

The Whitewood (*Endospermum Medullosum*) Value-Chain in Vanuatu and Impediments to Development of a Plantation-Based Industry

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Abstract Whitewood (*Endospermum medullosum*) is native to Vanuatu and has been designated as a priority species for plantation development by the Vanuatu Government for timber production after exhaustion of available natural forest supplies. Domestication is well advanced, with first and second-generation seed orchards and considerable silvicultural research having been accomplished, yet development of a plantation estate has been slow. This study analyses the value chain of whitewood on the two main islands of Efate and Santo that have land suitable for growing whitewood, most of the existing processing facilities and the main markets for whitewood products. The value chain is described and pricing along the chain is presented. Interviews with stakeholders identified impediments to the expansion and development of whitewood plantations. Despite a value-added chain existing, the price available to growers often reflects native forest timber prices that are inadequate given the input costs associated with plantation development, therefore providing little motivation to grow whitewood. There is a trend in the market for the highest profits to be taken by owners of key timber processing plant such as portable sawmills, kiln dryers and preservation vessels. However, prices achieved for processed whitewood products generally do not match those of radiata pine products, indicating potential for greater returns for growers and other stakeholders. As a result, landholder participation in plantation establishment is low and is dispersed as many small woodlots. Small-scale growers and processors face

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technical challenges, including growing of high quality and value stems and timely treatment of sawn timber. Greater capacity for consistency of product quality and the development of new products to maximise utilisation will improve revenue flows to growers.

Keywords Value adding · Timber product development · Round wood products · Market chain

Introduction

The transition from a native resource to plantation development is a common problem in the forest industry and presents challenges to growers and processors (Evans and Turnbull 2004; Nichols et al. 2010). In such situations, although there are existing markets, the establishment, growing and management of plantations (Montagu et al. 2003; Kearney et al. 2007; Smith et al. 2012; Glencross et al. 2012) and the nature of wood products produced (Smith and Brennan 2006; Warren et al. 2009; Virannamanga et al. 2012) are often very different to those of native forests. Similarly the value chain that deals with plantation timber may require new technology, often in the form of processing facilities designed for smaller, faster grown logs, and subsequent adjustment of existing market chains. This paper examines the market chain for whitewood, a native timber species in Vanuatu for which native forest supplies are almost unavailable and a plantation program has begun.

Plantation production of trees in smallholder woodlots will be necessary where land tenure systems dictate such land use. Conversely, tree products can be an important part of livelihood diversification for small landholders. However, where smallholders are the main producers there are several areas where market chains can be dysfunctional (Aoudji et al. 2012; Midgley et al. 2012). These include lack of market information and high transaction costs (Aoudji et al. 2012), including transaction costs associated with government fees and charges, as well as lack of access to information and skills to solve technical issues such as production of high quality and certified products that are suited to market (Midgley et al. 2012).

Scherr (2004) explained that small farmers are relatively more competitive in open and well-defined niche markets where there are no economies of scale and low cost barriers to entry due to government policies and regulatory support measures. For instance, the smallholders of rubber (*Hevea brasiliensis*) plantations in Malaysia and Thailand are becoming competitive in the local, regional and global markets in both latex and wood products through government subsidies supporting replanting, processing and marketing. Because of strict control on the harvesting of natural forests, both countries explore and promote value-adding of lesser-known timber species including rubber trees. The proportion of rubber wood production exported in Malaysia increased from 26 to 35 % and that of Thailand from 40 to 70 % between 1998 and 2007. The highest proportions of these exports has been of furniture, 80 % in Malaysia and 90 % in Thailand (Shigematsu et al. 2011).

There is a large land base on Santo suitable for new whitewood development (Grant et al. 2012a). The available land is of sufficient quality that establishment of

whitewood does not require capital investments such as ripping and fertilising to enhance growth (Smith et al. 2012) and growth rates of 20 m³/h/year have been recorded in stands of unimproved genetic material that have received minimal management (Grant et al. 2012a). Whitewood was also successfully grown at stocking density ranging from 400 stems per hectare (suitable for agroforestry situations) to over 1,000 sph (Glencross et al. 2012). Whitewood has highly desirable wood properties (Groves and Wood 1998) and similarities with radiata pine with which it competes in the market. Early results from wood quality testing showed high stability in drying and good penetration of preservative treatment, providing a sound basis for product development (Viranamangga et al. 2012).

