit volume and for wood is commonly expressed in kg/m^3. It is one of the most useful indicators of a wood's utilisation potential due to its significant correlations to hardness, strength and stiffness. A good rule of thumb applies in that the denser the wood material (assuming clear sections, free of defects), the greater are the mechanical properties.

Basic density

Basic density is a measure of the oven-dry mass of a saturated volume of wood and is useful for scientific interpretations and for assessing pulp and paper properties. It can also be used to model or predict wood mass at different moisture contents, for example for shipping and freight situations.

Basic densities were determined in accordance with AS/NZS1080.3:2000 (Standards Australia, 2003) for pith-to-bark segments at two heights in the stem. For the teak, specimens were prepared from inner heartwood, outer heartwood and sapwood zones and the average for the tree calculated. Poumuli doesn't always have clear demarcation between heartwood and sapwood, so the results are given as the mean of the full radius with no segregation of heartwood and sapwood zone data.

Air-dry density

The most commonly used expression of wood density used by the Australian timber industry is air-dry density, defined as the mass per unit volume of wood at 12% moisture content (MC). This nominal moisture content level is the theoretical equilibrium moisture content (EMC) for seasoned wood on average during the year, implying the condition of wood products in service.

Samples were taken from two heights in the stem and conditioned to 12% moisture content by storage in a constant environment chamber set to 20°C and a relative humidity of 65%. After attaining the required seasoned condition, the samples were processed into cube-shaped specimens of 20 x 20 x 20 mm. The volume was accurately calculated from measurements taken by digital calliper and mass was determined by weighing on an electronic balance in accordance with the procedures described in AS/NZS 1080.3:2000 Timber – Methods of test – density (Australian Standard/New Zealand Standard, 2000).

Mechanical properties

Modulus of Elasticity MOE

MOE is a measure of a timber member's ability to resist deflection under the stress of a short term duration load which implies its relative stiffness. This property was measured by three-point bending as described in Mack (1979) on dressed samples 300 mm (length), 20 x 20 mm of wood clear of defects. For the teak, test specimens were taken from butt and top logs. Teak feedstock was also sourced from a commercial supplier for comparison of mechanical properties.

Modulus of Rupture MOR

MOR is a measure of the ultimate strength of a beam subject to a slowly applied, short-term load. The measurements were determined using the three point (centre loading) procedure in accordance with Mack (1979) on the same set of specimens as for the MOE testing.

Roundwood strength

Selected poumuli logs were tested in roundwood form using the 4-point bending test method as described in AS/NZS 4063.1992- Timber- stress-graded- In-grade strength and stiffness evaluation (Australian Standards/New Zealand Standards, 1992).

Hardness

Hardness is the measure of the wood surface's resistance to indentation and indicates suitability for high value applications such as flooring, decking and benchtops. It also indicates a material's ease of working with hand tools and processing equipment, excluding factors such as the presence of naturally occurring lubricants or abrasants. In Australia the most common test method used to determine and describe hardness is based on the Janka hardness test as described in Mack (1979).

The procedure involves pressing a steel ball with a diameter of 11.284 mm into the specimen at a rate of 6.5 mm/minute (Plate 4). Janka hardness is the maximum force necessary to penetrate the timber in relation to half of the ball's diameter and the result is expressed in kiloNewtons (kN) (Plate 5).

Hardness samples were cut oversize to allow for shrinkage then conditioned in a controlled environment (20°C/65% RH) until approximately 12% MC. Specimens were re-cut into 40 mm (radial) x 50 mm (tangential) blocks. A deviation from the prescribed specimen length was sometimes required due to the high frequency of knots in the plantation logs. In total, four measurements were taken for each specimen and the average given as the hardness value for the specimen.

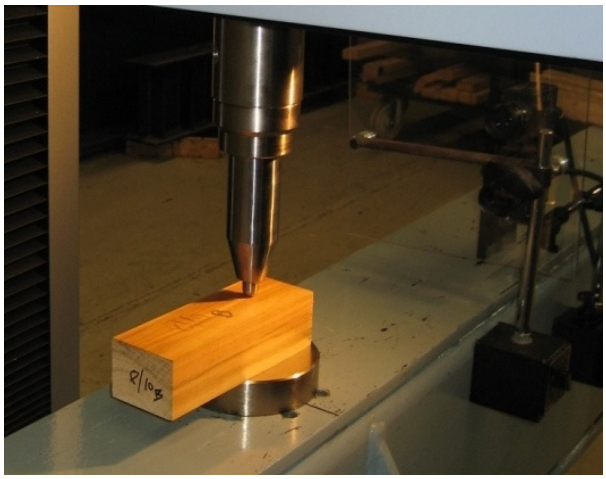

Plate 4. Specimen undergoing hardness test.

Plate 5. Specimens after test, showing indentation.

Shrinkage and movement

When trees are harvested they contain large amounts of moisture. If left in the round form the moisture content remains high and drying out occurs at a slow rate; however when logs are sawn into boards drying occurs more rapidly as the wood moisture equalises with the surrounding environmental conditions. Initially there is no change in dimension as free water vacates voids in the wood elements but from the point (fibre saturation point, FSP) where moisture desorbs from the cell walls, shrinkage occurs.

Changing environmental conditions such as seasonal variations in humidity or the use of climate control devices in buildings, cause wood components to shrink and/or expand as the wood material equalises to the surrounding conditions. This movement is measured as unit shrinkage and described as the percentage of dimensional change per 1% change in conditions (equilibrium moisture content, combined environment from temperature and relative humidity). Teak is renowned for its low shrinkage, whilst for poumuli values for shrinkage are absent in the literature.

Shrinkage test specimens of 20 x 20 x 25 mm were taken from all 15 poumuli billets and 30 of the Solomon Island teak logs (10 from each age group). Some knotty teak samples were also measured to determine the difference between knotty wood typical of young plantations and clear wood.

All samples were measured in radial and tangential direction using the optical triangulation principle with two laser sensors. Measurements were taken at the following moisture content points as described in Kingston and Risdon (1961):

- green
- air dry (12% MC)
- 5% MC
- 0% MC (oven dry)

After measurements were taken at 12% the samples were reconditioned for 2 hours under saturated steam conditions at 100°C. Unit shrinkage was determined using data from the range

12% MC (reconditioned) to 5% MC to comply with the protocols described in Kingston and Risdon (1961). This restores abnormal shrinkage caused by collapse.

Durability indicator

In the context of wood properties, durability refers to the material's natural resistance to attack from decay organisms and insects. Ratings are determined from long-term exposure tests in environments conducive to decay, ideally in both above-ground and in-ground treatments to reflect the differing in-service environments of products such as deck beams and joists (above-ground) and posts and poles (in-ground).

When time constraints limit the possibility of a field test, durability indicator tests can provide a short-term result however this can only be considered a guideline and not necessarily an accurate rating for long-term performance.

Due to the timeframe of this project, the latter option was undertaken using the durability indicator protocols developed by Bailleres and Francis (2010). Loss of mechanical properties such as stiffness occurs at a faster rate than loss of mass (Curling, 2002). Minibeams of dimension 7.5 x 7.5 mm, length 150 mm for each batch of teak and poumuli plus samples from two reference timbers (*Corymbia citriodora* spotted gum in-ground durability class 2 and *Pinus elliottii* slash pine durability in-ground class 4) were conditioned to 12% moisture content. All specimens were tested for stiffness values by acoustic vibration method (Brancheriau and Bailleres, 2002). They were then placed vertically to half their length in two tubs containing a mix of soil and vermiculite inoculated with *Tyromyces leucomallus*. This brown rot fungus was selected as it has been shown to be more aggressive against teak in accelerated decay tests (Thulasidas and Bhat, 2007). The soil mix was maintained in damp, warm conditions (approximately 80+% relative humidity and 27°C) to promote fungal activity and accelerate the wood decay process during a 10 week incubation period.

Plate 6. Accelerated mini-beam durability indicator test.

At the completion of the incubation period the samples were removed, rinsed and conditioned to 12% moisture content, weighed, measured and tested for stiffness by the acoustic vibration

method. The reduction in MOE caused by fungal activity provides an indication of the wood's relative resistance to decay durability.

Colour assessment

The aesthetic variables which determine whether a timber is in fashion for a particular market or product, especially for interior applications, include colour, grain, texture and presence of absence of natural features such as knots. Colour was measured during this project in accordance with the international standard recommended by the International Commission on Illumination (Commision Internationale d'Eclairage, CIE *L*a*b** (1976). This allows for comparison with other timbers or other populations of a different age or origin.

A scanning colour spectrometer with a detection range similar to the human eye (400 to 700 nm) was used to provide colour data from clear, dressed surfaces of dry wood.

This equipment has a head diameter of 16 mm, with an 8° diffuse measuring angle. A xenon flash lamp illuminates the sample. The reflected light is then separated into its components and expressed in the CIE *L*a*b** scale. This is an expression of a three dimensional measurement where:

- *L** represents lightness (100 = diffuse white, 0 = black)
- *a** describes redness (magenta) (+) through grey (0) to green (-)
- *b** describes yellow (+) through grey (0) to blue (-).

Natural grown Burmese teak samples were also measured for comparison.

Heartwood proportion

Heartwood is formed as trees mature. Also known as truewood, heartwood is the 'dead' core portion of the bole which no longer provides systemic functions such as conducting nutritional or waste products through the anatomical elements in the stem, but provides support for the tree. This zone of wood contains chemical compounds known as extractives which can provide distinctive colouration and impart durability to the wood tissue.

The development of heartwood and the relative proportions of heartwood and sapwood impact on utilisation, recovery and processing costs and are particularly important attributes in the case of teak. The heartwood zone of the stem provides the coloured, stable, acid- and termite-resistant wood fibre that teak is valued for. The pale-coloured sapwood of teak is susceptible to lyctine beetle attack and, as for all species, is non-durable in weather-exposed applications. This implies added processing costs if treatment is required or reduced recovery if the sapwood is removed.

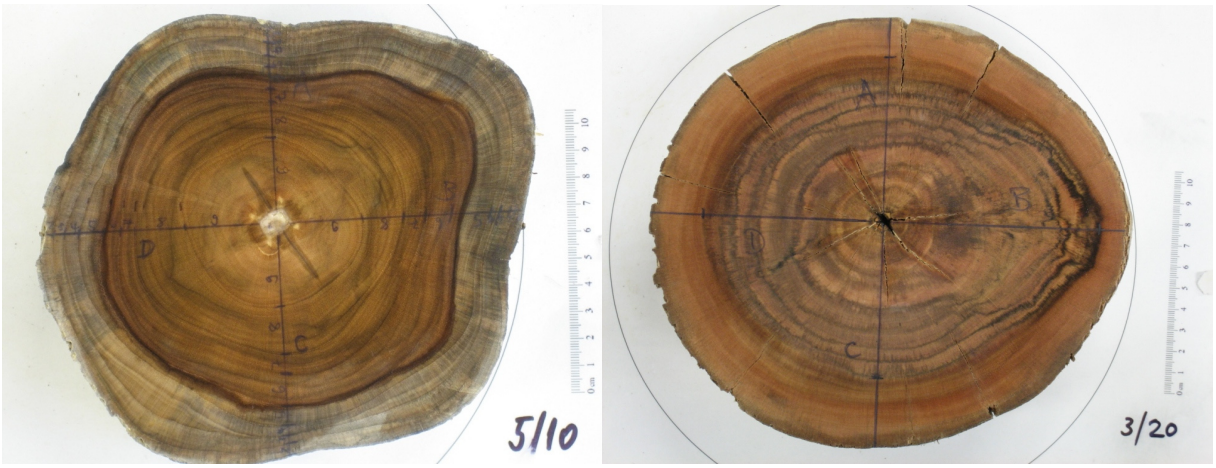

Plate 8. Teak (left) and poumuli (right) cross-sections prepared for heartwood:sapwood mensuration.

In large logs procured from managed natural forest, the heartwood proportion is generally sufficient to provide an economical return without recovering products from the sapwood zone. However in the case of immature trees such as logs sourced from early-age plantations, the relative proportions of these wood zones can impact heavily on the economics of processing and marketing. Due to teak's primary reputation as an outdoor furniture and marine decking material, sapwood characteristics require careful consideration.

In teak, the heartwood zone is generally demarcated from the sapwood band by colour differentiation, although a transition zone may also be present. Poumuli generally has a less distinctive demarcation between heartwood and sapwood in the dry condition, though it can be visually delineated on fresh-sawn cross-sections. Where poumuli is used in roundwood applications such as small building poles, the sapwood is removed to above ground line, therefore a high heartwood proportion and narrow sapwood band is preferred for roundwood in-ground applications.

Heartwood and sapwood proportions and sapwood band width were measured on planed, wetted samples. Four radial measurements were taken on the disc surface (Plate 8). The cross-sectional area (under bark) calculated.

Extractives content

Extractives are non-structural chemicals that are mostly produced during heartwood formation. They impart colour and durability to wood, and some can cause waxiness, odour, taste or toxicity. Extractives may also affect wood shrinkage and movement, impede successful gluing and/ or interfere with coating systems. The quantity and quality of extractives present in heartwood varies within trees and between trees and populations.

The method described by Francis (2011) was used to determine the level of extractives present in the wood. This task involved the sequential removal of solvent extractible compounds from oven dry wood particles, using a two stage process. For each specimen, two grams of ground wood particles (<2 mm) were placed in a cellulose thimble and immersed in boiling solvent. The first extraction was done with dichloromethane to remove low-polarity / non-polar substances such as lipids. The second extraction was undertaken with 90% acetone (to remove more polar compounds such as phenolics). The extracts were measured gravimetrically and reported as a proportion of oven dry mass of wood.

Product evaluation

An array of products was manufactured from sawn, dried boards of teak and poumuli and display panels were made using teak veneer. From the teak boards panels of yacht decking, parquetry and decorative veneer displaying a range of qualities and with different finish coatings were prepared. Small furniture items and shutters were also produced.

From the poumuli, parquetry demonstration panels were made. Based on the results of wood property tests, other products and markets were considered which could be manufactured in local processing facilities for domestic and export markets.

Results

Sampling

The project leader undertook the sampling and selection, providing 15 logs from each batch of teak (6.5-year-old north Queensland, 6-year-old Solomon Islands, 10-year-old Solomon Islands, 15-year-old Solomon Islands) and three logs from each batch of poumuli (5-year-old, 8-year-old and 20-year-old, all Solomon Islands). The logs were delivered to the Salisbury Research Facility in Brisbane for breaking down to trial specimens and feedstock for demonstration products.

Recovery, grading and nominal value

Log grades and nominal value

Log grades in accordance with the Myanmar Timber Enterprise MTE Standard (Anon., no date) and nominal value factors for each batch of teak are presented in Table 2. In the absence of any standards for poumuli, the MTE standard was used to grade the poumuli logs as well.

Table 2. Teak log average dimensions, grades and nominal values (Myanmar Timber Enterprise Standard).

Age, origin Dimension	6.5, Qld	6, Sol.Is.	10, Sol.Is.	15, Sol.Is.
Log length (m)	6.0	5.7	5.7	5.7
Average DBHOB (cm)^	16.5	23.9	21.4	31.1
Original stocking rate (spha)	1,000	833	1,600	333
Grade (value factor)	**Reps (value)**	**Reps (value)**	**Reps (value)**	**Reps (value)**
Small pole (1)	15 (15)	-	2 (2)	-
Pole/post (1.5)	-	4 (6)	9 (13.5)	2 (3)
Post (2)	-	5 (10)	1 (2)	-
Post/small sawlog (2.5)	-	5 (12.5)	3 (7.5)	7 (17.5)
Small sawlog (3)	-	-	-	-
Medium sawlog (3.5)	-	1 (3.5)	-	5 (17.5)
Larger sawlog (4)	-	-	-	1 (4)
Veneer log (4.5)	-	-	-	-
Number (total value)	**15 (15)**	**15 (32)**	**15 (25)**	**15 (42)**
Mean nominal value per log*	**1**	**2.1**	**1.7**	**2.8**

^ diameter at breast height under bark

* see Method section

As expected the older logs attained the highest nominal value when a grade value factor is applied to the number of logs per grade class for each batch. These logs were sourced from an agroforestry, mixed crop stand that was planted at a low stocking rate (333 spha). The 6-year-old Solomon Island teak logs were from the stand with the second lowest stocking rate (833 spha, then thinned at age four) and attained a higher value than similarly aged north Queensland teak (1,000 spha) and 10-year-old Solomon Island teak (1,600 spha). The north Queensland logs were too small to make the smallest sawlog grade and were all classed as small poles.

The poumuli logs ranged in diameter from 13 to 20 cm thereby excluding any logs from sawlog and veneer grades when graded in accordance with MTE specifications. All five and eight-year-old logs were allocated to the post/pole category. The logs selected from the 20-year-old plot included two larger, higher value posts.

Table 3. Poumuli log average dimensions, grades and nominal values (MTE Standard).

Age, origin Dimension	5, Sol. Is.	8, Sol. Is.	20, Sol. Is.
Log length (m)	2.31	5.63	5.71
Average DBHOB (cm)^	13.8	14.9	17.9

Grade (value factor)	Reps (value)	Reps (value)	Reps (value)
Pole/post (1.5)	3 (4.5)	3 (4.5)	1(1.5)
Post (2)	-	-	2 (4)
Post/small sawlog (2.5)	-	-	-
Small sawlog (3)	-	-	-
Medium sawlog (3.5)	-	-	-
Larger sawlog (4)	-	-	-
Veneer log (4.5)	-	-	-
Number (total value)	**3 (4.5)**	**3 (4.5)**	**3 (5.5)**
Mean nominal value* per log	**1.5**	**1.5**	**1.8**

^ diameter at breast height under bark

* see Method section

Veneer graded recovery

Peeling

No A or B grade veneers were produced during the peeling trial. Fifty-four percent of the veneer made C grade and 46% was classed as D grade. Knots were the primary reason for downgrade, accounting for over one quarter of all veneer being allocated to C grade. Insect damage and discolouration accounted for a further 10% being graded to C quality. Twelve percent of the veneer sheets were downgraded to D due to splits and approximately 10% due to bark-included knots. The splits present in the veneer were pre-existing voids (for example, log end splits developed from growth stress release after harvesting and worsening during surface drying awaiting peeling) and not induced during processing.

Slicing

Sliced veneer quality was affected by insect damage (ambrosia beetle, pin-hole/shothole borers), stain and knot defects, limiting the value for current decorative veneer markets. Although 80% of the sliced veneer was C grade, 7% was of sufficient quality to make B grade. The reason these sheets didn't make A grade was the presence of some insect holes and to a lesser extent, some staining. The primary defects limiting the grade classification to C were knots and knot holes. The colour of the teak veneer was considered good by the decorative veneer industry representatives.

Density

Basic density

Mean un-extracted basic density values are listed in Table 3 (teak) and Table 4 (poumuli).

Table 3. Basic density data, plantation teak.

	Australia	Solomon Islands' plantations		
Age at harvest	**6.5-yr-old kg/m^3**	**6-yr-old kg/m^3**	**10-yr-old kg/m^3**	**15-yr-old kg/m^3**
heartwood	470	465	535	520
sapwood	450	530	545	520
mean	460	480	540	520

Table 4 Basic density data, Solomon Islands' plantation poumuli.

	Solomon Islands' poumuli		
	5-yr-old kg/m^3	**8-yr-old kg/m^3**	**20-yr-old kg/m^3**
mean	585	610	585

Air-dry density

Air-dry density values were determined for plantation material (butt logs and top logs) as well as for commercial Burmese teak samples collected from a Brisbane importer. The results from testing are presented in Tables 5 (teak) and 6 (poumuli).

Table 5. Air dry density data, plantation teak.

Australia	Solomon Islands' plantations		
6.5-yr-old kg/m^3	**6-yr-old kg/m^3**	**10-yr-old kg/m^3**	**15-yr-old kg/m^3**
560	575	635	620

The values for butt logs and top logs harvested in north Queensland were very similar with mean air-dry densities of 560 kg/m^3 and 555 kg/m^3 respectively, although the density values were more consistent for the top logs with a standard deviation of 18 kg/m^3 compared to 30 kg/m^3 for the butt logs. The mean air-dry density of regrowth Burmese teak (13 samples) was 670 kg/m^3.

The density results indicate that the plantation teak has attained reasonable wood density for many applications but is on the threshold of what is normally accepted for internal uncovered domestic (565 kg/m^3) and commercial flooring applications (Smith *et al*, 1991). The density is suitable for soft traffic applications such as boat decks.

Table 6. Air dry density data, Solomon Islands' plantation poumuli.

Poumuli air dry density			
5-yr-old kg/m^3	**8-yr-old kg/m^3**	**20-yr-old kg/m^3**	**all poumuli mean kg/m^3**
725	745	680	715

The lower density result for the 20-year-old poumuli may be due to faster growth (wider spacing between trees or superior growth conditions) or genetic predisposition.

Despite the young age of the poumuli wood its density was relatively high compared to published data for mature wood of many commercial hardwood species as shown in Table 7. The species

selected for comparison are accepted in traditional parquetry and cabinetry markets. The air-dry density of poumuli is in the desirable range for cabinetry and joinery and is above the recommended threshold for domestic wood flooring products. The density values obtained for poumuli indicate that it will resist indentation but still work well with sharp tools.

Table 7. Air-dry densities of selected commercial hardwoods compared with poumuli (kg/m^3)

Timber	Air dry density kg/m^3
cherry, *Prunus serotina*	590
rubberwood, *Hevea brasiliensis*	640
European beech, *Fagus sylvatica*	670
teak, *Tectona grandis*	670
20-year-old poumuli	**680**
5-yr-old poumuli	**725**
sugar maple, *Acer saccharum*	725
8-year-old poumuli	**745**
white oak, *Quercus alba*	750

Mechanical properties

Modulus of Elasticity MOE

Modulus of elasticity results for the teak samples are presented in Table 8 and for poumuli in Table 9. As with the density results, the trees sourced from the higher stocked 10-year-old plantation produced stiffer wood than the 15-year-old material produced from a widely spaced plantation. Genetics may also be a factor in the different average values obtained between the different age classes.

Table 8. Modulus of Elasticity, plantation teak.

	Australia	Solomon Islands' plantations		
Age at harvest	**6.5-yr-old GPa**	**6-yr-old GPa**	**10-yr-old GPa**	**15-yr-old GPa**
Butt log samples	10.1	9.8	11.8	10.8
Top log samples	10.3	10.5	13.0	11.8

Commercial samples sourced from a Burmese teak importer were tested for comparison, providing a result of 13.8 GPa, higher than the plantation material tested. However data published in the literature was comparable to the results determined in these trials, with Bootle listing 10.0 GPa for Myanmar teak and 11.0 GPa for Indian teak. The MOE values were relatively consistent across all age classes.

Table 9. Modulus of Elasticity, Solomon Islands' plantation poumuli.

MOE plantation poumuli		
5-yr-old GPa	**8-yr-old GPa**	**20-yr-old GPa**
10.8	12.1	10.6

These data are from the first known tests conducted on poumuli wood. The stiffness of the material across all age classes is very similar to plantation teak.

The results for both species indicate that they are suitable for applications where stiffness is a desirable attribute such as furniture components.

Modulus of Rupture MOR

Modulus of Rupture data for all the plantation resources tested as well as for commercial teak samples collected from an importer in Brisbane are presented in Tables 10 (teak) and 11 (poumuli).

Table 10. Modulus of Rupture, plantation teak.

	Australia	Solomon Islands' plantations		
Age at harvest	**6.5-yr-old MPa**	**6-yr-old MPa**	**10-yr-old MPa**	**15-yr-old MPa**
Mean	88	87	108	105

The strength results for the plantation teak correspond well with the literature. Bootle (2005) listed MOR values for seasoned mature teak ranging from 88 MPa (India) to 106 (Myanmar) MPa.

Table 11. Modulus of Rupture, Solomon Islands' plantation poumuli.

MOR plantation poumuli		
5-yr-old MPa	**8-yr-old MPa**	**20-yr-old MPa**
101	113	98

It was difficult to extract truly clear wood specimens from the poumuli logs due to the high incidence and degree of sloping grain. Despite this limitation, the poumuli results were similar to the MOR figures for plantation teak. It is anticipated that straight, parallel-grained poumuli would produce higher strength results than the values determined from the material supplied for these tests.

Roundwood strength

The poumuli roundwood mechanical properties are summarised in Table 12. All poles were partially green when tested with moisture contents of approximately 30% and had relatively high sloping grain (Plate 9), so the data for the roundwood can't be directly compared with the small clear results presented in the tables above which were conducted on air dry specimens under the 3-point bending method.

Table 12. Mechanical properties for small poumuli poles.

Age	Dimensions, mass	Grain angle	MOE (GPa)	MOR (MPa)
8-yr-old	3.0 m x150 mm, 29 kg	7.4	9	40
8-yr-old	2.5 m x 150 mm, 31 kg	7.6	9	55
20-yr-old	2.7 m x 150 mm, 40 kg	7.1	10	45

Plate 9. 20-year-old Solomon Island poumuli pole under test for MOE and MOR.

The results are similar to plantation slash pine *Pinus elliottii*, a high volume timber grown in Queensland and used in shaved, treated roundwood applications such as vineyard posts or gazebos similar to traditional Pacific Island shelters and housing such as the Samoan *fale*. Slash pine has published MOE values of 7.0 GPa (green) to 9.7 GPa (12% moisture content) and MOR of 42 MPa (green) to 85 MPa (dry) (Bootle, 2005).

Hardness

At 4.1 kN, the young, Australian-grown teak has a lower hardness value than published values for teak of 4.5 kN (Burma) and 4.6 kN (India) (Bootle, 2005). The commercial samples from Brisbane importers achieved a good hardness rating of 5.2 kN, indicating that the young Australian material would be more prone to indentation than current material available in the market.

The Solomon Island teak achieved equivalent values for the 6- and15-year-old wood which also matched values published in the literature. The 10-year-old Solomon Island teak was superior to all other material with a mean Janka hardness of 5.3 kN, slightly surpassing the values obtained for the mature teak.

Table 13. Janka hardness, plantation teak.

	Australia	Solomon Islands' plantations		
Age at harvest	**6.5-yr-old**	**6-yr-old**	**10-yr-old**	**15-yr-old**
Janka hardness kN	4.1	4.6	5.3	4.6

The results from hardness testing on the poumuli indicate a reverse trend for hardness by age class to what would normally be expected. The youngest material, harvested at age 5 had the hardest wood and the older 20-year-old material produced the lowest hardness values. In the absence of genetic and silvicultural history, we are unable to provide any explanation for the results.

Table 14. Janka hardness, Solomon Islands' plantation poumuli.

	Solomon Island poumuli		
Age at harvest	**5-yr-old**	**8-yr-old**	**20-yr-old**
Janka hardness kN	6.3	6.0	5.2

Table 15. Comparative Janka hardness data for the test species and commercial timbers.

Timber	Janka hardness kN
6.5-yr-old teak (Aust.)	**4.1**
Burmese teak, *Tectona grandis* (Burma)	4.5
6-yr-old teak (Sol.Is.)	**4.6**
15-yr-old teak (Sol.Is.)	**4.6**
20-year-old poumuli (Sol.Is.)	**5.2**
10-yr-old teak (Sol.Is.)	**5.3**
8-year-old poumuli (Sol.Is.)	**6.0**
white oak, *Quercus alba* (USA)	6.0
5-yr-old poumuli (Sol.Is.)	**6.3**
European beech, *Fagus sylvatica* (UK)	6.4
sugar maple, *Acer saccharum* (USA)	6.4

The poumuli data compares favourably with well known commercial species which have all been used successfully in applications such as parquetry, flooring, step treads and furniture.

Shrinkage and movement

Shrinkage rates from green to air dry (12% moisture content) for clear and knotty Solomon Island teak butt log samples are listed in Table 16.

Table 16. Shrinkage rates, green to dry, Solomon Islands' plantation teak.

	knotty teak	clear wood		
Age at harvest	**mixed**	**6-yr-old**	**10-yr-old**	**15-yr-old**
Radial shrinkage	2.0	0.8	0.7	0.7
Tangential shrinkage	2.5	2.4	2.3	2.1

The shrinkage rates for the clear teak wood are lower than the published rates for mature teak. This is an advantage as it means that recoveries are marginally higher due to less oversize allowance during sawing and potentially less degrade as the wood shrinks during drying. Although the knotty teak had marginally higher shrinkage rates than clear plantation-grown wood, the magnitude of shrinkage was still relatively low compared to many commercial hardwoods (Table 18).

Table 17. Shrinkage rates, green to dry, Solomon Islands' plantation poumuli.

Age at harvest	5-yr-old	8-yr-old	20-yr-old
Radial shrinkage	1.7	1.5	1.1
Tangential shrinkage	4.3	5.0	4.4

The shrinkage rates for poumuli wood sit between teak and the other commercial timbers of similar density listed in Table 17.

Although the results indicate that teak has 'low' shrinkage and poumuli has 'medium' shrinkage, the ratio of tangential shrinkage to radial shrinkage is higher in poumuli than many comparative timbers.

Table 18. Comparative shrinkage data for the test species and commercial timbers.

Timber	Radial shrinkage %	Tangential shrinkage %
15-yr-old teak (Sol.Is.)	**0.7**	**2.1**
10-yr-old teak (Sol.Is.)	**0.7**	**2.3**
6-yr-old teak (Sol.Is.)	**0.8**	**2.4**
Burmese teak, *Tectona grandis* (Burma)	1.5	2.5
knotty teak	**2.0**	**2.5**
5-yr-old poumuli (Sol.Is.)	**1.7**	**4.3**
20-year-old poumuli (Sol.Is.)	**1.1**	**4.4**
8-year-old poumuli (Sol.Is.)	**1.5**	**5.0**
white oak, *Quercus alba* (USA)	3.0	5.0
European beech, *Fagus sylvatica* (UK)	4.0	6.0
sugar maple, *Acer saccharum* (USA)	3.0	6.0

Unit shrinkage results for the Solomon Island teak plus comparative data for natural teak are presented in Table 19.

Table 19. Unit shrinkage rates, Solomon Islands' plantation teak butt logs and natural teak.

	natural teak[#]	knotty teak	clear wood		
Age at harvest	**na**	**mixed**	**6-yr-old**	**10-yr-old**	**15-yr-old**
Radial unit shrinkage %	0.12	0.19	0.16	0.14	0.14
Tangential unit shrinkage %	0.22	0.25	0.31	0.30	0.26

[#] www.timbersanswers.com.au

There was no significant difference in unit shrinkage between the knotty wood and clear wood, nor between the different age classes. The unit shrinkage rates correspond to the green to dry shrinkage rates with relatively low radial values, but similar tangential values to other commercial hardwoods.

The unit shrinkage values for poumuli are similar across all age classes. As with the teak material tested, the poumuli wood has relatively low radial unit shrinkage with similar tangential unit shrinkage to other commercial hardwoods.

Table 20. Unit shrinkage rates, Solomon Islands' plantation poumuli.

Age at harvest	5-yr-old	8-yr-old	20-yr-old
Radial unit shrinkage %	0.16	0.17	0.17
Tangential unit shrinkage %	0.32	0.37	0.38

Durability indicator

The changes in wood stiffness values measured using the vibration method after 10 weeks' exposure to a high decay hazard environment (brown rot fungi, optimised environmental conditions) allowed for ranking the test material and two reference timbers (Table 21).

Table 21. Indicative durability of Solomon Island plantation hardwoods and selected commercial timbers.

	Timber	MOE loss %	Durability rating*
Higher durability indicated	mature Burmese teak	4.20	2
	15-yr-old Solomon Islands' teak	4.36	na
	10-yr-old Solomon Islands' teak	5.08	na
	plantation poumuli	7.04	na
Lower durability indicated	mature spotted gum	7.74	2
	6-yr-old teak	12.85	na
	mature slash pine	20.35	4

* in-ground durability rating, AS5604.2005.

The results indicate that for teak, older material is more durable and durability decreases with reduced age. The poumuli samples were pooled into a single 'plantation poumuli' batch due to the limited number of logs per age class. The MOE loss % results indicate that poumuli is relatively resistant to decay under the conditions of this test, performing similarly to mature spotted gum, a durability class 2 species.

As expected the non-durable slash pine had the lowest resistance to decay under the test conditions, with a 20% reduction in stiffness over the 10 week exposure period. The spotted gum didn't perform as well as expected in this test compared with the other species. This may be attributed to a lag effect whereby the wood is initially attacked after exposure to fungi and some degrade occurs, but the rate of deterioration slows or plateaus, with lower rates of deterioration over a longer period, during which other species may continue to degrade with a corresponding loss of mechanical properties.

