STUDY ON ECONOMIC VIABILITY OF GENERATION FOREST

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For: Community and Forest Foundation

Contents

1. Introduction

This study has been elaborated for the Community and Forest Foundation. The purpose of this study is to evaluate the economic viability of the Generation Forest. The Generation Forest is a mixed plantation forest with new establishments over the course of years to create a forest stand with diversity in both species and trees of all ages, resembling as much as possible the characteristics of a natural forest.

The Generation Forest as a concept has been developed by Futuro Forestal S.A., an enterprise founded in 1994 and active in forest plantations in different Central American countries. The Community and Forest Foundation decided to study the economic feasibility of the Generation Forest.

This study has been elaborated to test this economic feasibility. In the first part of this study, timber prices of 16 tree species that will or could be incorporated in the Generation Forest were investigated. All of the included species are native to Central and South America, except for Teak, and apt for use in forest plantations.

In the second part of the study, the author analyses the economic feasibility of the Generation Forest based on the investigated prices and through a financial model that simulates the cash flow and economic profitability of the Generation Forest. It simulates a case of a 500 hectare productive forest project in Panama.

The author would like to express its sincere gratitude to all sources that contributed in providing price information, and to the technical team of Futuro Forestal S.A. that greatly during both the prices study and the development of the economic model.

2. Timber Price research

The market of timber is not transparent: no international trade database exists that registers species and prices of trades for different products. Closest comes the bimonthly ITTO Market Service Information that reports on prices of a variety of timber species and products throughout the world, though its data is limited to most commonly traded species and certain products are only recently tracked. The author therefore relied on the information provided by sources all over the world but mainly from the Latin American region, including information provided by forest professionals and traders.

All indicated prices in this study are expressed in USD/M3 unless stated otherwise. If certain sources provided prices in different currencies or units, the author converted these to USD/M3 to make information comparable for the reader. As far as the information was provided by the source regarding product or price specification, the author included these specific details (e.g. sawn or dried timber (AD/KD), lengths and diameters for logs and).

The purpose of this price study of 17 different species is to obtain general price levels for species that can be used in the Generation Forest. As produced timber could be marketed in both the domestic and international market, the author tried to obtain data for both markets. Apart of international prices, the author tried to obtain prices from Panama and the Central American region – for some species prices from South America were included (domestic or international prices). In chapter 3 of this document an estimate of prices was made to apply in the economic model, used to calculate the economic profitability of the Generation Forest.

i. Teak – Tectona Grandis

Teak is a tropical hardwood species native to South and Southeast Asia such as India, Sri Lanka and Indonesia, but particularly in Myanmar which harbors half of the teak in natural forests. Teak timber is particular valued for its durability water resistance and its appearance and is used in e.g. boat building, exterior construction and furniture.

With natural teak becoming scarce, plantations of teak all over the world have attracted private investors, resulting in an area that is overall still increasing. Estimates range from 4.3 to 5.9 million hectares worldwide with 133,000 hectares to 250,000 ha [1]) in Central and South America[2]. With a worldwide production of 2.0 to 2.5 million M3 per year, of which approximately 20% comes from natural forests, teak takes up a share of less than 2% of the global market in terms of volume, though in terms of value this is probably higher. In terms of trade, India is a mayor player accounting for approximately 75% of global teak imports, followed by China and Vietnam[3].

Despite the species being one of the most important tropical hardwood species, no good international price database exists nor do commonly agreed log grading rules exist to easily compare prices. Quality and value of teak depends on its dimension, bole shape (roundness and straightness), heartwood/sapwood ratio, regularity of annual rings, number of knots, color, texture and the soundness of the butt log. Teak timber from natural forests is normally higher valued than plantation teak, counting with characteristics for higher-valued sizes such as larger size, different coloring, texture and a higher proportion of heartwood. Yet, natural (often protected) teak forests do not meet the high global demand of teak timber (products), making timber from teak plantations an increasingly interesting commercial product.

International timber prices

Myanmar, counting with almost 50% of natural teak forests produces approximately a quarter of globally reported teak supply[4]. The author decided to include long-term price trends of Myanmar logs[5], with data available since 1998.