There appear to be few biophysical impediments to the establishment of a successful whitewood plantation estate, and some factors provide an excellent basis for a profitable plantation program. The Vanuatu Department of Forests has already had policies in place to encourage plantation development for many years, providing genetically improved planting material and technical advice on tree planting and management to farmers. In spite of this history of promotion of whitewood plantations and the favourable environmental conditions, only a small number of woodlots have been established by small landholders. Aru et al. (2012) reported that 139 whitewood farmers surveyed on Santo had planted only 63 ha of whitewood since the early 1990s, while 270 ha were planted by a single leaseholder (Melcoffee Sawmills) in 1993. The average size of the small-farm forest was <1 ha.

This study was designed to investigate the value chain for whitewood using the value chain analysis methods described by Kaplinsky and Morris (2002), and to explore why there has been so little whitewood plantation establishment. More specifically, the current impediments to the development of a whitewood plantation estate, in terms of wood processing and distribution of pricing along the value chain are investigated. The study comprises several elements of value chain analysis: it describes the structure of the chain from growing through to consumption of various products, the pricing structure along the chain to infer power relations through the chain and where any bottlenecks may be occurring, and any technical or other issues that may be preventing participation or limiting utilisation. The latter is especially important given the complexity of forest value chains and the variety of products that can be produced. The governance and institutions relevant to the whitewood value chain are briefly reviewed but are not investigated in this study.

Forestry Development in Vanuatu

Vanuatu is an archipelago comprising 86 islands that stretch approximately 1,400 km from north to south, between the latitudes of 13–21° South and longitudes 166–172° East, in the western Pacific Ocean (Fig. 1). In Vanuatu and elsewhere in the Pacific deforestation has reduced living standards and opportunities for economic and social development. Forestry and the people of rural communities are inseparably linked as the land is both a source of cash income and a source of a wide range of locally made products, and provides food, water and environmental services which contribute to the livelihood of the communities. Forestry is also a