Colour assessment

The deviations of the colour of plantation-grown teak from the benchmark data gathered from measurements taken on dressed surfaces of commercial grade Burmese teak are listed in Table 22.

Table 22. Colour values for plantation-grown teak and Burmese teak.

CIE *L*a*b factor**	**Burmese teak**	**Australia**	**Solomon Islands' plantations**		
age	**na**	**6.5-yr-old**	**6-yr-old**	**10-yr-old**	**15-yr-old**
L*	50	56	66	62	59
a*	11	9	8	10	10
b*	24	24	28	28	28

On the *L** scale, 0 is black and 100 is diffuse white. Solomon Island teak wood displays increasing colour darkness with age. The north Queensland teak was darker than the similar age class Solomon Island teak and was closer in average tonal value to 10-year-old Solomon Island teak. It was noted that the north Queensland teak contained dark streaks, possibly due to drought stress, which increased the average darkness of the wood.

The Solomon Island woods were all close to Burmese teak in degree of redness, with relatively neutral values between magenta and green. The north Queensland wood had a higher degree of deviation from Burmese teak for the red/green factor.

The north Queensland teak matched the Burmese teak on the yellow/blue scale, whereas the Solomon Island materials had larger deviations from Burmese teak. An age trend was apparent across the Solomon Island plantation woods, with increasing levels of blueness/less yellow correlating with increased age at harvest.

For many outdoor applications it is accepted that teak will weather to a natural grey through the effects of ultra-violet radiation and oxidation. In some decking markets, the natural silver-grey weathered appearance is preferred or accepted, therefore the natural colour of the wood, including variation within a board or panel, isn't always a consideration. For example some yacht purchasers request pre-weathered decking requiring maritime carpenters to use products to artificially accelerate the greying process prior to delivery of the vessel.

Heartwood proportion

The results for the heartwood proportion measurements for both teak and poumuli correspond with normal wood formation trends- the younger trees had lower heartwood proportions and these ratios reversed with increasing age. This trend is detailed in Table 23.

Table 23. Heartwood to sapwood proportions for plantation teak and poumuli.

	Heartwood proportion (% of cross-sectional area)					
Australia	**Solomon Islands**					
teak	**teak**	**teak**	**teak**	**poumuli**	**poumuli**	**poumuli**
6.5-yr-old	**6-yr-old**	**10-yr-old**	**15-yr-old**	**5-yr-old**	**8-yr-old**	**20-yr-old**
43	39	48	67	22	32	47

Extractives content

Teak

The levels of extractives measured in mature teak controls (8.6% of oven-dry mass) were consistent with published data (Simatupang et al., 1995). The extractives' content of 15-year-old teak heartwood was similar to that of the mature reference material (7.8%, see Figure 1). For timber sourced from the Solomon Islands, extractives contents decreased with tree age. The difference between 15- and 10-year-old trees was smaller than the difference between 10- and 6-year-old trees, due to the higher proportion of juvenile heartwood in the younger material.

Interestingly, 6.5- year-old teak from north Queensland had considerably higher extractives' contents than 6-year-old teak from the Solomon Islands. Great variation in total extractives content as well as concentrations of single compounds have previously been reported in teak from different localities and countries (Simatupang et al., 1995), highlighting the influence of genetics and possibly silvicultural interventions. The Queensland plantation experienced relatively slow growing conditions due to extended dry periods compared to the Solomon Island plantation of a similar age.

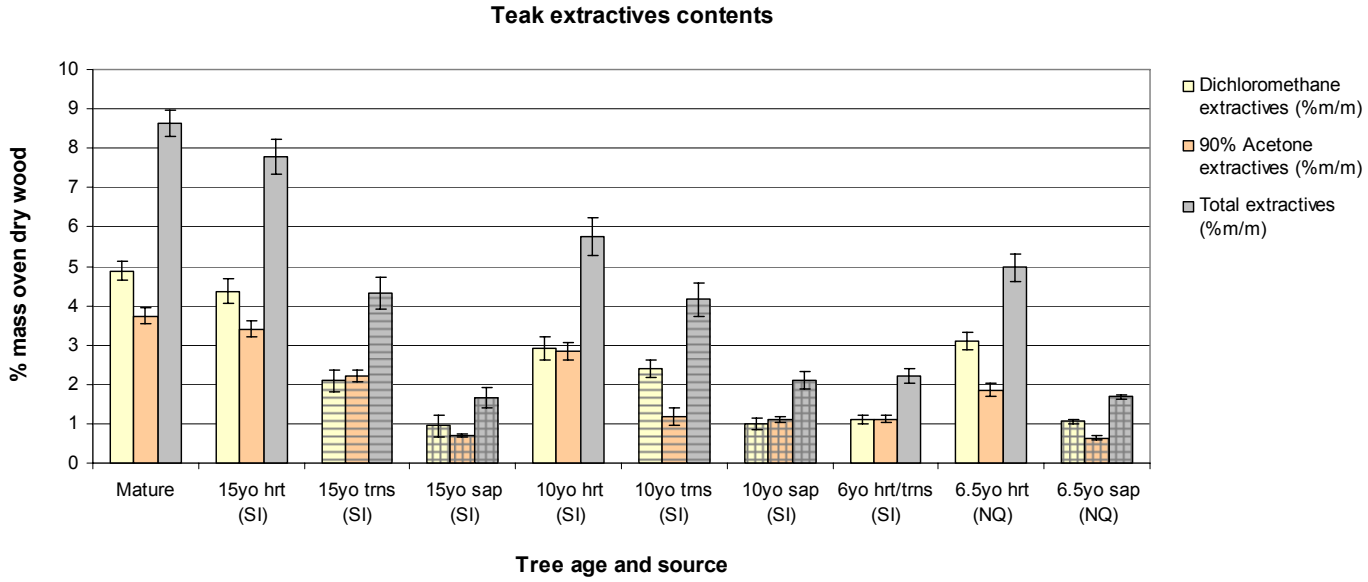

Figure 1. Teak extractives' contents.
(Legend notes: hrt=heartwood zone , trns=transition wood, parallel hatching in graph, sap=sapwood zone, cross-hatching in graph, SI=Solomon Is., NQ=north Queensland).

High concentrations of dichloromethane extractives were measured, which is consistent with other studies of teak. Compounds removed by dichloromethane are responsible for the waxiness of teak wood and they have moisture repellent properties.

Caoutchouc (latex-rubber, a polyprene compound) is known to be the most abundant of teak extractives, representing up to 5% of the oven dry mass of wood (Simatupang et al., 1995). Other non-polar / low-polarity substances that are also removed by dichloromethane such as fatty acids and terpenoids have also been identified, but they are present in lower quantities (Simatupang et al., 1995).

The concentrations of 90% acetone extractives were lower than or similar to that for dichloromethane extractives. Compounds removed by 90% acetone are known to impart resistance to decay and insect attack. These include anthraquinones and derivatives that protect against termite attack (Rudman and Gay, 1961) and other quinones such as tectoquinone that protect against decay fungi (Niamke et al., 2011). Simatupang et al. (1995) reported that quinone derivatives represent the second highest concentration of teak extractives after caoutchouc, and are present in concentrations of up to 2%.

Poumuli

The extractives' contents of poumuli increased slightly with age, ranging from 4.8% for the 5-year-old, 5.6% for the 8-year-old, to 6.7% for the 20-year-old as depicted in Figure 2.

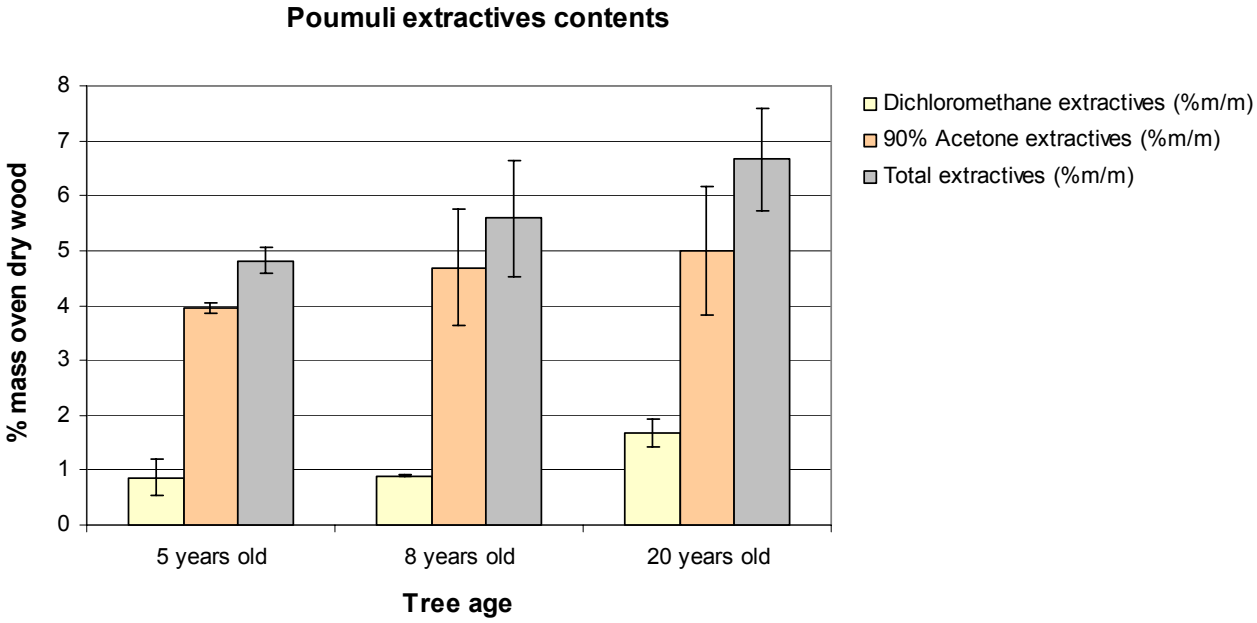

Figure 2. Poumuli extractives' contents.

This species had reasonably low levels of dichloromethane extractives (such as waxes and other lipids). Given anecdotal reports of the durability of this species and its performance in the durability indicator test, it is probable that the 90% acetone extractives contain compounds that impart resistance against attack by decay fungi.

Product evaluation (including slicing and peeling)

Teak

Solid wood products

Sawn, dried teak feedstock was used to manufacture a range of solid wood products including furniture, parquetry flooring panels, yacht decking panels and louvred shutters. These represent mid to high value products for teak and provided the opportunity to assess the workability and finishing characteristics of the material during manufacturing. The wood from all age classes worked well with machine and hand tools and accepted finish coatings.

Plate 10. Solomon Island plantation teak louvre shutters.

Feedstock for the shutter samples performed well through normal processing operations in a commercial production plant and the finished item exhibits the qualities of a high value building product (Plate 10).

The teak yacht decking samples had a different appearance to traditional, mature teak yacht decking due to the wider growth rings and finer grain of plantation-grown wood (Plate 11). The finished product was considered attractive by yacht builders, however they warned that it may not meet the requirements for some markets where the coarse grained latewood is a prominent and desirable feature, even in silver-grey, weathered teak.

Plate 11. Solomon Island plantation teak, clear grade yacht decking (top half has been clear finished, lower half is natural).

Knotty feedstock was processed into flooring (Plate 12) and presented no problems during manufacturing, unlike in some species where high density knots can damage tool edges during processing. Further, the knots remained in sound condition without becoming loose after 6 months service in an air-conditioned environment (equilibrium moisture content 8%). Industry representatives noted the similarity to white cypress pine flooring, a popular native softwood of Queensland and New South Wales. This knotty aesthetic is popular in certain markets, for example Japan, a long time importer of knotty white cypress (*Callitris glaucophylla*) from Australia.

Plate 12. Knotty grade Solomon Island plantation teak flooring (left half with clear finish coating, right side unfinished, natural).

Prefabricated decking ‘tiles’ offer the builder or homeowner an easy to install system which makes good use of small wood sections. The appearance of the furniture, shutters, parquetry and yacht decking samples is somewhat different to traditional, mature teak due to the wider growth ring widths, finer texture and colour variation, but the plantation grown teak has the properties and quality to be used in all typical applications despite the different aesthetic (Plate 13).

Plate 13. Plantation-grown teak and poumuli product array.

Veneer

The young age of the material had no impact on processing and the veneer panels produced were considered acceptable in colour and quality by industry representatives. Teak is currently rated 2 on a 7 class value band used by the Timber Veneer Association of Australia (formerly the Decorative Veneer Association, Australasia) where 7 is the highest value. This places teak veneer in the same band as veneers from rock maple (*Acer saccharum*), white ash (*Fraxinus* spp.), European beech (*Fagus sylvatica*), and American walnut (*Juglans nigra*). Examples of higher value veneer species on this scale are highly figured walnut ‘burr’ (*Juglans* spp.) and variegated Macassar ebony (*Diospyros celebica*).

Poumuli

Poumuli has sufficient density and hardness to provide good performance in flooring, parquetry, step treads and benchtop applications. The pink wood is suitable for specialty uses such as knife handles, where medium hardness timber is desirable, although the pink, red colour may not be fashionable. These products require careful seasoning to dry the wood to the moisture content range of the target market zone. If drying kilns were available, these products could be manufactured in local processing facilities in the Solomon Islands for local use and export trade.

The high level of sloping grain in the logs supplied and high shrinkage ratio need to be considered in product design to ensure satisfactory performance in service. These attributes won’t cause problems in small sections such as parquet fingers and blocks, but wide backsawn boards should be avoided in furniture and flooring products to avoid problems with movement in service.

Concluding remarks

These results add to the global information on plantation teak wood properties and uses and provide the first dataset for poumuli wood properties based on empirical tests. The north Queensland teak logs were small and knotty- normally regarded as non-commercial thinnings or pre-commercial thinnings. However the wood specimens obtained from these logs exhibited sufficient material properties to be used in sawn timber products. The mid-rotation aged logs from the Solomon Islands generally provided wood of reasonable quality with properties suitable for typical teak product manufacturing (garden furniture, louvred panels, peeled and sliced veneer, parquetry and yacht decking). Indications from the accelerated durability trial are that teak wood from age 10 may be durable, however further long term tests are recommended.

The poumuli sample (n=9) was relatively small for wood properties testing and a larger scale trial is recommended to assess a wider range of material. Poumuli has excellent density and hardness characteristics and when graded to avoid high sloping grain the wood can be used for cabinetry, furniture, flooring, parquetry, step treads, benchtops in addition to its current main use as a building pole in traditional Pacific housing and structures.

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Analysis of potential market for product based on the results of testing and processing

Introduction

It is a generally accepted wisdom that plantation Teak is of lower quality than natural forest Teak and in reality even the best logs command a lower price than the lowest grade of natural forest trees (Coillte Consult. 2006). However, Myanmar is the only country still supplying logs from natural forest and with a global teak supply of around 2-2.5m cu. m. per year it is estimated that the sustainable harvest from Myanmar is only 400,000 cu m per year, leaving a substantial shortfall that has to be filled by plantation Teak. The area of Teak plantations has increased dramatically and there is now an estimated 4.75 million ha of teak plantation predominantly under 20 years. The pressure for an economic return from these investments is likely to result in a substantial supply of small diameter logs of 20 years and under (Koller and Cherubini, 2012), the very market where SI Teak is placed.

The Solomon Island Teak logs that were tested as part of ACIAR project FST/2007/020 *"Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands by interplanting with Flueggea flexuosa and other Pacific agroforestry species"*, were in the age classes 6, 10 and 15 years with the 6 year stand planted at normal operational spacing of 833 stems per hectare (sph) with a pre-commercial thinning operation applied at 4 years. The 10 year old teak was grown at 1600 sph with a pre-commercial thin at 4 years though it is not clear to what stand density. There was no subsequent thinning applied. The 15 year stand was planted at 10 x 3 m spacing or 333 sph and was never thinned. All of the trees were grown on Kolombangara Island though the older age class was grown at Ringi whereas the other 2 were grown at Poitete. These logs were tested against commercial grade Burmese teak and against the Myanmar Timber Enterprise standard (DEEDI, 2011)

Some of the most desirable timber qualities are: percentage heartwood, colour, homogeneity of colour, number of rings per cm, strength and hardness; durability is important for end uses like garden furniture. The results from the testing programme revealed that the Solomon Islands Teak at as young as 6 years was still a viable timber for most common end uses such as garden furniture and even yacht decking though the ratio of heartwood to sapwood in trees of this age was an obvious drawback. However, the generally positive test results for the Teak and the further improvement programme currently underway points to a healthy future for Solomon Islands Teak.

The value of the market to the grower depends upon a number of factors but silvicultural management and age are paramount. The larger the size class, the higher the price that is available, the following table gives prices in SI $ for at-the-gate delivery to Lagoon Eco Timbers in Honiara.

Diameter	Height in meters	Volume Cu. M.	Solomon $ a cubic meter	how much you get for a tree this size
10 cms	10	0.08	365	29
20 cms	10	0.31	525	165
30 cms	10	0.71	982	694
40 cms	10	1.26	1050	1320

50 cms	10	1.96	1120	2199

These prices are for premium grade logs with minimal defects and straight bole. With a current exchange rate of approximately 7:1 to the AUD these are poor prices and it would be reasonable to expect closer to US$ 350 per cubic meter for the larger sizes once there is an element of competition in the market. Good silvicultural management will affect the size and also reduce defects such as knot holes and insect damage, ensuring the best possible price.

Potential Markets - International

Veneer Logs

The test results indicated that, with reasonable silvicultural management, the SI Teak was well suited to veneer applications. The only current veneer operation in SI is the eucalyptus veneer production undertaken by Eagon Pacific at Arere. This is a small operation with the veneer being containerised and shipped overseas for further value adding. The company was unwilling to try using Teak as a veneer when approached. The building of a plywood factory at Noro in Western Province will make a significant difference to local growers as there will be a potential for selling thinnings and lower grade logs for the interior ply within the sheets whilst higher quality logs can be used for the surface ply. Good quality Teak veneer plywood with a mixed species hardwood core sells at US$500 cu.m. f.o.b. High quality natural forest teak veneer logs fetch a premium price on the international market (US$1,600-US$2,000 per cu. m.) but it remains to be seen the prices that the Noro factory will be prepared to pay local growers.

Furniture

Teak has traditionally been used for high quality furniture both for interior and exterior use. The testing programme was unable to verify the longer term durability of SI teak though the loss of the modulus of elasticity for the 15 year old SI Teak compared favourably with Burmese Teak (4.36% and 4.2% respectively) and suggests older SI Teak will perform well in outdoor conditions. Another important aspect is colour, with darker timbers gaining a higher value. SI Teak darkened with age though at 15 years was still lighter than the comparison Burmese Teak. Both these results indicate that SI Teak would be acceptable for the furniture trade and that encouraging the growers to longer rotations will yield benefits not only in size but in perceptions of quality. Indian plantation timber with some heartwood present is currently offered at up to US$400 per cu.m. and it is reasonable to assume Solomon Islands teak would fetch a similar price on the open market.

Flooring

Two of the main aspects of timber required for flooring are hardness and shrinkage. On both these measures the older Teak performed well by matching or exceeding other commercial timbers (including Burmese Teak) in hardness and with shrinkage rates lower than those published for mature Teak (DEEDI, 2011). Once again, colour is an important factor in choosing a timber for flooring with age being an important factor.

Potential Markets - Domestic

Furniture

A series of visits to furniture makers in Honiara has shown that it is rarely, if ever used for furniture making with local species such as Vassa preferred. It may be that the little teak that finds its way in to Honiara is already consigned for export and is simply not available for domestic use. The project has demonstrated that thinned, small diameter teak can be used to make attractive and functional furniture (see picture) and it is probably a case where some raising of local awareness of Teak as a cabinet timber will see a greater utilisation. It is planned that further furniture items will be commissioned, particularly in Honiara and will be used in the annual trade shows that celebrate Solomon Islands Independence Day to promote local usage of small diameter or short length logs.

Furniture made from Teak thinnings by local carpenters in Solomon Islands

Carving

Solomon Island carvings are gaining an international reputation with a thriving export market either online (www.solomoncrafts.com) or through local shops and hotel outlets. Solomon Island carvings have also been seen in Fiji being sold commercially (Blumfield, pers. comm.). Traditional woods used for carving are kerosene wood (*Cordia subcordata*), ebony (*Diospyros spp.*) and coconut (*Cocos nucifera*). Of these, Kerosene wood is the most widely used and discussions with carvers has revealed that it is becoming increasingly hard to get with harvesting far outstripping regeneration. Teak is ideally placed to fill this niche as it is very suited to working with hand tools and produces a fine finish. This is a good end use for those trees that would be thinned to waste as most carvings are small in size and careful design would see the incorporation of the sapwood as a feature of the carving. It is difficult to judge the value of this very fragmented market where many of the pieces are sold as a fringe activity in resorts and hotels. However, it is reasonable to assume that, as the tourist activity increases in Solomon Islands, carving will provide an additional source of income to rural families. The re-release of the booklet “Handicrafts of the Solomon Islands” by the Secretariat of the Pacific Community is a deliberate strategy to boost this trade. (Austin,2012). Unlike the other end uses for Solomon Islands Teak, this does not require the development of infrastructure before the market can operate.

Conclusion

It would seem that Solomon Island Teak is at least competitive with other plantation Teak that will be coming on the market and may actually be better than some. The rapid growth potential and excellent form displayed by the Solomon Island provenance also means that, with proper silvicultural management, the log sizes and quality may be better than some competitors. However, this all counts for little without access to market for both thinnings and for the mature Teak. Currently market access is restricted to the immediate environs of Honiara and some very small scale shipping in other areas. The majority of Teak is grown in remote areas well away from the infrastructure required for establishing reliable market access and will remain unmarketable until that problem is solved. The PARDI project PRA 2011.06 "Development of a market mechanism for Teak and other high value timber in the Western Province of the Solomon Islands" is examining potential solutions to this problem in Western Province, but the problem is country-wide.

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Agro-forestry and its Social Impacts
Social Science Research Final Report – 2012

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1.0 Introduction

Our project – 'Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands' – involves researchers, government representatives and others working alongside communities to introduce a mixed species forestry system across a range of sites in the Solomon Islands. The purpose of the project is to support the sustainable management and improvement of economic returns related to community timber plantations that have expanded since the locally named 'teak mania' started in the Solomon Islands in the 1960s – and peaking in the 1990s – buoyed by optimism related to its economic potential. There is currently an estimated 15,000 to 20,000 hectares of teak planted in the Western Province alone. While some communities demonstrate little enthusiasm for teak planting and management, citing frustrations in access to information, resources and markets, others remain optimistic about its potential contributions to socio-economic development. In this context, this project aims to support the introduction of a mixed species management system that is able to improve social, economic and environmental outcomes for communities across the medium and long term.

In order to support the realization of these positive community, economic and environmental outcomes, it is first necessary to understand the social, cultural and political dynamics that shape decision-making related to land use and management, the effectiveness of current education and agricultural extension, as well as the broad range of community issues that shape uptake and effectiveness of forest management. Here we report on some of these issues and dynamics across a number of sites in the Solomon Islands where there has been some uptake of this ACIAR-funded forest management system.

The selected sites for this study include Baraulu and Saika villages in the Western Province, and a site on the Guadalcanal Plains. Our earlier work also included Takaburo, on Guadalcanal; however extreme weather caused social and ecological disruptions that made it difficult for community members to continue participating in the research. The collection of data across each of these sites has enabled us to make some comparisons across geographical, cultural, and religious and other dimensions.

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As part of the mid-term review in 2010, the Social Science Research team provided an interim report – presented at a workshop in Munda, Western Province – on the social dimensions related to community timber plantings. This document comprises the final comprehensive report. It provides a background to the selected study sites, identifies the positive and negative outcomes associated with system uptake, and concludes by providing strategic recommendations to improve the effectiveness of similar projects in the South Pacific.

2.0 Research Objectives

The findings presented in this report provide an increased understanding of: the socio-economic and cultural dimensions that shape involvement in teak planting; decision making about teak management; and distribution and access to economic and other benefits associated with the teak plantings. These findings provide insights that contribute to a better understanding of each of the stated research objectives associated with this project; by increasing socio-economic and cultural understandings of the context in which this project is being implemented.

The findings presented in this report also specifically address Research Objective 5 (outlined in the original ACIAR project proposal):

Conduct socio-economic analysis of the effects of the adoption of these systems on smallholder and community economies with particular reference to effects on resource exploitation, social outcomes and poverty alleviation.

3.0 Structure of the Report

The report starts with a background to the research methods employed for this social science research component of this project. We then provide an overview and background to the communities selected for analysis. We compare and contrast the findings across the selected cases, and on the basis of this, conclude with a series of recommendations to assist ACIAR in its on-going reafforestation efforts in both the Solomon Islands, and the Pacific more broadly.

4.0 Research methods

A social science research team has conducted three field visits between 2008 and 2012.

1. In 2008, Professor David Burch and Dr Kristen Lyons (and alongside Dr Tim Blumfield) visited Takaburo (Guadalcanal), Baraulu and Saika (Western Province) for a preliminary visit and pilot study. This included interviews with local government officials, spiritual leaders and community representatives.

2. In 2010, Dr Kristen Lyons and Mr Henry Boer (and along with Gideon and Rose Bouro, as translators), conducted interviews, focus groups, resource mapping and transect walks in Baraulu and Saika (Western Province) and a new site on the Guadalcanal Plains. Resource mapping involved community members mapping their village so as to identify infrastructure, natural and other resources, and access and ownership of these resources. Transect walks with community member's enabled in-depth discussion of resource and land ownership, land management and other issues.
3. In 2012, Dr Kristen Lyons, Dr Peter Walters and Ms Erin Riddell (and with Gideon and Rose Bouro, as translators) completed a final phase of interviews and focus groups at Baraulu, Saika and the Guadalcanal Plains. Ms Riddell also undertook resource mapping and focus groups in Saika as part of her Masters of Development Practice research at the University of Queensland. Upon completion (December 2012), this thesis will also be submitted to ACIAR.

Research and analysis focused on five themes:

1. Patterns of land use and resource access;
2. Village level social structure and decision-making patterns;
3. Social and economic dynamics;
4. Workload impacts associated with system uptake, including the gendered impacts; and
5. Processes of learning and education related to land management and use.

This report focuses on these themes across the selected sites included in this research: Baraulu; Saika; Guadalcanal Plains; and Takaburo.

5.0 Baraulu

Baraulu is located in the Roviana Lagoon, in the Western Province of the Solomon Islands. Baraulu village comprises approximately 800 residents, and with an additional (approximate) 200 residents living in the Bulelawata village. Between 2008 and 2012 birth rates have led to a steady increase in population numbers. The proportion of young people is increasing, which is widely recognized as creating challenges to ensure meaningful activities and education are provided to keep young people in Baraulu.

Teak has been planted on both community and family plots of land since 1998. By 2010, community teak plantings covered an estimated 16 hectares (while the area of teak plantings on family plots is currently unknown).

Up until 2010, it was expected that future population expansion, agricultural production and cash crops (including food gardens, teak and oil palm) would be

located at Bulelawata. Here, resource pressures were described as less acute than those faced at Baraulu. However, a recent church-related conflict, (discussed further below) – has effectively split the community in two – the outcome of which is changing patterns of land use. In early 2012, the two opposing groups in this conflict – named by community members themselves as 'Group A' and 'Group B' – continued to reside together at Baraulu, however subsistence and cash crops were being established on separate islands. The larger group – Group A – was expanding its commercial cocoa plantings on the nearby island of Raraghana, including planting a recently cleared 18 hectares area. Group A has also secured access to the previously established commercial crops at Bulelawata (including teak, oil palm and copra), to which all community members (including members from Group A and Group B) had previously contributed labour. Meanwhile, members of Group B are limited to the cultivation of subsistence and cash crops at Baraulu, and have recently planted a 4-hectare clearing (cleared at the same time as the larger area at Raraghana) with cocoa.

The majority of members of the Baraulu community are members of the Christian Fellowship Church (CFC). The CFC plays a profoundly significant role in the Western Province in the governance of its member communities. As such, some background to the CFC – including the current conflict within the CFC community – is necessary to understand decision-making related to land use, resource access and distribution of economic gains amongst the community.

5.1 The Christian Fellowship Church (CFC)

The Christian Fellowship Church (CFC) was established in the Western Province in 1960 as a breakaway from the Methodist Church, which was established in 1902 by Reverent John Frances Goldie. The founding philosophy of the CFC included communal work and self-sufficiency, aspects that have facilitated a range of Church based community development projects (including teak, oil palm and copra projects). In the absence of a well-resourced (and at times functioning) state, the CFC fills a range of governance roles (including the provision of infrastructure and services such as schools and health clinics), and plays a central role in defining community economic development (McDougall, 2011). In recognition of its contribution to alleviate poverty and foster rural development, in 2005 the CFC leader, or 'Spiritual Authority', Ikam Rove, was bestowed the title of the order of Knight Commander of the British Empire.

Historically, the CFC has refused to work with aid agencies (including AusAID), preferring to maintain autonomy in setting their community development agenda. One documented exception to this includes the CFC collaboration with the University of Queensland between 1999 and the early 2000s as part of a community reafforestation project. In this case of international collaboration however, the CFC provided seed funding for the initiative to ensure the Church was able to drive the project and its management (see Makim and Dart, 2002).

The CFC was established under the leadership of the original Spiritual Authority, Silas Eto, who was believed to have been an incarnation of the Holy Spirit. Silas Eto quickly gained many followers, resulting in a peak in the CFC membership in the 1960s (McDougall, 2008). While many people soon reverted back to other faiths, by the late 1990s the CFC continued to hold 14% of the total population of the Western Province, with the highest concentration of CFC adherents around Rove's home in North New Georgia and Roviana Lagoon (McDougall, 2008).

Following Eto's death in 1983, his son Reverend Ikan Rove was appointed as the new Spiritual Authority of the CFC. Eto proclaimed his son the Spiritual Authority, and another son, Job Dudley Tausinga, should enter Government. Following his father's vision, Tausinga presided as Premier of the Western Province between 1983 and 1987, and continues as a Member of Parliament, a position he has held since 1984 (McDougall, 2008). These relations have enabled the CFC to establish links with government; in contrast to the Methodist Church (from which the CFC split), who reportedly had antagonistic relations with Government (McDougall, 2008).

As the charismatic leaders of the CFC, both Silas Eto, and later Ikan Rove, are widely revered. Yet at the same time, Ikan Rove is also criticised. Amongst his critics, concerns have been raised about the extent to which the CFC leadership is able to concentrate resources and wealth; circumstances that appear central to the current conflict within the CFC community in the Western Province.

5.2 Conflict in the CFC and the Split

Towards the end of 2011, and as an outcome of growing tension within the Church leadership and broader Church community, significant conflict broke out amongst CFC communities, (including on Rendova and in Vona Vona Lagoon). The resultant split within the Church has led to the formation of two separate groups – a larger 'Group A' and a smaller 'Group B' (these were the terms used by the groups themselves in our discussions). Between October 2011 and February 2012 (the time of our fieldwork), there were many cases of physical violence, arguments and intimidation between the two groups. During our visit there were two fights in Munda, New Georgia, one of which resulted in a number of arrests. Reflecting this animosity, in a focus group with women from Group A, many explained they were no longer interested to talk to Group B members. Some described walking past Group B women and ignoring them, as well as turning away to avoid contact. This split has divided families and friendships.

There are various explanations for this split within the Church community. Some community members explained there was conflict between the two brothers – Rove and Tousinga – related to access to Church wealth and resources. Some members of

the smaller group, Group B, explained that members of the CFC Leadership Committee were enjoying the profits arising from community members' hard work (eg. through the sale of copra, oil palm and other cash crops), yet were failing to distribute this amongst community members, as was expected. Tousinga was also reported to have described leaders in the CFC as "treating the Church like a company".

Meanwhile, others suggested the conflict was not between the brothers themselves, but rather between middle ranking leadership of the CFC, who were purportedly using their position to benefit personally ("benefit financially"), and of a political, not spiritual, nature. According to members from the Saika community, the comments made by Tausinga were actually supported by his brother, however as the Spiritual Authority Rove is unable to engage publically on "political issues". Tausinga's comments have been employed by these elite individuals to create division and followers have since positioned themselves as described above (Group A: Ikan Rove, Group B: Tausinga). On the ground, the roots of the split are located to the "bad" ways of thinking among many CFC communities who have lost their way ("lost their unity"). Elders also noted that there is discontent within the CFC constituency as families "contribute lots of their personal income to the CFC church… this is making people poor".