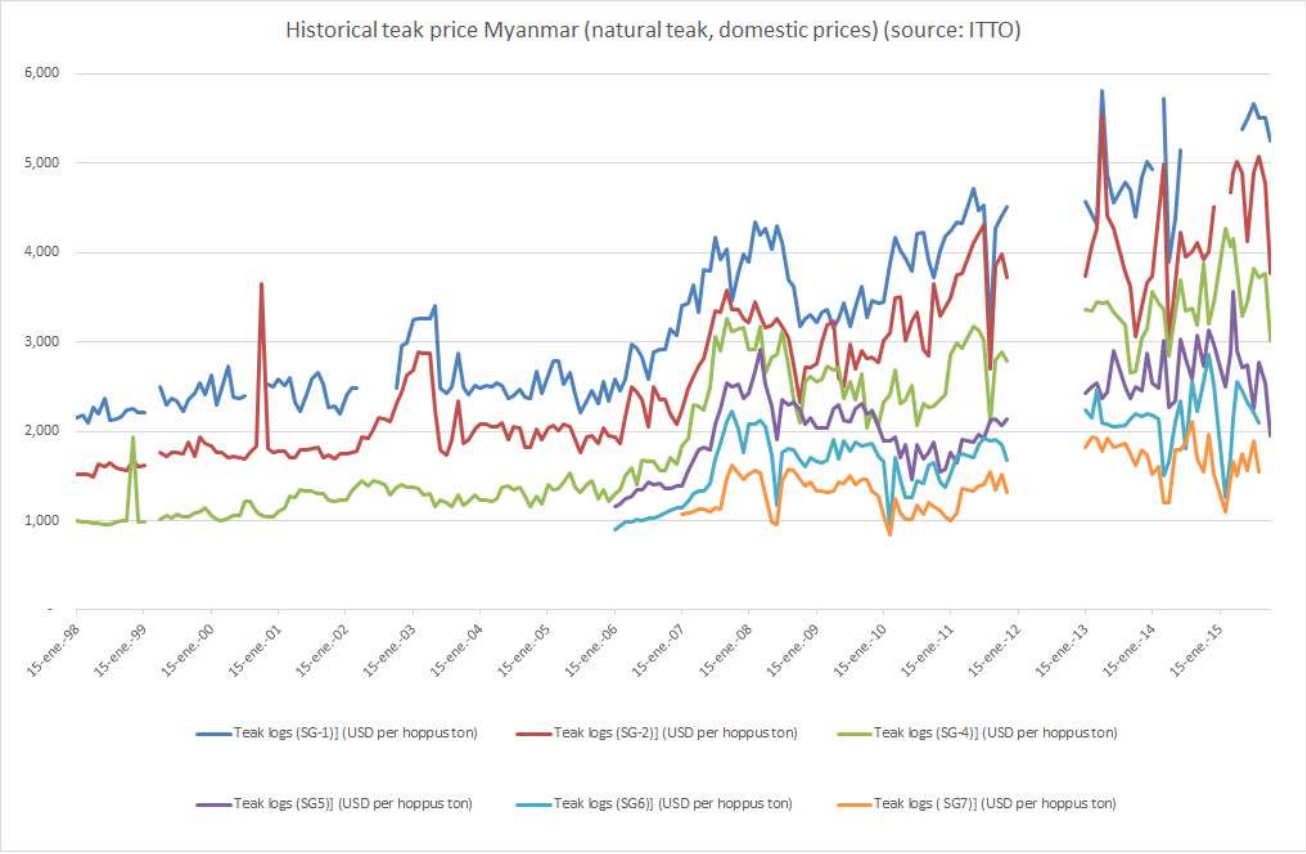


Figure 1- Historic price trend Teak (data: ITTO)

[1] Oro Verde, 2014.
[2] ITTO 2013, Presentation given during Teak Conference in March 2013, Bangkok, Thailand.
[3] Midgley et al., 2015.
[4] FAO, 2015.
[5] Data provided by the ITTO.

In the next table one can get a general idea about the price increase of the different quality logs of Myanmar.

	Average prices during indicated period					
period	Teak logs (SG-1)] (USD per hoppus ton)	Teak logs (SG-2)] (USD per hoppus ton)	Teak logs (SG-4)] (USD per hoppus ton)	Teak logs (SG5)] (USD per hoppus ton)	Teak logs (SG6)] (USD per hoppus ton)	Teak logs (SG7)] (USD per hoppus ton)
1998-2000	2,276	1,670	1,060			
2000-2009	2,975	2,354	1,769	1,966	1,556	1,342
2010-2015	4,754	4,106	3,297	2,495	2,071	1,600

	Relative price increase (for Grade 1,2,4 1998-2000 average = 100%; for Grade 5,6,7, 2000-2009 average = 100%)					
1998-2000	100%	100%	100%			
2000-2009	131%	141%	167%	100%	100%	100%
2010-2015	209%	246%	311%	127%	133%	119%

	Price relation between grades (SG-1 = 100%, calculations made per indicated time period)					
1998-2000	100%	73%	47%			
2000-2009	100%	79%	59%	66%	52%	45%
2010-2015	100%	86%	69%	52%	44%	34%

Figure 2 - Averages teak price trends and price indices

Price relations related to log diameter and age were analyzed by Moya and Perez (2008)[6].

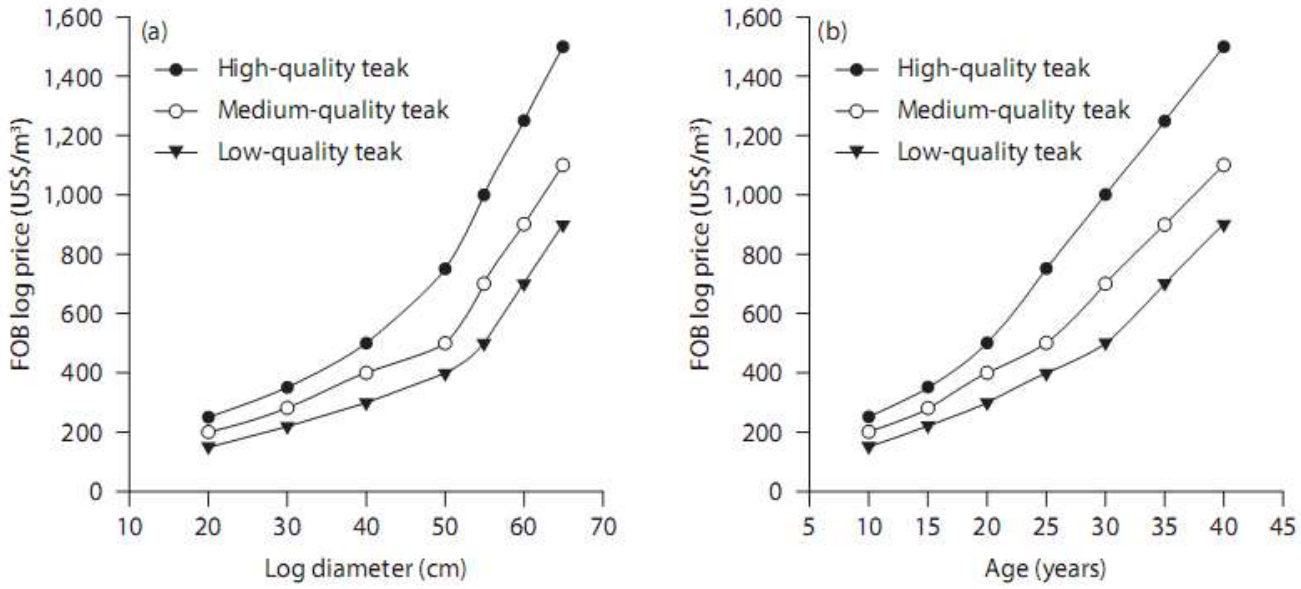


Figure 3 - Teak price relations (price/diameter & price/age)

On the 1 April 2014, the Myanmar government put a ban on teak log exports, resulting in price increases for both average and high quality teak produce, thereby stimulating teak production in other parts of the world and creating incentives to improve high-quality logs from planted teak forests.

The following prices of teak timber concern teak timber from plantations, as teak timber from natural forests is in general superior in quality and has a different price range and market.
Data from ITTO bi-monthly Market Information Service (MIS) was extracted at regular intervals from the past 6 years[7].

[6] Moya and Perez, 2008. Graph from Midgley S. et al.,2015.
[7] For the period 2013-2015 data from 2 reports per year was used, for 2009-2011 one report per year. Note that due to financing problems no ITTO Market Information Service reports were published during 2012, therefore data from December 2011 and January 2013 was used to obtain data close to the year 2012.