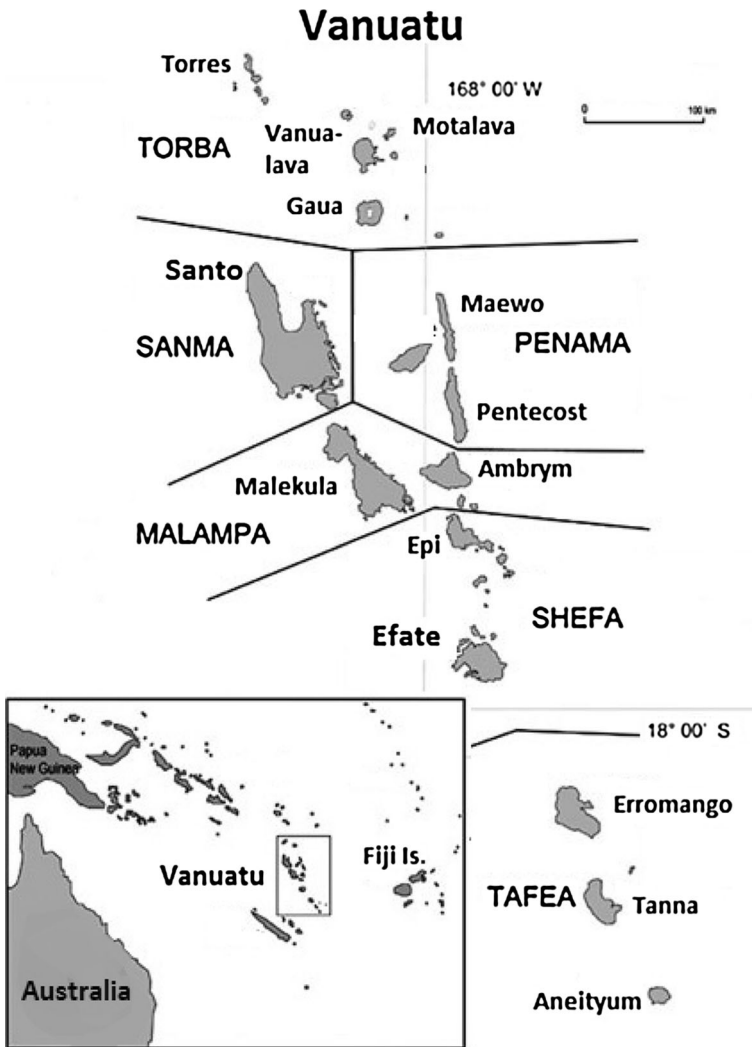


Fig. 1 The location of Vanuatu and the study islands of Efaté and Santo

source of revenue collection for government through various forms of taxes and permits in commercial forestry operations. Ownership and management of forestry resources are primarily the responsibility of traditional landowners as specified in Articles 7d and 7 l of the Vanuatu Constitution. However, the Vanuatu government is also committed to ensuring that forests are managed on a sustainable basis.

Large-scale deforestation in Vanuatu began after the arrival of the European settlers in the early 1900s, mainly to establish cattle grazing and crops including coconuts, cotton and coffee. Pressure on natural stands of whitewood continued to grow as indigenous people changed from traditional small shifting cultivation to meet their basic food requirements and traditional ceremonial needs, to subsistence

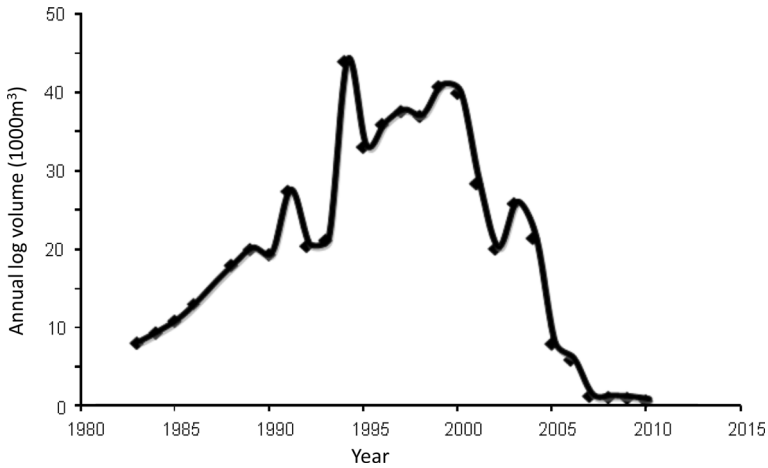


Fig. 2 Vanuatu annual log production, 1983–2010, *Source* Viranamangga (2010)

farming combined with efforts to earn cash in the commercial society brought in by European settlers. Early logging targeted dense durable timber species, and it was only in the late 1980s and early 1990s that the lighter-coloured low density timbers, particularly whitewood (*Endospermum medullosum*), were discovered to be excellent timber species. At this time three Malaysian logging companies entered the country in competition with five existing logging companies, creating a situation of exploitation in which the remaining merchantable volumes of whitewood were removed within <15 years.

The trend in annual log volumes harvested from the natural forests for the entire country increased and decreased very rapidly between 1983 and 2010 (Fig. 2). The highest peak in cutting, 1994, represents a large volume of *Callophyllum neoebudicum* that was harvested at Ipotia and Erromango Islands for export. The last logging peak in 2005 was the harvesting of whitewood on Pentecost Island. The volume harvested after 2005 was mainly processed in portable sawmills, with log volumes continuing to decrease due to the reduced supply of merchantable timber in natural stands. The diminishing volume of native forest timber has been replaced by imported pine from New Zealand and Fiji, and processed wood products including rubberwood furniture from Asia.

Forest plantation establishment was introduced in Vanuatu during the early 1970s with the aim of producing wood on a medium to large scale for both domestic and export markets. The shift of whitewood supply from natural forests to planted forests brought about a new era in the country's forestry sector. The Department of Forests reviewed its National Forest Policy and regulations to accommodate the shift, and particularly to facilitate small farmers in rural areas to economically harvest and trade their plantation whitewood.

