Enhancing management and processing systems for value-adding in plantation-grown whitewood in Vanuatu project

2015 Annual Report

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Introduction

In 2015 Vanuatu encountered two severe natural disasters, cyclone Pam (category 5) on March followed by drought from second quota to end of year. Cyclone Pam memorably created its landmark on the environment, infrastructures and livelihood of the Ni-Vanuatu.

Project activities commenced at a slow pace as people aspire to get their living back to normal. Most of the government officers were involved in the cyclone relief programme collecting, recording cyclone damages and assist to distribute food to affected areas.

Fortunately Santo was not severely affected compared the islands in the southern provinces. All the project materials and equipment were safe except for a minor damage to the Timber Research Facility (TRF). The only unrecoverable damage to the project investment is the Epau and Epule whitewood pure, mix and agroforestry trials on Efate. Nevertheless the project and Department of Forests (DoF) have assured the landowners to supply them seedlings to replant the areas but not as project trials.

The main activity which the project invested on this year is investigation on how to process the small diameter whitewood trees at Sara belonging to Mr Malakae Vele, one of the prominent whitewood farmers in Sanma Province and Vanuatu. Mr Vele, his sons and grandsons were very instrumental during the entire operation at Sara and without them the operation won't be that successful. Still under processing much of the project investment and efforts is spent on upgrading the timber research facility to be able to accommodate the various level of secondary of processing anticipated by the project. Already furniture manufactured from the small diameter whitewood trees have indicating outstanding results compared to old whitewood trees from natural forests.

Implementation of the project activities are implemented in accordance with these questions cited from the project document;

Research questions

1. *What mixed species and food crop agrofroestry systems can provide early and medium term returns to growers and encourage planting of whitewood?*
2. *What are optimal thinning ages and intensities to maximise clearwood production and minimise risks such as weed and wind, for whitewood grown at various spacings?*
3. *What is the optimal pruning regime to maximise clearwood development in whitewood trees?*
4. *What preservative treatment practices would increase the durability and marketability of small dimension whitewood?*
5. *What sizes and grades of whitewood can be used in structural applications rated for cyclonic winds?*
6. *What growers and processor group structures will facilitate knowledge transfer, marketing and increased planting of whitewood.*

Project Aim

The aim of the project as cited from the project document *is to improve the management, productivity and profitability of planted timber resources in Vanuatu through enhancing landholder capacity, improving the development of wood products from young trees*.

Project Objectives

Objective 1: Increase scientific knowledge for a range of locally appropriate agroforestry and plantation stand management systems to maximise returns to smallholder landowners.

Associated Activities1.1: Design stand management regimes appropriate to large plantations and mixed species agroforestry systems.

Agroforestry and plantation management

Agroforestry system is substantially the basis of whitewood woodlot establishment in Vanuatu as I have mentioned in my thesis on whitewood value chain in Vanuatu. In view of the fact that whitewood farmers are subsistence farmers, they need agricultural crops for food while they manage the growing trees. In addition to food the agricultural crops are used as cover crops suppressing weeds, they provide micro-environment to whitewood during the first 12 months and crops such as island cabbage, cassava; provide competition to whitewood at the early stage. Consequently semi –industrial whitewood plantation such as the one at Monexile belong to Mr. Benwel Tarilongi adopts the agroforestry system to establish, manage and maintain his whitewood plantation including the other priority species namely Mahogany, Natapoa, Nangai and Sandalwood.

Mr. Tarilongi divided his plantation into hectare blocks and allocate to farmers from nearby villages to clear for their choice of gardening. And in doing so he provided them seedlings to plant among their crops. He employs supervisors to supervise the plantings in collaboration with the Department of Forests to ensure seedlings are properly planted and at the correct spacing. Monday each week is set aside for farmers to either plant the seedlings or maintains the seedlings. Farmers are supervised and inform accordingly if they do not or properly maintain the seedlings.