Whatever the cause of the conflict, the outcomes for CFC community members have been profound, including presenting significant implications for the teak planting. Currently, Group A has retained access to land and assets of the Church – including community teak and oil palm projects at Bulelawata. In contrast, Group B no longer has access rights to these 'community projects', despite their contribution over years to the establishment of these crops. Similarly, Group B no longer has access to Church funds and resources, including CFC schools. Group B is unable to continue spiritual practice in the Church at Baraulu, and are required to travel to other islands to maintain their church based faith.

5.3 Social and Economic Dynamics - Service Delivery and Infrastructure

Baraulu faces significant challenges in terms of meeting basic service and infrastructure needs, some of which appear to be exacerbated in the context of the contemporary conflict. Women and men in Baraulu and Bulelawata have repeatedly over the course of this research identified a number of issues that require improvement. The following represent priority areas:

- Improvements in intermittent water supply and access;
- Improvements in health service delivery, including availability of a medical practitioner;
- Provision of sanitation; and

- Improvement in education service delivery, including the introduction of educational services for vocational school, adult education and life skills.

There were some suggestions that the MP Dani Phillip (who is a member of the Seventh Day Adventist Church) was not looking after the community in terms of delivering on these vital services. But questions also remain regarding the whereabouts of income generated for the various CFC community projects.

Part of the medium and long term monitoring and evaluation of the agro-forestry development project will require assessment of the extent to which these identified community needs might be met via the income generated from the sale of teak (and other timber and food crops associated with the mixed species planting).

5.4 Patterns of Land Use and Resource Access

There are two types of land tenure across the Solomon Islands; customary and private land tenure. Resource tenure in Roviana is complex, and is based on kinship, spousal affiliation, genealogical associations, and location of residence (Aswani 1999). The advent of the informal reforestation of private land, or blokos, signals a shift in land tenure systems, including the individualization of land tenure. This shift has been authorized by the Spiritual Authority.

The planting of long-standing timber trees is key to staking claim to land, in part because they imply permanence. This translates into de facto permanent rights to reforested land. Baraulu is characterized by matrilineal land inheritance. Yet there is some evidence that contemporary timber rights have usurped matrilineal land ownership.

While there is a range of issues and concerns associated with what appears to be a changing land tenure system, Hviding and Bayliss-Smith (2000) in their research in other parts of the Solomon Islands have also found that the strengthened property rights that emerges as an outcome of timber planting has, in effect, become a key driver to reforestation.

5.5 Village Level Social Structures and Decision Making

In order to understand the uptake of the agro-forestry management system and its outcomes, it is first necessary to understand the social structure and processes related to decision-making within the community.

At Baraulu, decision-making occurs via a system of community and spiritual governance. At the local level, a number of standing committees are responsible for different aspects of community and economic life: the Planning, Development and Finance Committee (PDFC); the Church Committee; the Education Committee; and the newly established Traditional Committee (2011). Between our visits, the Church

and Education committees appear to have become less active (this may be related to the current conflict within the community – demonstrated in the vandalism that had been directed towards one school), meanwhile PDFC appears the most active. The recent establishment of the Tradition Committee arose to bring specific concerns of elders to the CFC. There are also a number of sub-committees. The PDFC and Church Committees are responsible for the majority of decisions in Baraulu, however these are also overseen by the CFC Committee and the Spiritual Leader, who appear to have significant and direct power and influence over decision-making and daily practices. The Spiritual Leader visits Baraulu just once or twice a year, and lives at North New Georgia, arrangements that have further fuelled criticisms about his remoteness and rumours about his excessive personal wealth.

In the context of the current conflict, representation of Group A and B membership across each of these committees is yet to be resolved. The planned annual CFC conference to be held in June 2012 is anticipated to make some decisions to resolve the current conflict, including these representation issues.

The PDFC is responsible for decisions related to community development projects, including teak, oil palm and other plantation based projects, including workload allocation and distribution of income generated from these projects across households. Decision-making related to teak management also appears to be shaped by a number of groups/individuals, including the Forestry Department, the Spiritual Leader, and the Pastor. Community members indicated that even decisions about thinning of teak trees would come from His Grace at conference.

Membership in local committees was described as occurring via a democratic election process; however, in some cases, certain individuals were also specifically selected for appointment (for example, based on individual merit and capacity). This arrangement raised some concerns amongst community members, including its impacts for transparent decision-making, especially related to the distribution of financial and other resources.

At a regional level, the Christian Fellowship Church (CFC) Leadership Committee make those decisions,, including decisions related to land use, development and land use conflict (although the latter may also be negotiated with the two village chiefs). Membership of the Leadership Committee comprises approximately 20-22 representatives from across all CFC villages in the Western Province, and includes representatives from each of the village committees and four Ministers. Some community members we interviewed raised concerns that elites within the committee might be profiteering from economic activities, circumstances that might also underlie the current spilt.

However, authority for all community decisions related to community development planning rests with the spiritual leader, Ikam Rove. Each year, the CFC holds a

general conference (sometimes these events are held a few times each year), enabling the spiritual leader and a small group of CFC Leadership Committee representatives to discuss business and community development projects for the coming year(s).

These community and spiritual governance arrangements may assist to explain the extent to which community members have, or have not, adopted agro-forestry management practices. It may also be useful in understanding some of the limits in the uptake of the project. For example, it is possible that information related to forest management that is being delivered via the Rural Training Centres, ACIAR project staff and others might be inconsistent with the broader development agenda and governance procedures of the CFC and local committees that exist at Baraulu. Demonstrating this schism between the project and the CFC, an employee from a RTC, who is also affiliated with this project, and who is also the son of the Pastor, does not follow the management plan for thinning trees. It appears that ideas from the Church are more influential than that of the ACIAR project.

5.6 Social and Economic Dynamics - Income-Generating Activities

In addition to subsistence food and agriculture production, community members at Baraulu and Bulelawata are engaged in a range of individual and community income generating activities.

5.6.1 Individual Income-Generating Activities

At the individual and household level, families grow and harvest a range of crops from their gardens (with families having up to 3 or 4 separate gardens – and now extending into new cocoa plantings) for subsistence, as well as to sell at markets, as well as fishing – which many identified as making a significant contribution to family income. There is a gendered division to these income-generating activities; with women primarily responsible for the harvest of fruit and vegetables and making of handicrafts (including baskets and mats) for sale at markets, while men are primarily responsible for fishing and related activities. Many households have also initiated tree planting on their individual plots as part of a longer-term individual income generation strategy.

Income generated from the sale of these items is used to buy food supplies (including rice, tuna, sugar and tea) that supplement subsistence food production, as well as soap, tobacco, matches and kerosene. Individual households also contribute food and/or income generated from individual gardens to the CFC – there is a minimum requirement of $10 per fortnight. In return for giving money and labour to the church, community members described their connection through the CFC as uniting them (until recently, anyway); enabling them to work as a group and to learn new things, including cocoa management – a recent initiative in the community.

5.6.2 Community-Based Income-Generating Activities

There are a number of community-based income-generating development projects. These projects are primarily focussed on *economic* development. They have been initiated on communal land under the directive of the spiritual leader and the CFC Leadership Committee, and are part of a broader CFC development program. Workload related to the maintenance of these various crops occurs on rotation and via direction from the church. In 2012, cocoa appeared to be a priority project, and with less interest in the teak.

As a result of the current conflict, Group B has lost access to these community projects, as well as the community account and any resources that might be provided from the Church. This is despite their labour contribution to their establishment and maintenance over many years.

There are currently four community-based CFC development programs in Baraulu:

1) ***Cocoa:*** An original plantation was established in 1983, and in the last 5 years additional plantations have been established. Cocoa is considered to have a moderate economic value. In recent years a Cocoa Livelihood Improvement Project has been established, and with financial support from the Australian Government via AusAid. This is the current focus of interest within the community – with 2 separate plots (18 hectares for Group A and 4 hectares for group B) recently cleared by the Malaysian owned United Pacific logging company, which is also purported to have links with the CFC leadership. According to residents, the company offered to clear the area and provide a number (10,000 according to one informant) cocoa seedlings and polyethene bags. In exchange, the company was able to sell the felled logs, presumably at a sizable profit. Further evidencing the misinformation circulating the village, the same informant however explained that the seedlings came from the EU, as part of the Livelihoods project.

2) ***Oil Palm:*** This plantation was established in 2005, and with subsequent plantings in the last 1-2 years; but some community members are already saying that they don't have time to work on recent plantings, given they are now focused on cocoa. A community member, who also previously worked at the Department of Agriculture, suggested that this community was not able to maintain its various community plantings as well as it could.

3) ***Teak:*** This plantation was established in 1998. Teak is considered a high value product, and has generated what many describe as *'teak mania'* (and is colloquially referred to as *'$1 million dollar crop'*). Given the long-term nature of this development program (with incomes expected over a 10-20 year period), some suggest teak is changing approaches to planning for

development. In 2012 the Spiritual Authority's son, Junior, was looking for markets for the sale of teak with Malaysian companies. Comments on teak planting are continued below.

4) ***Coconut:*** These plantations were established approximately 20 years ago. The by-product, copra, is considered a low value crop. The copra-buying group is owned and managed by the PDFC.

These four community development programs provide income streams that support the CFC community religious program, as well as the improvement of services and community infrastructure. Copra, cocoa and oil palm have each generated communal income for the CFC. In addition, some individuals have generated incomes via employment harvesting crops (eg. coconuts). Yet some community members also raised concerns about the limited extent to which income from these communal activities was being shared amongst the community – and such concerns appear central to the current conflict. In addition, while these programs are oriented towards economic development, some community members also raised concerns about the broader social and environmental needs of community members.

5.7 Workload Impacts Associated with System uptake, including the gendered impacts

Community members work at both the individual and community level; community level work includes cocoa copra, coconut, oil palm and teak projects.

Community members described working 2 days a week on community projects, and explained this was also part of their spiritual practice. The tasks undertaken as part of this community work is directed by the church appointed work leader, and in consultation with the PDFC. Establishing cocoa planting on recently cleared parcels of land is a current priority. Some members of Group A explained they slept overnight in the cocoa field so they were able to work longer hours. As stated earlier, Group A has a much larger membership than Group B, and reflecting this, at the time of our research in 2012, the cocoa planting is more well established at the site managed by Group A. Meanwhile, members of Group B described having much more work still to do.

While women and men described regularly contributing to the community labour force (for example as part of the community oil palm and cocoa projects), they also articulated motivation to direct their work to individual plots; citing the prospects for ensuring greater individual economic returns and autonomy. Some community members also described the adoption of more labour intensive management practices on their own land as a strategy to maximise the productivity – and income – generated from crops cultivated on their private land holdings.

Reflecting this, a number of community members described teak trees on their individual plots growing bigger, and faster, as an outcome of the increased care and attention they received compared to those growing on the community land. This raises some important questions regarding the long-term viability of the community teak plantings, and the broader community development agenda of the CFC. This is contrasted to the circumstances at Saika (outlined further below). In Saika, where greater community cohesion was evident, there appeared to be less tension between communal and private enterprise. The focus on private work in Baraulu, even for the larger and less marginalised Group A, may be a manifestation of less confidence in the ability of a commons to underwrite their future.

5.7.1 Teak and Work

While many community members explained they had little time to undertake work related to teak maintenance, there is a site at Duvaha, North New Georgia, that some community members visit each fortnight to work (an outcome of the earlier UQ/CFC collaborative project). Duvaha requires a long day trip to reach (an estimated 18 km by dug out canoe and walking – the community owns two outboard motors, one is reserved for sole use by the Spiritual Leader).

When discussing the labour requirements related to management of the teak, community members described weeding the undergrowth and pruning as the most time consuming tasks. They also explained there were no plans for thinning the teak timber plantings. In explaining the decision not to thin trees, a number of explanations were provided. Firstly, community members were worried about losing trees, and explained they wanted to keep as many as possible. For some, thinning was seen to 'waste trees'. There was also a widely held concern that there would be no market for the thinned trees, so it was better to grow them to maturity.

Some also articulated that time factors constrained work related to teak management. Community members reasoned they couldn't work on everything; and quite simply, they had to work in their gardens, or people would go hungry. As one community member explained: "days are too short, if we don't prioritise (our work) over the week we will go hungry".

More broadly, some members of the community indicated that while they had been previously enthusiastic about planting teak (for example, one young man explained he left school to plant teak), they were now less enthusiastic. Many described simply not seeing any benefits from engagement in teak. One community member lamented that "nothing is happening", and like many others, had left teak to work on gardens and the establishment of cocoa plots. While men realised that teak took years to mature, they now felt that they could no longer sacrifice present needs for a future benefit. This was exacerbated by a lack of information or news about any other communities who had actually sold and profited from their investment in teak.

Perhaps related to this lack of information, some participants in focus group discussions explained that while they had lost their enthusiasm for teak, our visit – which was accompanied by a staff member from the Department of Forestry – had renewed their interest and enthusiasm. Some community members explained that no one from Forestry had visited them since 2010, and as such, they had directed their community labour towards other projects, including the newly established cocoa project.

5.8 Processes of Learning and Education Related to Land Management and Use

Villagers in Baraulu said that teak was originally seen as a potentially very lucrative planting when they had first started planting the trees 10-12 years ago. Although the decision to plant was made by their church, the Christian Fellowship Church (CFC), they said the information about teak generally came to them by means of the 'coconut news' – or what Westerners might call the 'grapevine'. This is more than just idle gossip; rather, it relies on trusted sources from the same language group and related groups. However, information still lacks the rigour and evidence-base that information from government (Rural Training Centres and the Department of Forestry) or NGO sources might bring. A constant theme in our discussions was the rarity of visits from anyone representing the government or scientific establishment. Villagers felt that they had been overlooked or ignored by institutions and had to rely on their own trusted, but possibly ill-informed, social networks for ongoing education about teak and other crops.

So the decision to originally plant teak was made on this basis. Now that the teak is between 8 and 10 years old, opinions have shifted somewhat. While some attempts have been made by Forestry officials [and the ACIAR project] to inform villagers of the optimal ways to maintain, prune and thin their teak plantings, there is resistance to this, as villagers believe that it would be economically wasteful to thin ten year old trees and then not be able to sell the timber. Interestingly, our guide and boat driver, who is a member of the Baraulu community, is also a Forestry employee. When asked whether he planted his own teak, he said he did, but he had not thinned it, providing the same reasons as the other members of the community. The teak we saw on our tour of village land confirmed this. Stands were overgrown with weeds - many trees had divided trunks and all had lower branches, which required removal. None had been thinned.

The consensus on teak was that it was potentially a valuable crop, but that it was labour intensive for something that would not provide a return for another decade - there was some reluctance about the prospect of planting more teak. Like the farmers on the Guadalcanal Plains (discussed further below), attention seemed to be firmly focussed on planting cocoa. The community [CFC] had recently engaged a Malaysian logging company to clear 18 hectares of primary forest on traditional land to make

way for a cocoa plantation. The logging company paid a 15-precent royalty to the CFC as representatives of the community and as part of that payment, provided cocoa seedlings for planting. The clearing operation carried out by the Malaysian company was, based on our own observation, and the opinion of our hosts, inadequate for proper planting. Villagers told us that the company had undertaken to clear unwanted logs and stumps from the site, but had yet to return once high-value timber logs had been removed.

The planting of cocoa on this site was being supported by the Australian government funded Cocoa Livelihood Improvement Project (CLIP) (http://www.cliponline.org/). This project provides training and resources in the growing and management of cocoa, provided villages are approved and can provide a 25 per cent equity contribution, which we were told would be covered by the logging company contribution to the CFC. Villagers showed us a resource book on the cultivation of cocoa, produced by CLIP. It recommended the intercropping of cocoa with cassava, potato, yam, taro, banana, paw paw, similar to the intercropping that has been recommended by ACIAR project for teak. People seemed quite willing to follow this tangible 'how to' document.

6.0 Saika

Saika is located in the Vona Vona Lagoon, in the Western Province of the Solomon Islands. Saika village formed in 1996, after a group of families followed two Spiritual Leaders who separated from the broader Christian Fellowship Church. The village was established on customary land associated with families from Kindu tribe, who are also now residents in Saika.

The current agro forestry project located at Saika is made up of a number of different woodlots. There are a number of stands of mahogany, teak, eucalyptus and *Flueggea flexuosa*. In 2012, there were approximately 17.6 ha of community planted teak and mahogany, as well as a mixed species one-hectare demonstration plot established as part of the ACIAR project. Long term (20 – 30 years), community leaders articulate a commitment to plant up to 100 hectares of teak. The community's Director described community members as being 'interested' in the demonstration plot, though community members themselves did not always substantiate this. In 2012, the first thinning of *Flueggea flexuosa* was undertaken, with thinned trees made available for community members for use in building materials. While community members appear to have welcomed the thinned *Flueggea flexuosa* for use, few members were actually involved in the thinning. The Director described the outcomes of the thinning as positive, explaining that "the remaining trees now have space", yet it was not clear if this was a widely held view amongst other members of the community.

6.1 Population

The population of Saika is approximately 270 adults. There has been a small population growth in time we have been visiting this village as part of this research. Access to land and other resources was not reported to be a challenge, and one community leader described the village as being well equipped to sustain future population growth; which was anticipated as 'religious refugees' – ousted from other communities (such as Baraulu) as a result of the schism – sought a new home. Given the recent migration patterns of community members – from numerous islands in the region – many families also have land outside Saika, providing additional opportunities for food and other crop production into the future.

While some members from the Saika village described their community as being historically marginalised – given its breakaway status from CFC – the current conflict within the church appears to have altered this perception. The Director and Spiritual Leader both described their village as a beacon of stability, well respected by those outside it; and expressed willingness to share village skills, including those related to agro-forestry, and to welcome new village members. Moreover, these leaders suggested that "refugees" would learn spiritually from Saika, which purportedly adheres to an uncorrupted version of CFC doctrine. Reflecting this, the Saika community – and under direction from the Spiritual Leader – has been engaged in

fundraising activities to support construction of buildings and other infrastructure to support this anticipated additional population growth.

6.2 Patterns of Land Use and Resource Access

All land within the boundary of Saika village is defined as community land. This land is collectively shared by families in the Saika community, and every person in the community has a right to use the community land for farming, collecting resources and housing etc. Households and/or families in the community are also able to identify land to establish new gardens, or to extend already established gardens. In a focus group, women explained they had either 1 or 2 gardens on which they grew food for the household and for sale at the local markets of Noro and Goldie College. Additionally, women and children routinely travel by dugout canoe to neighbouring islands where they collect coconuts, shellfish and additional garden plots.

The Saika community also has approximately 1000 hectares of 'alienated' land (land held by the State following independence), which it is currently in the process of reclaiming as customary land. To date, community members have invested 10 years in this process. There is some recognition that if they are successful in recouping this land, there will need to be a further internal process of claims on the land, which might create new problems in terms of ownership and access.

6.3 Village Level Social Structure and Decision-Making Patterns

The Saika village is in many ways a contrast to the social structure and remote centralised decision making imposed on Baraulu, and characteristic of the wider CFC. In Saika, the Spiritual Leader lives alongside other community members, engaging in community labour and living in humble conditions comparable with other community members. The Spiritual Leader explained that living simply was part of his spiritual practice, and that he is the last to benefit financially from community fund-raising projects. While the spiritual leader at Saika is instrumental in community decision-making, many community members described decision-making processes as informed by a participatory and inclusive process. Decisions, whether made by the local spiritual leader, or more inclusively, are local, and a high degree of autonomy from any church hierarchy exists in Saika. In contrast, the local spiritual leader in Baraulu acted more as a local representative and implementer of decisions made by more senior CFC hierarchy. There appeared to be very little participation in Baraulu.

Decisions related to a broad range of community issues occurs via the Elders Committee – also referred to as the Leadership Committee. This committee meets weekly, and is comprised of between 15 – 18 members.

6.3.1 Women's involvement in Local Level Decision Making

Men hold the majority of leadership positions, though in recent years there has been increased involvement by women, who the Director described as 'good decision

makers'. The local spiritual leader selected the majority of positions on the committee. The interesting exceptions to this are the 3 women's leaders positions, which are selected by the broader community of women. The leader of the women is 'Marama', the spiritual leader's wife, who described herself as being active on this committee; including regularly speaking and raising issues that women raise with her during the week. Marama had taken leadership of the women's' initiative for the fund raising project to raise money for forecast community infrastructure. She commented that men 'were not smart with ideas'. The initiative had the support of the community Director, who believes women needed to be better integrated throughout the community decision-making and consensus-building process.

The spiritual leader also engages specifically with the community Women's Committee through his wife, Marama. Marama provides a conduit for information flows between the Women's Committee and the Spiritual Leader. Despite this arrangement, a number of women at Saika also indicated they had little knowledge or input into community planning and decision-making, including little knowledge of the teak planting project and a forthcoming fundraising project.

6.3.2 Committee Membership

The committee for community level decision-making at Saika is comprised of the following positions, many of which are assigned colour codes belts to denote their position:

- Senior pastor
- Junior pastor
- Village Chief
- Senior Elder (advisory)
- Community Director (orange belt)
- Women's Leader – Marama
- Justice Minister
- 3 elected Women's Representatives
- 3 Work Leaders (red belts)
- 2 Singing Leaders
- 3 Standard Seven Leaders Work Leaders (yellow belts)
- Main Carpenter
- 4 Supplementary Work Leaders (yellow belts)

Appointment to senior positions within the community (including Director, Senior and Junior Pastor, Village Chief and Women's Leader) occurs via the Spiritual Leader. Village members are selected to occupy these positions over a fixed long-term period (many are positions for life), expect the three Women's Leader's roles, which rotate every three months.

Elders confirmed that within the Leadership Committee, four senior male members (namely the Director, Chief, Justice Minister and Senior Pastor) and Marama hold the greatest influence on the Committee, and regularly meet outside of Sunday meetings to discuss village management. Marama was described as sometimes participating in these extraordinary meetings. Additionally, these leaders often consult with the Spiritual Leader, who has final authority on all village decisions.

All community members are invited to attend Leadership Committee meetings; but to date, most observers are older males. It was difficult to ascertain whether any women have attended Sunday meetings as observers, with some women expressing that the broader community were only invited to attend 'all village' meetings that take place from time to time. According to the Community Director, increased female participation will still take some time, as it is a 'new' concept. Indeed this is reflected in the near total absence of women in governance at both the village and state level. Several elders noted that Saika was different to other villages on the matter of female participation in leadership; emphasising those women have good ideas and they are listened to.

It is important to note that women did not display/express discontentment with this arrangement; instead, emphasising their devotion to the Spiritual Leader, who is literally perceived to be a god.

6.3.3 The Community Director

William Taylor, the Community Director, is particularly important in relation to the agro-forestry project. For example, the Community Director is responsible for community business activities and development programs, as well as managing external relations, including with neighbouring villages, government departments and researchers and other staff related to the ACIAR project. The Community Director is responsible for advising community work managers on priorities and scheduling for community work, and manages community finances (in consultation with Marama) and the community bank account. The Community Coordinator is also the main conduit of information and advice between the broader community and the Spiritual Leader.

The current Director at Saika has also been recently appointed as a consistuency officer for state politician Salais Kerry Vungara, the son of Job Dudley Tausinga (the CFC Spiritual Leader's brother). Vungara is also, interestingly, the youngest Member of Parliament in Solomon Islands. This position has enabled the Director to leverage certain benefits for the community, including government support for the local primary school and the pending installation of sanitation in the community. This position also allows the Director to maintain an awareness of regional and national politics and development opportunities. The Director is a highly educated individual, having studied in Australia and worked in the office of the Prime Minister in Honiara, as well as lecturing in various educational institutions in the Solomon Islands. Within

the village, he is purportedly well respected and, while living in similar conditions as his neighbours, does maintain a high-ranking position socially – heightened by his familial ties to the Spiritual Leader and his connections to Holy Mama.

The Director and his wife hosted our Masters' student for a further two weeks following the social science team's most recent visit.

6.3.4 Decision Making Related to Teak

Overall, we got the sense from our dealings with community members that they were satisfied with this structure of community decision-making. They cited regular opportunities for broad community engagement in dialogue and decision-making related to their weekly work and community life.

Currently there are 18 hectares of community land under teak cultivation. One hectare of this comprises the ACIAR demonstration site that has been well maintained, inter planted with *Flueggea flexuosa* and thinned in accordance with best practise.

There are plans eventually to clear a further 50 ha of land by hand and plant with teak. Clearing will commence in 1-2 years but the entire 50 ha is a long-term project. The oldest teak in the community is 13 years old and none has been planted for past 8 years, so harvesting of the oldest teak is still 7-8 years away. In the meantime, the community earns income through the sale of market garden fruit and vegetables, coconuts and betel nut.

Decision-making on issues pertaining to the teak plantations maintains a significant spiritual dimension. In regards to the management regime proposed by ACIAR, it is important to understand the emotional and spiritual values that influence perceptions of thinning.

Although many villagers understand its rationale, thinning was described as 'not allowed' by the Spiritual Leader for a number of reasons. Moreover, there was visible resistance to the concept of thinning, stemming from spiritual, emotional and material factors.

Materially, there was an expressed desire to make money out of each tree planted. Several participants mentioned that each seedling was purchased with community funds (i.e., they were not received freely from the Forestry Department as in other villages) and they should not be wasted. Such sentiments were amplified by word from the 'coconut news' and from the accounts of local youths who have worked on logging barges in the region, reporting that smaller sized teak logs are already fetching a 'good' (though unclear) price. Moreover, there is no evidence to validate the value of thinning; it remains an abstract concept. Some participants also expressed frustration with the Forestry Department that encouraged teak cultivation but failed to provide instructions on proper management; meaning that their teak trees are now too

big to be thinned.

Villagers also expressed emotional and spiritual attachment to the teak trees. The impetus to cultivate teak in Saika was reportedly not a result of the 'teak mania' that incited other villages but, rather, the outcome of a 'heavenly vision' experienced by a local woman and the consequent proclamation of the Spiritual Leader. Participants, especially women, commented that they would be 'sad' and 'feel sorry' if any of the teak trees are left to rot. Participants expressed that ACIAR and Forestry must be sensitive to the spiritual significance of Saika's teak plantations.

Significantly, however, most participants expressed that they could accept a thinning regime so long as certain conditions were granted. Each participant conveyed that thinning's cannot be left to 'rot'; the consistency of this sentiment throughout the village indicated that the matter is talked about regularly. Two suggestions to avoid this were forwarded by community members. First, to sell the thinning's; however, the quantity was said to be too small for the minimum requirements of companies such as Kolobangara Forest Plantation Limited (KFPL), necessitating co-operation with neighbouring villages. Secondly, many village favoured the idea of establishing a furniture workshop in Saika that would use the thinning's to create high-quality furniture for sale in the Western Province. As operations grow, villagers anticipate purchasing thinning's from other villages. This idea was also in line with broader priorities set down by leadership of developing local skills base, especially of younger people, with the Standard Seven Leavers (detailed below) forwarded as a ready and enthusiastic vehicle to realise it. Village elders noted that this idea requires the support of an organisation like ACIAR, to assist the procurement of tools, development of necessary infrastructure, such as roads, and co-ordination of market networks

6.4 Social and Economic Dynamics - Service Delivery and Infrastructure

Similar to Baraulu, Saika faces significant challenges in terms of meeting basic service and infrastructure needs. Women and men community members at Saika have identified a number of issues that require improvement. In the years we have been visiting there has been a significant improvement in delivery of education – with the arrival of nine new teachers on salary supported by the provincial government (in addition to the Director who has a role as teacher, but not on salary), and expansion in buildings for school rooms and access to state curriculum, including English lessons. Women were particularly enthusiastic about rising levels of education, particularly that children were becoming increasingly fluent in pidgin, the lingua franca of the Solomon's and necessary for further education and employment away from Saika. The village had also been successful in obtaining funding from the provincial government, via MP Salais Kerry Vungara Tausinga. Prior to his appointment as MP, Tausinga was involved in philanthropic activities in communities, personally

supporting, for example, the construction of schools across the region and various other community projects, engendering broad support in the Western Province. As the son of Job Tausinga, Vangarra is ostensibly from a wealthy family, and has used money made from logging to invest in Australian real estate.

A 'thought experiment' conducted with a group of senior men from the village to try and determine what the most pressing needs of the village might be, initially met with the response: 'that is a decision for the spiritual leader'. However, further elicitation, and a discussion of what the research team had discussed in 2010 in Saika generated agreement from the men on the following ten needs in priority order:

- Permanent buildings and sanitation (toilets) for all households;
- Improvements in water supply, including funding to complete water tank installation;
- Completion of health clinic and improvements in health service delivery;
- Construction of school building, registration of school curriculum and salary for teachers, establish high school and university;
- Increased availability to equipment, including carpentry tools, sewing machines, outboard motor, chain saw, garden tools, pruning saws and fishing equipment etc.;
- Improve sports field;
- Provision of effective communication systems (mobile phone, two way radio);
- Provision of solar panels for lighting; and
- Provision of a roofed church building.

The community is currently working at this list of priorities with its own resources, by, for example building additional buildings to accommodate teachers using local skills and materials.

6.5 Social and Economic Dynamics – Income-Generating Activities

Households at Saika are engaged in a range of income generating activities at both the household, and community levels:

6.5.1 Individual Income-Generating Activities

Women and men fish and garden, and sell their products at markets in Munda and Noro, as well as to the Goldie Secondary College. Community members also cite regularly donating to Goldie Hospital. Income generated from the sale of these items is utilised to purchase supplementary food and other items, including kerosene, materials for sewing etc. This income is reportedly managed largely by women, who also frequent the markets more often than men. Men also reported selling fish, fresh and barbequed, and shellfish at the markets, as well as crayfish to nearby resorts.

There are also several hectares of individual and community land under coconut and betel nut plantings, and income generated from the harvest of these crops is accrued at the household level.

Many villagers are also engaged in micro-enterprise, including selling phone credit and establishing home-based 'canteens', selling such household supplies as kerosene, soap, rice and tea, as well as snacks and sweets. Several villagers have purchased solar panels, which they rent to their neighbours to charge mobile phones. Many women in the village also bake breads, cakes and puddings, which they sell to their neighbours.

6.5.2 Community-Based Income-Generating Activities

The community also engages in a number of community fundraising activities. For example, women discussed 'bring and buy' events and baking events; community markets where a portion of funds raised are donated to broader church fundraising efforts. All village funds are a product of local fundraiser efforts. These funds are divided into several boxes covering education, Standard Seven Leaders, community work, church, and events and visitors. The women have recently established their own fund. Revenue made from the sale of teak will purportedly go towards assisting Saika families to pay high school fees. These arrangements contrast with those at Baraulu (and other CFC communities, more broadly), where community members must donate a portion of their individual income to wider church fundraising efforts, which may or may not benefit them directly.

Community fishing is also used for communal fundraising, and while families pay school fees, profits from fish sales are also divided amongst families, thereby providing discretionary funds, including pocket money for children at school (especially high school) and for purchase of books, stationary, clothes etc.

Additionally, there are also a number of community agriculture projects, the funds of which are being utilised to support the broader community development agenda articulated by the Spiritual Leader (and negotiated with the Leadership Committee). Amongst these includes betel nut, coconut and teak plantings, as well as a community rice project, run largely by students, which operated up until 2009, when it was abandoned due to continued problems with disease. Given the project's initial success and the prospect of being rice-sufficient, the Director is keen to re-establish it in the future.

6.5.3 Teak

The introduction of teak as a community income generating activity has brought with it significant changes for the Saika community. To begin, while betel nut and coconut (amongst other traditional crops) can be harvested all year round – generating a constant income stream – teak represents a long-term income-generating stream that arrives only once the trunks are felled. However, the Spiritual Leader (and along with

some community members) also discussed the opportunities of translating teak into a medium term income stream; for example via thinning and generating an income through the sale of thinned timber trees. Secondly, the introduction of teak plantings has also introduced a new management plan. While community members draw from local knowledge and skills to grow food crops for harvest and sale, many describe teak as reliant upon a new management system that is informed from an external knowledge source.