	Brazil Logs	Brazil squares	Costa Rica logs	Nicaragua logs	Panama logs
May-09	-	-	-	-	-
May-10	-	450 - 475	400 - 425	-	300 - 325
May-11	-	500 - 600	350 - 500	-	315 - 400
Dec-11	-	400 - 600	350 - 650	-	350 - 475
Jan-13	-	400 - 600	400 - 650	-	350 - 450
May-13	-	350 - 600	350 - 550	-	350 - 550
Nov-13	-	360 - 680	350 - 700	430 - 535	260 - 550
May-14	360 - 680	350 - 750	355 - 700	370 - 535	360 - 550
Nov-14	390 - 750	360 - 680	360 - 840	340 - 450	275 - 750
May-15	404 - 1063	370 - 680	455 - 739	350 - 596	286 - 750
Dec-15	370 - 665	370 - 556	320 - 780	402 - 505	368 - 430

Figure 4 - International teak log prices (price range)

Median values for these prices are the following:

	Brazil Logs	Brazil squares	Costa Rica logs	Nicaragua logs	Panama logs
May-09					0
May-10		463	413		313
May-11		550	425		358
Dec-11		500	500		413
Jan-13		500	525		400
May-13		475	450		450
Nov-13		520	525	483	405
May-14	520	550	528	453	455
Nov-14	570	520	600	395	513
May-15	734	525	597	473	518
Dec-15	518	463	550	454	399

Figure 5 - International teak log prices (medians)

ITTO Resume for prices of higher grades teak in Chinese ports, wholesale prices[8].

[8] Prices converted from Yuan to USD, applying exchange rates from ITTO MIS reports.

	Teak logs dia. 30-60 cm, Guangzhou Yuzhu	Teak sawn wood, Special grade, Guangzhou Yuzhu	Teak sawn wood, Grade A, Guangzhou Yuzhu	Teak sawn wood, all grade, Shanghai Furen
May-09	1766 - 2569		1365 - 1525	
May-10	1806 - 2134			
May-11	1794 - 2120		1566 - 1566	
Dec-11	1711 - 2022		1493 - 1493	
Jan-13			1564 - 1564	
May-13	1045 - 2089		1543 - 1543	
Nov-13	952 - 1905		1407 - 1407	
May-14	1259 - 1888	2203 - 3147	1510 - 1510	1809 - 5664
Nov-14	1172 - 1757	2050 - 2929	1406 - 1406	1684 - 5272
May-15	1230 - 1846	2153 - 3076	1477 - 1477	1769 - 5537
Dec-15	1370 - 1854	2257 - 3224		

Figure 6 - International teak prices, Chinese ports (price range)

With the following medians:

	Teak logs dia. 30-60 cm, Guangzhou Yuzhu	Teak sawn wood, Special grade, Guangzhou Yuzhu	Teak sawn wood, Grade A, Guangzhou Yuzhu	Teak sawn wood, all grade, Shanghai Furen
May-09	2168		1445	
May-10	1970			
May-11	1957		1566	
Dec-11	1866		1493	
Jan-13			1564	
May-13	1567		1543	
Nov-13	1429		1407	
May-14	1573	2675	1510	3737
Nov-14	1465	2490	1406	3478
May-15	1538	2615	1477	3653
Dec-15	1612	2740		

Figure 7 - International teak prices, Chinese ports (medians)

More detailed Brazil log prices for March 2014 and December 2015 were provided by an economist from Brazil[9]:

[9] Mr. A. Linhares, Teak Wood Brazil.

GIRTH	UNIT PRICE FOB US$ / M³	
	May-14	Dec-15
50-59 cm X 2,10 m and up	-	210
60-69 cm X 2,10 m and up	-	-
70-79 cm X 2,10 m and up	390	
80-89 cm X 2,10 m and up	430	390
90-99 cm X 2,10 m and up	470	440
100-109 cm X 2,10 m and up	540	510
110-119 cm X 2,10 m and up	570	550
120-129 cm X 2,10 m and up	610	590
130-139 cm X 2,10 m and up	620	630
140-149 X 2,10 m and up*	660	670
150-159 X 2,10 m and up		710
160- and up X 2,10 m and up		750

** for May 2014 the price is for 140 cm and up*

Figure 8 – Brazil Teak log prices according to girth

Another source could provide more detailed prices, FOB loaded on ship in Panama for November 2015:

GIRTH	UNIT PRICE FOB US$ / M³
	November 2015
70-74 up to 3 meters	246
75-79 up to 3 meters	307
80-84 up to 3 meters	329
85-89 up to 3 meters	354
90-94 up to 3 meters	383
95-99 up to 3 meters	412
100-104up to 3 meters	434
105-109 up to 3 meters	462
110-114 up to 3 meters	488
115-119 up to 3 meters	503
120 and up, up to 3 meters	509

Figure 9 - Panamanian Teak log prices

The trend in increased teak provisions from both Africa and Latin America is clear from the following graph[10].

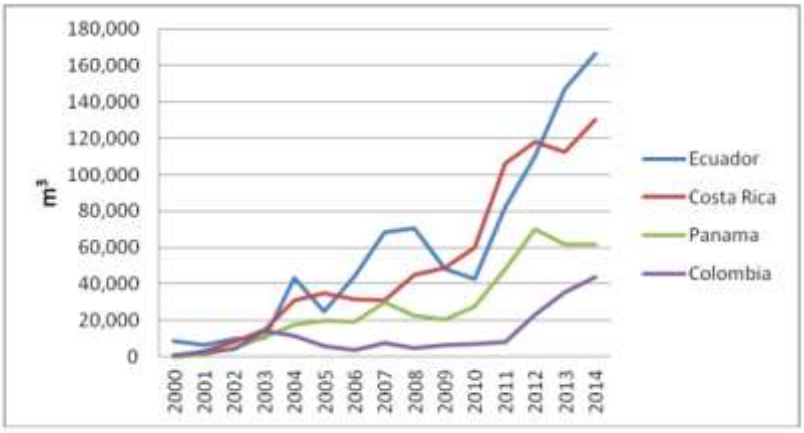


Figure 10 - Global teak exports by region, 2005-2011[11]

[10] Raiyani, 2013.
[11] FAO, 2015

A technical report from the Australian ACAIR, provides a comparison of average prices of both Indian and China teak imports for both roundwood and squared logs and sawn timber between 2010 and 2012[12].