The aim for most of the farmers is to sell their crops at the Luganville markets. They have their own gardens near their villages for own consumption. The consistent planting pattern observed on most blocks is once the trees are planted; kava is the initial crops establishment among the trees followed by peanuts combine with vegetables. It is a cattle grazing area therefore, planting peanuts and vegetables allows the farmers to keep on chipping/weeding the grass plus weed such as piko/wild eggplant scientifically known as Solanum *torvum* and others.

The peanut and vegetable are then replaced by cover crops such as sweet potatoes, water melon and pumpkin depending on planting seasons. This is to make sure the weeds are totally suppressed with suckers, tubers, and seeds do not have the change to re-establish. Dry land taro is always the final short rotation crops before leaving the kava and trees to continue growing. Kava starts to capture the site before dry land taro is harvested. Rotation of these crops does not only suppress weeds but restore nutrients to the soil and providing growing environment for both kava and whitewood. Taller crops such as cassava, island cabbage, sugarcane, banana and others usually planted along the border of the blocks.

Value estimation of agricultural crops plant between trees

The research question of what mixed species and food crop agroforestry systems can provide early and medium term returns to growers and encourage planting of whitewood is first on the list in the project document. Agroforestry is one of the main awareness packages DoF uses to boost tree planting in the rural areas. However, information provided by and large lack research experiment to provide scientific data and information for the farmers to adopt.

Table 1: Estimated value of crops planted at Epule & Epau whitewood mix planting trial

Crops	Stem/960m^2 (Experiment Size)	Stem/ha	Stump value (VT)	Stump value (VT)/ha
Peanut	728	7583	20	151667
Spring Onion	150	1563	5	7813
Corn	100	1042	10	10417
Capsicum	119	1240	20	24792
Kumala	120	1250	100	125000
Cassava	28	292	50	14583
Dry Land Taro	79	823	100	82292
Fijian Taro	70	729	50	36458
Banana	8	83	300	25000
Island Cabbage	34	354	20	7083
			Total Est. Value	485104

To provide answers for that research question the project established a hectare plot each at Epule and Epau on Efate and Lorum on Santo to collect on agriculture rotation crops data for analysis. The experiment trails consist of 5 treatments with 3 replicates of pure and mix whitewood.

Following the farmers expertise in traditional gardening they decide which crops to plant among and in between the rows at the beginning of the experiment. The farmers decision on which crops is essentially driven by the planting seasons, traditional values and market. The figures (table 1) indicated the average stems per hectare planted at Epule and Epau for the entire 2 ha trials. The data should have presented on a level where the value of the crops are investigated according to the species composition and different spacing used in the 5 treatments. Mr Taura was unable to collect more data after the two trials were thrashed by cyclone Pam on March 2015.

Nonetheless, the data on agriculture crops collected by Mesek at Lorum 2 will investigate and provide a more accurate and statistically analysed data for DoF to use in its awareness to continue boost tree plantings in the rural areas. Lorum 2 trial is well protected with pig fence and Late Kalsei and his wife have grown plenty vegetables and root crops and sold at Lorum road and Luganville market.

The value of the agricultural crops presented in Table 1 albeit pseudo replicated and statistically incorrect, it could still be used to certain level with clarifications. Farmers definitely require market values of the crops as indication of early return on their tree planting investment. Furthermore, high value crops such as kava will significantly increase the early return to the farmers.

Associate Activity 1.2 Quantify log product quality outcomes under various spacing, pruning and thinning scenarios

Wood poles

Wood pole is the main construction material in the rural areas of Vanuatu compare to timber, steel and concrete. Ni Vanuatu use wood poles to build their traditional bedroom houses, traditional kitchen, community halls and other traditional houses. The structure of the house starting with the post to the beam, rafters and purlin are all wood poles. Large traditional buildings such as community hall use a lot of wood poles from large to small sizes (5 to 30 cm DBH). The wood poles are harvest from the natural forest and old garden sites. Islands in the northern part of Vanuatu such Ambae, and Pentecost South Santo and offshore islands normally use Namamau wood poles for traditional house buildings while central and southern islands use other heart wood of other species such as Burao and other hardwood species.