6.6 Workload Impacts Associated with System Uptake, Including the Gendered Impacts

Women and men engage in a range of work activities on both their individual and communal land. In terms of communal work, women indicated they spend time each week working on communal vegetable gardens; the harvest of which is sometimes donated to the Helen Goldie Hospital, as well as others outside the community in need. In addition to standard weekly labour, women also contribute labour on Saturdays and engage in "women's work" on Mondays. Saturday labour, in which the men 'sometimes' participate, is typically church-oriented, such as cleaning or maintenance. Mondays are known in the village as "women's day"; on this day, women have tended to work together on garden activities; sharing the upkeep of household gardens amongst each-other. This work includes weeding ("brushing"), clearing, planting and harvesting. Marama, noting the workload of women, has also suggested expanding this to include sharing household responsibilities. Mondays are an important time for women to plan; it is on Mondays that the Women's Leader and the three representatives update village women on Sunday's proceedings and gather any feedback or ideas for the following meeting. The representatives also take this time to plan women's labour for the week.

Women also arrange 'working bees', working communally in rotation in each others' gardens as well as collectively maintaining communal assets, including the church and community hall.

Women, men and children also all work on the agro-forestry plot. Work activities include forest management, such as planting seedlings, pruning, clearing undergrowth (Brushing) and removing timber. Women also indicated the workload related to the forestry plot has increased over time, especially given the area under teak cultivation is expanding. Communal work is part of spiritual practice and devotion. Community work is done first thing in morning, three times a week, before disturbances of the mind from the day can interfere, sometimes as early as 5.30am. Work is typically carried out in silence, and is opened and closed with prayer. Labour is typically for one hour, with three 30 second breaks every fifteen minutes.

Based upon a concept championed by Holy Mama, the Standard Seven Leavers (S7L) is a local institution of unmarried school-leavers aged between 16 and 25. The S7L

were responsible for the establishment and maintenance of a large teak plantation several years ago. The S7L provides space for young participants to learn forestry and carpentry skills. It is also viewed as an important time for youth to learn leadership and responsibility, strengthen bonds and develop a sense of place within the village community. Some young members demonstrated a sound comprehension of thinning and expressed their support for it; however, their capacity to influence such matters remains limited as such decisions are made by leadership. Their Work Leader sits on the Committee, communicating the ideas and plans to the Elders of S7L members and also professes to support thinning. Both the Work Leader and its members expressed enthusiasm to learn new forestry skills and represent a supportive institution for ACIAR to engage.

Like Baraulu, there are competing priorities in terms of direction of labour. The expansion of the school, for example, is currently taking up time and energy. While this is a directive that comes from the local spiritual leader, we sensed there was less resistance as the allocation of work was for the direct benefit of the community and decisions were made with a measure of consultation, according to a transparent process, and with the possibility of appeal.

6.7 Processes of Learning and Education Related to Land Management and Use

Forestry officials visit Saika every month to inspect the demonstration plot, but although the community could see the benefit in the demonstration, they were still not engaging with the practise of thinning. The Director was conscious that there was clearly a difference between the demonstration plot and the community plots. He also said that while community members has acknowledged recent thinning (Feb 2012) had left room for the remaining trees to grow, they still had reservations about cutting down trees; with many describing trees as a passion, and as representing their livelihood.

When asked about their perceptions of the demonstration plots, most villagers and elders expressed that the plot belonged to Forestry (though sometimes referred to ‘the University’). Many participants, particularly younger people and women, expressed that they had not yet visited the plot, and that it had not been explained to them. It appears that representatives from Forestry arrive at the village and work on the demonstration plot without involving local people.

Most, but not all, participants were familiar with the term ‘thinning’, however comprehension of its meaning fluctuated. Although many were aware that thinning is done in order to generate greater revenue, there was scepticism and/or hesitation, given there is currently no physical evidence of this and it would come at the cost of several trees that are seen to be marketable. Younger boys involved in the Standard Seven Leavers reported learning about the concept of thinning from their work leader,

while women professed to have learned of the concept from their husbands and other men in the village. From discussions with community members, it seems there is a palpable lack of inclusion of women and young people in agro-forestry extension activities. Significantly, thinning still lacks the approval of the Spiritual Leader, suggesting that he has not been adequately engaged and that the spiritual dimension of teak management in Saika has not been sufficiently appreciated.

Most participants, especially the women, reported very little engagement with the Forestry Department or ACIAR, or understanding of their respective roles. The Director is the primary point of contact and for most people their irregular presence does not foster confidence/trust. Participants noted that Forestry arrive often without talking to anyone in the community; at best, talking only to the Director. One Elder commented that he is 'very unsatisfied' with the lack of communication, he feels that the organisations focus '… on their own research success and forget about us and keeping us informed.' From discussions with community members, it seems apparent that village participation or engagement in agro-forestry activities is minimal. Data revealed that only two all-village meetings have taken place over the course of the five-year project.

This lack of engagement manifests primarily in the experiences of women; who purport to receive their information about thinning from their husbands or 'rumour' from the 'coconut news'. Although they are aware that Forestry visits Saika from time to time, they made such reflections as: 'they came, just follow their plans … they didn't explain what they were doing… they just come and go'. When asked, female participants responded that Forestry is indeed helpful; but were unable to explain why they felt this way. Women also noted that their visits could become a burden, when women are expected to provide refreshments and crockery.

Community members made several suggestions as to how relations could be improved. Most pointed to better communication; such as notification of arrival and explanation of their planned activities; honesty and openness; and listening and responding to their requests, such as the development of the furniture workshop. The Director also emphasised the significance of evidence and experiential learning; currently, there is no visual evidence to demonstrate the value of thinning and villagers are not actively involved in learning the new management regime. Participants expressed that ACIAR and Forestry must understand their feelings towards the teak; that is, that thinning's are not left to rot. Moreover, even those participants that understood and agreed with the 'science' of thinning, highlighted that thinning will not happen without the labour of the village and must have the sanction of the Spiritual Leader.

7.0 Guadalcanal Plains

We undertook social research on the site at Guadalcanal Plains part way through the course of this research project, after the site at Takaburo was no longer viable to participate in this study. As part of this region, we visited a community where three relatives within the one family were planting teak on their property. These plantings had been established since around 2005. For each of these individuals, some family members had assisted in the provision of labour related to maintenance of the timber planting, and one plot the land owner had been assisted by College students, who had provided labour for forest management. At the time of our final visit, it appeared the landholders had little interest in their teak planting, and were engaged in work related to cocoa and vegetables as income generating activities. In contrast to their earlier enthusiasm, each of the three landholders – and other family members we spoke to – were less optimistic about the economic opportunities afforded by teak. Reflecting this, there were little signs of maintenance of the current teak plantings, and no family had instigated thinning.

Overall, it appeared the landowners we spoke to, and some of their family members, have lost confidence in the potential of teak. This was not through any lack of knowledge of the prevailing market, but – and similar to the community in Baraulu – they had yet to see anyone in their own social networks profit from the activity. Reflecting the brother of one of the men in this community trialling teak stated; “teak is a waste of time, we could put our time into other crops to generate an income”.

While landholders across all study sites indicated that for the first two years they were able to grow gardens amongst the teak, as the canopy grows and shades the forest floor, this is no longer possible. While the landholders we spoke to indicated they were content to leave the trees in place (neither site appeared to have a shortage of land) the labour and other resources required to prune, clear and thin the teak allotments were considered to be better allocated to other activities, particularly cocoa – which was providing a decent return twice a year. Other activities included market vegetable gardens, which also provided a regular return.

Of the three teak plantations in Guadalcanal Plains we visited, we spoke with none of the principal owners, despite the best efforts of ACIAR project staff to arrange meetings before our arrival. Speculating on this inability to meet, we could see three possibilities:

1. A genuine inability to meet due to other employment and family commitments, with one landholder recently gaining employment as a bus driver between Honiara and Guadalcanal;
2. A loss of interest in teak due to a lack of evidence that it would provide a return either now or in the future; and

3. Related to the above, a reluctance to meet out of embarrassment that they had 'moved on' from their interest in actively managing their teak.

Although villages appeared to have excess land, developing and rehabilitating this land for planting crops such as teak was difficult without capital. Villagers complained that while funds were made available from time to time from the central government, these funds were provided to local politicians to distribute, and this did not always occur equitably. The broader context is that there are many socio-economic problems in Guadalcanal Plains. And according to community members, government is not adequately addressing these, as such; community members themselves must be engaged to meet their own needs. This means it is difficult to work on teak – which is seen as speculative and long ranging. As such, initial enthusiasm for teak is being replaced by motivation to work on immediate income strategies (cocoa).

In short, there was much uncertainty about teak, even though forestry officials and the agricultural college had been involved with the project Overall, there is a sense here that initial enthusiasm for teak – the teak mania – has slowed. This appears to have occurred for a number of reasons: 1) there is no evidence in the area from people they know that teak will deliver economic benefits 2) competing labour priorities 3) concerns there will be no market for the teak when it matures 4) land is then locked up and not available for other crops 5) 15 – 20 years is a long time to realise any economic return from sale of teak.

8.0 Takaburo

Takaburo was the first site we visited as part of our social research. Here, a number of individuals were planting teak and intercropping with *Flueggea flexuosa* and mahogany. Takaburo, like other communities we visited, faced similar social, economic and environmental challenges. Community members identified limited medical and health services, limited opportunities for young people to engage in meaningful activities to keep them in the community, conflict amongst young people and the increasing cost of living as foremost amongst such challenges.

Sadly, this community was devastated by flooding, causing significant damage to infrastructure, agricultural and forestry plots, as well as loss of life. This resulted in the cancellation of on-going research at this site.

However, there some important issues were evident in the context of teak planting at Takaburo that should be noted here. Firstly, it appeared that the majority of plantings were occurring on individual land holdings, rather than communal lands – as demonstrated at Baraulu and Saika villages. People we spoke to explained that by planting on their own land, they were ensured to receive the payment for the high value timber crops when they matured. Some landholders – who had the knowledge,

political acumen and finances, were also registering their land to avoid future conflict related to land and financial entitlement. In other words, it appeared teak – and optimism related to economic returns – was driving a shift from customary land to privatisation of land ownership. The relatively close proximity of Takaburo to Honiara made it possible for community members to travel to town to formalise such arrangements. Some community members also suggested that this proximity had provided a comparative advantage for their community – including regular visits from Forestry, AusAID and international forest buyers.

A second challenge that community members discussed related to the teak plantings related to the labour requirements for its up keep. Many community members discussed the challenges of working cooperatively, in contract to Baraulu and Saika, where community work appears to be part of spiritual practice. In the context of labour shortages, and like communities elsewhere, individuals at Takaburo often prioritised work that could generate an income in the shorter term, including vegetables.

9.0 Conclusions and Recommendations

The expansion of mixed species agro-forestry plantings has the potential to deliver social, economic and ecological benefits to communities in the Solomon Islands. Indeed, many community members in the villages we conducted social research demonstrated early enthusiasm for the ACIAR project – and tree planting more generally – on the basis of such positive impacts. Yet at the same time, the introduction of teak (alongside other tree species) has introduced a new forest management system, new labour and workload requirements, the outcome of which has also introduced new challenges and issues for community members, including in some instances driving changes in land tenure systems. As such, many of the communities we spoke with had lost interest in teak as a pathway for community economic development.

In the context of our findings, we conclude that it is imperative to understand the broader socio-cultural contexts in which this ACIAR project is being introduced, to ensure that staff and management systems are cognisant of local level needs and aspirations, as well as being sensitive to the cultural, including religious and gendered practices, of the communities in which this project is being introduced. For example, by working with already established governance arrangements, including local processes for community decision-making, it is more likely the project will have buy in and support from the community. The communities we undertook research with are also organised along gender lines. As such, on-going work on the ACIAR project could reflect on increased understandings of these gendered dimensions, to ensure gender sensitivity and appropriateness.

Here we conclude with a number of recommendations related to on-going work on forestry and agro-forestry in the Solomon Islands. Some of these recommendations might also usefully inform broader ACIAR initiatives in the Pacific Region.

- Recognise and work with local level governance and decision-making processes to actively enrol community members in the ACIAR project, including demonstration plots. For example, at Saika village the Leadership Committee meets weekly, and may provide a conduit for further community engagement in the ACIAR project. In addition, the Standard Seven Leavers are already engaged in forest related work – and supported by the Spiritual Leader. This community, and through the Leadership Committee and key power brokers, could be engaged to participate in the demonstration plot. Significantly, thinning still lacks the approval of the Spiritual Leader at both Saika, suggesting that he has not been adequately engaged and that the spiritual dimension of teak management in Saika has not been sufficiently understood by the ACIAR project.
- Recognise the power brokers in the community (eg. Spiritual Leader and Ministers at Baraulu and Spiritual Leader, Community Director, Marama and the Senior Pastor at Saika), that shape decision making related to land management and community labour, and work with these to enrol communities in the project – including related to thinning and pruning activities.
- On-going maintenance of current demonstration plots, and expansion in the number of demonstration plots elsewhere, to provide visible evidence of the outcomes of forest management practices, including thinning.
- Support the expansion of reliable and trustworthy information sources on forest management practices, including their benefits. This might include increased community visits by Forestry workers, increasing opportunities for community members to visit Rural Training Centres, as well as media coverage of the ACIAR project (including radio and newspapers), as well as information booklets on forest management. Such information should demonstrate the market opportunities and other community-based opportunities for thinning, including anecdotal stories from individuals and communities who have benefited through the sale of teak.
- Recognise the value of experiential learning, and find innovative ways (including those suggested above) to better integrate local community members in demonstration plots and other activities related to the project.
- Improvements in the supply of equipment. This includes equipment related to forest management (pruning tools, chainsaws etc) as well as that required to support Forestry staff, the ACIAR research team and other visitor needs. Women identified the need for crockery, thermos and other kitchen equipment to cater for the increased visitors.

- Increase efforts to establish relationships between ACIAR research and other staff and community members. Community members made several suggestions as to how relations could be improved. Most pointed to better communication; such as notification of arrival and explanation of their planned activities; honesty and openness; and listening and responding to their requests, such as the development of the furniture workshop (at Saika).
- Active inclusion of women and young people in agro-forestry extension activities.
- Acknowledge the diverse needs and aspirations community members articulated – including related to service provision, infrastructure, education, employment etc. Part of the medium and long term monitoring and evaluation of the agro-forestry development project will require assessment of the extent to which these identified community needs might be met via the income generated from the sale of teak (and other timber and food crops associated with the mixed species planting), and how the project might be altered to assist in delivering on these needs.
- On going support for the expansion of short and medium-term income generating activities (including thinning); given community members cannot wait 15-20 years before they begin to generate an income through the sale of teak.

Overall, this project points to both the challenges and opportunities associated with tying community socio-economic and environmentally sustainable development to market-based initiatives. In addition to the market-based initiative advocated by this ACIAR project, our social research also points to the urgent need to address national and international regulatory and trade arrangements in ways that might conserve the small percentage of forests that remain in the Solomon Islands, and to foster environmentally responsible land management practices.

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Competing Claims:

Perceptions, Disjunctures & Programme Efficacy in the Solomon Islands

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Writing this thesis has been a challenging yet thoroughly enjoyable experience, and I hope it may prove useful for all who read it, especially ACIAR and the village.

Executive Summary

"If the spiritual leader says "thin" then we will all agree to thin. If the spiritual leader says "yes", then we all say "yes", but if he says "no", then we all say "no".'

- *Female Village Participant*

Approximately 7000 hectares of smallholder teak plantations have been established across the Solomon Islands (SI) since 2002. These plantations represent an opportunity for long-term livelihood security for Islander communities and a potential means to redress the decimation of natural forest wreaked by commercial logging. Although global teak markets are strong, grower communities are not engaging in the management practices necessary to grow marketable logs. In response to this, the Australian Centre for International Agricultural Research (ACIAR) has developed an extension programme that aims to assist growers implement a mixed-species silvicultural regime based agro-forestry principles. Implementation is hoped to deliver tangible socio-economic and environmental benefits to grower communities.

The following study explores the experience of one of ACIAR's project sites under the 'Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands by inter-planting with *Flueggea flexuosa* and other Pacific agroforestry species' programme, to propose recommendations for heightened uptake of the regime. A community development perspective has been used to frame the research process and inform the final recommendations for

project planners. Participatory methods in the field allowed qualitative data to be gathered on project perceptions, participation and socio-cultural structures and processes that shed light on why the agro-forestry regime has not been widely embraced by this community.

Significant divergences emerged between project rationales and objectives and the motivations and perceptions of community members in respect to livelihoods, development aspirations and teak plantations. The village was found to have strong community structures for planning and decision-making, and a powerful sense of unity and co-operation. Significantly, teak is located within both material and spiritual dimensions of the village and the role that spirituality and spiritual narrative plays in teak management surfaced as particularly salient. Data suggests that extension has not adequately engaged with these important aspects. The study thus argues that the ways in which the silvicultural concepts introduced by this project are understood by community members is critical to project's success. Moreover, it argues that the project should utilise the existing capacity of the community, such as its institutions, its decision-making processes and its demonstrated commitment to co-operation. By identifying both gaps and common ground between them, the study hopes to locate spaces for improved collaboration and, ultimately, uptake of the regime.

Summary of Recommendations

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Introduction

Approximately 7000 hectares of smallholder teak plantations have been established across the Solomon Islands (SI) since 2002. These plantations represent an opportunity for long-term livelihood security for Islander communities and a means to redress the decimation of natural forest wreaked by commercial logging.[1] Although global teak markets are strong, across the Solomons grower communities are not engaging in the management practices necessary to grow marketable logs. In response to this, the Australian Centre for International Agricultural Research and Griffith University Environmental Futures Centre (hereafter referred to as ACIAR) has developed an extension programme that aims to assist growers implement a mixed-species silvicultural regime based agro-forestry principles.[2] Although its implementation is hoped to deliver tangible socio-economic and environmental benefits to grower communities, uptake of the regime has been marginal in this village.

The following study explores the experience of one of ACIAR's project sites to propose recommendations for heightened uptake of the proposed management system. Located in the Western Province of the Solomon Islands (SI), the village has been involved in the project since 2007. Although housing a successful demonstration plot, the agro-forestry regime has not been applied to the remaining 16.6 hectares of teak plantation. This study forms part of a wider social evaluation conducted at the end of the current five-year funding period, as the organisation looks towards the second stage of the project, namely securing international markets and regional grower networks.

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[1] Pauku R 2009 'Solomon Islands Forestry Study' Food and Agriculture Organisation of the United Nations Regional Office for Asia and the Pacific, Bangkok p iii

[2] Elevitch C R and Wilkinson K M (eds) *Agroforestry Guides for Pacific Islands* Permanent Agriculture Resources: Holualoa; Martin F W and Sherman S 1992 *Agroforestry Principles* ECHO Publications: North Ft Myers

Through a community development lens, qualitative data has been used to inform a set of recommendations for Australian project planners from ACIAR. Focus was directed towards power relations, decision-making and participation in relation to the community teak plantation, with particular emphasis on gender, age and spirituality. This approach was utilised in order to elucidate why the regime has not been embraced and how its uptake could be better supported.

It was found that, despite local involvement in this programme, there are significant epistemological divergences between project rationales and the motivations and perceptions of the community. The project is grounded in Western science and economic rationality, and lacks explicit mandates on gender, culture or spirituality. This disjuncture forms the basis of inquiry in this study.

Aims of the Study

By exploring the spaces of disjuncture between the perceptions and lived realities of community members and the claims of the project, this qualitative study aims to investigate the limits and potentials of the extension project. In particular, it explores how teak management and concepts of wellbeing are located within local spirituality and spiritual narrative. By identifying both gaps and common ground between local realities and project objectives, this study hopes to locate spaces for improved collaboration towards regime uptake and long-term sustainability.

The study will argue that the ways in which the silvicultural concepts introduced by this project are understood and engaged with by community members is critical to project success. The village under study was found to have strong community structures for planning and decision-making, and a powerful sense of unity and co-operation. Importantly, its teak plantations were found to be discursively located

within both material and spiritual dimensions of the village. Evidence from the ground suggests that extension processes have not adequately engaged with these aspects; this study thus hopes to highlight the importance of understanding these realities and of utilising existing capacities. Additionally, this report seeks to make a contribution towards redressing the prevailing lack of in-depth inquiry into the relationship between spirituality and development partnerships.

Project Scope

The field research component for this project was undertaken in SI over total of five weeks. The researcher accompanied the social evaluation team as an assistant for three weeks, visiting three project sites across the Guadalcanal and Western Provinces, and the capital Honiara. The researcher stayed an additional two weeks in the family home of the Village Director collecting data for this study. Field work involved discussion and liaison with project staff in SI and Australia and participatory research with diverse community members to reveal insights into the challenges and opportunities associated with this agro-forestry project. Fieldwork evidenced a profound relationship between spirituality, livelihoods and teak management. Accordingly, the researcher sought to explore these dimensions in respect to implementation of this regime and the potential spaces for improved collaboration.

Structure of the Report

The report opens with an overview of the agro-forestry project, followed by a brief history of teak and development assistance in the SI. This is further contextualised by a socio-cultural profile of the SI, covering rural and urban issues and culture and diversity across the archipelago. This is followed by an introduction to the Western

Province, focussing on its forestry activities and the Christian Fellowship Church (CFC) – a local denomination, based in Roviana and Morovo Lagoons, to which the village under study adheres. These particular dimensions were included due to their salience to the project and the fieldwork findings. The literature review that follows explores Community Development (CD) frameworks, which guided the methodological approach and informed the final set of recommendations. The CD principles of participation, power, wellbeing and spirituality were focussed upon due to their relevance to the programme and recommendations. The subsequent methodology explores the participatory and qualitative methodological approaches used to collect and analyse data and associated ethical reflections. This is followed by the findings and critical discussion. The findings elucidate the project claims juxtaposed with local perceptions of teak and the project as well as an in-depth social profile exploring socio-cultural and governance structures of this village, with particular attention to spirituality, gender, age and local process. The critical discussion draws on these findings to generate a SWOT (strengths, weaknesses, opportunities, threats) analysis of the project to contextualise the final set of recommendations.

1. BACKGROUND TO THE STUDY

1.1. THE PROJECT

The project 'Improving silvicultural and economic outcomes for community timber plantations in the Solomon Islands by inter-planting various Pacific agro-forestry species' has been designed and implemented by the ACIAR in collaboration with various stakeholders across the SI. Postulating that demand for teak is likely to increase as natural forests resources diminish, the project formed in response to the growing community-based teak plantation industry emerging in the SI. Since 2002, approximately 7000 hectares have been established but grower communities are reluctant to engage in the management practices required to produce marketable logs.[3]

Both formal and non-formal sectors of the SI Education Department are involved in the project, as well as government and industry partners in Australia and the SI. Given the critically unsustainable nature of the SI's current timber industry, there is an urgent need for improved forestry practices. With extensive areas of suitable land, appropriate climate and a history of indigenous agro-forestry practices, the SI is well-positioned to develop a strong community-based timber-growing industry based on agro-forestry principles.

ACIAR has developed a scientific approach to teak management that may allow for earlier harvest and the opportunity for grower communities to inter-plant useful, local species, in particular *Flueggea flexuosa.*[4] ACIAR hopes that its application may translate into improved opportunities for socio-economic development among

[3] Blumfield T 2007 'Project Outline (Full Proprosal)' Griffith University/ACIAR: Brisbane p 3 - 6
[4] Thomson L A J 2006 '*Flueggea flexuosa* (poumuli) ver. 2.1.' in: Elevitch C R (ed) *Species Profiles for Pacific Island Agroforestry* Permanent Agriculture Resources : Hōlualoa

grower communities. Thus, in addition to forestry extension, the project aims to investigate and promote local applications for *Flueggea flexuosa* and other agro-forestry species and heighten awareness of the product potential of these species and short-rotation teak in Pacific, Australian and Indian markets. The project boasts numerous sites across the SI and is set to enter a new phase focussing on markets and grower networks.

This project maintains strong potential for success. It is responsive to the tangible local needs of improved teak management practices and retains a long-term, holistic outlook in the sense that it addresses management, eco-sustainability and marketing.[5] Additionally, it has committed resources to social and scientific studies, evaluation and planning to improve project efficacy. In the village under study, the project coordinator has built strong relations with the Village Director, and the extended stay of the author, funded by ACIAR, with the Director and his family is a pertinent reflection of this. In the village under study, a one hectare agro-forestry demonstration plot has been established with a core impetus towards encouraging thinning the teak plantations. Project staff and various researchers often visit the plot to collect data on its progress and explore avenues for innovation.

1.2. HISTORY OF TEAK

The most log export-dependent country in the world,[6] timber sales account for over half of the SI's total exports and nearly one third its total budget.[7] Logging practices, largely clear-felling natural forest, remain between two and five times above sustainable levels, and have engendered significant loss of biodiversity and forest

[5] Blumfield T 2007
[6] Furusawa T, Ohtsuka R Pahari K, and Umezaki M 2004 'Impacts of selective logging on New Georgia Island, Solomon Islands evaluated using very-high-resolution satellite (IKONOS) data' *Environmental Conservation* Volume 31 Number 4 pp 349–355: 349
[7] Furusawa T, Ohtsuka R Pahari K, and Umezaki M 2004 'Impacts of selective logging on New Georgia Island, Solomon Islands evaluated using very-high-resolution satellite (IKONOS) data' *Environmental Conservation* Volume 31 Number 4 pp 349–355: 354

resources.[8] Given that 84 per cent of Solomon Islanders depend upon forest resources for survival, experts warn that the social impacts of forest loss will be severe.[9] Government efforts to restore or reafforest degraded lands have, according to Dauvergne (1998), remained haphazard and 'conspicuously ineffective'.[10]

Teak forestry has emerged as primary industry for development in the SI.[11] Locals and government alike refer to the *"teak fever"* that characterised the 1990s and early 2000s.[12] Dubbed unofficially, but nevertheless cogently, as the *"million dollar crop"*, the government has encouraged the establishment of small-holder teak plantations across the provinces, often providing or subsidising seedlings to grower communities, with sights set on international markets.[13] Several thousand hectares' of such plantations have been established in recent years; however, prevailing management practices place the livelihood security of grower communities, and their environments, in jeopardy.[14]

[8] Oxfam Australia 2008 'Solomon Islands & Forestry' Oxfam International From Poverty to Power Series. Accessed online: http://policy-practice.oxfam.org.uk/publications/solomon-islands-and-forestry-112458 [05 May 2012] and Pauku R 2009 the Pacific, Bangkok p iii

[9] Thaman R (date unknown) 'Biodiversity is the key to food security' Foundation for Advanced Studies on International Development: Tokyp. Accessed online: http://www.fasid.or.jp/daigakuin/sien/kaisetsu/gaiyo17/data/05/THAMAN - spore article revised.pdf [29 June 2012] p 1

[10] Dauvergne P 1998 'Corporate Power in the Forests of the Solomon Islands' *Pacific Affairs* Volume 71 Number 4 pp 524 – 546: 529

[11] Blumfield T 2007

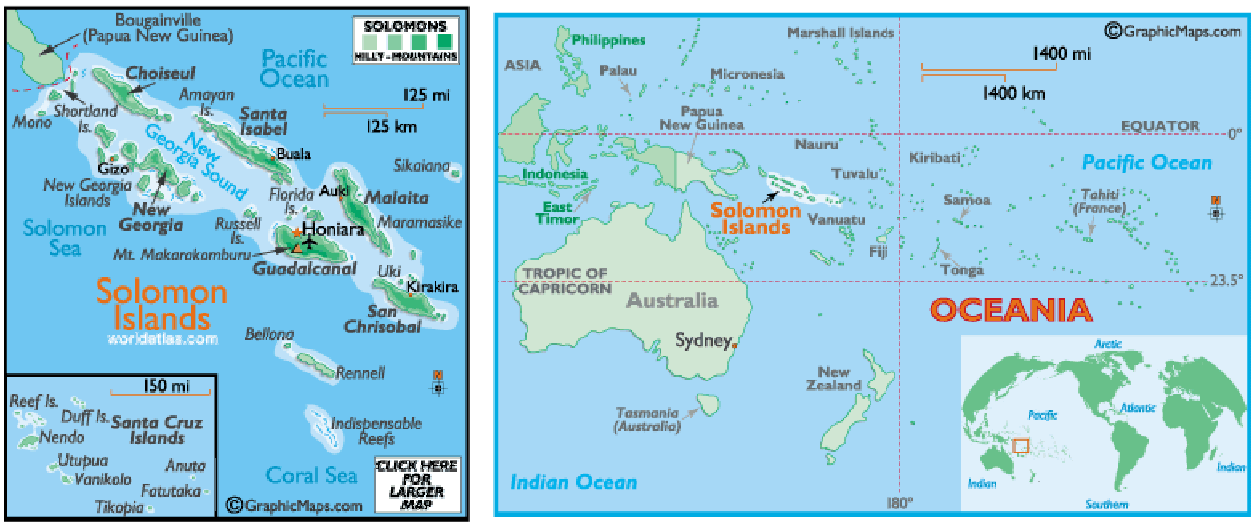
[12] Researcher's own data

[13] Pauku R 2009 p 32

[14] Blumfield T 2007

1.3. DEVELOPMENT ASSISTANCE IN THE SOLOMON ISLANDS

Figure 1: Map of the Solomon Islands[15]



Strengthening the rural economy and sustainable resource management form two primary focus areas for the many foreign government and non-government organisations (GO/NGOs) operating in the SI.[16] Particularly relevant to this study are efforts to promote 'sustainable' forestry through community agro-forestry systems.[17] Such efforts hope to redress ecological and social consequences of current forestry practices, and reverse rural-urban migration trends.[18]

As elsewhere[19], agricultural and forestry extension is confronting traditional knowledge and ways of knowing. Modern agriculture and forestry is concerned with higher yields, and informed by Western science and economics. Conversely, traditional Melanesian agriculture is oriented largely towards subsistence, infused

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[15] World Atlas 2012 Online: http://www.worldatlas.com/webimage/countrys/oceania/sb.htm [accessed 22 September 2012]
[16] Foale S 2001 'Where's our Development? Landowner aspirations and environmentalist agendas in the Western Solomon Islands' *The Asia Pacific Journal of Anthropology* Volume 2 Number 2 pp 44-67: 44
[17] Pauku R 2009 p 31
[18] *Ibid*
[19] Dessein J 2005 'Between the traditional and the capitalist modes of farming' in Haverkort B, Hiemstra, Reijntjes V, Remmers G and van 't Hooft K (eds) 2005 *Compas Magazine* Number 8 Compas Publications: Luesden pp 38 – 40: 39

with spirituality and ritual.[20] Although most organisations emphasise the value of 'indigenous knowledge' scholars such as Gegeo and Watson-Gegeo (1999, 2002) note the continued 'epistemological collisions' that characterise development interactions in the Pacific in respect to the divergent worldviews between communities and agencies.[21] Roughan (1986, 1997)[22] and Rhodes (2007)[23] echo this, noting the marked lack of culturally-appropriate development programmes in the SI. Foale (2001) and Douglas (2003) contend that development programmes in Melanesia are often based on assumptions that grossly over-simplify the social complexity of Islander communities and their relationship with nature and 'modernity'.[24]

1.4. SOCIO-CULTURAL PROFILE

2.4.1. Rural populations

Over 80 per cent of Solomon Islanders live in villages across the country's nine provinces, engaging primarily in subsistence lifestyles of gardening and fishing for domestic consumption and sale at local markets.[25] Villagers are, however, increasingly diversifying their livelihoods through small scale cash-cropping[26] as

[20] Daniells J, Englberger L, Foley W and Lyons G 2010 'Growing gold in Melanesia – gold foods, that is' *Melanesian Geo Magazine* Y University of the South Pacific: Laucala p 1 and Hviding E 2003 'Contested rainforests, NGOs, and projects of desire in Solomon Islands' *International Social Science Journal* Volume 55 Issue 178 pp: 539–554: 542

[21] Gegeo D W and Watson-Gegeo K A 2002 'Whose Knowledge? Epistemological Collisions in Solomon Islands Community Development' *The Contemporary Pacific* Volume 14 Number 2 pp 377-409: 378 and Gegeo D W and Watson-Gegeo K A 1999 'Adult Education, Language Change, and Issues of Identity and Authenticity in Kwara'ae (Solomon Islands)' *Anthropology and Education Quarterly* Volume 30 Number 1 pp 22–36

[22] Roughan J J 1986 'Village Organization for Development' PhD dissertation, University of Hawai'I; Roughan J J 1997 'Solomon Islands Nongovernment Organizations: Major Environmental Actors' *The Contemporary Pacific* Volume 9 pp 157–166