Partner region	2010		2011		2012	
	India	China	India	China	India	China
World	493	686	504	692	530	810
Burma	827	718	800	807	880	862
West Africa	392	569	394	642	398	721
Africa (other)	434	393	447	351	476	567
Central/South America and Caribbean	337	527	366	497	388	530
Asia (other)	268	532	370	483	321	575
Pacific	411	–	890	181	459	–
Non-growing countries	378	726	370	695	415	738

Figure 11 - Imports by India and China, teak logs

Partner Region	2010		2011		2010	
	India	China	India	China	India	China
World	364	839	299	836	381	872
Burma	1,977	925	3,822	931	1,292	954
West Africa	406	3,297	439	859	421	4,029
Africa (other)	403	983	444	624	456	4,642
Central/South America and Caribbean	393	5,895	489	626	483	12,817
Asia (Other)	536	6,783	430	618	455	6,683
Pacific	467	745	428	757	471	–
Non-growing countries	241	598	227	955	260	48

Figure 12 - Imports by India and China, teak sawn wood

Central America prices

The Costa Rican *Oficina Nacional Forestal* has regularly published figures on local timber prices in the last years for a number of species, including teak. The following table shows log prices (standing trees, cut logs on logyard of sawmill and sawn timber at logyard)[13].

[12] Midgley et al, 2015 (page 42).

[13] Prices were converted from Costa Rican colon to USD using historical exchange rates of xe.com. Also *tican* timber inches ('pulgada maderera tica') were converted to M3 according to ratios provided in the ONF reports.

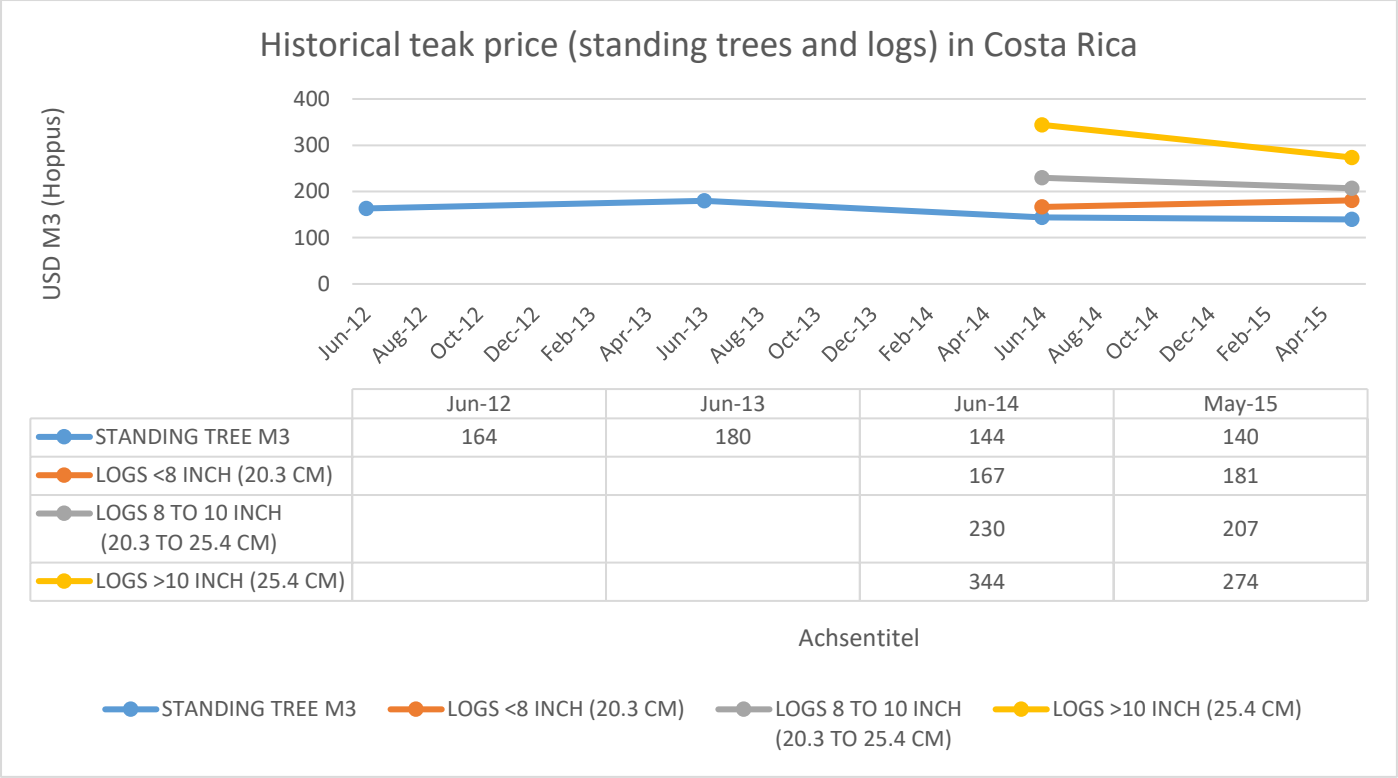


Figure 13 - Costa Rican teak prices (standing trees and logs)

The following graph is based on the same source for sawn timber.

Figure 14 - Costa Rican teak prices (sawn timber)

In the 2013 report of the *Oficina Nacional Forestal* on Costa Rican timber prices a more detailed value of Teak timber based on lengths was published.

TEAK STANDING TREES						
GIRTH (cm)	LOGS +6M USD/M3	LOGS 4.5-5.95 M USD/M3	LOGS 2.2 OR 2.6M USD/M3	% OF MAXIMUM PRICE	% OF MAXIMUM PRICE	% OF MAXIMUM PRICE
40-45	85	72	51	15%	15%	15%
46-50	115	98	69	20%	20%	20%
51-55	145	123	87	26%	26%	26%
56-60	175	149	105	31%	31%	31%
61-65	205	174	123	36%	36%	36%
66-70	235	200	141	42%	42%	42%
71-75	265	225	159	47%	47%	47%
76-80	295	251	177	52%	52%	52%
81-85	325	276	195	58%	58%	58%
86-90	365	310	219	65%	65%	65%
91-95	385	327	231	68%	68%	68%
96-100	415	353	249	73%	74%	73%
101-105	445	378	267	79%	79%	79%
106-110	475	404	285	84%	84%	84%
111-115	505	429	303	89%	89%	89%
116-120	535	455	321	95%	95%	95%
121+	565	480	339	100%	100%	100%

Figure 15 - Teak log prices according to girth and lengths

Indicated M3 are M3 Hoppus[14].

Ratios (% of value compared to maximum value) are shown in gray – it shows a constant relationship between girth and value (independent of diameter). Comparing differences in price according to log length, the following value relation appears[15]:

GIRTH (cm)	LOGS +6M USD/M3	LOGS 4.5-5.95 M USD/M3	LOGS 2.2 OR 2.6M USD/M3
-	100%	85%	60%

Figure 16 - Value relation of lengths of Costa Rican teak logs

The following table shows similar data for Teak loaded in a container (product not further specified in source material).