Livestock fencing is another area of construction whereby wood poles is the source of materials. Cattle grazers use life wood poles from species such as Burao, Rosewood, Erythrina etc and dead wood poles from Namamao, Namariu and other hardwood species.

The aim of this associate activity is to investigate the quality of wood poles harvested from the whitewood silvicultural trials established in the previous whitewood project. There are several silvicultural trails established in different areas on Santo however, the whitewood silvicultural trails at Lorum East Santo were selected to thin and also investigate the quality of wood poles following the applications of various silvicultural regimes such as intercropping with other timber/poles species, agroforestry crops, spacing and pruning intensity.

Thinning of Silvicultural Trials at Lorum East Santo

Table 2 Lorum silvicultural trails selected for thinning and control

Lorum thinning trial			
Plot no	**Spacing**	**Thin**	**Control**
1	8x3	☑	
2	8x2	☑	
3	4x3	☑	
4	8x3		☑
5	4x3		☑
6	8x2		☑
7	8x3	☑	
8	8x2	☑	
9	4x3	☑	
10	4x2		☑
11	4x3		☑
12	8x2		☑
13	8x3		☑
14	4x2	☑	
15	4x2		☑
16	4x2	☑	
17	8x3		☑
18	4x3		☑
19	8x3	☑	
20	4x3	☑	
21	8x2	☑	
22	4x3	☑	
23	8x2		☑
24	8x2	☑	
25	8x3	☑	
26	8x2	☑	
27	8x3	☑	
28	4x3	☑	
29	8x3		☑
30	Rip	☑	
31	8x3	☑	
32	Rip		☑

Thinning of the silvicultural trials was done in 2014 and out of 32 plots, 19 plots were thinned and 13 were selected as control (Table 2). The number of trees selected to thin depends on the planting space as provided in Table 3. The diameters and heights trees selected to thin were recorded while still standing and once they were felled the total length of the trees were again recorded before docked into either 2.1 m or 3.6 m logs. Thinning is done manually and it involved tree felling, debarking, loading and transporting to drying shed at the operation site and later transport to TRF.

Table 3 *Thinning prescription for each planting space*

Spacing	**Trees/ha**	**Thinning requirment (trees/ha)**	**No of trees in plot including buffer trees**	**No of trees/plot**	**No of trees to thin in a plot**	**No of rows in a plot**	**No of trees to be thinned in a row**
4x2	1250	400		60	19	12	2
4x2	1250	400	117		37	9	4
4x3	833	300		35	13	5	3
4x3	833	300	99		36	9	4
8x2	625	200		45	14	3	5
8x2	625	200	105		34	5	7
8x3	417	100		30	7	3	2
8x4	417	101	80		19	7	3

Figure 1 Thinning at Lorum

Logs from shorter planting space 4x2 & 4x3 are more cylindrical, less branches and smaller in size compared to wider planting space 8x3 & 8x3 where the logs are bigger but larger and lower branching. Both large and small logs have the advantage of meeting certain market requirement but the difference is, shorter planting space provides more logs compared to wider spacing. Nevertheless, wider planting spacing might compensated by the revenue collected from the agricultural crops planted among the trees.

Figure 2: Logs harvested from Malakae's whitewood plantation, Sara

The project continues to harvest wood poles from Malakae's plantation at Sara especially from the smaller trees and the top of the logs which won't be able to process to timber (Figure2). Logs price offered to Malakae is at VT 2000 per cubic meter.

Associate Activity 1.3: Identify current limitations to product quality and economic value, such as blue stain, insect damage and decay. Conduct analyses of remedial action to reduce the impact of identified limitations.