[23] Rhodes D 2007 'Analysis of the "Community Sector" in the Solomon Islands' AusAID: Canberra. Accessed online: http://www.ausaid.gov.au/publications/Documents/Community_Sector_in_SI_May_08.pdf [10 May 2012] p 26

[24] Foale S 2001 p 47

[25] Author's own data

[26] Author's own data and United Nations Development Assistance Framework (UNDAF) 2002 'Common Country Assessment, Solomon Islands – Working Document for UNDAF' Office of the United Nations Resident Coordinator: Suva p 42

well as formal and informal micro-enterprises such as vending phone credit.[27] Additionally, many rural Islanders migrate to urban areas for seasonal or long-term employment.[28]

Somewhat uniquely, villagers have, since the late 1970s, been negotiating directly with multi-national logging and mining companies; leasing land or selling access rights. While outcomes have not always been in favour of communities or their environments and have provoked significant disputes, scholars such as Hidving (2008) and Kabutaulaka (1998), call for re-examination of the agency demonstrated by Islanders in these negotiations.[29] Around 80 per cent of government funds are spent within Guadalcanal, meaning that many rural communities are denied basic services and infrastructure, such as garbage disposal or road systems.[30] Such gaps are in part redressed by provincial government systems and extended kinship networks.[31]

2.4.2. Urban populations

With a population set to double by 2020, the SI is already confronting increasing urbanisation, unemployment, crime inadequate infrastructure often associated with rapid population rise, arguably felt most acutely in urban hubs.[32] The social break-down present in urban centres such as the capital Honiara is often attributed to the absence of traditional forms of control, reconfigured land rights, poverty and ethnic

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[27] Author's own data
[28] Author's own data and Noble C, Pereira N and Saune N 2011 'Urban Youth in the Pacific: Increasing resilience and reducing risk for involvement in crime and violence' United Nations Development Programme (UNDP) Pacific Centre: Suva. Accessed online: http://www.undppc.org.fj/_resources/article/files/UrbanYouth_in_the_Pacific.pdf [05 May 2012] p 15
[29] Jourdan C 2008 'Youth and Mental Health in Solomon Islands: A Situational Analysis: *Tingting Helti, Tingting Siki*! Foundation of the Peoples of the South Pacific International: Suva p 13 and Hviding E 2003
[30] Author's own data and Fa'anunu K (date unknown) p 9
[31] Author's own data
[32] Bililki N 2007 Solomon Islands Agriculture and Rural Development Strategy: Building local foundations for rural development (summary) Ministry of Development Planning and Aid Coordination, Solomon Islands Government: Honiara. Accessed online: http://siteresources.worldbank.org/INTPACIFICISLANDS/Resources/442114-1180930407961/ARDS_Summary.pdf [18 May 2012] p 2

tension. Such factors violently manifested in Honiara in 1998, the legacies of which remain potent.[33] Housing in Honiara is cited by many as a significant problem, with overcrowded homes and informal settlements continually growing.[34]

2.4.3. Culture & Diversity

The SI is characterised by high levels of cultural diversity, with around 70 ethnic groups[35] defined along lines of kinship, clan, ethnic, language, geography and Church.[36] Family remains 'the most basic and fundamental social group', defining individual and collective identity and the bounds of political, economic and social activity[37]. Business and politics, for example, tend to be forged first around close family before percolating through wider kinship and clan groups.[38] Cultural realities of the SI have witnessed significant change since British colonisation and the spread of Christianity, which has affected kinship, governance, land rights and gender relations and profoundly altered spirituality and cosmology.[39] 95 per cent of Solomon Islanders today identify as Christian.[40]

Across the South Pacific, slavery[41] and contemporary employment migration has also seen the rise of new identities, embodied in the concept of *"wontok"*; a term of solidarity that can express a form of kinship with other Islanders through common

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[33] Kudo D (d/u) 'Impact of the Ethnic Unrest of Social Development and Disadvantaged Groups in the Solomon Islands' Solomon Islands Ministry of National Planning & Human Resource Development: Honiara. Accessed online: www.nrc.ch/8025708F004CE90B/(httpDocuments)/09D726A85399A43F802570B70059F72E/$file/EGM_Report_AnnexE3.pdf [12 May 2012]

[34] Kudu D and Hou T 2012 'Solomon Islands: Honiara Urban Profile' United Nations Human Settlements Programme (UN-Habitat): Nairobi p 15

[35] Author Unknown 2012 'Solomon Islands People Groups' The Joshua Project. Accessed online: http://www.joshuaproject.net/countries.php?rog3=BP [14 September 2012]

[36] Kabutaulaka F T 1998 p 21-22

[37] Allen M, Roughan P D, Tagini P and Wairiu M (date unknown) Doing Business in the Village/Community/Kastom Domain (date unknown) Working Paper 2, Island Knowledge Institute: Honiara. Accessed online: http://www.islands-knowledge.org/files/5013/1017/5998/WP2-Doing_business_in_context_July2011_online.pdf [15 May 2012] p 2 and and Kabutaulaka F T 1998 p 22

[38] Kabutaulaka F T 1998 gton p 22

[39] *Idbid* p 23

[40] Fa'anunu K (date unknown) p 11

[41] Graham T 1995 'Sugar slaves [videorecording] : the history of Australia's slave trade' (Video Recording) Film Australia: Sydney; Kabutaulaka F T 1998 p 24

church, island group, province, language or country[42]. A relatively new mode of social identification, *wontok* translates to "one talk" (i.e., one language) and is a means for individuals from different cultural groups to engender group identity, either within the SI or globally, the term's meaning changing with circumstance.[43]

The story occupies a central place in SI culture; so much so that the word *"stori"* is used as a verb in *Pijin.*[44] Stories provide a space share to experiences, knowledge and history, strengthen social bonds and pass the time.[45] Kabutaulaka (1998) notes that stories are profoundly relevant to contemporary politics and development; origin stories, for example, relate directly to issues of identity, land ownership and resource control.[46] Additionally, power is often embedded in story with those maintaining control over oral traditions tending to hold social and political power.[47]

[42] Kabutaulaka F T 1998 p 24
[43] *Ibid* p 13.
[44] Researcher's own data
[45] Researcher's own data
[46] Kabutaulaka F T 1998 p 13
[47] Goddelier M and Strathern M (eds) 1991 *Bigmen and Great Men: personifications of power in Melanesia* Cambridge University Press: New York; Sahlins M D 1970 'Poor Man, Rich Man, Big-Man, Chief: political types in Melanesia and Polynesia' in Harding T G and Wallace B J (eds) *Cultures of the Pacific: selected readings* The Free Press: New York pp 203 -215

1.5. THE WESTERN PROVINCE

2.5.1 Overview

Figure 2: Map of the Western Province[48]

The Western Province accounts for 19 per cent of the total land area of the Solomon Islands (5475-km^2) and is the archipelago's major logging site. In 1960, 93.2 per cent of the Western Province was covered with evergreen tropical rainforest.[49] Since commercial logging began in the 1960s, however, this area has witnessed severe degradation and loss of forest resources.[50] The province's protected lagoons, chiefly Wana Wana and Roviana, are home to around 30 per cent of its population; providing a 'natural interaction zone' between villages and islands, through the 'ease of canoe travel', and increasingly outboard motors.[51]

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[48] The Matikuri Lodge 2012 Online: http://www.matikuri-lodge.com/ [22 September 2012]
[49] Furusawa T, Ohtsuka R Pahari K, and Umezaki M 2004 'Impacts of selective logging on New Georgia Island, Solomon Islands evaluated using very-high-resolution satellite (IKONOS) data' *Environmental Conservation* Volume 31 Number 4 pp 349–355: 350
[50] *Ibid*
[51] Harwood F H 1971 'The Christian Fellowship Church: A Revitalization Movement in Melanesia' PhD, University of Chicago 1971: 5

Logging in the Western Province contributes significantly to national revenue; in the 1990s, accounting for around 75 per cent of the country's total round log export revenue.[52] Despite this, its population has been largely excluded from ensuing material benefits, with government spending overwhelmingly concentrated in Honiara.[53] Logging operations take place largely on customary land, following the exhaustion of forest resources available on 'alienated' (i.e., government) in the 1970s. Since then, foreign logging companies have negotiated directly with landowners, often sparking conflict over leadership, representation and resource rights among and between different communities.[54] These negotiations have seen hierarchy and inequity reinforced or redefined, and the 'conspicuous consumption' by some to the exclusion of others.[55] Logging has, in particular, contributed to changed gender relations and altered women's access and control over forest resources.[56]

2.5.2 Christian Fellowship Church (CFC)

An 'indigenous' church with Methodist roots emerged in the 1960s in the Western Province.[57] Followed by 14 per cent of the province, the 'iconic' Christian Fellowship Church (CFC) today wields significant power and resource control, acting as somewhat of a proxy government for adherents, maintaining its own models of development, economic and land management and education system.[58] The current Spiritual Authority, His Grace Revered Ikan Rove,[59] holds significant spiritual and

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[52] Bennett J A 2000 *Pacific Forest: A History of Resource Control and Contest in Solomon Islands, c.1800-1997* White Horse Press: Cambridge p 280
[53] Fa'anunu K (date unknown) p 9
[54] *Ibid* p 7
[55] Hviding E 2003 'Contested rainforests, NGOs, and projects of desire in Solomon Islands' UNESCO: Oxford pp 539 -553: 543
[56] Dureau C M 1994 *Mixed blessings: Christianity and history in women's lives on Simbo, Western Solomon Islands* Macquarie University: North Ryde; Pollard A A 2003 ' Women's Organisations, Volunteerism, and Self-Financing in the Solomon Islands: A Participant Perspective' *Oceania* Volume 74 Number 1/2 pp 44 - 60
[57] Harwood F H 1971 p 1
[58] Fa'anunu K (date unknown) p 11
[59] The British Government conferred the title of "His Grace" to Reverend Ikan Rove in 2005 for his efforts to alleviate poverty and foster rural development, see Aswani S and Racelis A E 2011 'Hopes and Disenchantments of Religious Community Forestry in the Western Solomon Islands' Ecological and Environmental Anthropology Volume 6 pp 26 – 38: 27

political influence. Together with his brother Job Dudley Tausinga – the longest serving member of parliament in the Solomon Islands – and newly elected nephew Silas Carey Vangarra MP, they are among the major drivers of development agendas in the Western Province.

The history, structure and beliefs of the CFC as well as its relationship to development are extremely relevant to this study. Although the village under study is a 'break-away' from the CFC institution, villagers still identify as adherents of CFC leadership and teachings. Community members profess to practice a more pure form of CFC devotion and leaders claim continued ties with CFC leadership.

History

Established by a man named Silas Eto, now known as Holy Mama, the CFC can be understood as a Methodist revitalisation movement. Perceptions of the late Holy Mama vary; some describe him as the 'protector of rainforests' while others condemn him as 'a bloody fruitcake whose been giving us [a hard time] over logging rights on New Georgia…as if he owns the damned place'.[60] Importantly, for followers in the Western Province, he is perceived as *tamasa toana* – a living god 'bestowed with supernatural abilities', as evidenced by the following remark:

"If you believe and put all your trust in Him [the spiritual authority] when you are sick to the point of death, you will not die. Or if you walk and a crocodile is waiting for you on the way, He can change your mind at that point, make you want to get a banana and cause you to change your direction, and you walk away from your danger." [61]

[60] Fa'anunu K (date unknown) p 10
[61] Aswani S and Racelis A E 2011 'Hopes and Disenchantments of Religious Community Forestry' *Ecological and Environmental Anthropology* Volume 6 pp 26 - 38: 35

This reverence can be contextualised with the history and fall of the Methodist Mission; particularly its primary leader, Australian Reverend Goldie, who began preaching in 1914. Goldie developed 'a large and strongly personal following' with a group of local men, including Eto and other who later formed the original CFC leadership body.[62] Starting with a heavenly vision experienced by Eto the CFC spread along kinship lines throughout the Western Province.[63] Eto's capacity to develop a 'monopolised, supernatural power, spiritual authority' that maintains 'strict command over his followers' has enabled the CFC to regulate the actions of followers, redefine regional property rights and redistribute land that no other organisation, including the government, has been able to emulate.[64] The CFC's structure is based on that of the Mission[65] and like the Mission, its success is said to have rested largely with the charisma of its leaders[66]

Beliefs

The CFC fuses Methodism with customary beliefs and leadership structures, encouraging communal work, reciprocity and self-sufficiency.[67] Having never renounced the tenets of Methodism,[68] CFC doctrine does not emphasise what to believe but, rather, how to behave,[69] promoting a moralistic ethic of *"living the life of Christ"*.[70] The normative content is composed of such moral imperatives as *"to love one another"*, *"to work together"* and *"to be of one mind"*.[71] Services mimic the standard Methodist format of hymns, Bible readings, sermons, and congregational responses, with some notable additions. In particular, CFC members clap to locally-

[62] Harwood F H 1971 p 35
[63] Fa'anunu K (date unknown) p 11
[64] Aswani S and Racelis A E 2011p 35
[65] Harwood F H 1971 p 33-34
[66] *Ibid* p 52-53
[67] Aswani S and Racelis A E 2011 p 27
[68] Harwood F H 1971 p 220
[69] *Ibid*
[70] *Ibid* p 221
[71] *Ibid* p 220

composed hymns and punctuate sermons with calls to *"new life!"*.[72] Such interactions, according to anthropologist Harwood (1971), function to 'bind[s] speaker and congregation together in a shared emotional experience'.[73] Worship is formalised and communal; services are the foundation of village life, serving as the space to disseminate news, to organise communal enterprises and socialise.[74]

Anthropologist Hocart (date unknown) posits that two worlds exist for Solomon Islanders: the physical world of objects and the spiritual world of forces. The latter world may be perceived by humans through dreams, visions, and prophecies and, from time to time, the spiritual world can break through to the physical word as 'remarkable events' that constitute divinity. Like Christ who lived as flesh and as spirit, Holy Mama and current Spiritual Authority are perceived as Gods and through the 'remarkable events' that colour them, the spiritual world is manifested to CFC adherents.[75]

Land & Logging

The CFC has played a significant role in the region's development, particularly in the area of logging. The Church has been able to gain 'near executive control' over land use within its constituency as members must relinquish their lands upon joining. Although the CFC initially maintained a stance of resistance towards logging,[76] today is active in the community-based timber industry.[77] The CFC is currently promoting the *"bloko"* system of plantation,[78] in which individuals and households manage

[72] *Ibid* p 222-3
[73] *Ibid* p 226
[74] *Ibid*
[75] Researcher's own data and Harwood F H 1971 p 240-241
[76] Aswani S and Racelis A E 2011 p 27 and Bayliss-Smith T and Hviding E 2000 *Islands of Rainforest: Agroforestry, Logging and Eco-Tourism in Solomon Islands* Aldershot: Ashgate
[77] Fa'anunu K (date unknown) p 10
[78] Ernst M 1994 'Winds of change: rapidly growing religious groups in the Pacific Islands' Pacific Conference of Churches: Suva P 74 – 75

private plantations on community lands.[79] These plantations have, however, remained are small, scattered and economically unviable in terms of production.[80]

Current Schism

The CFC, its members and its forestry operations have been significantly affected by a recent schism which has seen the formation of two CFC sects – 'Group A' and 'Group B'. Very little literature exists on the split; however, it was much discussed during data collection, as will be explored in the Findings (section 6).

While accounts of how and why the split has emerged vary, what seems evident is the significant impact on social and familial relationships, village structure and on livelihood, with Group B particularly affected. Allegiances to Groups A or B were reported to have split families and friendships with one participant describing the situation as a *"big disaster"*. Alarmingly, it appears that those from Group B have been barred from their gardens and plantations, and Group B children denied access to CFC schools. The *Solomon Star* has reported incidents of violence, including homes being burnt. According to the newspaper, and confirming the accounts of some research participants, the split among followers reflects a schism between the two brothers;[81] a notion denied by CFC officials.[82] A conference in June was purportedly organised to address this volatile situation.

As a breakaway community, the village under study has remained outside of this conflict however the issue remains relevant. According to community members, this event was foretold by their Spiritual Leader and the village is expecting to host up to

[79] Foale S 2001 p 56
[80] Fa'anunu K (date unknown) p 18
[81] Osifelo E 2012 ' Church Rift: Houses burnt as church split deepens' Solomon Star 25 April 2012
[82] Kakai J 2012 'Police probe burning of homes' *Solomon Star* 10 May 2012

1000 ‘church refugees’ from Group B. According to village leadership, the new arrivals will learn the ways of this village and help to extend the teak plantations.

2. LITERATURE REVIEW

The following literature review will explore the theoretical principles and frameworks for praxis of Community development theory (CD). Given the broad development objectives of the agro-forestry programme and the values of the researcher, CD – with its emphasis on local experiences, gender and participation – has been identified as relevant and appropriate. CD has provided the framework in which to embed and inform the methodological approach to data collection, participatory research (PR), and inform the final set of project recommendations. The following literature review aims to locate this study and the chosen methodology within the broader landscape of CD, reviewing those concepts particularly salient to this study, namely: participation, power, wellbeing and spirituality, as well as critical studies that address the challenges and complexities of meaningful community work. These themes reflect that which emerged during field research, including the significance of local spirituality and spiritual institutions; local aspirations for development; relations of power within and between project stakeholders; and the absence of project participation. Works reviewed come from scholars and practitioners working in relevant development research contexts.

2.1. BACKGROUND

Critical theories of development have directed attention to knowledge, power and patriarchy, promoting grassroots, gender sensitive and participatory alternatives to the prevailing top-down orthodoxy.[83] The term 'participatory research' (PR) was

[83] SEE: Agarwal B 1997 'Re-sounding the alert: gender, resources and community action' *World Development* Volume 25 pp 1373–1380; Chambers R, Narayan D, Petesch P and Shah M K 2000 *Voices of the Poor: Crying Out for Change* Oxford University Press: Oxford p 21 – 42; Chambers 1995 'Whose reality counts?' *Environment and Urbanization* Volume 7, Number 1 pp 173-204; Escobar A 1991 'Anthropology and the development encounter: the making and marketing of development anthropology' *American Ethnologist* Volume 18 Issue 4 pp 658–682; Freire, P 1970 *Pedagogy of the Oppressed* Continuum: New York.Hall B 1981 'Participatory research, popular knowledge and power: a personal reflection' *Convergence* Volume 14 Number 3 pp 6 – 17; Haverkort B and Hiemstra W (eds) 1999 *Food for Thought: Ancient Visions and New Experiments of Rural People*

first coined in the early 1970s[84], referring to fusion of research, education and action, [85] consciously oriented towards the inclusion and empowerment of dominated, marginal or otherwise 'muted'[86] groups.[87] These themes have since been further distilled, and critiqued, and complex research methodologies developed.[88]

CD is an umbrella term covering the broad set of practices and studies that aim to improve the wellbeing of community groups, characterised by meaningful participation at all stages of development programmes, attention to gender and other dimensions of marginalisation and recognition of the aspirations, worldviews and expertise of beneficiary communities.[89] Scholars Bhattacharyya (1995) and Eade and Williams (1995) posit that CD should be directed towards strengthening the agency and solidarity[90] of beneficiary groups, and their respective capacity to determine and act upon their own priorities.[91]

2.2. PARTICIPATION

Based on the premise that people 'are knowledgeable and skilful managers of their own environment', the concept of participation is central to CD theory and practice. [92] Ife (2002) asserts that participation is key to empowerment,

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COMPAS, Books for Change and Zed Books Ltd: India/UK p 11; Ife J 2002 *Community Development: community based alternatives in an age of globalisation* Longman: Frenchs Forest; Kingsbury D 2004 'Community Development' in Hunt J, Kingsbury D, McKay J and Remenyi J 2004 *Key Issues in Development* Palgrave MacMillan: New York pp 220 – 243

[84] Hall B 1992 'From Margins to Center? The Development and Purpose of Participatory Research' *Sociology* Volume 26 Number 1pp 15 – 28: 15

[85] Hall B 1981 'Participatory research, popular knowledge and power: a personal reflection' *Convergence* Volume 14 Number 3 pp 6 - 17

[86] Ardener E 1975 'Belief and the problem of women' Ardener S (ed) *Perceiving women* pp 1-17 Malaby Press: London

[87] Hall B 1992 p 16

[88] Rowlands J 1997 *Questioning Empowerment: Working with Women in Honduras* Oxfam GB Publications: Oxford

[89] Ife J 2002 *Community Development: community based alternatives in an age of globalisation* Longman: Frenchs Forest

[90] Bhattacharyya J 1995 'Agency and Solidarity: Rethinking Community Development' *Human Organisation* Volume 54 Number 1 pp 60-69

[91] Eade D and Williams S 1995 *The Oxfam handbook of development and relief, Volume 1* Oxfam Great Britain: Oxford

[92] Gegeo D W and Watson-Gegeo K A 2002 'Whose Knowledge? Epistemological Collisions in Solomon Islands Community Development' *The Contemporary Pacific* Volume 14 Number 2 pp 377-409: 377

inclusiveness and the shared realisation of development visions.[93] Participation is defined by Desai (2002) as those actions executed by beneficiaries in decision-making processes.[94] In this context, outsider development agencies are facilitators assisting these processes.[95] As CD aims to improve wellbeing of beneficiaries, Kingsbury (2004) contends that it must start with the people themselves. Lack of meaningful participation, he argues, reflects a lack of bureaucratic will to meet the development needs of those it claims to assist.[96]

CD advocates, Ife and Kendie and Guri (2006), call for the participation not only of individuals, but of existing institutions and the utilisation of local decision-making processes. Doing so, they posit, may work to engender a greater sense of local ownership, build rapport and strengthen project sustainability.[97] Kendie and Guri note the importance of understanding the structures or institutions through which beneficiary communities plan and conduct their own development.[98] In the context of Melanesia, the Pacific Agricultural and Forestry Network (PAFN) note that Islanders belong to families; families belong to communities; and communities to village, clans and churches. They highlight the significant role played by community institutions, including the church, in the welfare and development of its members. Their research indicates that people respond to, trust and identify with these groups, reinforcing the importance of engaging local institutions in development programming.[99]

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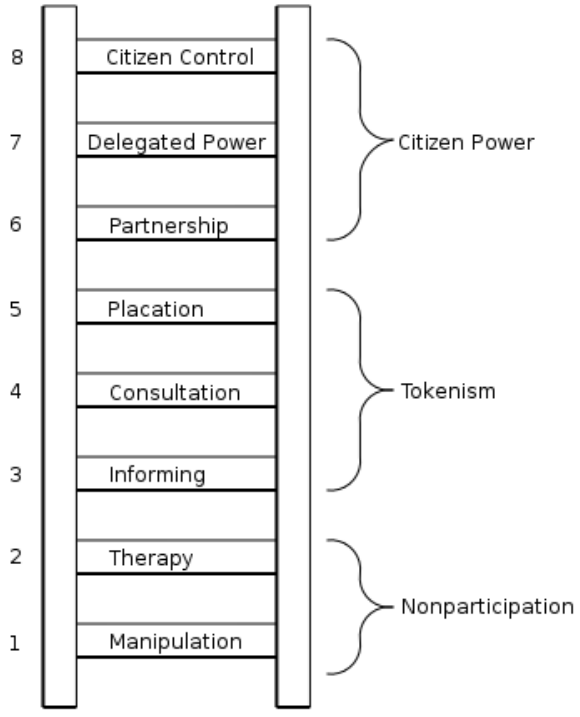
[93] Ife J 2002 p 219
[94] Desai V 'Community Participation in Development' in Desai V and Potter R (eds) 2002 *The Companion to Development Studies* Hodder Arnold: London pp 117-121: 117
[95] Chambers R 2002 'Relaxed and Participatory Appraisal: notes on practical approaches and methods for participants in PRA/PLA-related familiarisation workshops' Participation Group, Institute for Development Studies: London p 3
[96] Kingsbury D 2004 'Community Development' in Hunt J, Kingsbury D, McKay J and Remenyi J (eds) 2004 *Key Issues in Development* Palgrave MacMillan: New York pp 220 – 243: 222
[97] Kendie S B and Guri B 2006 'Indigenous institutions, governance and development: Community mobilization and natural resource management in Ghana' in Haverkort B and Rist S (eds) 2007 *Endogenous Development and Bio-Cultural Development: The Interplay of Worldviews, Globalisation and Locality* COMPAS and Centre for Development and Environment (CDE): The Netherlands pp 332-349: 332, 349 and Practical Action 2007 *Learning Endogenous Development: Building on Bio-Cultural Diversity* Intermediate Technology Publications Ltd: Warwickshire p 90, 183
[98] Kendie S B and Guri B 2006 p 332
[99] Secretariat of the Pacific Community and Pacific Agricultural and Forestry Network 2010 'Pacific Youth in Agriculture Strategy 2011 – 2015: Echoing the Voices of Pacific Youth' Copyright Secretariat of the Pacific Community: Suva p 8

Participation of beneficiary groups today forms a standard component of most development programmes.[100] 'Participation', however, occurs at different gradients; Arnstein (1969) proposes a typology of participation (below).[101] Though created in the 1960s, this typology remains pertinent; in particular, the notion of 'tokenism'. Tokenism encompasses consultation, informing and placation; processes that, within development, are often confused with or present as 'participation'. These processes cannot be seen as true partnership or collaboration and are unlikely to challenge the social and political forces that oppress.[102]

Figure 3: Arnstein's Typology [103]



[100] Brock K and Cornwall A 2005 'What do buzzwords do for development policy? a critical look at 'participation', 'empowerment' and 'poverty reduction'' *Third World Quarterly* Volume 26 Number 7 pp 1043-1060
[101] Arnstein S R 1969 ' A Ladder of Citizen Participation' *Journal of the American Planning Association* Volume 35 Number 4 pp. 216-224
[102] Cornwall A 2008 'Unpacking 'Participation': models, meanings and practices' *Community Development Journal* Volume 43 Number 3 pp 269–283: 269 - 270
[103] http://lithgow-schmidt.dk/sherry-arnstein/ladder-of-citizen-participation.html

2.3. POWER

An important element of CD is the recognition of power, visibility and representation, both within communities and community groups, as well as between communities and outside institutions. The very term 'community', for example, may mask the realities of internal exclusion, deprivation or oppression.[104] Thus Argarwal (1997), Cornwell (2008) and Mosse (1995) assert the importance of not equating 'participation' with equity[105] or that needs or aspirations are collective.[106]

CD demands safe and equitable spaces for participation by diverse sectors of beneficiary groups. This may be fostered, for example, by dividing participating groups along lines of difference such as age, gender or caste and ensuring sessions are conducted at appropriate times and locations. Cornwell calls for high levels of sensitivity on the part of the facilitator and multiple spaces for participation of those most vulnerable, warning that these 'natural' groups are rarely free from exclusion or competing interests.[107] Simply including 'women', for example, may mask or entrench inequality.[108] These scholars place emphasis on long-term visions, working at the appropriate 'pace'[109] and attention to factors such as workloads, expectations and reciprocity.[110]

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[104] Cahill C, Pain R and Sultana F 2007 'Participatory Ethics: Politics, Practices, Institutions' *ACME: An International E-Journal for Critical Geographies,* 6 (3), 304-318: 305
[105] Agarwal B 1997 'Re-sounding the alert: gender, resources and community action' *World Development* Volume 25 pp 1373–1380: 1374
[106] Cornwell A 2008 'Whose Voices? Whose Choices? Reflections on Gender and Participatory Development' *World Development* Volume 31 Number 8 pp 1325–1342: 1328
[107] Cornwell A 2008 'Whose Voices? Whose Choices? Reflections on Gender and Participatory Development' *World Development* Volume 31 Number 8 pp 1325–1342: 1329
[108] Cornwell A 2000 'Making a Difference? Gender and Participatory Development' Institute of Development Studies Discussion Paper, Number 378
[109] Cornwell A 2008 'Whose Voices? Whose Choices? Reflections on Gender and Participatory Development' *World Development* Volume 31 Number 8 pp 1325–1342: 1332-1333
[110] Cornwell A 2008 'Whose Voices? Whose Choices? Reflections on Gender and Participatory Development' *World Development* Volume 31 Number 8 pp 1325–1342: 1333

Chambers (2004), however, notes that despite rhetorical concerns, significant chasms persist between participatory discourse and reality,[111] drawing attention to the 'biases' of development. These biases privilege the needs and voices of more accessible and visible groups at the expense of those most vulnerable.[112] Kapoor (2004) and Harasym and Spivak (1990) point to the tensions between institutional needs and beneficiary needs[113] and subsequent issues concerning voice and representation.[114] Sultana (2007) likewise contends that 'knowledge is always partial' and institutions and their representatives must be responsive to this.[115] With this in mind, scholars Quarry and Ramírez (2009) assert that 'good development' is characterised by meaningful dialogue and the capacity of development agencies and their staff to 'listen before telling'.[116]

2.4. WELLBEING

Development programmes typically profess to aim for improved social and environmental wellbeing of beneficiary communities, through the application of certain ideas and technologies.[117] Success is largely equated with quantifiable data, such as crop yields or income, neglecting the question of precisely what constitutes 'wellbeing' in a given socio-cultural context.[118] A CD perspective, while acknowledging the importance of material factors, directs emphasis towards that defined by beneficiaries, which may encompass non-material aspects such as

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[111] Chambers R 2004 'Ideas for development: reflecting forwards' IDS Working Paper 238, Institute for Development Studies: Sussex p 34
[112] Chambers R 2006 'Poverty Unperceived: Traps, Biases and Agenda' Institute of Development Studies Working Paper 270 Accessed online: http://community.eldis.org/.59b4ab37/wp270.pdf [29 May 2012]
[113] Kapoor I 2004 'Hyper-Self-Reflexive Development? Spivak on Representing the Third World 'Other' *Third World Quarterly* Volume 25 Number 4 pp. 627-647: 634
[114] Harasym S and Spivak G 1990 *The Post-Colonial Critic: Interviews, Strategies, Dialogues* (ed) Routledge: New York p 5
[115] Sultana F 2007 'Reflexivity, Positionality and Participatory Ethics: Negotiating Fieldwork Dilemmas in International Research' *ACME: An International E-Journal for Critical Geographies*, 6 (3), 374-385: 382
[116] Quarry W and Ramírez R 2009 *Communication for Another Development: Listening Before Telling* Zed Books: London and New York
[117] Carr E R 2010 'The place of stories in development: creating spaces for participation through narrative analysis' *Development in Practice* Volume 20, Number 2 pp 219-226: 220
[118] White S 2010 'Analysing Wellbeing: a framework for development practice' *Development in Practice* Volume 20 Number 2 pp158 — 172: 163

livelihood, food sovereignty, identity or happiness. Norberg-Hodge (2005) aptly asserts that there are '… thousands of different cultures and faiths, each with their own concept of wellbeing',[119] White (2010) proposes wellbeing as the relationship between the material, relational and subjective dimensions of social reality, as illustrated in the figure below.

Figure 4: Dimensions of Wellbeing Explained[120]

- *The material* concerns practical welfare and standards of living.
  - Objective aspects include:
    - income, wealth, and assets
    - employment and livelihood activities
    - levels of consumption.
  - Subjective aspects include:
    - satisfaction with income and wealth
    - assessment of one's standard of living compared with others'
    - assessment of present standard of living compared with past.
- *The social* concerns social relations and access to public goods.
  - Objective aspects include:
    - social, political, and cultural identities
    - violence, conflict, and (in)security
    - relations with the state: law, politics, welfare
    - access to services and amenities
    - networks of support and obligation
    - environmental resources.
  - Subjective aspects include:
    - perceptions of safety, respect, and discrimination
    - (dis)satisfaction with access to services
    - assessment of treatment/support given or received
    - perceptions of environmental quality.
- *The human* concerns capabilities, attitudes to life, and personal relationships.
  - Objective aspects include:
    - household structure and composition
    - education, information, and skills
    - physical health and (dis)ability
    - relations of love and care.
  - Subjective aspects include:
    - (dis)satisfaction with levels of health, information, skills, education
    - self-concept and personality
    - sense of competence, (in)capability, and scope for influence
    - trust and confidence
    - religious faith.