[14] Hoppus Volume (h ft) = ("Quarter Girth" (in))2 × Length (ft) / 144 = (circumference (ft) / 4)2 × Length (ft).
[15] Also applicable to Teak loaded in container, see Figure 11.

TEAK LOADED IN CONTAINER						
GIRTH (cm)	LOGS +6M USD/M3	LOGS 4.5-5.95 M USD/M3	LOGS 2.2 OR 2.6M USD/M3	% OF MAXIMUM PRICE	% OF MAXIMUM PRICE	% OF MAXIMUM PRICE
40-45	128	108	77	21%	21%	21%
46-50	155	132	93	26%	26%	26%
51-55	184	156	110	31%	31%	30%
56-60	213	181	128	35%	35%	35%
61-65	243	206	146	40%	40%	40%
66-70	272	232	163	45%	45%	45%
71-75	302	257	181	50%	50%	50%
76-80	332	282	199	55%	55%	55%
81-85	362	307	217	60%	60%	60%
86-90	403	342	242	67%	67%	67%
91-95	421	358	253	70%	70%	70%
96-100	451	384	271	75%	75%	75%
101-105	481	409	289	80%	80%	80%
106-110	511	434	307	85%	85%	85%
111-115	541	460	325	90%	90%	90%
116-120	571	485	343	95%	95%	95%
121+	601	511	361	100%	100%	100%

Figure 17 - Costa Rican teak prices of logs loaded in container

The same, quite linear value relationship was found by forestry professional who elaborated the following scatter plot graph based on a variety of sources from 2012.

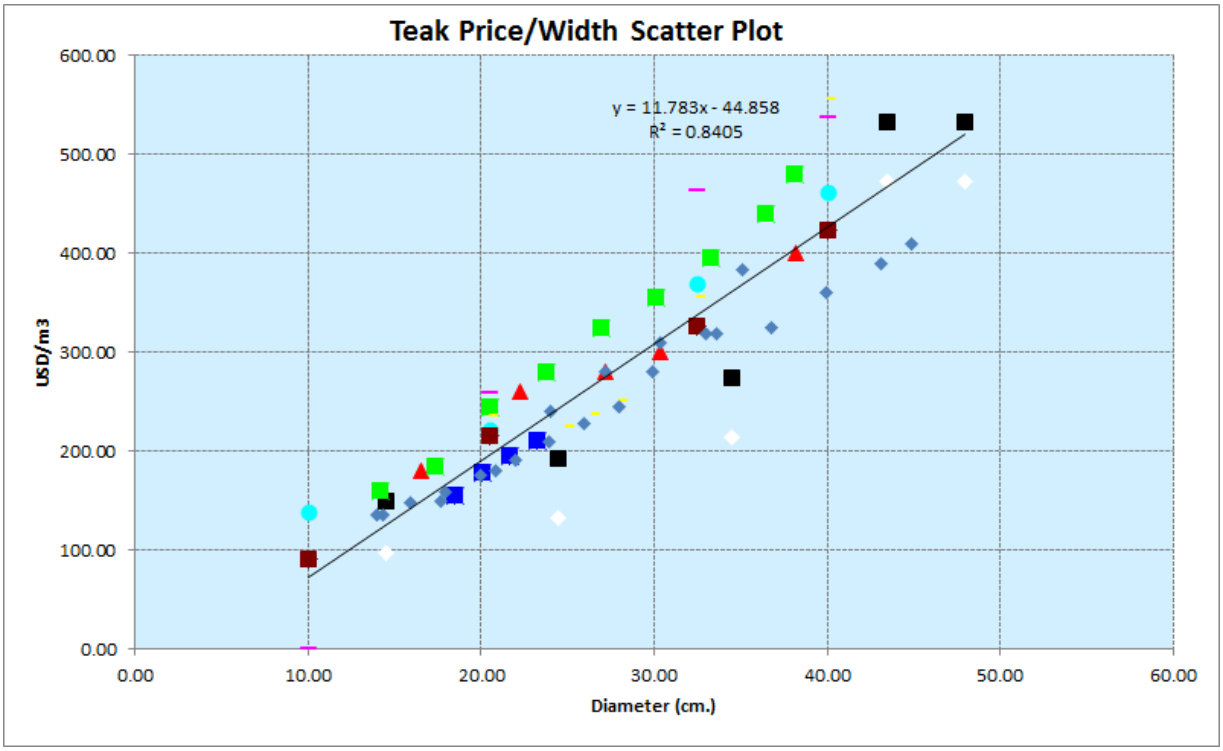


Figure 18 - Scatter plot teak prices value/girth.

Other reported local prices in Panama were 950 USD/m3 for sawn timber (2016) of 45 year old teak.

ii. Mahogany – Swietenia Macrophylla King

Mahogany is a tropical hardwood species native to the Americas. While officially the genuine Mahogany is composed of three varieties (*Swietenia macrophylla King*, *Swietenia mahagoni* and *Swietenia humilis*), the first concerns the commercial trade of Mahogany.[16]

Mahogany is valued for its esthetics, durability and its color, being used for paneling and to make furniture, boats and e.g. musical instruments. Mahogany grows from Central America southwards to South America as far as Peru, Bolivia and Western Brazil. Main exporter of Mahogany is Peru, while Brazil prohibited export of Mahogany from 2001. With several other countries also prohibiting export, the price of Mahogany has increased. Chimeli & Soares estimate the average annual trade value of Mahogany timber at 129 Million USD for the 1971 – 2001 period, with 75% of the value corresponding to exports to U.S. and Europe. Mahogany was put on the Appendix II list of CITES in 2002, meaning that the species requires careful monitoring of international trade by both the exporting and importing countries. It is estimated that most of the natural Mahogany is cut illegally. Some countries such as the U.K. greatly and voluntarily reduced the import after environmental campaigns. A 2001 report mentions that approximately 100,000 M3 of Mahogany timber was imported by the U.S., though imports greatly declined after the Lacey Act took effect. A recent study mentions that the average Peruvian and Bolivian Mahogany export was 7,344 M3 and 27,144 M3 respectively during the January 2000 – April 2008 period[17].

Plantations of Mahogany have been established in Asia and Latin America. An FAO study of 2003 reports the existence of 326,007 ha of Mahogany, of which more than half in Indonesia[18].

International prices

Peruvian export prices for Mahogany were obtained from the ITTO MIS reports, as well as Grade A Mahogany prices for ports in China.