Early planting efforts concentrated on introduced species, particularly *Cordia alliodora* (Leslie 1994). These efforts were discontinued when many introduced species failed to survive cyclonic weather conditions and pests and diseases that

characterise the growing environment in Vanuatu. A shift in focus from introduced species to native species led to a new arrangement where forests were established by landowners. Whitewood was one of five species prioritised by Department of Forestry for plantation development due to the suitability to growing and market conditions. Whitewood has proven performance in resisting wind damage and for having few problems with pests and diseases, especially brown root rot (Ivory and Darubi, 1993; Wu et al. 2011; Fu et al. 2012). Seed orchards of whitewood were established in 1998, as part of the South Pacific Regional Initiative on Forest Genetics which lasted from 1996 to 2006, and of targeted domestication of various native tree species in Vanuatu, Solomon Islands, Samoa, Tonga and Fiji (Thomson 2011).

Research Method

Whitewood value chain analysis and investigation of impediments to development of the industry were carried out on the islands of Santo and Efate, Vanuatu. These islands were chosen because they contain the two largest urban areas in Vanuatu and are the main markets for whitewood products. The two urban areas of Port Vila and Luganville also have most of the industry infrastructure that processes whitewood into various products. Santo is the largest island in Vanuatu and has a large area of land suitable and available for forestry within a transport distance to Luganville and was therefore be expected to have the greatest concentration of growers.

The reference populations of stakeholders in this study were whitewood farmers or producers, processors (including sawmillers, timber yard owners, and value-adding processors) and consumers. Farmers or producers include all individuals or companies that are involved in whitewood plantation establishment and management. Processors are all individuals and companies who are involved in value-adding and marketing of whitewood forest products. Consumers are individuals and companies that use but do not trade whitewood products. For instance, construction companies may be involved in value-adding, including producing engineered products and furniture making but because these activities are part of their construction agreement with the building owner these companies are categorised as consumers. However, if they are involved in trading of value-added whitewood products outside housing construction then they are categorised as value-adding processors. There are individuals and companies involved in more than one category and they were surveyed according to each level of operation. After initial surveys were conducted, the study was extended to Noumea in New Caledonia during the second phase of data collection, to include consumers of exported wood.

Each of the stakeholder groups were sampled to ensure as complete and unbiased as possible representation of each stakeholder group. A list of farmers and details of their locations were obtained from a previous forestry farmer survey completed by the Department of Forests. The sampling of farmers was stratified from each of four regions growing whitewood on each island; 10 from each region on Santo and 5 from each region on Efate, to ensure any variation between regions was captured. The farmers selected for interview were chosen using both random and judgemental

Table 1 Number of stakeholders surveyed by type and location

Stakeholder group	Stakeholder sub-type	Island	
		Santo	Efate
Farmers and other growers		40	20
Primary processors/sawmillers	Chainsaw mini-mill	1	0
	Portable mill	8	4
	Forest mill	1	0
Secondary processors	Timberyards	3	3
	Furniture manufacture/joinery	7	4
Consumers	Domestic—builders	8	8
	Domestic—individuals	1	4
	Foreign companies—noumea		
		69	43

sampling. Primary processors (sawmillers) were identified from the operator license database of the Department of Forests. Several that were not on the database were identified from Forestry Extension officers and secondary processors. The sampling of secondary processors and consumers involved random, judgemental and snowball sampling. Snowball sampling is commonly used in business and marketing research to discover the sellers and buyers of any particular product (Malhotra 2004). It has been widely used especially when respondents are difficult to identify and are best located by referral networks (Emory and Cooper 1991). The list of consumers was obtained from several sources, including the Department of Forests and Forestry Extension officers, and asking whitewood producers and processors who customers were. The number surveyed in each stakeholder group is presented in Table 1. In total the sample comprised 60 tree growers, 14 primary processors, 24 secondary processors, 21 timber consumers and 3 foreign company's.

Due to the contraction in the whitewood industry caused by the reduced supply of whitewood from natural forests, the number of stakeholders interviewed in the primary and secondary processing categories constituted almost all those still processing whitewood. Consequently, the sampling intensity of the processing category was very high compared to that of growers and consumers.

Surveys of stakeholders were conducted to collect data about the attitudes, perceptions and behaviour of individuals in the whitewood value chain. Given the diverse social and business environment, personal interviews were considered most appropriate. A questionnaire was used to survey stakeholders using both qualitative and quantitative methods. Both closed and open-ended questions were used, following the processes described by Malhotra (2004). Combinations of closed and open-ended questions are highly useful during surveys to ensure all the response categories are covered (Pallant 2011). Questions covered the operation of the businesses and the pricing of whitewood products, as well as problems encountered by stakeholders in business operations. Stakeholders were also questioned on the level of knowledge about technical aspects of whitewood growing and processing.