[119] Norberg-Hodge H 2005 'Strengthening local economies Searching for options towards fair economic development' Haverkort B, Hiemstra, Reijntjes V, Remmers G and van 't Hooft K (eds) 2005 *Compas Magazine* Number 8 Compas Publications: Luesden pp 9 – 13: 13

[120] White S 2010 'Analysing Wellbeing: a framework for development practice' *Development in Practice* Volume 20 Number 2 pp158 — 172: 161

Theorists such as Chambers (1995, 2002, 2006) and Keough (1998) advocate that criterion for wellbeing to be ascertained through participatory methods. Ife places particular emphasis on utilising local knowledge and ways of knowing and planning processes.[121] CD is forwarded as a means to empower marginalised groups to analyse their own conditions, determine their own development goals and facilitate the realisation thereof.[122] CD thinking has prompted numerous studies into the experiential dimensions of wellbeing and ill-being as expressed and perceived by marginalised communities that evidence the complex and multi-faceted nature of these concepts and their relevance to development planning.[123]

2.5. SPIRITUALITY IN DEVELOPMENT

Although central to the livelihoods, decision-making processes and welfare of many beneficiary populations around the world, spirituality remains overwhelmingly absent from development literature. Ver Beek (2000) asserts that spirituality 'provides meaning and a basis for personal and communal reflection, decisions, and action.'[124] He argues, in concert with Holenstein (2005) and Tyndale (2000), that its exclusion jeopardises programme outcomes.[125] Many argue that spirituality, and attendant institutions, healers, shamans, priests and elders should be viewed as local assets and, where appropriate, engaged as partners for positive change.[126] While

[121] Haverkort B and Hiemstra W (eds) 1999 *Food for Thought: Ancient Visions and New Experiments of Rural People* COMPAS, Books for Change and Zed Books Ltd: India/UK p 11; Ife J 2002 *Community Development: community based alternatives in an age of globalisation* Longman: Frenchs Forest p 211-14; Molenaar H 2007 'Raising the Veils of Aid: Development and Diversity' in Haverkort B and Rist S (eds) 2007 *Endogenous Development and Bio-Cultural Development: The Interplay of Worldviews, Globalisation and Locality* COMPAS and Centre for Development and Environment (CDE): The Netherlands pp 389 – 399: 397-8

[122] Chambers 1995 'Whose reality counts?' *Environment and Urbanization* Volume 7, Number 1 pp 173-204: 186

[123] Chambers R, Narayan D, Petesch P and Shah M K 2000 *Voices of the Poor: Crying Out for Change* Oxford University Press: Oxford p 21 – 42

[124] Ver Beek K A 2000 'Spirituality: a development taboo' *Development in Practice* Volume 10 Number 1 pp 31 – 43: 31-32

[125] Holenstein A M 2005 'Role and Significance of Religion and Spirituality in Development Co-operation: A Reflection and Working Paper' Swiss Agency for Development and Co-operation: Bern; Tyndale W 2000 'Faith and economics in 'development': a bridge across the chasm?' World Development Volume 10, Number 1 pp 9 – 18; Ver Beek K A 2000

[126] Haverkort B and Hiemstra W (eds) 1999 *Food for Thought: Ancient Visions and New Experiments of Rural People* COMPAS, Books for Change and Zed Books Ltd: India/UK p 11 and Holenstein A[1] 2010 'Religion - a decisive factor in development cooperation' *Rural 21* Volume 5 pp 36 - 38: 37

recent times have seen increased donor support for faith-based organisations, these partnerships remain overwhelmingly aligned to mainstream religious institutions, divorced from the complexities of local cosmologies or alternative spiritual practice,[127] rarely breaking the boundaries of the prevailing development agenda.[128]

In the context of the SI, spirituality is cited by numerous scholars as an integral source of motivation, information, cohesion and meaning.[129] Indeed, church groups across the archipelago often drive development and welfare initiatives coupled with spiritual motivation, thus representing important spaces for engagement.[130] While church groups across the Pacific have been involved in international development programmes, emphasis remains focussed on their legitimacy and social access, rather than on the spiritual values and worldviews of members.[131]

[127] McDuie-Ra D and Rees J A 2010 'Religious actors, civil society, and the development agenda: the dynamics of inclusion and exclusion' *Journal of International Development* Volume 22 Number 1 pp 20 – 36: 27
[128] Clarke G 2007 'Agents of Transformation? Donors, Faith-Based Organisations and International Development' Third World Quarterly Volume 28 Number 1 pp 77 – 96: 90 – 91
[129] Secretariat of the Pacific Community and Pacific Agricultural and Forestry Network 2010 'Pacific Youth in Agriculture Strategy 2011 – 2015: Echoing the Voices of Pacific Youth' Copyright Secretariat of the Pacific Community: Suva p 17; Rhodes D 2007 p 24 - 26
[130] Bird C 2007 'Blowing the Conch Shell: a baseline survey of churches engagement in service provision and governance in the Solomon Islands' AusAID: Canberra
[131] Dart J and Hall M 2010 'Church Partnership Program Papua New Guinea: Case Study Report September 2010' AusAID: Canberra. Accessed online: http://www.ode.ausaid.gov.au/current_work/documents/cse-cpp-casestudy.pdf [22 June 2012]

3. METHODOLOGY

3.1. INTRODUCTION

This research project employed a host of qualitative research tools and methodologies, chiefly participatory research (PR) and constructivist social inquiry (CSI). Guided by the CD principles outlined in the literature review, the methodological approaches were utilised for their facility for investigating 'the complex world of lived experience from the viewpoint of those who live it'.[132] The following section will describe and contextualise the research process and the methodological frameworks in which it is embedded. The section concludes with a discussion of the project's ethical parameters, assumptions and potential implications.

3.2. METHODOLOGICAL APPROACH

Participatory Research (PR)

A greater emphasis on participation in research has emerged from the 'transformative paradigm' that developed in the 1980s and 1990s.[133] In concert with CD and other critical theories, transformative researchers brought attention to the unequal relations of power between researcher and researched, and called for inquiry that explicitly addresses issues of social justice, marginalisation and

[132] Schwandt T A 1994 'Constructivist, Interpretivist Approaches to Human Inquiry in Denzin N K & Lincoln Y S (eds.) 1994 *Handbook of qualitative research (Second Edition)* Sage Publications: Thousand Oaks pp 118 – 137: 118

[133] Mertens D M 2005 *Research methods in education and psychology: Integrating diversity with quantitative and qualitative approaches (second edition)*Sage Publications: Thousand Oaks p 17

institutional bias.[134] PR has since emerged as an approach in its own right, with numerous scholars and practitioners forwarding methods and principles for praxis.

PR, like CD, posits that ground-level stakeholders must be involved in the appraisal of their own social condition[135] and advocates a conscious emphasis on diverse perspectives.[136] Methods are creative and typically interactive, visual and social; such as informal interviews, resource mapping and ranking exercises, as well as participatory observation.[137] Participatory Rural Appraisal (PRA), championed by Chambers, has emerged as a key 'toolkit' for participatory researchers.[138] PRA tools aim to maximise participation by employing visual and oral techniques that also allow for unanticipated insights to emerge. Tools include social mapping transect walks, venn diagrams and timelines, as well as interviews and focus groups.[139] PRA practitioners must embrace an attitude of 'reflexivity'[140]; that is, responsiveness to local contexts and conditions, and to issues or ideas that arise during the research process,[141] as well as conscious attention to the positionality of the researcher.[142]

Gender studies have added further scope by recognising gender constructions and relations as fundamental factors determining social organisation.[143] Collection and

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[134] Creswell J W 2003 *Research design: Qualitative, quantitative, and mixed methods approaches (second edition)* Sage Publications: Thousand Oaks p 9
[135] Chambers R 1997 *Whose Reality Counts? Putting the First Last* Intermediate Technology Publications: London p 106
[136] Somekh B and Lewin C 2005 *Research methods in social sciences* Sage Publications: London p 275 and Arevallo M, Guijt I and Saladores K (eds) 1998 'A brief guide to the principles of PLA' *PLA Notes* Issue 31 pp: 78–80 IIED: London p 79
[137] Kumar S 2002 *Methods for Community Participation: A Complete Guide for Practitioners* Practical Action Publishing: Rugby and Chambers R 2002 'Relaxed and Participatory Appraisal: notes on practical approaches and methods for participants in PRA/PLA-related familiarisation workshops' Participation Group, Institute for Development Studies: London
[138] Chambers R 1994b The Origins and Practice of Participatory Rural Appraisal' World Development Volume 22 Number 7 pp 953 - 969
[139] Kumar 2002
[140] Arevallo M, Guijt I and Saladores K (eds) 1998 'A brief guide to the principles of PLA' *PLA Notes* Issue 31 pp: 78–80 IIED: London p 79
[141] Chambers R 2002 'Relaxed and Participatory Appraisal: notes on practical approaches and methods for participants in PRA/PLA-related familiarisation workshops' Participation Group, Institute for Development Studies: London
[142] Sultana F 2007 'Reflexivity, Positionality and Participatory Ethics: Negotiating Fieldwork Dilemmas in International Research' *ACME: An International E-Journal for Critical Geographies*, 6 (3), 374-385
[143] Kabeer N 1994 *Reversed Realities: Gender Hierarchies in Development Thought* Verso: London; Moser C 1993 *Gender Planning and Development: Theory, Practice, and Training* Routledge: London; and Parker R 1993 *Another Point of View: A Manual on Gender Analysis Training for Grassroots Workers* United Nations Development Fund for Women (UNIFEM): New York

analysis of data through a gendered framework allows the different needs, responsibilities and expectations of women and men to be perceived; and further, the heterogeneous nature of gender as a non-uniform category, crosscut by additional variables of age, ethnicity, class or (dis)ability[144].

PR was identified as a relevant methodological approach to inform the research methods, owing to its emphasis on participation, diversity, inclusivity and reflexivity – in line with the values of CD and the researcher. It was identified as appropriate to the context of the village, which has had previous experience with participatory methods and had expressed enthusiasm for further research. This methodology allows for appropriate, responsive and creative research activities, that can help to ensure participants feel comfortable, allow for the inclusion of diverse participants. Its emphasis on reflexivity, culture and context also renders this approach complementary to the CSI used to inform data analysis, detailed below.

3.3. RESEARCH METHODS & DATA GENERATION

The research process employed research methods informed by participatory research using a host of techniques from the PRA toolkit, proposed by practitioners such as Chambers (1994a, 1994b 1996, 2002, 2006), Evans *et al* (2006) and Kumar (2002). The following section details this process, participants and research context.

Participants & Context

[144] Moser C 2005 An Introduction to Gender Audit Methodology: Its design and implementation in DFID Malawi' Overseas Development Institute: London. Sourced Online: http://www.odi.org.uk/resources/download/1195.pdf [29 April 2010] p 9

The researcher resided in the family home of the Village Director, living alongside his wife and young child for two weeks. Both the Director and his wife (an important figure among the village women) were extraordinarily helpful and enthusiastic; arranging and translating all research sessions. The Director secured interviews with men, while his wife the women, and offered their living room as the primary venue for research. Primary participants numbered 27 and included village elders and representatives from leadership committee; young men from S7L; and village men and women, and took place in a number of contexts.

Research was conducted in a dynamic amalgamation of the local language (*Roviana*), English and SI Pigeon (*Pijin)*. Most participants could understand *Pijin* and limited amounts of English, while the researcher was able to understand some *Pijin.* This allowed for a degree of direct comprehension and greater transparency of translation. Verbal communication was, when possible, complemented with visual research activities and interactions. The village was aware of my presence, as it had been announced during church services and welcomed my participation in village activities. Interestingly, the arrival of researchers in this village has been foretold and endorsed by Spiritual Leader some time ago, perhaps explaining the enthusiasm demonstrated by the community to the presence of the researcher and the requests to stay much longer (six months to a year).

Research Methods

Semi-structured interviews with individuals and groups formed the primary research method in the field, often coupled with visual activities. Additionally, informal discussion, narrative, participatory observation, transect walks and in-depth conversations with the Village Director and his wife.

Atkinson *et al* (2007) purport that semi-structured interviews play '… the single most important role' in participatory research, manifesting in numerous different contexts, including semi-formal group discussions, formal village meetings or informal conversations. These talks are open and dynamic; guided by the researcher towards certain issues,[145] while maintaining enough flexibility to respond to unanticipated topics.[146] As opposed to conventional question-answer approaches, that may limit responses, semi-structured interviews allow for two-way communication between researcher and participant.[147] Semi-structured interviews can be combined with visual techniques such as mapping or ranking allowing for greater depth of data and increased scope for participant expression.[148] Semi-structured interviews may take place in individual or group settings; the former allowing for in-depth, more personalised exploration of topics; and the latter, for dynamic, multi-voice discussions as well as providing an opportunity for the researcher to observe interaction within and between different groups.[149]

Semi-structured interviews provided the primary research tool in the village. A total of twenty-one interviews were carried out, with a total of twenty-seven participants including male and female community members, village elders, male and female representatives from the Leadership Committee and male members of the village youth labour group. Interviews were conducted on both individual and group basis. Most interviews took place in the living room of the Village Director. Five interviews

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[145] Korf B 2003 'Field Guide for Participatory Needs Assessment' Integrated Food Security Programme, Technical Paper 6 Trincomalee, Sri Lanka p 23

[146] Food and Agriculture Organisation (FAO) (date unknown)' Tool 9: Semi-Structued Interviews' FAO Corporate Document Repository. Accessed online: http://www.fao.org/docrep/x5307e/x5307e08.htm [12 May 2012]; see Appendix 1.

[147] Alexander L, Aroni R, Minichiello V and Timewell E 1996 *In-Depth Interviewing: Principles, Techniques, Analysis (Second Edition)* Addison Wesley Longman Pty. Ltd.: Melbourne p 65-68

[148] Chambers R 2002 'Relaxed and Participatory Appraisal: notes on practical approaches and methods for participants in PRA/PLA-related familiarisation workshops' Participation Group, Institute for Development Studies: London

[149] Alexander L, Aroni R, Minichiello V and Timewell E 1996 *In-Depth Interviewing: Principles, Techniques, Analysis (Second Edition)* Addison Wesley Longman Pty. Ltd.: Melbourne p 65-68

took place outside this context, one in the teak plantation; two in the respective homes of participants; one in the community meeting space and one took place informally while walking through the village. This had the dual purpose of allowing for a transect walk.[150]

As much as possible, interviews were kept conversational, with open-ended questions that allowed space to explore unanticipated topics and dimensions.[151] In addition to verbatim, participant behaviour and interactions were observed and formed critical data. When possible, interviews included visual components, such as mapping, drawing, ranking and diagramming, informed by PRA. The conversational dimension purposefully allowed participants space to probe the researcher on issues or topics they were interested in, helping to engender a sense of reciprocity and trust, complimented by the tea and biscuits shared by participants and researcher. Data was collected largely though written notes, with some photos taken.

Narrative

From the researcher's experience, sharing stories is major part of SI culture.[152] Many PR scholars have likewise reflected on the value of story and narrative; Carr (2010), for instance, notes that narratives serve as '… windows on to indigenous narratives of development'[153] as well as 'more experiential sources of information' about community realities.[154] Similarly, Askham (1985) suggests that stories allow for participants to reflect on their own experiences in relation to particular topics,[155]

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[150] Kumar S 2002
[151] Woods M 1995 *Semi-structured Interviews: Mechanics and Analysis* Institute of Geography & Earth Sciences, Aberystwyth University. Accessed online: www.aber.ac.uk/~pgswww/en/ARMiges.pdf [19 June 2012] and Korf B 2003 'Field Guide for Participatory Needs Assessment' Integrated Food Security Programme, Technical Paper 6 Trincomalee, Sri Lanka p 23; see Appendix 1
[152] Researcher's own data
[153] Carr E R 2010 p 219
[154] *Ibid*
[155] Ashkam J 1982 'Telling Stories' *Social Review* Volume 30 pp 555 - 573

while Sandelowski (1991) describes story-telling as a way in which participants can 'transform knowing into telling'.[156] Posting that human lives and identities are 'understood as and shaped by narratives'[157], Sandelowski notes that both the devices used by individuals to engender meaning and the content relayed have valuable application for social research.

Listening to narratives of various individuals formed a core part of the research process. These individuals were limited to those the researcher had time to build rapport and develop friendship with, namely the Director and his wife; however, during interviews, various personal and anecdotal narratives also emerged. The research was sensitive to factors such as what is told, what is not told, who is speaking, for what purpose, time, place and the and positionality of the researcher.[158] In the context of this village, the various narratives reflected different forms and sources of identity, values and aspirations. In particular, they served as avenues to explain the spiritual significance of the teak plantations, the divine origins of the village and the devotion to leadership.[159]

Participatory Observation

Participatory observation involves immersion and participation in the lives, routines, activities of participants. This method can help to engender greater insight into local practices and norms enriching the researcher's capacity to investigate behaviour, motivations and attitudes of the individuals or group in question[160]. Such

[156] Sandelowski M 1991 'Telling Stories: Narrative Approaches in Qualitative Research' *IMAGE: Journal of Nursing Scholarship* Volume 23 Number 3 pp 161 – 167: 162
[157] *Ibid* p 163
[158] *Ibid* p 162
[159] Clandinin D J and Connelly M F 1994 'Personal experience methods' in Denzin N and Lincoln Y S (eds) *Handbook of Qualitative Research (Second Edition)* Sage Publications: Thousand Oaks pp 413 - 427
[160] Dawson C 2009 *Introduction to Research Methods: A Practical Guide for Anyone Undertaking a Reserach Project (fourth revised edition)* How To Books Ltd.: Oxford

observation is typically, and certainly in this case, complemented by extensive note-taking and constant reflection.[161]

In this study, participant observation allowed for great insight into village routines and to build rapport; indeed several villagers commended the researcher's involvement in communal labour. The researcher was housed in the family home of the village director, and participating in daily life was not only a research method but indeed obligatory and enjoyable part of life, and opportunity for reciprocity. Thus the researcher partook in domestic duties such as cooking, cleaning, bathing and collecting water, spending significant amounts of time with the Director and his wife. Additionally, the researcher participated in community activities, including labour, a fundraiser, church services and singing, playing with children and socialising with women, men and young people from the village. Most free time was spent with female relatives of the Director's wife and their children. Participating in these activities revealed and validated village dynamics, and vastly fuelled the research process by illuminating new dimensions of experience and engendering trust and rapport within the community.

Reflections Journal

The process of writing and reflecting functions as space to 'record the changing focus of our interests, preliminary speculations and 'embryo theorising', laying the foundation for analysis.[162] Thus the researcher reflected on and wrote about each day on topics including personal feelings, experiences and early and sense-making of the data and engaged in data de-brief with the Director and his wife. Key details such

[161] Guest G, Mack N, MacQueen K M, Namey E and Woodsong C 2012 *Qualitative Research Methods: A Data Collector's Field Guide* Family Health International 360: Durham Accessed online: http://www.fhi360.org/nr/rdonlyres/emgox4xpcoyrysqspsgy5ww6mq7v4e44etd6toiejyxalhbmk5sdnef7fqlr3q6hlwa2ttj5524xbn/datacollectorguideenrh.pdf [05 June 2012] p 13

[162] Barbour R 2008 *Introducing Qualitative Research: A Student Guide to the Craft of Doing Qualitative Research* Sage Publications: London p 192

as date, time and context were also recorded to allow for more in-depth patterns to be deduced at later stages of the research.

3.4. DATA ANALYSIS

Constructivist Social Inquiry (CSI) was employed to analyse and make sense of the data, culminating in a SWOT (strengths, weaknesses, opportunities and threats) analysis to buttress the final set of recommendations. The following section explores the principles and practice of this theory and its applicability to this research context.

Constructivist Social Inquiry (CSI)

As opposed to orthodox social research theories that pre-suppose an observable, empirical reality to exist,[163] CSI assumes social phenomena are products of social contexts[164] and that knowledge is the result of perspective.[165] This form of inquiry argues that meaning is generated, negotiated, sustained and modified through different forms of action or text, including discourse or narrative.[166] This form of analysis pays particular attention to the environment in which data generation occurs, social dimensions of difference such as gender, and to the discursive patterns that emerge in order to locate meaning within wider social, political and cultural context.[167] Data and analyses are understood as products of interaction between researcher and participant. The positionality and analytical views through which the researcher interrogates the data as well as the research context are acknowledged. To this ends, CSI inquiry acknowledges the complexity of human experience and the

[163] Guba E and Lincoln Y 2005 'Paradigmatic Controversies, Contradictions and Emerging Confluences' in Denzin N and Lincoln Y (eds) 2005 *The Sage Qualitative Handbook of Qualitative Research (Third Edition)* Sage Publications: Thousand Oaks pp 191-217: 193-9
[164] Hardy C and Phillips N 2002 *Discourse Analysis: Investigating Processes of Social Construction (Qualitative Research Methods Series 50)* Sage Publications: Thousand Oaks p 2
[165] Schwandt T A 1994 p 125
[166] *Ibid* p 120
[167] Schwandt T A 1994 p 125

multiple truths that will be uncovered during research and draws attention to the discursive tools use by participants to generate meaning.[168]

Data Analysis: Process

Drawing on these analytical approaches, recurrent themes and exceptions were noted and reflected upon to form initial stages of coding and theorising. These 'anchors' were used as points of reference during later processes of analysis. The decisive role that narrative, especially spiritual narrative, and perceptions play shaping project outcomes in this village emerged as a central, though unanticipated, research concern. Thus, in line the reflexivity advocated by CD, analysis was oriented towards these uncovering perceptions and locating them within the wider socio-cultural context.

Upon return to Australia, data was transcribed from handwritten notes and coded to 36 themes. Major themes relevant to the research question were identified and further explored, with reference to literature. Particular attention was paid to the research context; reflecting on such dimensions as gender, age, speaker, mode of expression and interactions with translators, as well as the positionality of the researcher and mode of research. Participatory observation and data on routines, activities and rituals allowed for the discursive patterns that emerged during conversation to be correlated with action. From field data, literature and ACIAR project material, the researcher was then able conduct subsequent forms of analysis, including a social profile of the village, project participation and perceptions analysis and a project SWOT analysis, towards the final set of recommendations and conclusions.

[168] Schwandt T A 1994 p 125

3.5. ETHICAL REFLECTIONS: ASSUMPTIONS AND LIMITATIONS

This study encountered a number of challenges and limitations, particularly in respect to positionality and accountability, and ensuring ethical standards were met.[169] The following discussion explores these dimensions and the mitigation strategies employed to ensure integrity and validity of this study.

Time and language formed two primary limitations of this study. The researcher spent a total of five weeks in the SI, including two weeks within the focal village of this study. Ostensibly, this time period is too short to fully comprehend the complexities of this village, or to build meaningful relationships with villagers outside the host family. Participants were limited by availability and willingness to participate; older women, for example, tended to have a heavier workload than men and thus less time to participate, while younger women professed to be too shy to participate.

In response to this, research sessions were made to fit the schedules of participants and, as much as possible, in contexts comfortable for participants. Additionally, participation in village activities allowed villagers, especially women, to grow more comfortable with the researcher's presence. Importantly, the researcher engaged with the Spiritual Leader whose sanction strengthened trust among community members, complemented by the assurance and encouragement provided by the Director and his wife to participants.

The location of research sessions played a significant role in data generation. At his behest, interviews took place in the living room of the Director, an elite and influential village leader who was usually present, serving as translator. Thus, these

[169] Sultana F 2007 p 376

sessions took on a slightly more formal atmosphere. Male participants tended to demonstrate comfort with this format and efficacy in comprehending and responding to more technical questions. Women, however, appeared less comfortable; often providing very short answers, especially to questions regarding village management or decision-making. In contrast, women who participated in less formal research settings using visual PRA-based communications were far more responsive. However, these differences revealed valuable insights into gender roles and relations.

In respect to language, because most participants can understand *Pijin* they were able to monitor the translations of their answers allowing for a degree of transparency. Others were able to speak English and were able to respond to questions largely independent of the translator.

It is critical to reflect on one's positionality before, during and after data collection and how this affects interactions in the field.[170] The researcher is 'inserted' into village relations with multiple identities and through a host of lenses and perceptions.[171] In this instance, the researcher is young, unmarried, educated, not religious and foreign, with affiliations real and imagined to various institutions and persons, namely ACIAR and Forestry, and residing in the family home of the village Director. Thus the researcher strived to establish trust and rapport with participants; through acts of reciprocity, such as supplying tea and biscuits, engaging in village activities and support of Director and Spiritual Leaders.

The issues of voice and representation remain critical in reflexive research.[172] Cornwell, Agarwal and Kapoor offer insightful discussions of visibility, gender and

[170] Sultana F 2007 p 376
[171] *Ibid*
[172] Kapoor I 2004 p 628

power[173], and call for 'hyper-reflexivity' when claiming to represent the Third World Other, especially women.[174] Indeed, in the context of the Western SI, there is a remarkable tendency to assume communalism and equity.[175] This reflexivity also includes reflecting on one's own assumptions and biases; the researcher has been schooled in particular forms of social inquiry and influenced by various scholars, movements and theories, as well as a foreign cultural upbringing. It is important, as a researcher, to remain conscious of these biases and how they impact upon research. This was mitigated by allowing for open discussion during research sessions and constant communication with the Director and his wife about research findings and initial interpretations.

Certain conflicts of interest were involved in this research project; namely, the institutional requirements of the study in respect to the needs, confidentiality and wellbeing of the community under study. Such conflict is present in most research.[176] Harasym and Spivak (1990) argue that all research is limited by its respective institutional procedures and requirements.[177] Additionally, researchers are also caught between various personal and professional relationships that may engender sensitivity, obligation or negotiation.[178]

In this research, the researcher was bound to the institutional requirements of researching and submitting a thesis as per the requirements of the faculty, as well as ACIAR, which funded the study. Moreover, during data collection the researchers formed friendships and a deep sense of gratitude to and respect for the village which demonstrated openness, generosity and kindness. It is of the upmost importance to

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[173] Kapoor I 2002 'The devil's in the theory: a critical assessment of Robert Chambers' work on participatory development' *Third World Quarterly* Volume 23 Number 1 pp 101–117: 114
[174] Cornwell A 2008 'Whose Voices? Whose Choices? Reflections on Gender and Participatory Development' *World Development* Volume 31 Number 8 pp 1325–1342: 1325
[175] Foale S 2001 p 44
[176] Kapoor I 2002 p 114
[177] Harasym S and Spivak G 1990 *The Post-Colonial Critic: Interviews, Strategies, Dialogues* (ed) Routledge: New York p 5
[178] Kapoor I 2004 p 632

the researcher that, while still fulfilling the necessary institutional requirements, village welfare is in no way compromised. The researcher has had dialogue with elders and community members both during data collection, and since (via telephone) to ensure this. The name of the village and participants thus remains anonymous and, as much as possible and appropriate, efforts have been made to ensure participants cannot be identified.

Informed consent is central to ethical research.[179] The village was aware that the research would be taking place well in advance; as ACIAR had liaised with the Village Director who subsequently announced it during church services. Additionally, research had sanction from the Spiritual Leader which engendered a high level of trust, approval and support from the village. All participants were volunteers and were made aware of the purpose and nature of research through verbal communication. The researcher refrained from formal paperwork on the matter as many participants were not literate and to avoid creating distance between researcher and participant through such formalities. Some children took part in mapping exercises under the supervision of their parents.

[179] Association of Social Anthropologists (ASA) of the UK and the Commonwealth 1999 'Ethical Guidelines for Good Research Practice' ASA: London. Accessed online: http://www.theasa.org/ethics/Ethical_guidelines.pdf [08 December 2011]

4. FINDINGS

The following section begins with an exploration of the prevailing claims, perceptions and experiences of local people in respect to the agro-forestry extension to reveals their critical significance in respect to project efficacy. This is followed with an in-depth social profile of the village to confer context to these experiential dimensions. Additionally, the profile illuminates the existing socio-cultural assets of this community that may prove valuable for long-term project sustainability, as well as where challenges may arise.

4.1. PROJECT CLAIMS, EXPERIENCES & PERCEPTIONS

4.1.1. Introduction

The successful uptake of the proposed agro-forestry regime and effective partnership between ACIAR and the village community is directly related to the prevailing perceptions of villagers. The primary points of resistance to thinning lie in the spiritual and material perceptions of teak plantations, reinforced by the lack of participation in project activities and resultant disconnection between the parties. The following section details the varying perceptions of the agro-forestry regime, demonstration plot and implementing organisations held by community members. Additionally, it will explore villagers' spiritual connection to teak plantations and their relevance to project effectiveness.

4.1.2. Teak Narrative

According to community members, the plantations were first established in 1992 after a *"heavenly vision"* was experienced by a local woman in which she observed a seedling in the palm of God, who said *"this is the future for you [i.e., village]"*. The seedling was identified by the Spiritual Leader as teak who proceeded to declare that *"teak is our future"*, culminating in the 17.6 hectares of teak plantations present in the village today. Importantly, this took place before *"teak fever"* and thus before the government distributed free seedlings. In this village, unlike many others in the region, teak seedlings were purchased by the community with community funds. These origins confer profound significance to current teak management, decision making and harvest as each teak tree, to an extent, embodies spiritual significance and the foretold promise of prosperity. Any decision regarding teak management must have the sanction of the Spiritual Leader.

4.1.3. Summary of Teak Perceptions

Figure 5: Summary of Perceptions

Perceptions of teak

- Embedded in a spiritual narrative.
- A product of *"unity"* and *"cooperation".*
- Mandate of God and Spiritual Leader.
- Long term livelihood strategy.
- Great sense of ownership; seedlings purchased by community and plantations are managed by villagers during structured community labour sessions.
- A primary area of communal labour.
- High revenue expectations; embedded in spiritual promises.
- Varying levels of knowledge about teak management, harvest, village plans, markets etc., big gap between that of women and men.
- Decisions are made by Leadership Committee and require the sanction of Spiritual Leader.
- More teak is planned to be planted; varying levels of knowledge, with particular gaps between men, women and youth.

Perceptions of Thinning

- Mixed opinions: many participants were able to cite the benefits but stated that allowing any teak logs, including thinnings, to *"rot"* is unacceptable.
- All stated that the decision ultimately lies with the Spiritual Leader.
- All expressed an emotional and spiritual attachment to the trees.
- Thinning may be acceptable on certain conditions; namely, that logs are used or sold.
- Few possessed detailed insight into thinning, such as spacing or precise knowledge of its economic benefits.
- Women demonstrated less understanding than men; their knowledge of thinning came primarily from their husbands and other males.
- Thinning has been on leadership agenda in past, but not currently.
- Some young people and work leaders profess to discuss thinning among themselves informally.
- Management is often explained as *"brushing and pruning";* i.e., not thinning.
- A potential threat to livelihood and income.

Perceptions of Demonstration Plot

- Most participants stated to have not visited or seen the demonstration plot.
- Understandings of the purpose of the demonstration plot were varied.
- The *flueggea* was used for building and furniture.
- There is little, if any, sense of local ownership of demonstration plot; explained as belonging to *"Forestry"* or *"the university".*
- Few participants expressed being involved in the management, especially thinning, of demonstration plot.
- Seemingly irrelevant to day to day life.

Perceptions of ACIAR/Forestry

- Report that their visits are irregular and unannounced.
- Project staffs do not engage with community members.
- Women expressed that their visits can be a burden, such as providing crockery.
- Limited village participation in project activities.
- Information channel flows from project staffs → Village Director → percolates inconsistently through village by word of mouth.
- Calls for more dialogue and appropriate modes of communication.
- Government legacy cited as important: the advice to thin comes *"eight years too late"* (i.e., teak has been established for nearly a decade)

4.1.4. Local Perceptions of Teak Management

When asked about the most important job in teak management, *"brushing"* (clearing weeds with a bush knife) surfaced as the most important, followed by manual weeding and pruning. These tasks dominate routine management carried out during community labour cycles and are performed by men, women and children alike. Teak management forms a core village activity; associated with the divine. Apart from the village Director, who works closely with the forestry department and project co-ordinator, no participants cited thinning as management activity.

4.1.5. Local Perceptions of Thinning

Data revealed both congruencies and divergences among and within different sectors of the community. While the term 'thinning' is known to all participants, in-depth comprehension of the process and its purpose varies significantly, especially between women and men. Some women demonstrated a basic understanding of thinning (i.e., that it involves felling some trees to allow others to grow larger), others purported to *"…not know[ing] about thinning; only pruning"*. Despite playing an active role in day-to-day plantation maintenance, none of the women interviewed had been involved in any formal education from Forestry, ACIAR or other organisation. Those women who were informed learned from their husbands, other men in the village or through the *"coconut news"*[180]; reflecting how such information flows in the village. Moreover, this suggests that women are outside the domain of plantation decision-making and extension activities. It was evident that for most women, thinning remains an abstract and irrelevant concept, especially given that it does not have the sanction of the Spiritual Leader.