The fundamental aspect of this associate activity is to investigate the environmental factors that are impacting product value and returns for the whitewood farmers. It involves analysis of possible solution through modification of whitewood product development such as appropriate drying techniques, preservative treatment during processing and harvest, transport and processing systems. Proper action research and analysis of the whitewood helps to understand the advantages and disadvantages of companies specialising in certain products and how they are connected to final market.

Storing and air drying of poles and timber at operation sites

Whitewood as being white in colure and soft with plenty of sugar in the sap requires a great deal of attention after milling, until it is properly stored to avoid environmental, chemical and physical damage. Therefore, storage shed were built at the processing sites and the logs and timber (Figure 3) were initially stored and air dried before transported back to the Timber Research Facility (TRF) before pressure treated with coper azole preservative and borax in dip tank.

Figure 3: *Storing of poles and timber at operation site*

Blue stain experiment

Blue stain experiment setup at Sara operation site is to investigate various means of application to control blue stain. Blue stain is cause by fungi that grow in sapwood and partly for food. Even though it is not a stage of decay, it creates conditions that allow decaying fungus to invade the timber. The most effective way to prevent timber from blue stain is to kiln dry where the moisture content in the timber is dropped to below 20%. At that level of moisture content it disallows the blue stain to invade the timber.

Construction of kiln dry either using solar of bio-fuel is in the initially planning of the project but dropped due to limitation of fund. Consequently having air dry as the only method of timber seasoning, chemical has to be used to prevent the timber from blue stain invasion.

The blue stain experiment comprised of 3 treatments, 4 replicates and experimenting in both outdoor and indoor air drying. Treatment one is a mixture two anti-moulds namely Taratek and Tanamix, second is bleach and third control where no chemical is used. The 3 treatments are replicated with 4 boards per layer and stack to 4 layers. The total number of boards per treatment is 16, board size 100mm x 25mm and 1 m in length.

Two boards from each layer, one from the middle and one from the edge are labelled (Figure 4) to record the weights (Figure 5) and observes blue stain invasion each week. Once the boards are labelled and placed into stacks the chemicals are mixed into a 20 litre container poured into a spraying bottle to spray the boards (Figure 6).

Figure 4: Labelling of boards to record the weights and to observes blue stain

Figure 5: *Weighing and recording the weight of the boards*

Figure 6: Mixing of chemicals and spraying of boards

Preliminary results of blue stain experiment

Figure 7: *Blue stain observation on the outdoor experiment after one month*

As indicated in figure 7 the stack on the left is sprayed with mixture of Taratek and Tanamix, middle stack is control where no chemical is applied and stack on the right is sprayed with Bleach.

While Geoff Smith is still to provide formal results of the of the blue stain experiment, Figure 7 has indicated a clear observation that the mixture of Taratek and Tanamix provides the best outcome by stopping blue stain invasion on the boards after 4 weeks (outdoor) compare to the control and bleach. As a matter of fact there is no difference on blue stain invasion observed between bleach and control.

Blue stain & Ambrosia beetle observation on air dried poles

In spite of no experiment on blue stain observation on air drying of whitewood poles since it is a structural product, similar situation is observed between outdoor and undercover air drying indicating in Figure 8 & 9. Whitewood poles air dried outdoor were invaded with blue stain and Ambrosia beetles in 8 days with mechanical defects such as checks and end split (Figure 7) compared to undercover air drying where the poles were still white, less blue stain and no Ambrosia beetles observed (Figure 9). The moisture content of the logs is regularly monitored to make sure the logs treated when the moisture content is 20 % below.