This knowledge is important in producing high value wood products where growing and processing conditions can have a large effect on product quality.

Results

Description of Whitewood Value Chain

Farmers were found to sell whitewood logs from natural and planted forests to sawmill companies which process them and sell to timber yards, value-adding processors or directly to consumers. Timber yards and value-adding processors dry, preservative-treat and value-add the timber to finished products and sell to consumers. A diagram of the relations between stakeholders is presented in Fig. 3. Many operations are vertically integrated; for example, some farmers who own mobile sawmills and some timber yards also operate building companies. Owners of the largest plantation also own sawmills and treatment facilities and sell directly to consumers. The role of each stakeholder group is described below.

Growers and Smallholder Farmers

Growers include smallholder farmers growing woodlots on customary land, and leaseholders growing commercial plantations. Excluding the two largest growers, of the farmers interviewed 97 % of the planted area is on customary land and 3 % on leasehold land. Landholders still sell small quantities of native forest logs, although the supply is now almost exhausted. Woodlots average just over 1 ha in area and have been established since 1993. There are only two large growers with 270 and 25 ha on Santo and Efate respectively. Most of the smallholder plantings are established as agroforestry with crops grown between the trees for the first one to

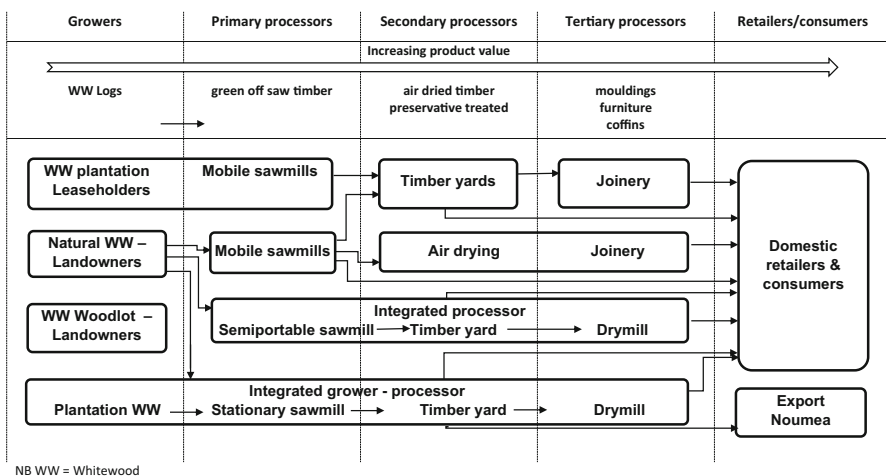


Fig. 3 Whitewood value chain showing stakeholder groups, products and product flows

three seasons depending on the initial spacing. The estimated total planting for 40 farmers on Santo was 67.7 ha and that of 20 farmers on Efate was 44.6 ha. Only the two largest growers and one other are currently harvesting from their plantations.

Primary Processors—Sawmillers

There is only one stationary sawmill and one semi-stationary Mahoe sawmill, both located on Santo. The stationary sawmill is owned by Melcoffee Sawmills Ltd and processes the company's own plantation logs and also value-adds to the green timber by drying and treating. The remainder are mobile sawmills, most of which are Lucas portable sawmills (70 % on Santo and 100 % on Efate). Of the mobile sawmill operators, 85 % process logs from natural stands and 15 % process plantation logs. Most are also involved in farming and other businesses. In recent years five portable mill owners on Santo and three on Efate have extended operations to add value and maximise returns. These portable mill owners now undertake secondary processing of green sawn timber (mainly air drying), and selling in timber yards. There are major challenges in transportation because road infrastructure is poor and roads can be unpassable during the wet season. Timber is normally transported to timber yards and secondary processors by sawmill operators, but occasionally during periods of short supply secondary processors will transport the timber. A major problem for portable sawmill operators is getting timber to drying facilities before blue stain effects the appearance of the timber.