[180] The *"coconut news"* is a concept often referred to by participants; it refers to the informal word-of-mouth modes of communication between and within families, lagoons and provinces. Fieldwork suggests that it is a central avenue of knowledge transmission.

Men, particularly elders and work leaders, tended to demonstrate a sounder comprehension of thinning, as the topic has been discussed during meetings and occasionally forms a talking point among the male population. However, few participants demonstrated in-depth insight into the mechanics of thinning, such as spacing or inter-planting. Overwhelmingly, knowledge was limited and came from informal sources.

Notably, some male members of the Standard Seven Leavers (S7L) (see section 5.2.2, p. 66), a local youth work group, demonstrated insight and support for thinning. These participants, along with their Work Leader, expressed that the S7L could provide a key labour force for thinning. Thinning was reported as a talking point among members, and was introduced by the Work Leader. However, levels of knowledge remain inconsistent with a younger member reporting that *"I don't really know about it [thinning] … We weren't taught".*

All participants, both male and female, expressed an emotive and usually spiritual connection to the teak trees; explaining they would feel *"sad"* or *"sorry"* if they were cut down and left to *"rot"*. Opinions on this matter displayed remarkable consistency, and it is likely to have been discussed during church services or other community forums. When asked to explain this emotional attachment, participants cited both spiritual and material grounds. Spiritually, participants referred to the *"heavenly"* origins of the teak plantations and explained that thinning represents *"interfering with spiritual things".* Because "*teak trees are from God"*, *"accidents"* may happen befall those who fell trees and allow them to rot.

These sentiments are reinforced by material values; most particularly that, according to the coconut news, the village's teak is presently big enough to sell.

Several young males in the village spend time working on logging barges where they claim to have witnessed teak logs of smaller sizes being sold for *"a good price".* Although no participants were able to verify the precise sums, such accounts appear to have contributed to the prevailing reluctance to thin, compounded by the lack of *"evidence"* of the value of thinning. Village elders stressed that the community struggles to relate to the abstract projections of volumes and revenue. Evidently, villagers feel more comfortable with information received in familiar ways, namely the experiences of others and the coconut news. In terms of understanding the technicalities of thinning, elders emphasised participation and *"learning with their hands".* Most significantly, however, regardless of individual feelings, the decision ultimately lies with the Spiritual Leader; as one woman articulately explained:

"If the spiritual leader says "thin" then we will all agree to thin. If the spiritual leader says "yes", then we all say "yes", but if he says "no", then we all say "no".'

Participants conveyed interest in ACIAR's proposed plans to build regional networks to sell teak thinnings[181]. Moreover, however, many participants, including the men, young people and some women, demonstrated enthusiasm for establishing a local 'furniture workshop'. This workshop, in theory, would support agro-forestry by using thinnings and wild timber (potentially inter-cropped species) to make *"high grade"* furniture for sale in the Western Province. The local skills in carpentry were emphasised, and the S7L forwarded as the primary source of labour. Significantly, this project idea has the support of the Spiritual Leader, as it provides a means to ensure that thinned logs are not wasted. Leaders state that it has not yet been started as the village lacks the necessary capital, tools and infrastructure.

[181] As per the potential next phase of this project.

4.1.6. Local Perceptions of Demonstration Plot

There is little, if any, sense of local ownership of the demonstration plot established by project staff. Overwhelmingly, it is perceived as belonging to often uncertain others, namely *"Forestry"* or *"the university"*, arguably a consequence of non-participation in its creation. One elder noted that for the implementing organisations, the demonstration plot is *"... a big achievement, but for the [local] people it's no big deal*". Many participants professed that while the plot is in their lands, the trees belong to the Forestry Department. Villagers claim that, while they *"appreciate"* the project's intentions, and indeed utilised the thinned *flueggea flexuosa* in recent village construction, they have not to have been consulted or involved in plot activities, and thus feel disconnected from it.

Significantly, many villagers – especially women and young people – have not yet seen the demonstration plot, despite it having been constructed several years ago. Although some participants cited that the plot does receive some maintenance attention from villagers, its upkeep remains primarily managed by project staff. Conversations with villagers indicate that no whole-village meetings have taken place with project staff with the result that many villagers feel disconnected from, or remain totally unaware of, the project's agroforestry scheme. This is further consolidated by the fact that the decision to implement it lies with the Spiritual Leader and Leadership Committee, and is thus not something they need to be actively engaged in considering. Even elders reported that thinning is *"not allowed"*, implicitly referring to the counsel of the Spiritual Leader.

4.1.7. Local Perceptions of Forestry Department & ACIAR

Most participants, especially women, reported no or very little engagement with the ACIAR or the Forestry Department, or awareness of precisely what they do. The Director is the primary point of contact between project staff and the village, and for most people their irregular presence[182] does not foster good rapport. Participants noted that project staffs often fail to notify the community prior to their arrival, and no not engage with community members beyond the Director. One elder reported feeling *"very unsatisfied"* with the lack of communication, purporting that project staff focus *"… on their own research success and forget about us and keeping us informed."*

Similarly, another participant explained that:

"they came, just follow their plans, do their thinning – they didn't explain what they were doing… they just come and go".

Participants demonstrated varying levels of understanding about the role of Forestry, and most had not heard of ACIAR. When asked about the role of Forestry, villagers provided answers such as:

"If you want to do reafforestation they should be there to guide you, but they never do."

However, most reported having little direct interaction with it. Women appeared particularly uninformed; one woman, a former leader, for example explained that she

"[does] not really know the role of Forestry … all I know [is that] I see them coming, they look at the trees and then they go".

[182] Project staff and university researchers from Australia and Munda visit this village several times a year to maintain, survey or collect data from the demonstration plot. During the researcher's stay, one such visit took place. Most villagers were unaware of the visit; only the Village Director was informed.

Although tending to describe the Department as helpful, most participants agreed that it falls short of understanding or delivering what the community needs. Elders commented that its presence, however indeterminate, generates certain expectations among villagers.

Participants expressed that Forestry representatives *"talk to the male leaders, who pass it on to the women"*. For example, one woman noted that in 2011, representatives from Forestry came and *"taught pruning to men but not to women. The men taught the women.*" Women expressed that they have not been consulted on their needs in respect to the plantation; for example, at times Forestry's presence is a strain, if they require refreshments, crockery and utensils. Female participants professed to know less about Forestry than men, and explained that their information about the department comes from *"rumour"* and male relatives.

For those villagers more aware of Forestry's role, information about management and thinning arrived *"eight years too late".* That is, advice to thin has come once locally devised systems were firmly in place, trees had grown quite big and each tree represented *"money for the future"*. The idea of thinning thus represents somewhat of a threat to income and livelihood, compounded by spiritual significance attached to the trees. Forestry was described as having *"little sympathy"* to the villagers' attachment to their trees, and tried to implement thinning regimes aggressively. Villagers, in turn, felt *"frustrated"* with Forestry for allowing them to jeopardise their livelihoods. It was often expressed that Forestry should have talked to the village when the trees were small.

4.2. SOCIAL PROFILE

5.2.1. Governance & Decision Making

Leadership Committee

As the peak governance body, the Leadership Committee is responsible for village planning and decision-making during Sunday meetings. With the exception of the Women's Leader, all permanent leadership positions are held by men and, apart from the Chief, are chosen by the Spiritual Leader. These positions are said to be non-negotiable and for life. Three female representatives also sit on the committee, elected by the women every three months. According to elders, the weekly agenda is framed by the Spiritual Leader in consultation with the core group of leaders who regularly meet outside of Committee meetings to discuss village matters. There is no formal process for consensus; consensus is said to be reached through discussion and possible because of *"unity"*. All research participants expressed satisfaction in decision-making systems and faith in leadership, at times abstaining from opinion on certain matters, deferring responsibility to leadership.

The Spiritual Leader is the ultimate authority in the village and has not given his consent to the agro-forestry regime proposed by ACIAR. All discussions and plans made at Committee meetings are passed on to him, via the Senior Pastor, the Director or the Women's Leader for final approval. Should disagreement between Committee and Spiritual Leader arise, discussions may continue between the Spiritual Leader and core group until resolution is found. The agenda is largely driven by the priorities he sets down and often, such as the case of teak, based on his divinations. Participants stressed that the Spiritual Leader is a *"god"* and able to see the future; thus, his words are holy and final. Any development projects or long-term

visitors, such as the author, must have his clearance. He is present in most village activities, including community labour, and runs the Sunday Church service. He is also available for consultation on spiritual matters and sells phone credit to villagers.

While other committee members are less active in decision-making outside their appointed areas of responsibility, the core group of leaders are purportedly the most influential, in particular the Village Director. The Director is responsible for village funds, development plans and *"foreign affairs"* (relations with government and other agencies). He is highly educated, fluent in English and *Pijin* and sits on the Constituency Council for the region, below Silas Carey Vangarra MP (son of Tausinga MP). Highly respected within his village and beyond, the Director has worked in the office of the Prime Minister and taught in various educational institutions. As such, he occupies a unique position in terms of the village's development and capacity. He is well informed about regional politics, has connections to the CFC leadership and is a close relative of the Spiritual Leader. In respect to the agro-forestry programme, the Director is on good terms with project staff, and is generally supportive of the project's goals. He professes, however, to be in a *"difficult position",* balancing the project's goals and the sentiments of the community. The Director has a great deal of advice to offer the project team and professes a desire to work more closely.

Leaders, including the Spiritual Leader, although receiving no material privileges and participating equally in village work, are held in high esteem. During church services, for example, they wear particular clothes, occupy particular seats and perform certain rituals. Leaders state that all community members are welcome to attend all Sunday meetings as observers; however, discussions with other villagers indicated that there is little public attendance. This was particularly evident among young people and women with some unaware that meetings are open to those

outside of leadership. This could be explained partly due to wider gender and generational relations, as well as by the devotion to the Spiritual Leader, and subsequent faith in appointed leadership. These facets appear to engender a certain degree of distance and non-responsibility for governance issues among general community members.

Women in Governance

Women in this village purportedly occupy a different position to those in other villages; as one elder explained:

"We don't see women as women … we are all community members. All ideas are listened to, and all people are respected".

Women supported this, claiming that indeed their ideas are listened to. The women are led by the Women's Leader who occupies a permanent position on the Committee, as well as three Women's Representatives who are elected and rotated every three months by the female population.

The Women's Leader is said to be a significant and influential force on the Committee, at times joining extraordinary leadership discussions. Her role is to communicate the needs and ideas of women to the Committee and provide support to the village women. When asked for examples of her work, participants referred to her role in planning fundraising activities. Discussions indicate the high value of fundraising in this village and the sense of pride, purpose and responsibility it confers to women. Additionally, as wife of the Spiritual Leader, she maintains a spiritual role for women and composes the melodies for local hymns.

Both men and women explained that the female representatives are responsible for *"women's issues"*, equated largely with women's work on Mondays and Saturdays and fundraising. Representatives seem to be little involved in other areas of planning or decision-making; however, participants conceded that this is dependent upon the individual, as some are more outspoken than others. Their primary role is to communicate the work achievements and their pending work plans of the women to the Committee and relay proceedings back to the women. Tri-monthly rotation is said to be driven largely by practicality; women are described as too busy to commit to permanent positions. The rotation was also explained as giving all women an opportunity to participate and develop leadership skills. It also appeared to reinforce solidarity between women and add an extra level of transparency to meetings, and women expressed no discontent.

Despite this participation, decision-making outside of fundraising is evidently dominated by male committee members. Women seldom attend meetings as observers and Representatives tend to talk little during meetings. (Male) elders, while supportive, concede that female participation in decision-making is a *"new"* idea that needs to happen slowly, claiming that women do not yet have the necessary confidence. Given the wider context of female participation in decision-making in Melanesia, the formal inclusion of women in the Committee indicates a level of progressiveness within this community, which many participants described as unique in the region. Moreover, women hold other areas of influence; the Director's wife, for example, is able to communicate the ideas of women directly to him. As discussed below, all village funds come from fundraising activities that are largely managed by women. Discussions indicate the fundraising forms a core part of female identity and pride in this village; it is a vital role and women are described as doing a very good job. Women also have structured time during the week in which they plan, discuss and act – representing another dimension of female agency in this village.

Young People in Governance

Youth are largely absent from matters of governance. Community members talked about previously having a male and female youth representative on the Committee. Both representatives, however, have since left the village and have not been replaced. The S7L are represented on the Committee by their Work Leader, through whom they claim to maintain a voice in leadership. The Work Leader also conveys information back to the group. The young males involved in the research professed to have ideas for the future which they discuss regularly amongst themselves. These ideas, however, appear not to be communicated to the Leadership Committee to whom they appear to defer decision making responsibilities.

Young women are said to be very busy, with many chores, while younger men have a lesser stream of regular chores, especially given that the S7L is currently dormant. Although many young people are away from the village, working or at high-school, participants state that few leave permanently as life in this village is *"good"*. In fact, youth outside the village are claimed to want to move there to enjoy the lifestyle. There are strict rules about youth interaction, to which youth profess to agree with and consent to.[183] Youth misbehaviour is reportedly very low.

5.2.2. Livelihoods & Resources

Land: Tenure, Use & Control

The research site is one of three villages occupying a small lagoon island within the community's ancestral lands. The village under study is an intentional community,

[183] It should be noted, however, that the Village Director was present at all youth interviews and mapping sessions, which may have affected participants' comments.

established in the mid-nineties by those wanting follow the current Spiritual Leader, on a site with considerable spiritual significance. In respect to legal tenure, the land was formerly alienated lands[184] which the village was able to lay claim to.

All land is said to be community land and all profits generated from community plantations will go towards fulfilling community needs. Land can be awarded to individual families, for homes or gardens, by the Leadership Committee upon request. Importantly, the land itself remains community land; only what is grown on it can be privately owned. While some participants contend that *"We have no land security problems here",* the Justice Minister notes that

"Sometimes people argue that community land is individual land. This is not allowed. The Chief may also be involved in this"

Decision-making processes on land use vary; for domestic plots, the decisions lie largely with women who perform most garden labour, while decisions pertaining to plantations, unused land and other community spaces are in hands of Leadership Committee and the Spiritual Leader. Participants agreed that the village retains *"plenty"* of land, and so far, feel unconcerned about competing land interests. There is a further 1000 hectares of formerly alienated land nearby that the village is attempting to gain tenure of. According to elders, this is also ancestral land but is under government lease to a foreigner. The legal process is expected to cost several million Solomon dollars and take a very long time; the process already having started a decade ago. The primary obstacles are cited to be money and potential conflict among other tribe members. The term 'conservation' is recognised by community members as important; however, appears to be of little priority in respect to livelihoods and the abundance of land.

[184] See: Foukona J D 2007 'Legal Aspects of Customary Land Administration in Solomon Islands' Journal of South Pacific Law Volume 11 Number 1 pp 64 – 72

Community Funds

All community funds are generated locally, by fundraising events overwhelmingly managed by women; a fact that women are observably proud of. Women discussed "*bring and buy"* events; community markets where monies generated are committed to community funds.[185] Amounts are publically counted and managed by the Village Director and his wife, organised into seven boxes representing different areas of need, namely: education; the S7L; community work; church; women; and events and visitors. The women have also established their own fund-box, however, there are competing accounts of how it will be used.

Community Timber Plantations

The plantations are located a short walk from the village and all members of the community participate in maintenance activities, during scheduled community labour sessions. Maintenance includes planting seedlings, weeding, pruning and clearing undergrowth (*"brushing"*). Importantly, this labour is understood as part of spiritual practice. Women note that plantation workloads have increased over time, as they have expanded.[186] The introduction of timber plantations is said to have engendered significant changes for the community. Unlike traditional crops that can be harvested all year and thus provide a constant stream of income, timber represents a distant reward. However, the Spiritual Leader (and along with some community members) also discussed the opportunities of translating teak into a medium term income stream; in particular, the establishment of a furniture workshop. The community has demonstrated its capacity to work together on

[185] One such event took place while the researcher was present in the village. The sentiments, processes and protocols described by villagers were witnessed by the researcher, and the sense of pride and solidarity among the women was most evident.
[186] Boer H, Burch D, Lyons K, Riddell E and Walters P '2012 Agro-forestry and its Social Impacts Social Science Research Final Report – 2012' Social Evaluation Report for ACIAR: Brisbane 23

collective income-generated projects; having engaged in other past and present community agriculture projects. Funds from these projects are directed towards broader community development goals.

Community labour

Community labour is fundamental; on a functional level, community labour sustains village plantations and infrastructure, and also provides structured opportunity for villagers to assist each other on specific projects or needs, such as new roofing or garden maintenance. Additionally, community labour appears to reinforce the village's sense of collectivism and provides the pathway to future teak revenues.

The prevailing attitude among participants was that community labour is important and, because everybody participates, individuals do not need to commit many hours a week to generate significant outcomes. Participants expressed pride in the efficiency and functionality of the village's labour systems and stated that such systems are important components of a healthy community. Leaders reflected that communal work and delegation of responsibility among community members helps to maintain cohesion and villagers' sense of place. It also helps to keep younger people *"busy"* and thus out of trouble.

Community labour takes place on Tuesday, Wednesday and Friday mornings, for around one hour and is regarded by elders as spiritual practice. Villagers usually remain quiet during work, which is opened and closed with the blow of the conch and a prayer led by the Spiritual Leader or Senior Pastor. Prayer is a communal activity, and involves chants and clapping.[187] All village members participate in community labour, including young people and, during school holidays, children.

[187] Harwood F 1971 p 226

Men and women share tasks according to context; if work is particularly physical, women may be responsible for preparing food and refreshments.

Household Livelihoods

Women and men fish and garden, and sell their products at markets on neighbouring islands. This income is reportedly managed largely by women who frequent the markets more than men, and used to purchase supplementary food and items such as kerosene.

Many villagers are also engaged in micro-enterprise, including selling phone credit and establishing home-based 'canteens' selling such household supplies as soap, rice and tea, as well as snacks and sweets. Several villagers have purchased solar panels, which they rent to their neighbours to charge mobile phones. Many women in the village bake breads, cakes and puddings for local sale.

There is clear a gendered dimension to labour. Women were explained by both men and women to do more (*"stakka"*) work, while men often sleep in; but men contribute *"harder"* work – construction, boat building, felling trees or heavy lifting. Women commit several hours on a Monday to assist each other with household and garden chores. Men reported selling fish, fresh and barbequed, and shellfish at the markets, as well as crayfish to nearby resorts.

Standard Seven Leavers (S7L)

Based upon a concept championed by Holy Mama, the S7L is a local institution of unmarried[188] school-leavers aged between 16 and 25. The S7L were responsible for

[188] The transition from 'youth' to adulthood is largely marked by marriage across the Solomon Islands. Hassall & Associates 2004 'Youth in Solomon Islands: A participatory study of issues, needs and priorities (final

the establishment and maintenance of a large are of teak plantation several years ago. The S7L provides space for young participants to learn forestry and carpentry skills. It is also viewed as an important time for youth to learn leadership and responsibility, strengthen bonds and develop a sense of place within the village community. Currently, the group is inactive, though are sometimes called upon for building assistance. As previously explained, the group is under the guidance of a Work Leader who sits also on the Leadership Committee, and acts as instructor and mentor. He is assisted by a Youth Leader appointed by the Spiritual Leader. Current S7L members are all male. Several participants explained, however, that young women were previously involved but accounts of their responsibilities within the S7L varied.

The three members involved in the research displayed remarkable insight into forest management, including thinning, harvesting and marketing; and hold strong views on what should happen in their own village. As previously noted, several members claim to have witnessed the sale of comparable teak logs while working on barges; thus, participants purported that village thinnings could be sold. Although most professed support for thinning, they also emphasised that thinnings cannot be *"left to rot"*; they must be sold or used. Moreover, consent from the Spiritual Leader is necessary. One participant was a particular advocate of thinning, but explained that it was not his place as an unmarried youth to get involved in leadership affairs, though their ideas could be passed on to the Committee via their Work Leader. Young participants expressed enthusiasm for being involved in the furniture workshop proposal discussed above, and a desire to improve their woodworking and carpentry skills.

5.2.3. Concepts of Wellbeing

When asked to demarcate the criteria for wellbeing, answers displayed remarkable consistency with the concepts of *"unity"*, *"spirituality"* and *"a good [spiritual] leader"*

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report)' AusAID: Canberra. Accessed online:
http://www.paddle.usp.ac.fj/collect/paddle/index/assoc/ausaid00.dir/doc.pdf [21 October 2011] p 9

surfacing as the most predominant themes. In particular, the concept of *"unity"* surfaced as central to understandings of wellbeing in this village; cited by all research participants in relation to core dimensions of village life, such as community development and future plans, health, communal labour, livelihoods, happiness, leadership and spirituality. Unity was employed to explain why people are happy, and to define the concept of happiness itself: the manifestation of unity and togetherness. Most participants explained that unity is what maintains village operations, underpins livelihoods and the key to future prosperity. When asked, all participants, including youth, professed to be "*happy"* and, in contrast to literature on Pacific youth[189], expressed a desire to remain in their village. Many participants stated that their village is *"different"* to others in the Solomon Islands, which purportedly suffer from alcoholism and social conflict, attributed to an absence of unity.

Spiritual Underpinnings

In line with the CFC[190], local spiritual doctrine emphasises conduct; participants typically pointing to behavioural norms of co-operation, shared labour and church activities when quizzed on their spirituality. Unity was also said to stem from devotion to CFC values and their spiritual leaders, and reinforced by ritual, rules and long-term village goals, a point consciously recognised by leadership. Communal rituals take place almost every day; including church services on Sundays, village singing and youth marching choirs three times a week, Monday evening devotions and thrice-weekly community labour.

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[189] Noble C, Pereira N and Saune N 2011 'Urban Youth in the Pacific: Increasing resilience and reducing risk for involvement in crime and violence' United Nations Development Programme (UNDP) Pacific Centre: Suva. Accessed online: http://www.undppc.org.fj/_resources/article/files/UrbanYouth_in_the_Pacific.pdf [05 May 2012] p 15 and Secretariat of the Pacific Community and Pacific Agricultural and Forestry Network 2010 'Pacific Youth in Agriculture Strategy 2011 – 2015: Echoing the Voices of Pacific Youth' Copyright Secretariat of the Pacific Community: Suva. Accessed online: http://www.spc.int/lrd/index.php?option=com_content&view=article&id=678&Itemid=396 [28 June 2012] p 8

[190] Harwood F H 1971

Rules appear to form a salient part of village identity and provide a framework for normative behaviour. Reflecting this, one woman related local happiness to the Spiritual Leader who, in addition to being "*really good"* was also said to "*control[s] everybody".* In this context, 'control' was expressed as a positive, unifying force. In addition to the Ten Commandments, the village adheres to a further thirteen rules monitored by Justice Minister and often revised during church service. A combination of unique and CFC conventions, these rules emphasise appropriate dress, social interaction and respectful conduct. Deviant behaviour, according to the Justice Minister, is discerned by the psychic abilities of the Spiritual Leader. Reconciliation, rather than punishment, is asserted as the imperative, typically involving mutual payment and handshakes between parties. State authorities are a *"last resort"* reinforcing the sense of self-reliance and unity.

5.2.4. Expressed Needs

Needs were largely expressed in respect to the collective; i.e., sanitation, water supplies and the community hall, as opposed to personal or household needs. The needs for *"permanent houses"* (defined by a metal roof) and for organised (*"clean"*) village structure (i.e., *"houses in straight lines*") were consistently expressed as community needs, rather than personal needs, through the collective terms employed. Female participants expressed that sales from garden produce at local markets usually generated enough revenue to cover household expenses; however, when insufficient, women can call on their neighbours for assistance. The costs of secondary school were cited as a major difficulty for most families within in this village; however, this was explained as a policy problem rather than a cash-flow problem. Moreover, future revenue from teak plantations is said to be reserved for assisting families with high school costs. The high expectations surrounding the

future returns of teak harvest reflect the material aspirations of the community. Such invested hopes are embodied in the comments of a female elder, *"We will have a lot of money … for the future".* Finally, numerous participants expressed their enthusiasm for further research; there is an evident aspiration to be understood by outsiders such as ACIAR, particularly salient following the failed development projects implemented by other foreign NGOs that did not attempt to understand their social realities or development priorities.

5. CRITICAL DISCUSSION

The data revealed a number of patterns and factors that may account for the lack of uptake of agro-forestry practices. Most acutely, it was found that project success is largely dependent upon the ways in which it is perceived and understood by the community and its capacity to be relevant to prevailing priorities and aspirations. Using a SWOT analysis framework, the following discussion analyses the data and situates it within the context of the project. In particular, it focusses on those issues, themes and areas most salient in respect to improved project efficacy. The literature already explored provides grounds for comparison and contrast, and more in-depth comprehension of the data. It is hoped that the conclusions drawn will be of relevance to future project development and agency-village relations, ultimately contributing to increased, equitable and sustainable benefits for villagers from teak plantations. It is hoped that these findings may be of relevance to other organisations working in comparable contexts across the South Pacific. Figure 6 below summarises they key findings of the SWOT analysis, to provide a visual overview before the full discussion that follows.

Figure 6: SWOT Summary

PROJECT STRENGTHS	**PROJECT WEAKNESSES**
Responsive to teak management problems	Local learning processes vs. extension delivery
Long-term commitment	Local spirituality vs. institutional secularism
Capable and committed project staff	Non-participation
Committed to capacity building	Limited community rapport
Widespread partnerships (government …)	Limited engagement with local knowledge or process
International networks (NGOs, universities…)	Unaware of spiritual dimensions of teak
Sound scientific practices	Spiritual Leader is not involved, nor given consent
Support from government (forestry and education)	Inattention to gender and age
	Limited dialogue or collaboration
	Not sensitive to local needs, aspirations or sentiments
	Abstract, scientific concepts
	Key local assets overlooked
OPPORTUNITIES	**THREATS**
International teak markets	Prolonging poor relations
Inter-island teak co-operation (grower networks)	Lack of market infrastructure
High levels of enthusiasm for teak	Market demand
Strong village structures and systems	Requirements of buyers (eg. volume)
Demonstrated co-operation and unity among village members	CFC split (impact on co-operation)
Furniture workshop proposal	CFC split (arrival of church refugees)
Standard Seven Leavers	Market realities (teak/furniture)
Church and spiritual leader	Gender, age and power
Future labour pool will grow with ‘ church refugees’	Land tenure, control and use
Village plans for more teak plantations	Competing priorities and work commitments
Villagers’ desire to learn	
Agency of villagers	
Villagers’ suggestions of improved communication	
Villagers’ openness to collaboration and dialogue	

5.1. SWOT ANALYSIS:

Strengths, Weaknesses, Opportunities & Threats

5.1.1. Project Strengths

The programme maintains significant potential; this village, like others, has invested considerable resources into developing teak plantations yet do not engage in the management practices that may engender substantial economic returns. Thinning, as proposed by ACIAR, represents a manageable means to improve the value of local teak logs. Thinned logs are suggested by ACIAR as useful for local village construction. Additionally, the programme forwards inter-cropping teak with useful, local species, with the dual outcome of providing sustainable timber for village utility that when felled allows teak to increase in volume. If implemented, this approach would ensure that no teak logs would be *"wasted".* ACIAR has a long-term vision and is committed to building partnerships and networks across the archipelago with numerous stakeholders, professing to synthesise 'research, extension and capacity building'.[191] Project staffs, both local and international, are demonstrably capable and committed. From the perspective of beneficiary communities, like the village under study, this organisation represents opportunities for training and education, global marketing and building grower networks, especially in light of recently confirmed additional funding.

5.1.2. Weaknesses

[191] Blumfield T 2007 p 8

Programme effectiveness is, however, limited by various weaknesses in design and implementation. CD provides a pertinent lens for analysis; most significantly, in the context of this village, the programme demonstrates a lack of participation and community-wide dialogue. This is reflected in the lack of knowledge of the proposed regime or thinning and the clear lack of ownership of the demonstration plot among participants. Most clearly, this is evidenced by the fact that neither the agro-forestry regime nor thinning has been employed. There is clear distance between community members and project staff, and most participants demonstrated very little understanding of what project staff or the organisations they represent do. Data suggests that local needs and priorities have not been asked and, consequently, good rapport has not been developed among villagers, especially women.

Gegeo and Gegeo-Watson (2002) refer to the 'epistemological collisions' between development agencies and SI communities. It seems evident that within this village a similar collision is taking place; manifesting between local learning processes, namely experiential and social, and extension delivery based on science and economics. The significance of local spirituality in respect to teak management has been overlooked, perhaps a result of the institutional secularism that characterises most development organisations. Ver Beek notes that spirituality and spiritual institutions are often sidelined in development processes; and certainly in this village, the Spiritual Leader - gatekeeper to all village decisions, including teak management – has not been adequately engaged. Messages delivered by ACIAR, such as the encouragement to thin, appear to be undermined by that espoused by the Spiritual Leader. Fieldwork further suggests that for many community members, the abstract concepts of agro-forestry, such as thinning, conflict with the strong emotional feelings attached to teak plantations.

Beyond spiritual institutions, the programme has not utilised other local institutions or groups that could be of value to regime uptake, namely the S7L. CD advocates engaging local groups in the design, experimentation and implementation stages, learning from local knowledges and utilising local processes of learning, planning and decision making. In this context, the village possesses strong social structures for education, labour and governance and maintains a high level of co-operation, enthusiasm for teak and a self-professed sense of unity that should be capitalised on by ACIAR. Currently, project staffs visit the village, perform studies and leave with many villagers unaware of their presence; such visits could provide powerful platforms for collaboration, information exchange and agro-forestry uptake.

The fieldwork revealed that programme has not been as sensitive to factors such as gender and youth as it needs to be. Although 'gender' is flagged as a 'risk' and 'young people' are cited in the project proposal[192], data indicates that, in this village, neither group has been engaged. Communication has remained largely with male leadership that has not permeated to other sectors of the community, arguably contributing to the disconnection felt towards the demonstration plot and the non-uptake of agro-forestry techniques. More research needs to be conducted, however, into how this may affect the community; for example, how it may affect gender relations or the workload of women, as well as into effective ways of engaging diverse groups.

5.1.3. Opportunities

Data reveals numerous opportunities for improved collaboration that may translate to regime uptake, especially given that markets for teak exist and ACIAR's commitment to assisting growers to secure markets and establishing grower networks. Data reveals a significant degree of capacity within this community that

[192] Blumfield T 2007 p 15 - 16

could be more effectively engaged. This includes both local institutions, such as the S7L, and highly organised systems of governance, as well as the prevailing sense of unity and co-operation among community members. The faith in the Spiritual Leader held by the community indicates that residents are likely to be willing to learn and apply new practices should he give his approval. Epistemological gaps can indeed be bridged and seemingly abstract concepts grasped by the capable members of this village, most potentially if local learning processes are used to convey and exchange information.

The S7L presents a particularly ideal space of engagement: a group designed to equip young people with valuable skills for community development pursuits, such as carpentry, building and forestry. Group members are young, bright, enthusiastic and committed to the village's future; the group is currently dormant and awaiting a project. Involving group members would allow for local youth to learn in relevant and meaningful ways, in line with the S7L's mandate awarded by Holy Mama, namely community work and self-reliance skills. Many community members expressed support for using thinned logs to resource a furniture workshop in the village; and requested further dialogue with ACIAR on this matter. A CD perspective would suggest involving community members, such as youth from the S7L, in planning, decision-making and evaluation, as well as other aspects of the project such as soil sampling, thinning and other routine activities.

5.1.4. Threats

The current separation between project staff and project activities from the community remains a threat to the successful implementation of the regime. Outside of this, other threats include the market realities for both teak and for furniture as per the plan proposed by the community. Significantly the current schism within the

broader CFC community may not be conducive to the regional grower network proposed by ACIAR, though most participants were confident this would not be so. The pervasiveness of power relations, particular in regard to gender and age, may represent a threat to the equitable distribution of benefits in the future. Efforts need to be made to engage these groups in planning, decision-making and extension and further, collaborative social research needs to take place.