	Mahogany S&B KD 16%, 1-2" random lengths, FOB Callao Port Peru,	Grade A, sawn Shanghai	Mahogany Grade A, sawn Guangzhou Yuzhu
May-09	1722 - 1798		
May-10	1722 - 1798		
May-11	1655 - 1702		
Dec-11	1655 - 1702		
Jan-13	1570 - 1655		
May-13	1570 - 1655		
Nov-13	1570 - 1655		
May-14	1570 - 1655	944 - 1101	1023 - 1101
Nov-14	1570 - 1655	879 - 1025	952 - 1025
May-15	1570 - 1655	923 - 1077	1000 - 1077
Dec-15	1570 - 1655		1128 - 1209

Figure 19 - International mahogany prices (price range)

Medians of the same prices are the following:

[16] Other Meliaceae species are classified as 'true mahogany', such as the African genera *Khaya* and *Entandrophragma New Zealand mahogany* or kohekohe (*Dysoxylum spectabile*). In this study the author limited the research to the genuine Mahogany, *Swietenia Macrophylla King*. Therefore, in this document the species Mahogany refers to *Swietenia Macrophylla King*.

[17] Prestemon, 2015.

[18] Hoare, 2003.

	Mahogany S&B KD 16%, 1-2" random lengths, FOB Callao Port Peru,	Grade A, sawn Shanghai	Mahogany Grade A, sawn Guangzhou Yuzhu
May-09	1760		
May-10	1760		
May-11	1679		
Dec-11	1679		
Jan-13	1613		
May-13	1613		
Nov-13	1613		
May-14	1613	1023	1062
Nov-14	1613	952	989
May-15	1613	1000	1038
Dec-15	1613		1169

Figure 20 - International mahogany prices (medians)

Another consulted source mentions the price of 1846 USD (1700 EUR) for FAS quality Mahogany, AD, FOB port of origin[19].

Furthermore, data was gathered from one of the largest timber enterprises of Nicaragua. Shown prices are for Air dried (AD), Kiln dried (KD) and sawn timber (large volumes, >1 container), June-July 2015.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3		
	AD	KD	TIMBER	AD	KD	TIMBER
MAHOGANY	1483	1695	1271	1314	1420	-

Figure 21 - International mahogany prices (Nicaragua)

Central American prices

ITTO MIS provided data of domestic Peruvian timber prices for Mahogany till 2013.

	Price range	Medians
	Peru domestic prices, sawnwood	Peru domestic prices, sawnwood
May-09	935 - 951	943
May-10	887 - 923	905
May-11	867 - 909	888
Dec-11	867 - 911	889
Jan-13	867 - 911	889
May-13	867 - 911	889
Nov-13	867 - 911	889

Figure 22 - Domestic mahogany prices Peru

The author counted with the price for squared logs and sawn wood in Chirique, Panama (2015).

[19] Mr. Jochen Bellmann by email.

	Squared log USD/M3	Sawn timber USD/M3
Mahogany	466	847

Figure 23 - Mahogany prices Panama

Another source mentions 680 USD/m3 for Mahogany in local sawmills.

More historical prices (2012) were provided by one source, all for roundwood (FOB, in the indicated country).

Species	Roundwood Price (FOB) USD/M3	Country
Mahogany (Swietenia macrophylla)	379	Guatemala
Mahogany (Swietenia macrophylla)	297	Panama
Mahogany (Swietenia macrophylla)	254	Guatemala
Mahogany (Swietenia macrophylla)	285	Nicaragua

Figure 24 - Central American Mahogany prices (2012)

iii. Yellow Cedar – Terminalia Amazonia

The species *Terminalia Amazonia (Gmel.) Excell*, is common in many Latin American countries from Mexico to Argentina, and is also known by Yellow Cedar, Nargusta, Roble Coral and Amarillo Real (Amarillón) in Central America. It is a relatively fast growing species widely used in plantations in Central America due to its high growth potential and adaptability to difficult circumstances[20]. It is considered as the native species with most potential in Costa Rica and the one that can best handle eroded soils.[21] The timber is, and classified as, a semi-hardwood or hardwood species and is heavy to very heavy and known for its high durability. The timber is yellow to pinkish-red, often with dark red veins running along the grain and used for e.g. construction, flooring, cabinetry, furniture. One study from 2000 mentions an amount of 1956 hectares of forest plantations established in Costa Rica with this tree species[22].

International prices

A Nicaraguan company reported prices for *Terminalia sp.*, a species that is scientifically described as different from *Terminalia Amazonia (Gmel.) Excell.* It was, however, also described by the same company as '*Guayaba Negro*', a name that some sources also use for *Terminalia Amazonia (Gmel.) Excell*. Possibly, timber characteristics and prices are closely related to both varieties, therefore the author decided to include the reported prices here.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3	
ESPECIES	AD	KD	TIMBER	AD	KD
GUAYABO NEGRO	726.00	832.00	641.20	556.40	662.40