Secondary Processors—Timber Yards and Value Adding Processors

Timber yards are the main suppliers of whitewood products; 75 and 81 % on Santo and Efate respectively. They purchase green rough sawn timber from portable sawmillers, although on Santo the majority of timber yards also own sawmills. Green rough sawn timber is then further processed by air drying, kiln drying, vacuum or pressure preservative treated and dressing before sale to consumers. On Efate timber yards also import timber, mainly radiata pine from New Zealand. Three pressure treatment plants operate on Santo, while the one plant on Efate operates sporadically due to limited supply of whitewood. Secondary value-adding processors also purchase timber from mobile sawmills and then process this into furniture and mouldings. Many of these value-adding processors also own building companies, which are the main market for mouldings and furniture. All the secondary processing businesses are large enough to have employees.

Consumers of Whitewood Products

The majority of consumers of whitewood products were found to be builders and joinery firms. Preservative-treated whitewood timber was the most commonly used product. Whitewood is preferred to imported pine because it has superior characteristics. Whitewood mouldings are more common on Santo (26 % of consumers) than Efate (12 %) where imported pine is preferred. The majority of the whitewood consumers on Santo (40 %) and Efate (42 %) preferred furniture

Table 2 Market chain pricing for various whitewood products

Stakeholder	Species	Product	Grade	Buy/ sell	Efate		Santo	
					N	Price (Vt/m ³)	N	Price (Vt/m ³)
Farmers	WW	Logs		Sell			1	8,000
		Logs— native		Sell		2,200–4,400		2,200–4,400
Sawmiller	WW	GoS	1	Sell	10	35,000–40,000	11	28,000–40,000
			2	Sell	8	15,000–17,000	9	16,000–25,000
Timber yard	WW	GoS	1	Buy	4	35,000–50,000	3	25,000–30,000
			2	Buy	2	35,000–35,000	2	16,000–18,000
		Air dry	1	Sell	3	60,000–70,000	0	–
			2	Sell	1	50,000	0	–
		Treated	1	Sell	1	85,000	3	50,000–50,000
			2	Sell		–	3	30,000–35,000
Joineries	WW	GoS	1	Buy	2	30,000–40,000	3	28,000–40,000
			2	Buy	2	18,000–25,000	2	18,000–25,000
		Air dry	1	Buy		–	2	30,000–45,000
			Treated	1	Buy		–	2
		Mouldings	1	Sell	1	426,000	1	392,000
			2	Sell			1	258,000
Consumers— mainly builders	WW	GoS	1	Buy		–	1	28,000
		Treated	1	Buy	2	50,000–50,000	6	42,500–52,500
		PR ^a Dry treated	1	Buy	11	64,583–127,255	5	65,875–140,000
Foreign consumer	WW	Treated	1	Buy			1	64,900

^a *PR* *pinus radiata*—included for comparison, *WW* whitewood, *N* number of businesses sampled, *GoS* green off saw

manufactured from local hardwood species over whitewood furniture (Santo 17 % and Efate 10 %). However, furniture manufactured from whitewood is much less expensive and therefore more affordable compared to hardwood species, and therefore the market for whitewood may be larger than these preferences imply. No consumers interviewed purchased or preferred imported furniture.

Pricing Within the Whitewood Market Chain

Table 2 provides a summary of the prices paid and received by stakeholders in the marketing chain on Efate and Santo described in Fig. 3. It provides insights into the production and transaction costs and marketing margins within the chain. As an example, first grade green sawn timber sells for approximately 30,000–40,000 vatu/m³ (Vt¹) on both islands, with prices slightly higher on Efate than Santo. Prices on

¹ Vt = vatu. 100 vatu is equal to approximately US\$1, as of Oct, 2014.

Efate are much higher for air dry and treated whitewood of 60,000–70,000 and 85,000 Vt/m³ respectively. This is comparable to the price of imported radiata pine which dominates the timber market in Vanuatu, and in particular in Port Vila. The price for treated whitewood is considerably lower than that for treated pine on Santo.

The stumpage prices paid for logs (what growers receive for standing trees) are in many cases only 2,200–4,400 Vt/m³. However the price currently being paid for plantation logs by Melcoffee sawmills on Santo of 8,000 Vt/m³ represents a price that would be sustainable for growers (Grant et al. 2012b). These authors showed that under a wide range of silviculture regimes, based on realistic growing and production costs and using a discount rate of 5 %, a log price of 8,000 Vt/m³ represents a high net present value to growers.