Figure 8: *Blue stain and Ambrosia beetles observed outdoor air dried logs after 8 days*

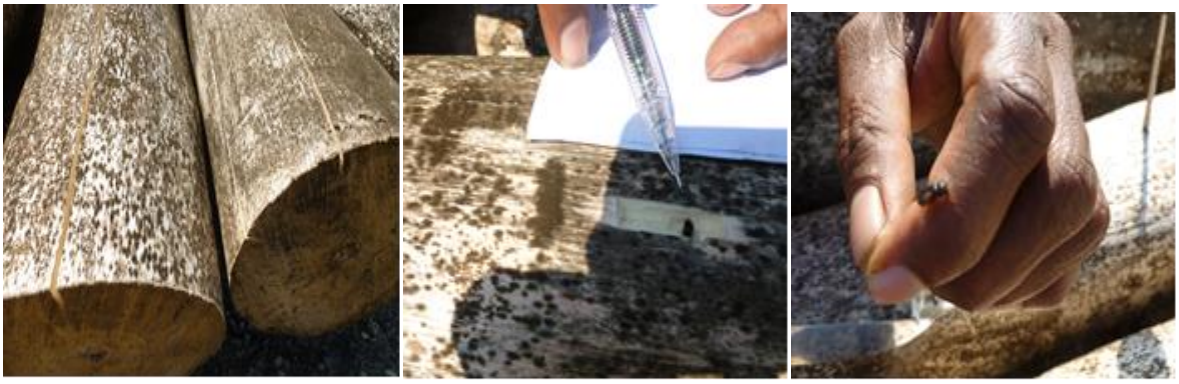


Figure 9: *Less blue stain, mechanical defects & Ambrosia beetles observed on poles air dried undercover*

Timber research facility (TRF)

To carry out the research activities under whitewood product development the project requires proper facilities to embark on these activities. According to the project document these facilities were anticipated to establish by the project. After few initial project consultations with its stakeholders especially the Department of Forest in Luganville and the Vanuatu Agriculture College, it was agreed for the project to renovate and upgrade the existing timber yard at Sapui, forestry Station into to timber research facility of TRF (Figure 10).

Figure 10: *Construction of timber research facility*

Figure 11: *Construction timber drying shed at TRF*

The other infrastructure build a TRF is the concrete slab in the main building where the pressure cylinder and the chemical tanks are, drip tank to stack poles and timber once remove from the cylinder, permanent timber drying shed (Figure 11) and temporary poles drying sheds.

Nevertheless, TRF still requires upgrading and installations of infrastructures operate efficiently. For instance installation of security fence and power supply for lights, air condition and equipment that need to install in the wood science laboratory. Additionally other equipment such as the rip and docking saws, pressure treatment plant require power. Currently the rip and docking saws do not operate efficiently with the power supply from the generator.

And very importantly the project needs to build a timber sale shed preferably at the DoF office in Luganville so that the consumers do not have to go to the TRF to buy timber, not only to avoid consumers expose to chemicals used at TRF but also safety for the equipment and materials at TRF.

Objective 2. Maximise value to growers through product development utilising lower value wood.

Associate Activity 2.1 Conduct product development research into the potential range of high value wood products from young plantation grown trees.

A search for opportunities to use small diameter trees from this project was conducted as part of an effort to improve the financial feasibility for the whitewood farmers. While there are few reports on products development from whitewood harvest from the natural forest, this project aims to identify potential products manufactured from small diameter trees thinned from whitewood plantation.