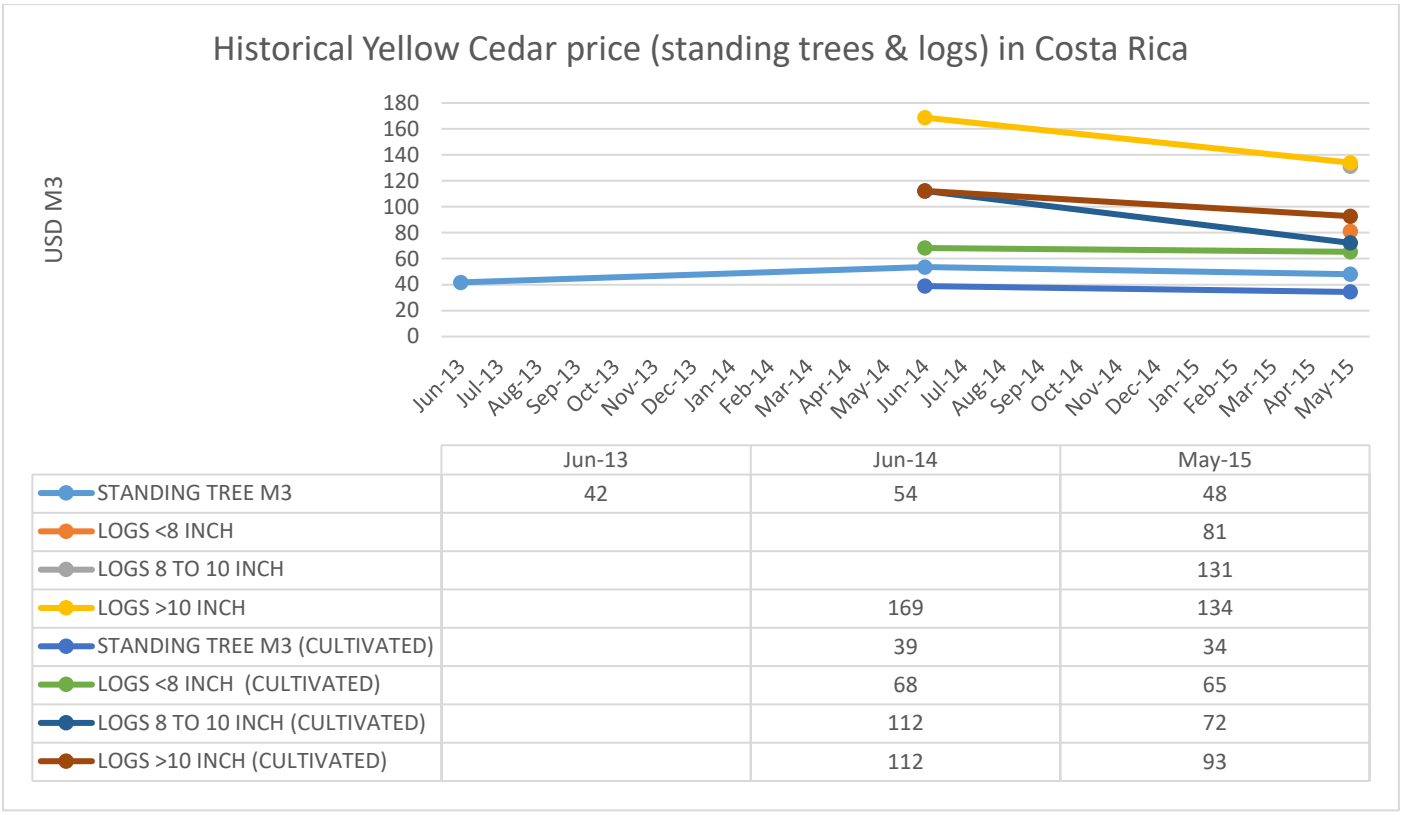
Figure 25 - Nicaraguan international sawn timber prices of 'Guayaba Negro'

Another source reported a price of 200 USD FOB Canada for roundwood in 2012.

Central America prices

The Costa Rican *Oficina Nacional Forestal* provided some information of Natural forest and cultivated logs (of different lengths) and sawn wood for Yellow Cedar.

[20] Montero, 2005.
[21] Chiu & Snow, undated.
[22] Herrera, 2000.



	Jun-13	Jun-14	May-15
STANDING TREE M3	42	54	48
LOGS <8 INCH			81
LOGS 8 TO 10 INCH			131
LOGS >10 INCH		169	134
STANDING TREE M3 (CULTIVATED)		39	34
LOGS <8 INCH (CULTIVATED)		68	65
LOGS 8 TO 10 INCH (CULTIVATED)		112	72
LOGS >10 INCH (CULTIVATED)		112	93

Figure 26 - Historical Yellow Cedar price (standing trees and logs), Costa Rica

	Jun-13	Jun-14	May-15
SAWN TIMBER	249	609	338
SAWN TIMBER (CULTIVATED)		314	228

Figure 27 - Historical Yellow Cedar price (sawn timber), Costa Rica

Furthermore, the author counted with one source reporting a price of 185 USD/M3 for roundwood in 2012, FOB Nicaragua.

iv. Rosewood – Dalbergia sp.

Genuine Rosewood timber belongs to the genus *Dalbergia*. The pre-eminent rosewood appreciated in the Western world is the wood of *Dalbergia nigra*. In Central America there are several varieties that are also known as Rosewood, such as *Dalbergia retusa* and *Dalbergia tucerencis*. The different Rosewood species do not only occur in the Americas, there are also varieties from Asia (e.g. *Dalbergia latifolia*). The *retusa* variant is probably the most common Central-American variant in trade and also traded under the name of Cocobolo.

Rosewoods are strong, heavy and dense and very suitable timber for music instruments, small items, furniture and floorings. Only the heartwood is used. It's one of the most attractive and most expensive of all timber species, one of the reasons why it is an overexploited species and listed as *Vulnerable* on the IUCN list of Threatened species. *Dalbergia retusa* is listed on the Appendix II of CITES.

A research paper of 2014 published by TRAFFIC and the Chatham House mentions that a Chinese Rosewood imports totaled 61 Million USD between 2007 and 2012[23].

No statistics were found on Cocobolo plantations.

International prices

ITTO Market Information Service reports provided Cocobolo prices since 2014 at 2 Chinese ports (wholesale prices).

	Price range		Median	
	Cocobolo logs, All grades, Guangzhou Yuzhu /M3	Cocobolo logs, Shanghai Furen Forest Products Market / tonne	Cocobolo logs, All grades, Guangzhou Yuzhu /M3	Cocobolo logs, Shanghai Furen Forest Products Market / tonne
May-14	8339 - 9125	6765 - 28320	8732	17542
Nov-14	7762 - 8494	6297 - 26361	8128	16329
May-15	8152 - 8921	6614 - 27685	8536	17149
Dec-15	4353 - 6448	4514 - 19345	5400	11929

Figure 28 - Cocobolo log prices in Chinese ports

For the interpretation of this data one must take into account that the Shanghai prices are expressed in tonnes. According to one source[24], average weight of Cocobolo timber is 1095 kg/m3, so per tonne prices are approximately 10% higher than per M3 prices.

Another European timber trader mentions a price of 4336 USD (4000 EUR) for heartwood FOB in port of origin (air dried).

This price is very similar to those indicated by a Nicaraguan timber enterprise, which also mention prices for different lengths and for AD/KD/timber.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3	
ESPECIES	AD	KD	TIMBER	AD	KD
COCOBOLO	4,393.60	4,457.20	4,330.00	4,160.40	4,266.40

Figure 29 - International Cocobolo prices Nicaragua

[23] Ferriss, 2014.

[24] http://www.wood-database.com/lumber-identification/hardwoods/cocobolo/

Central America prices

A study from 2011 realized in Panama by ANARAP (*La Asociación Nacional de Reforestadores y Afines de Panamá*) indicated a price of 4330 USD/M3 for sawn timber.