Most growers have yet to thin or harvest logs from their whitewood stands. However, none intend to sell logs for the low prices traditionally paid for native forest trees. Most intend to sell green sawn timber after primary processing. The range of prices anticipated for green sawn whitewood timber by growers is approximately 35,000–45,000 Vt/m³, which is comparable to current prices. The approximate production costs given by mobile sawmillers for green sawn timber of 13,000–17,500 Vt/m³ leaves a reasonable margin for growers and for sawmillers to cover log prices, transport, marketing and profit. The average processing costs are comparable with the estimated processing costs reported by Smorfitt et al. (2003) for portable sawmills and stationary sawmills for high-value rainforest cabinet timbers in northern Queensland.

Due to the high cost of kiln drying no timber yards have an operational kiln and therefore air drying is used. The cost of air-drying by timber yard owners was difficult to estimate because whitewood timber is not usually air seasoned before selling. Value-adding processors as the main consumers of air-seasoned whitewood timber purchase either from timber yards or directly from sawmillers and air-season the timber to the moisture content required for the products they manufacture at their processing sites. There is only one preservative treatment cylinder on Efate and it operates only intermittently.

Discussion

For a whitewood industry to succeed, there needs to be a sufficient supply of logs, and several factors are working to discourage the planting of whitewood by both large investors and smallholder farmers. A disincentive for farmers is the low price for logs of 2,200–4,400 Vt/m³. This price stems historically from the harvesting of native forest trees and does not reflect the cost of producing whitewood logs in plantations. After an investment of 200,000–300,000 Vt/ha to establish a plantation, these prices represent a loss to plantation growers (Grant et al. 2012b). However the low price also reflects the current low utilisation of whitewood. In many cases only first grade clear timber has been used and any lower grade material discarded. Markets are needed for knotty material which makes up a large proportion of the logs (Viranamangga et al. 2012).

The log price noted in the survey for the largest plantation (8,000 Vt/m³) is sufficiently high to encourage plantation establishment. It is also comparable to plantation softwood log prices in New Zealand, which is the primary imported competing resource. New Zealand group “Agrifax” reported unpruned radiata pine logs to 20 cm small end diameter (SED) are selling for A\$95/tonne (approximately 9,500 Vt, accessed April 2013) delivered to a wharf for export. Grant et al. (2012b) suggested a net present value of A\$8257 (825,700 Vt/m³) after 33 years may be achieved at log prices of \$50/m³ (5,000 Vt/m³) for up to 30 cm SED and \$80/m³ (8,000 Vt/m³) for up to 75 cm SED. Plantation growers will be motivated to establish plantations by returns on the investment. Current prices based on native forest royalties would represent a loss to growers.

The government of Vanuatu has pursued several policies and support programs to encourage whitewood planting since the early 1990s (and more recently for other priority species). These included: (a) a free seedlings policy adopted by the Department of Forests in the early 1990s to promote whitewood planting in the rural communities in which each year approximately 18,500 seedlings were distributed to farmers in the entire nation; (b) green timber licenses with a 10-year duration given to Melcoffee Sawmills and Santo Veneer in 1995 to promote a replanting program; (c) the declaration of 2001 as a year of reforestation by the Vanuatu government, during which free seedlings and nursery materials were distributed; (d) nursery and woodlot establishment projects of the Department of Forests’ development partners including FAO, NZaid and the SPC-Venezuela Project. Despite these policies the total area planted with whitewood consists of small woodlots and two larger plantations. The current resource will not support an industry given the capital requirements for plant needed in many standard timber processing steps, e.g. kiln drying (10,000,000Vt), pressure vacuum preservative treatment (50,000,000Vt) and finger jointing (20,000,000Vt).

Among the 60 whitewood farmers interviewed, 65 % responded that woodlot site preparation was completed by themselves, along with families and friends, 5 % employed casual workers and 10 % hired social groups such as womens’ groups, youth groups, sport clubs and associations. This trend indicates the landholders are not motivated to spend financial reserves on plantation establishment, but are willing to invest their labour.