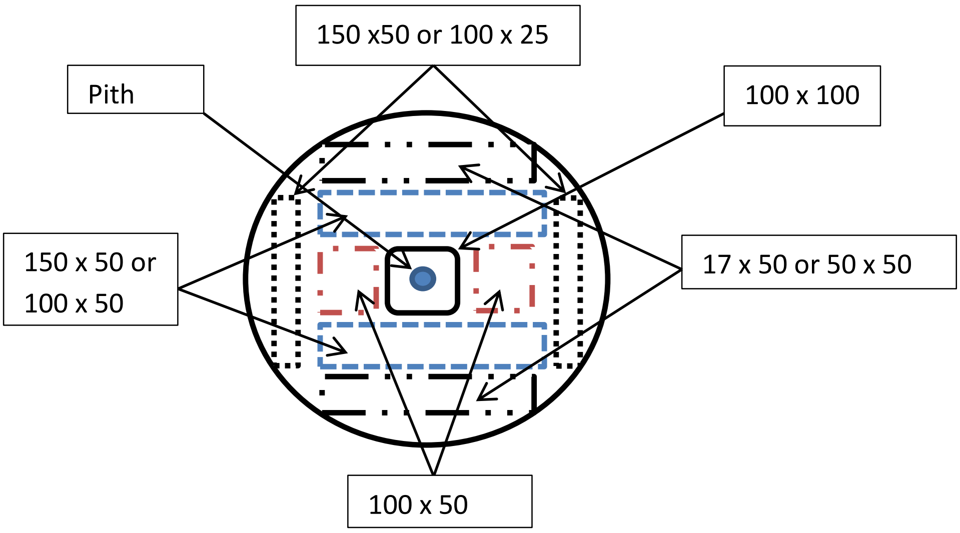
The investigation of potential opportunities for whitewood products is based on the existing product, processing and technology before moving to new products. The existing product opportunities includes structural timber, furniture, mouldings, panelling, finger joints and others while new product opportunities includes poles, biomass energy and other value-added products not listed in the existing products.

Sawmilling

Sawmilling as primary processing in the wood industry is very vital that the sawing techniques are correctly selected to ensure logs and boards are process into higher valued products such as furniture, joiner, mouldings and engineered wood products, most of which are normally associated with housing construction activities.

Plain-sawn is the sawing technique used to process the small diameter trees and not quarter-sawing technique. The reasons for selecting plain-sawing technique are; (1) to maximise sawing recovery from the small trees, (2) to maximise number of clear timber from the first opening cuts on each side of the log, (3) to make sure the middle size timber is either 100 x 100 or 150 x 50 so the pith in the middle of the log is in the timber and (4) whitewood is stable and liable to withstand the mechanical defects normally determining to avoid in quarter-sawing technique.

Figure 12: *Cross section of the log indicating where different sizes of timber are processed*



Correct positioning of the log on the sawmill rail considering the shape of the cross section of the logs, tapering and bending of the log is very important to maximise recovery. Nonetheless, with the small diameter whitewood logs, determining where the knots are likely to occur near the first few cuts is very important as well.

On the upper logs from the top section of the tree, knots in the log could be indicated by lamps on the bark and the logs but bigger logs from the base of the trees with smooth bark are unlikely to indicate. Therefore, determining which side of the logs knots are likely to appear in the first cuts is done before the logs are cross cut and skid to the ramp for debarking. In most circumstances the predeterminations of which side of the log the knots will occur closer or further in to the wood are correct. From observation this could have cause by closer planting space whereby branches in between trees are self-pruned early compared to the branches facing tree rows.

The first grade clear timber normally at sizes 150 x 25 and 100 x 25 processed from the side of the logs where knots are located further into the logs and larger sizes 75 x 50 or 50 x 50 are processed from the side of the logs where knots are closer to the surface (Figure 12). Once the log is sliced in all four sides, timber size 100 x 100 is marked around the pith of the log before other timber sizes are decided to process (Figure 12).

Figure 13: *Marking the levelling the logs on the sawmill rail before processing*

After the log is correctly positioned on the rail, the log has to be levelled so that the log is cut correctly. This is done by measuring from the pith of each end of log and the small end is always tilted with bearers to level the large end and small end of the logs. The log is again level (Figure 13) before the second side of the log is cut. Each timber is marked with a measuring tape before sawing.

The project purchased two sawmills a bandsaw and turbo circular saw operated by a chainsaw. The principle idea is to investigate the quality of timber and especially the recovery rate from the two sawmills.

The recovery rate from the bandsaw operated at Sara processing Malakae's small diameter trees range between 35 to 45 %. Lower recovery rate usually comes from smaller logs from the top of the trees.