6. RECOMMENDATIONS

Based on findings from the analysis of primary data and wider literature, the following recommendations are suggested to help foster successful and meaningful uptake of the proposed agro-forestry regime and improved relations between agency and community. Ultimately, in line with CD, these recommendations are oriented towards greater equity, strengthened community capacity and ensuring the project is framed in respect to locally defined needs and aspirations. The importance of participation, factors of difference, such as gender, and local values, especially spiritual values, must be recognised. Achieving this will require an emphasis on and investment in relevant and meaningful communication processes.[193]

- **Increase participation and dialogue at all stages of project cycles**

Presently, community members, especially women and young people, are not involved in the project; in some cases they are completely unaware of it. Currently, the Village Director forms the conduit to transmit information and encourage wider use of agro-forestry techniques; however, this has not been as fruitful as it could be. Dialogue between ACIAR and the community is critical; it may help to redress the gap between project staff and village members and establish a good sense of rapport. Dialogue, such as through an all-village meeting, may help to break down the barriers and generate enthusiasm for agro-forestry. This must be followed with commitment to community participation in project activities, including decision-making, planning and monitoring. Participation may help bolster support for thinning, as well as act as a means of education, project ownership and sustainability.

- **Engage with and utilise local processes and leadership institutions**

[193] Quarry W and Ramirez R 2009 p 134

Data reveals that any village activities must have the consent of the Spiritual Leader. It may thus be beneficial to formally meet the Spiritual Leader, with due attention to protocol, and potentially other key leaders to discuss the matter. The Spiritual Leader currently opposes thinning for various and significant reasons. These reasons must be discussed and understood in order to be addressed. Moreover, as the primary gatekeeper to community participation and project sustainability, his support is essential. Through him, other key leaders and institutions can be accessed, namely the Leadership Committee, the Women's Spiritual Leader, women and the S7L.

- **Utilise local capacity**

As detailed throughout this report, this village maintains remarkable local capacity for action and co-operation. This is something that should be utilised. In particular, the S7L offers an energetic pool of labour for thinning and, more importantly, demonstrate considerable enthusiasm for learning new skills and already possess an impressive repertoire of forestry knowledge and skills. Beyond basic agro-forestry techniques, this group of young people should be engaged in other areas of the project, such as scientific testing, data collection, monitoring and evaluation. Such involvement may confer a greater sense of confidence to these young people, enhance individual and collective skill-base and contribute to the long-term sustainability of agro-forestry in this village.

- **Respond to local learning processes**

Several participants asserted that local people *"learn with their hands".* One participant explained that scientific or mathematical explanations and rationales were abstract and irrelevant to local people. Additionally, participants emphasised the importance of prevailing communication channels, namely *"the coconut news"* between and within islands, families and communities, as it represents the sharing of information and the validation of rumour between trusted friends or family members. Thus, to effectively confer agro-forestry skills and knowledge to village members, learning must be

as visual and experiential as possible. Moreover, village members should be encouraged to experiment and share their knowledge and expertise with project staff.

- **Frame objectives in respect to local needs, aspirations and priorities**

Community members possess their own sets of needs, priorities, values and aspirations, with varying degrees of uniformity and diversity among different groups. Materially, sanitation and improved village infrastructure emerged as significant priorities for all participants and likewise, spiritually, village unity, co-operation and happiness emerged as important. In respect to the teak plantations, while opinions on thinning varied, what did surface as collective was the need for spiritual sanction to thin and for viable options to process or sell thinnings. The project must strive to be relevant to these issues; participation and ongoing dialogue representing a potential means to reach this ends.

- **Sensitivity to spirituality, gender and age and other dimensions of difference**

As in any community, power and resources are distributed unevenly along lines of difference such as age, gender and education in this village. Different community members maintain different experiences, perceptions and realities. Efforts must be made to ensure equity of inclusion, by paying careful attention to appropriateness, time of day and week, location, literacy, language and education, who is present, competing duties and so on. This will require further research and engagement with the community. PRA may provide useful tools for this.

- **Ongoing participatory social research, monitoring and evaluation**

Several participants emphasised their support for social research of village life; in fact, many called for a long-term researcher to stay for up to one year in order to learn the local language, Roviana, and begin to understand the community on a deeper level. And indeed, social research is critical in

order to comprehend local needs and realities and ensure that programme operations are appropriate and effective. In light of this, it is important to invest in ongoing social research, monitoring and evaluation. In particular, participatory research, where local people are actively involved in framing research and collecting and analysing data, represents an important platform for this.

7. CONCLUSION

The spaces of disjuncture between the perceptions and lived realities of community members and the prevailing project claims reveal both the limits and potentials of this agro-forestry extension programme and, more broadly, illuminated the significance of local level perceptions, spirituality and narratives. The ways in which teak, teak management and concepts of wellbeing are embedded within local spirituality and spiritual narrative illuminate the need to customised, appropriate and responsive engagement and communication strategies, grounded in dialogue, participation and attention to spiritual protocol. Moreover, this study has revealed the remarkable capacity that exists within this village, in terms of organised labour; a co-operative and collective ethic; energy and aspirations for improved, but self-defined, standards of living; and a great deal of ecological, forestry and entrepreneurial knowledge. The S7L represents an opportune space for engagement and collaboration, pending sanction from the Spiritual Leader and improved dialogue between project staff and community members.

Given its relevance, the prevailing character of the community and the long-term commitment evidenced by ACIAR, this programme maintains great potential for success. It is hoped that this study prompts greater village-agency collaboration, towards the sustainable uptake of the agro-forestry regime and, ultimately, socio-economic improvements within this village. It is important that further participatory social research is done with this village and skills in monitoring and evaluation developed locally, to ensure long-term sustainability of agro-forestry systems and perhaps buttress further development activities and partnerships.

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9. APPENDICES

APPENDIX 1: INTERVIEW THEMES OVERVIEW

Although each interview, focus group or other research session was tailored to the participant context, the researcher aimed to cover certain themes and topics, so to gain a holistic overview of community perspectives on key topics. These were based on the information I had before arriving at village from previous research and grew and developed with time spent in the village.

Who	Themes & Topics
Female Committee Representatives	Current Committee agenda Development activities (past/present/future) (timeline) Operational perspective of Leadership Committee (eg. Venn Diagram) Rotation of female representatives vs. permanent Role of women in village Status of women in Solomon Islands Women's issues in village Perceptions/knowledge/explanations/feelings of: • agro-forestry/thinning • teak plantations (past, future, purpose, benefits…) • demonstration plot • ACIAR/forestry Development needs, priorities, aspirations (especially for women); how this relates to position on Committee Spirituality and worldview; subscription to CFC Narrative of village (timeline) Views of youth Feelings about leadership and governance Explanation of " unity" Happiness; reasons for Women's spiritual leader Future expectations/visions for village (timeline) Livelihood, access to land/resources, daily routines and workloads Women's livelihoods (especially markets); making ends meet; micro-economy Women and fundraising
Village Women	(ascertain if have been on Committee before) Knowledge of current Committee activities Knowledge of village development activities (past/present/future) (timeline) Power diagram of village Rotation of female representatives vs. permanent Role of women in village

	Status of women in Solomon Islands Women's issues in village Perceptions/knowledge/explanations/feelings of: • agro-forestry/thinning • teak plantations (past, future, purpose, benefits…) • demonstration plot • ACIAR/forestry Development needs, priorities, aspirations (especially for women) Spirituality and worldview; subscription to CFC Narrative of village Views of youth Feelings about leadership and governance Explanation of " unity" Happiness; reasons for ; pride of place – is this village special? Why? Future expectations/visions for village Livelihood, access to land/resources, daily routines and workloads (mobility map) Transect walk (important places for women, gardens…) Household money (control, use…) Women and fundraising Women's spiritual leader
Village Men	Knowledge of current Committee activities Knowledge of village development activities (past/present/future) (timeline) Power diagram of village Perceptions of women in village and in leadership "men's" issues / priorities / different to women? Perceptions/knowledge/explanations/feelings of: • agro-forestry/thinning • teak plantations (past, future, purpose, benefits…) • demonstration plot • ACIAR/forestry Development needs, priorities, aspirations Spirituality and worldview; Subscription to CFC Narrative of village Views of youth Feelings about leadership and governance Explanation of " unity" Happiness; reasons for ; pride of place – is this village special? Why? Future expectations/visions for village Livelihood, access to land/resources, daily routines and workloads (mobility map) Household money (control, use…)
Leadership Committee (including senior elders)	Church and spirituality Diagram of seating Spiritual view of plantations Church view of women Role of men, women, young people Non-committee members in governance/decision making Village development activities (past/future/present) Village narrative Insight into CFC (governance, history, split…) Committee agenda Process of decision-making Community funds management Development aspirations and priorities Interactions with government; authorities

	Law and order at the local level Micro-economies; livelihoods Church activities Community labour and management Views of forestry and ACIAR Views of agro-forestry, thinning, demo plot Visions of future Role of each committee member Core leadership group (who, dynamics, decision making process) In-depth role of Spiritual Leader Communication with non-committee members (re: decisions, planning, labour, activities etc.) Election of members to committee; responsibilities; duration etc. Relations with outsiders; protocol; reasons etc
Standard Seven Leavers Members	Views on youth; youth needs and aspirations Youth mobility; activities (mobility maps) Youth in governance and leadership Knowledge of the Leadership Committee; current agenda; opinions Plans to leave the village (employment, education); reasons How communicate with leadership Household/family roles Gendered views/gender relations Perceptions/knowledge/explanations/feelings of: • agro-forestry/thinning • teak plantations (past, future, purpose, benefits…) • demonstration plot • ACIAR/forestry • Conservation Aspirations and visions for future (timeline) Transect walk (important places for youth) Would you like more forestry training? Interest in thinning/agro-forestry? How? Why? Who? Collaborations? (eg with rural training centres, ACIAR or forestry)

APPENDIX 2: STAKEHOLDER ANALYSIS

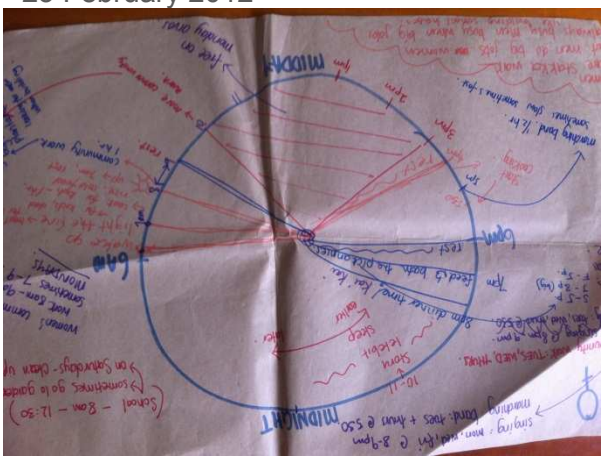
Stakeholder Group/Actor	Role	Interest (high-med-low)	Institutional Power (high-med-low)	Local Power (high-med-low)
Spiritual Leader	Highest village authority, imbued with spiritual power	High	Low	High
Village Director	High level village authority; liaison with external actors	High	Medium	High
Women's Leader	Women's spiritual leader and committee liaison; fundraising	High	Low	High
Committee Members	Village planning, decision-making, management	High	Low	High
Village Members	Local livelihoods, micro-economy, forestry, communal labour	High	Low	Medium
S7L (youth)	Forestry and carpentry	High	Low	Low
Project Staff	On the ground extension	Medium	Medium	Low
SI Government agencies (forestry, education..)	Implementing partners	Medium	Medium	Medium
Griffith	Directing	High	High	Low
ACIAR	Funding, directing	High	High	Low

Women
23 Febr

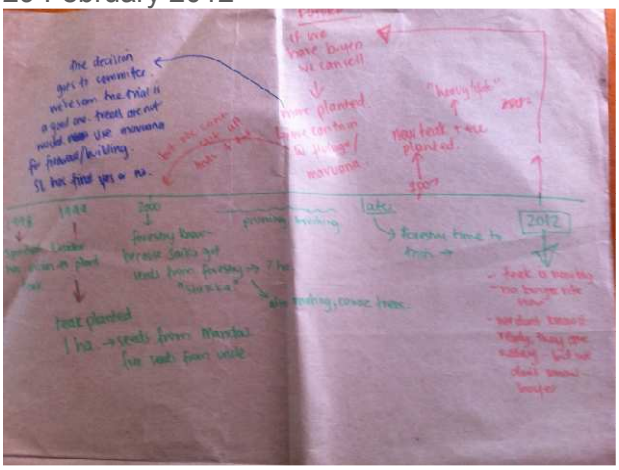
Youth Social Map
29 February 2012

Woman's Social Map
16 February 2012

Women's 24 Hour Clock
23 February 2012

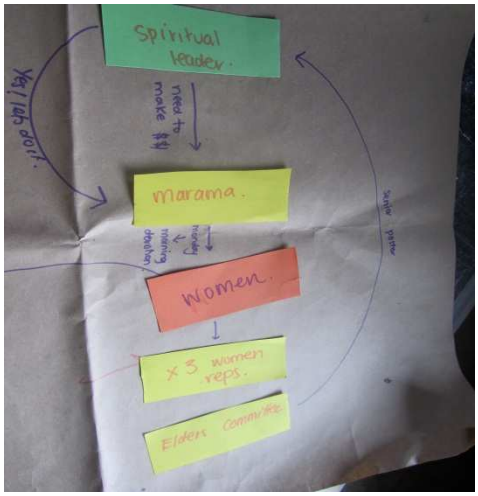


Timeline of Village Events
29 February 2012



Participation
23 February 2012

Women's Communication & Decision-making
28 February 2012



EU-funded Facilitating Agricultural Commodity Trade Project
Land Resources Division
Secretariat of the Pacific Community

Market Information Factsheet: Solomon Island Teak

FACT is a pioneering pilot project funded by the European Commission (EDF 9) and implemented by the Secretariat of the Pacific Community. We partner with export enterprises in 14 Pacific Island nations, providing technical assistance holistically across their supply chain and facilitating access to export markets.

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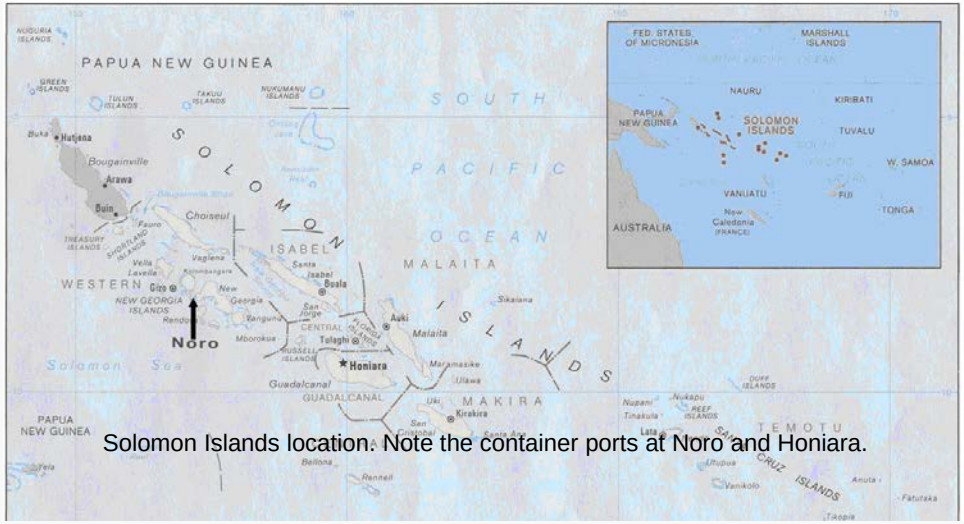
- Solomon Islands and Forestry
- The Smallholder teak resource
- The Supply Chain
- The Logs
- The Wood
  - Colour
  - Graininess
  - Heartwood Proportion
  - Inherent Properties
  - Production Considerations
  - Potential Products
- Current Markets
- Opportunities
- Contacts
- References

Solomon Islands and forestry



Solomon Islands location. Note the container ports at Noro and Honiara.

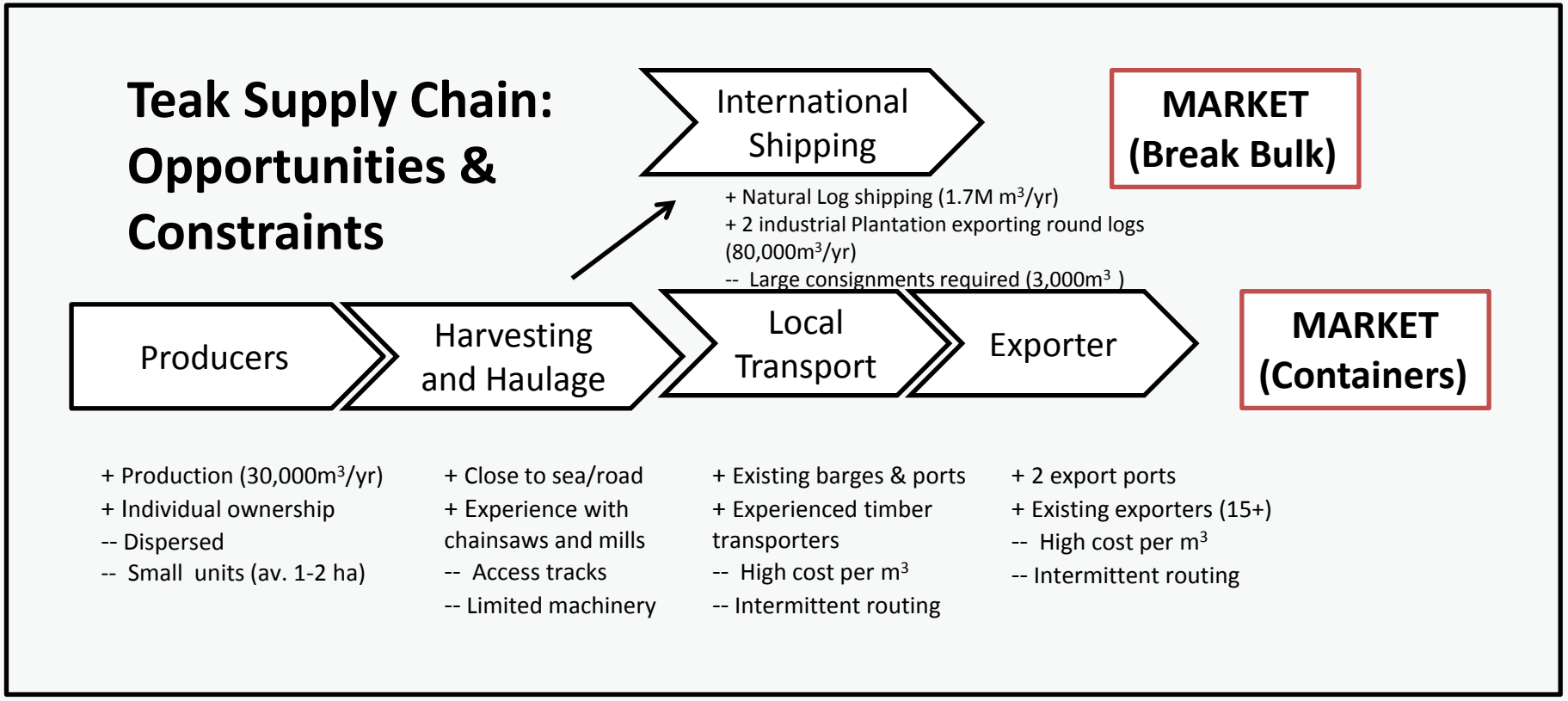
The Solomon Islands is a tropical archipelago of over 138 islands in nine provinces in the south-west Pacific and has a total land area of 28 450 sq km (Figure 1.1). Forests are rich due to the high rainfall and fertile soils. Forestry is important as more than 85% live in rural areas and the industry accounts for approximately two-thirds of the countries foreign revenue. This 'sunset' industry of unsustainable natural forest logging has meant the government supports a maturing new industry of high value plantation development. Teak is the main species for many thousands of smallholder tree growers and a substantial component of two industrial plantation estates in Western Province. This factsheet aims to give an overview of the Solomon Island teak resource to improve stakeholders knowledge and encourage participation in its management, marketing and processing.

The smallholder teak resource

There is at least 3000 ha and 70% of this resource is aged 10 years old or more. With a conservative rate of 15m^3 /ha/yr for unmanaged plantations, it is realistic to expect 30,000m^3/yr of good quality teak is available.

Owners of 1 ha of teak plantation measuring one of their 4 year old trees in 2007. The dbh of this tree was 35 cm.

The Supply Chain



The logs

SIZE: Logs will be sold according to their average diameter in 5cm classes. Recent sales of 10 year old plantations had an average end of log diameter of 30cm, with logs up to 45cm.

MEASUREMENT: Solomon Islands uses Brereton Scaling Method for Measurement (*Average Diameter under bark **X** Length **X** 0.7854).* Allowances will be given for cracks, major fluting and other defects.

GRADING: There is currently a set of grading guidelines for Solomon Island teak with A and B grades depending on heartwood, knots, straightness and other quality factors.

VOLUME: Exportable quantities are under evaluation but there has been 5 containers in a month completed. For the moment it is expected that 2 containers a month would be able to be exported while relationships and systems are been built.

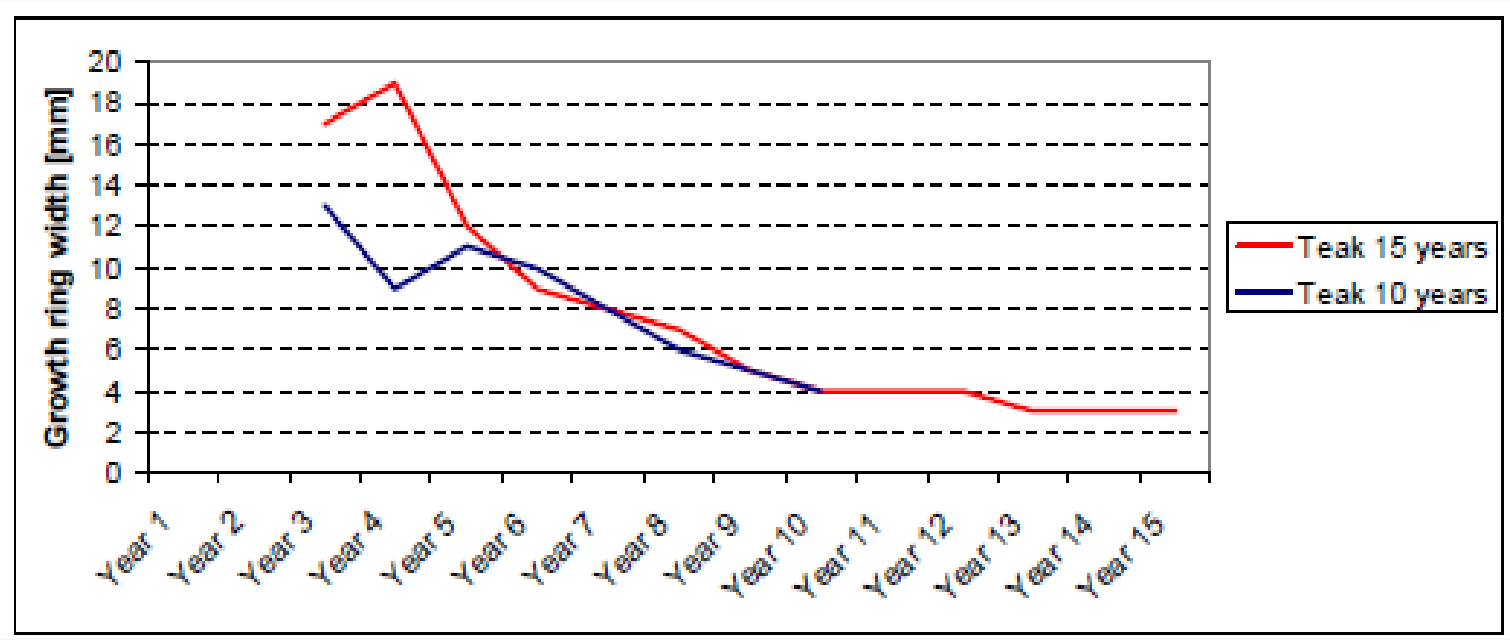
Wood Properties

Recently Australian Centre for International Agriculture Research (ACIAR) commissioned a study completed of 6, 10 and 15 year old teak wood from the Solomon Islands. This factsheet draws the wood properties from this work and published by Fehr and DEEDI in 2011.

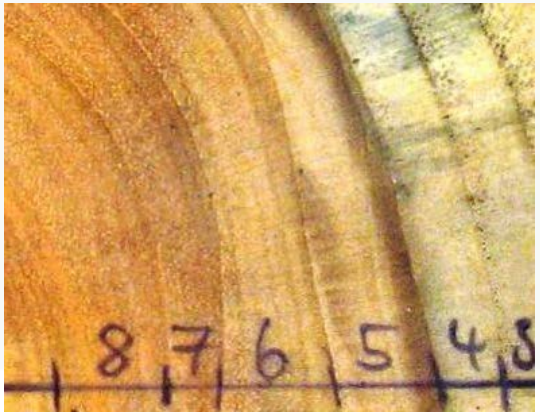
Colour

Colour Factor	Burmese	Solomon Islands		
		6 yr	10 yr	15 yr
Black /White	50	66	62	59
Magenta/green	11	8	10	10
Yellow/Blue	24	28	28	28

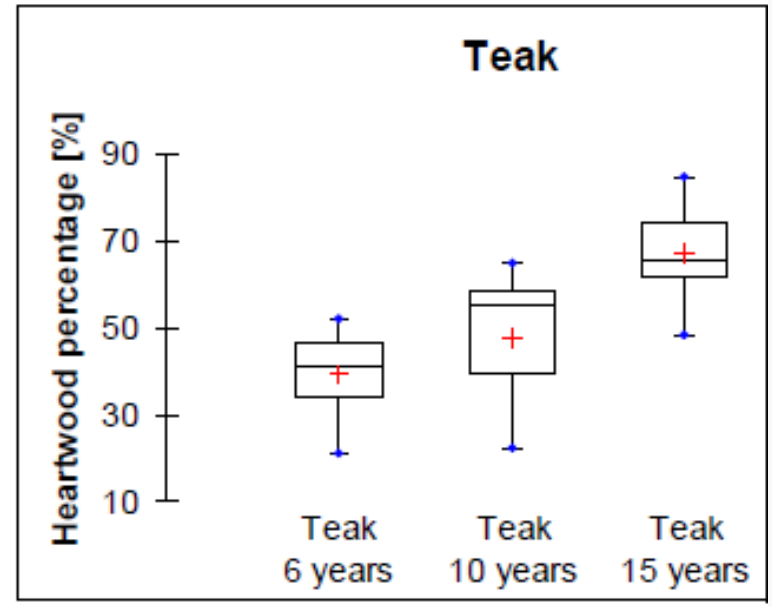
Graininess



Wood Graininess: Graph and disc showing the average annual growth ring width for 10 and 15 year old teak showing wide younger growth rings rapidly decreasing
Source: Fehr. C. (2011)

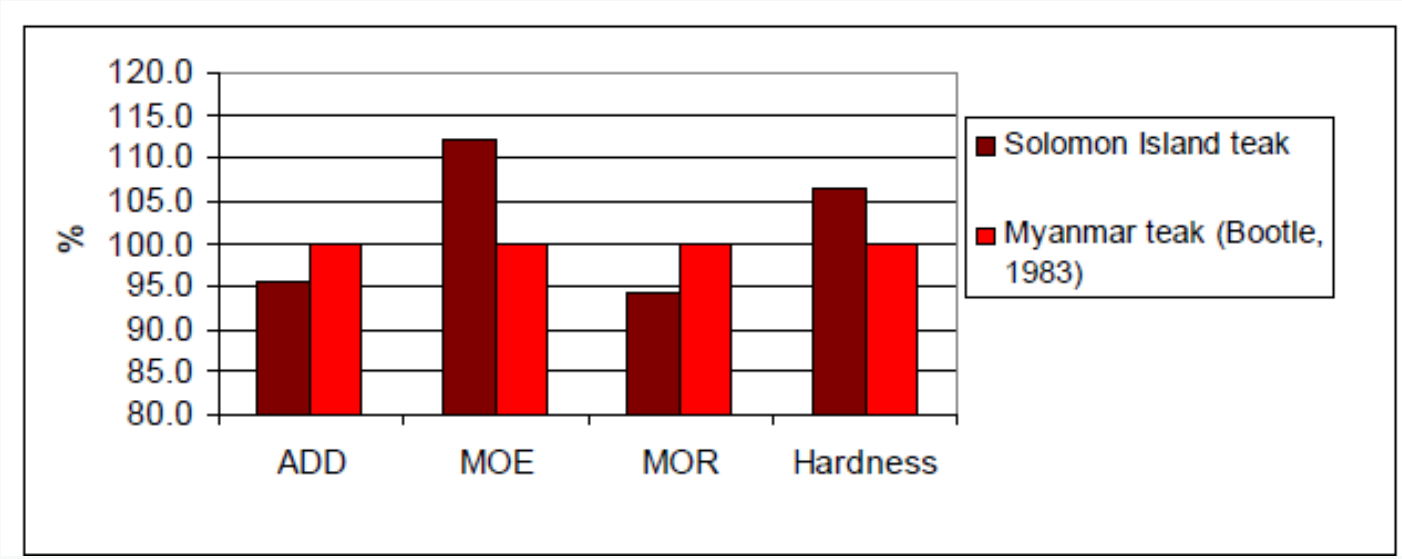


Heartwood Proportion



Heartwood Proportion: Graph showing the rapid onset of heartwood from 10 years. Slide showing heart wood of a 10 Year old tree. Source: Fehr. C. (2011)

Inherent Properties



Above graph (Fehr C., 2011) showing how Solomon Islands teak compares , often fvaourably, to Myanmar teak, including:

Air Dried Density (ADD): 575-630kg/m^3, reaches the threshold (565kg/m^3) for flooring;

Modulus of Elasticity (MOE): 9.8-10 Gpa, similar to other reports in literature;

Modulus of Rupture: 87-108 Mpa, similar to other reports in literature; and

Hardness: In general, similar or better to Burmese and Indian teak (4.3 and 4.6Kn respectively) with the 10 year old teak at 5.3 kN

Properties related to use in service

Durability: of 6 year old teak was quite low with 12 % loss of MOE, making the younger trees suited to indoor use. However, once above 10 years this measure dropped to 5%, indicating that they could be used for boat decking.
Extractive content: Similar with teak from around the world (7.8%).
Shrinkage: Shrinkage for clear wood is less than other published rates for mature teak.

	knotty teak	clear wood		
Age at harvest	mixed	6-yr-old	10-yr-old	15-yr-old
Radial shrinkage	2.0	0.8	0.7	0.7
Tangential shrinkage	2.5	2.4	2.3	2.1

Potential Products


Sliced Veneer


Rotary Veneer


Clear grade Yacht Decking
(top half clear coated)


Indoor Louvers

Current Markets

There have been two types of smallholder wood sales in the last year:

Industrial Plantation Company facilitating and selling break bulk

The company bought from small holders adjacent to their estate, charging a harvesting cost (US$60/$m^3$) and marketing fee (5%). They received approximately US$ 240 to 520m^3 FOB depending on the diameter for their buyers in Vietnam. This was only possible as they could add to their large consignments on existing barges and ships.

Local Trader buying and selling in containers

Plantation owners received roadside ($50-$100/m^3) and mill gate prices ($100-200)/$m^3$ for their teak logs which were then loaded into containers and sold for FOB for $150-$250 m^3 to India for a CIF price of $350-$500/ m^3. Most of the price received in India was taken up by the high inter-island and international transport costs.

Opportunities

Government and Regional Organisations promoting responsible markets: The Ministry of Forestry and Secretariat of the Pacific Community have funds for supporting producers accessing responsible markets through subsidises and industry development.

Industrial Plantations: Provide economies of scale for smallholders to complement and access break bulk transport.

Certification: There is currently a program to support producers and processors to become certified so that FSC controlled wood and FSC 100% wood can be available.

In country value addition:

- **In village:** Solomon Islands has over 600 portable sawmills that can be used to square logs
- **With industrial plantations:** As the companies are investing in industrial processing capacity to improve the value addition, there is opportunity to rotary veneer and in the future sell semi-processed and dry timber. .
- **Complimenting the sawn timber trade:** There is a country wide trade and export of rough sawn timber with processors in exporting towns with breakdown saws and some with the ability to complete secondary processing.

Contacts

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Fehr. C. (2011) *Physical and mechanical properties of plantation grown teak and poumuli of varying ages from the Solomon Islands***.** Bern University of Applied Sciences, Architecture, Wood and Civil Engineering, Division Bachelor Wood. Thesis No. **H / M17 / 655 / 11 / 0.**

DEEDI. (2011). *Selected wood properties andpotential uses for plantation teak and poumuli.* ACIAR Project report FST/2007/020. State of Queensland, Department of Employment, Economic Development and Innovation.