Plantation establishment incurs the largest cost in a rotation and it is the main investment hurdle that must be carried for a long period. The important decision on tree spacing affects the continuing commitments to thinning and pruning, and therefore the quality of logs, possible wood products and potential financial return. Whitewood farmers on Santo and Efate adopted their own methods of site preparation from shifting cultivation, through slashing and burning weeds and secondary growth undertaken by hand, not employing mechanical or chemical techniques. The most common plantation establishment spacing of 5 m × 5 m (adopted by 60 % of growers) was recommended by the Department of Forests based on trial results. This spacing implies thinning at least once to promote growth of selected stems to large commercially valuable sizes (Cassidy et al. 2012). The technical and financial concept of non-commercial thinning was not accepted and not permitted by farmers. The unwillingness to thin is consistent with the findings in many places where farmers

do not understand the concepts of larger trees having increased value (e.g. Baynes et al. 2011 in the Philippines) or increased growth after thinning of retained trees. The current whitewood farmers are faced with the problem of not having sufficient understanding of forest plantation planning, management, potential end-products and markets (Price 1989; Russell and Franzel 2004).

The timber processing sector in Vanuatu is small. In fact, it was possible to collect data through a census of all 31 processors involved in primary sawing or value-adding processes. The available infrastructure is remnant from a history of a larger-scale industry that processed native forest resource, and is currently in decline due to diminishing resource. This situation leads to aberrant market conditions that limit competition and competitive pricing. For example, the processor survey revealed that logs could be purchased for between 2,200 to 4,400 Vt/m³, equivalent to 5,500–11,000 Vt/m³ sawn timber after 60 % wastage from sawing. The sawn timber can then be sold for between 38,000 and 49,000 Vt/m³ having incurred a cost of sawing of 13,100–17,500 Vt/m³, a profit margin of over 100 %. Similarly, the increment in timber value through preservative treatment is substantially higher than the cost of this process. That is, green sawn wood can be purchased for approximately 38,000–49,000 Vt/m³, air dried and preservative treated at a cost of 8,700 Vt/m³ and then sold for up to 93,000 Vt/m³, a profit margin of approximately 100 %. Preservative treatment is mandatory to prevent degrade due to staining fungi soon after sawing, or protection from insect attack. There is a trend in the market for owners of plant to capture most of the value added in the chain while wood producers are not covering their costs at current prices.

Of note is the lower price of treated whitewood and whitewood mouldings compared to radiata pine. Only in Port Vila and the export market in Noumea does the price approach that of radiata pine. This may be due to the inconsistent supply and perhaps inadequate quality control for dry and treated products. However, there is scope for whitewood to compete with pine and for returns throughout the market chain to be greater for all stakeholders, if impediments to growing whitewood can be overcome.

Conclusion

Forests are important to communities in Vanuatu because forests yield environmental services, materials, food and cash. In Vanuatu, the exploitation of native forests has all but exhausted the wood supply. Rebuilding a timber industry has been identified by the government of Vanuatu as an important economic and social development goal.

Analysis of the value chain of whitewood from forests to consumers has exposed a number of impediments to industry growth. The most important factor is the low value attributed to logs based on historic prices applied to native forest resources. This results in little motivation to grow whitewood. As a result the area planted to date is small, and is dispersed into many small woodlots. This resource is insufficient to underwrite needed investment in processing plant. However, products produced from whitewood generally attract lower prices than equivalent radiata pine

products. Farmers also have limited knowledge of forest management in respect of how to produce stems of high final value, and many woodlot stands are unmanaged, comprising smaller poorly formed stems.

There is a trend in the timber market for the high profits to be taken by owners of key plant (portable sawmills, kiln dryers, preservation vessels), with a much smaller return to tree growers. To encourage whitewood planting a price that reflects the cost and risks associated with growing plantation trees needs to be established.

Several technical challenges also need to be confronted by growers and processors. Trees need to be dried or treated quickly after harvest and sawing to protect timber from bluestain. Portable milling, drying and treatment technologies that are appropriate for relatively isolated rural communities would enable greater participation in the market. There is currently no market for much of the wood produced in a whitewood plantation. The development of products that utilise lower value knotty wood and thinnings would greatly increase financial returns to growers.

Before a timber industry can be rebuilt based on plantation-grown whitewood, these impediments must be overcome to increase returns to wood growers and provide drivers for substantially higher plantation establishment rates.

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