In spite of the small diameter logs the rate of recovery recorded from the bandsaw is adequate. Having the option to turn the logs while cutting maximises the number of timber produce per log.

Timber quality and recovery rate recorded from the turbo circular sawmill will be provided in Mesek's annual report.

Figure 14: *Praying of first grade clear timber with mixture of Taratek and Tanamix*

Figure 15: *Envelope treatment of first grade timber with Borax at TRF*

The first grade clear timber are sprayed with a mixture of two anti-moulds, Taratek and Tanamix (Figure 14) straight after sawing to protect blue stain while drying at the timber drying shed at Sara before transported back to TRF. Timber graded as first grade are clear of knots and pith on the entire length of the timber. However, timber that has knots only on one face but none on the other faces (one face free) are also grade as first grade to use for bench and table tops, selves and other furniture except for mouldings which will snap at the knots.

Once the mc of the timbers are down to 20% or less the timber are bundled and immerged in a dip tank half filled with borax. How long the timbers are left immerged in the borax depends on the sizes of the timber. It is based on the theory that borax enters the timber at the rate of 25 cm or 1 inch per week through osmotic pressure. Thus, 100 x 25 and 150 x 25 are immerged for one week, 100 x 50 and 150 x 50 for two weeks and 100 x 100 for four weeks. When the timber are removed from the dip tank they again air dried to 20% mc before can be used by the furniture factories.

Figure 16: *Furniture manufactured from the small diameter trees harvested from Malakae's whitewood plantation at Sara, East Santo*

As mentioned previously, the two categories of investigating potential opportunities for wood products is based on existing and new product, processing and technology. The project made arrangements with Sim Construction and Joiner to manufacture two bedside tables, two coffee tables, book shelf, a stool, sample of door panel and samples flat/corner moulds, skirtings and stoppers (Figure 16).

Mr Kevin the overall supervisor for the joinery under Sim construction and joinery have indicated that wood working the timber from the small diameter trees is much easier from the old whitewood stand from the natural forest and the outcome or the presentation/features display is of no difference to old whitewood stand.

The only problem encountered in this first trial is the blue stain, even though the timber appears to have less blue stain on the surface of the timber it does spread inside the timber and show once the timber is dressed. There are two observations as to why blue stain occurred on the timber: (1) the timber is bundled without stakes to separate the timber and allow the timber to absorb the borax and (2) the timber bundle was left for too many days over the dip tank for the chemical to drip back into the dip tank. The blue stain starts to occur in between the timber during the dripping period. .

Associate Activity 2.2: Investigate preservative treatment options and treated product performance for whitewood.

Timber and wood pole treatment

The project adopts two methods of treating timber and poles harvest from the small diameter whitewood plantation namely pressure treatment and dip treatment. Pressure treatment is a process that forces chemical preservative into the wood. Wood is placed inside a closed cylinder, then vacuum and pressure is applied to force the preservatives into the wood. The perseverative helps protect the wood from attack by termites, other insects and fungal decay. Dip treatment is a process where wood is bundled and immersed in the dip tank to allow the chemical to absorb by the wood through osmotic pressure usually regarded as envelop treatment.

The two methods of wood treatment selected are based on the level of products the project is anticipated to produce from the small diameter whitewood trees. Pressure treatment is to treat structural timber and poles to durability hazard level 3 and 4 to extend the lives of wood products used in construction industry, increase their life to not by a handful of years, by to multiple decades. The dip treatment is to treat first grade clear timber for furniture factories.

Figure 15 *Pressure treatment of structural timber with coper azole preservatives*

The project uses copper azole (trade name Tanalith E) preservative to treat poles and structural timber. Copper azole is a water-based preservative that prevent fungal decay and insect attack, it is a fungicide and insecticide. Colour of the treated wood is greenish-brown and has little to no odour.

Copper azole is one of the new wood preservatives that have lower toxicity profiles when compared to older wood preservatives such as chromated copper arsenate that contains chromium, copper and arsenic. Copper azole contains copper and tebuconazole but not arsenic which is a metallic luster that forms poisonous compounds when heated.

Nevertheless, copper azole is still a preservative and TRF crews always wear safety gears while mixing the preservatives with water in the tank and treating timber. Currently treatment is based on H4 with a chemical mixing ratio of 30 millilitres per litre. Other durability hazard level such as H3 is still to investigate especially for interior and above ground structural timber. This is because timber preservatives are expensive and treating timber is the highest processing cost along the chain of whitewood production.

Graveyard trail

The method of testing durability of wood base materials outdoor in ground contact is known as graveyard test. This will enable the project to investigate the rate of wood decay from exogenous factors such as weathering and biological attack and endogenous factors emanate from the wood itself.

Tables 4*: Treatment combinations: Species/chemical/installation Code Species Chemical treatment*

Code	Species	Chemical treatment	Installation treatment
WW/CA/E	Whitewood (WW)	Chromated copper arsenate (CCA)	Earth (E)
WW/TE/E	Whitewood	Copper Azole (CA)	Earth
WW/TE/CL	Whitewood	Copper Azole	Coral (CL)
WW/TE/CT	Whitewood	Copper Azole	Concrete (CT)
PR/CA/E	Pine *radiata* (PR)	Chromated copper arsenate	Earth
NM//E	Namamau (NM)	None	Earth

Also u or d on the end signifies cut end up or down

The treatment combination for the graveyard provided by Geoff Smith in table 4 will experiment on Santo and Efate. Tree species are selected for the experiment, whitewood poles treated with copper azole at TRF (H4), whitewood poles treated with CCA by Santo Veneer (H4), Pine *radiate* from New Zealand (H5) and namamau poles with no preservative treatment. The poles from the respective species will be buried according to the installation treatment provided in table 4.

The installation treatments are selected based on the common practises builders and farmers use to build houses, home fencing and livestock fencing. Geoff and Graeme will provide training to the Forest officers responsible to monitor and record the level of decay over the years once the project ceased.

Associate Activity 2.3: Investigate structural product options for non-appearance grade whitewood.

This associate activity aims to investigate how the lower grade wood in structural applications requires quantification of the mechanical properties of small diameter whitewood trees. However, this associate activity will be implemented in 2016.

Whitewood structural timber testing

The project will build a wood testing machine to test the strength of the structural whitewood timber and provide wood quality parameters for structural applications to consumers.

Objective 3. Enhance landowner knowledge and participation in the production of wood products for local and export markets.

Associate Activity 3.1: Conduct cost benefits analysis for harvest and primary processing at central point or using mobile sawmilling techniques, including the opportunity for cooperative single desk selling logs to processors versus woodlot growers acting autonomously.

The data for this activity that aims to identify crucial economic parameters for the main opportunities for value adding for landholders are in progress from the previous associate activities. Once the data collection is completed it will be analyse to provide whitewood farmers various economic scenarios regarding different sizes of whitewood plantations, processing facilities and cooperative local processing.

3.2. Identify and test what forms of grower organisation are feasible and sustainable, and will improve knowledge transfer among growers, improve grower marketing of products and therefore increase returns to smallholders.

This activity that aims to discussions about formal grower groups to assist in dissemination of knowledge, encourage grower participation in policy formulation and decision making and provide a framework for centralised cooperative processing and group marketing is well undertaken by Cherise.

This work will build on relationships established with landholders in the first project conducted in collaboration with DoF.

3.3. Utilising available data on growth, stand management, resulting products and markets, investigate financial returns of stand management and market scenarios for various grower situations.

This activity will shed light on the profitability of various silvicultural options being researched. Financial analyses of different silvicultural and market scenarios for agro-forestry and plantation grower situations will include comparison of returns with and without intermediate products (including food crops in agroforestry systems, small roundwood in plantation systems) will be implemented in 2016.