Other reported prices of 2012 in Central America were the following:

Species	Roundwood Price (FOB) USD/M3	Country
Cocobolo (Dalbergia retusa)	400	Nicaragua
Cocobolo (Dalbergia retusa)	466	Panama
Cocobolo (Dalbergia stevensonii)	890	Guatemala
Cocobolo (Dalbergia stevensonii)	500	Guatemala

Figure 30 - Central American Cocobolo prices (2012)

v. Andiroba – Carapa guianensis

Timber of the Andiroba tree resembles Mahogany (both are part of the same family) and is used in quality furniture, stairs and flooring, also known by the name crabwood or Brazilian Mahogany (Cedro Macho in Central-American Spanish). The natural distribution of the tree is the north of South America (including northern Brazil) and some countries in Central America including Cuba. The pale reddish brown timber is soft yet durable and its impalatability to insects guarantees commercial demand. The tree also produces a chesnut-like nut, containing oil with wholesome and insecticidal properties, widely used for centuries.

The timber is known as a substitute for Mahogany. Both lumber and veneer products are made from this timber. The tree is used in mono-culture plantations, also in other parts of the world such as Indonesia. The tree can survive in swampy areas so it can also survive seasonal floodings.

International prices

No prices were available from the ITTO MIS reports. A Nicaraguan enterprise reports the following international wholesale prices:

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3	
ESPECIES	**AD**	**KD**	**TIMBER**	**AD**	**KD**
ANDIROBA	662	747	620	493	599

Figure 31 - Andiroba International prices, Nicaragua

No other sources of international market prices could be found. A German timber trader mentions that there is no market for this timber species in his market area.

Central America prices

No prices reported in Central America could be found.

vi. Almendro – Dipterex panamensis

Almendro is a tree species native to Nicaragua, Costa Rica, Panama and Columbia. The tree can grow very tall (60 meters) and thick (2 meters) and has an extraordinary hardness. Its hardness makes it difficult to saw.

The timber is used for floorings, construction. In Costa Rica, after an increase of use in the 90's, cutting and processing became illegal since 2002.

In the same family is *Dipterex Odorata*, better known as Tonka Bean, Cumaru or Brazilian Teak, an increasingly popular hardwood used for flooring, furniture and other uses in the United States and also has markets in Asia and Europe. The tree is grown on plantations, though mainly for its vanilla-cinnamon scented seed, called the tonka bean.

International prices

Little information on international prices could be found for *Dipterex panamensis* in the ITTO MIS reports. One source from Nicaragua provided international prices for *Dipterex panamensis.*

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3		
	AD	KD	TIMBER	AD	KD	TIMBER
ALMENDRO	890	983	805	720	826	0

Figure 32 - International prices Almendro, Nicaragua

Another *offered* price on Alibaba.com could also be found, offering squared logs at 575 – 700 USD per ton, shipped from the Balbao port in Panama[25].

For the better-known Cumaru timber (Tonka bean) prices could be obtained from several sources. From ITTO MIS reports:

	4" thick, 6'-11' length KD Asian Market	4" thick, 6'-11' length KD Central American market	Cumaru decking AD, S4S E4S, US market	Cumaru KD, S4S Asian market	Cumaru KD, S4S Swedish market
May-09	768 - 789	792 - 822	778 - 867	924 - 967	655 - 708
May-10	829 - 888	831 - 855	929 - 1103	1077 - 1234	788 - 897
May-11	798 - 871	825 - 844	940 - 1015	930 - 982	797 - 920
Dec-11	798 - 871	834 - 849	934 - 996	970 - 1020	852 - 961
Jan-13	798 - 871	834 - 849	934 - 996	990 - 1035	866 - 981
May-13	811 - 893	834 - 849	1210 - 1298	1332 - 1552	866 - 981
Nov-13	811 - 893	834 - 849	1210 - 1298	1289 - 1350	866 - 981
May-14	866 - 939	841 - 865	1215 - 1311	1255 - 1345	897 - 1025
Nov-14	871 - 916	841 - 865	1187 - 1278	1224 - 1254	912 - 1045
May-15	871 - 916	841 - 865	1262 - 1326	1123 - 1142	922 - 1058
Dec-15	1036 - 1078	841 - 865	1188 - 1222	1036 - 1078	950 - 1094

Figure 33 - International Cumaru prices (price range)

[25] http://www.alibaba.com/product-detail/ALMENDRO-DRIPTERYX-PANAMENSIS_172883726.html

With the following medians:

	4" thick, 6'-11' length KD Asian Market	4" thick, 6'-11' length KD Central American market	Cumaru decking AD, S4S E4S, US market	Cumaru KD, S4S Asian market	Cumaru KD, S4S Swedish market
May-09	779	807	823	946	682
May-10	859	843	1016	1156	843
May-11	835	835	978	956	859
Dec-11	835	842	965	995	907
Jan-13	835	842	965	1013	924
May-13	852	842	1254	1442	924
Nov-13	852	842	1254	1320	924
May-14	903	853	1263	1300	961
Nov-14	894	853	1233	1239	979
May-15	894	853	1294	1133	990
Dec-15	1057	853	1205	1057	1022

Figure 34 - International Cumaru prices (medians)

Prices are for Peru, FOB Callao[26].

A German timber trader mentions prices of 975-1300 USD (900-1200 EUR) for Cumaru, FOB port or origin. A large Dutch timber company reports prices of 800-1000 USD/m3 FOB, port of origin, with the following prices for Decking:

- 1250 USD/m3 Cumaru Decking 21x140x7'
- 900 USD/m3 Cumaru Decking 21x90x7'

Another Dutch timber enterprise reports the following price for sawn timber:

- FSC Cumaru 33x105mm – 33x205mm – 52x155mm - 997 USD/M3 (920 EUR)

Central American prices

Reported domestic prices for Panama were 810 USD/m3 for sawn timber at local sawmills.

[26] No specific port in Peru was indicated in the ITTO MIS reports.

vii. Suradan Pilon (Zapatero) – Hieronyma alchorneoides

This tree species is known by its name Suradan Pilon in English, and Zapatero, Nanciton or Pilón in Spanish (among others), and is native to Mexico and Tropical Pacific and the Caribbean. The timber of the tree is also called Mascarey wood or Nicoyan Nogal. It is known as an abundant species and its timber is midrange-valued. The timber is reddish-brown and suitable for heavy construction such as column and beems but is also used for furniture. It is durable and fairly resistant to termites.
The species is known for its adaptability for different soils, including those with low-fertile characteristics. Its shade tolerance allows it to be combined in mixed plantations.

International prices

A large Nicaraguan company came with the following 2015 prices.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3	
ESPECIES	AD	KD	TIMBER	AD	KD
SURADAN PILON	726.00	832.00	683.60	556.40	662.40

Figure 35 - International prices Suradan Pilon, Nicaragua

No price information for this species is reported by the ITTO.

Central American prices

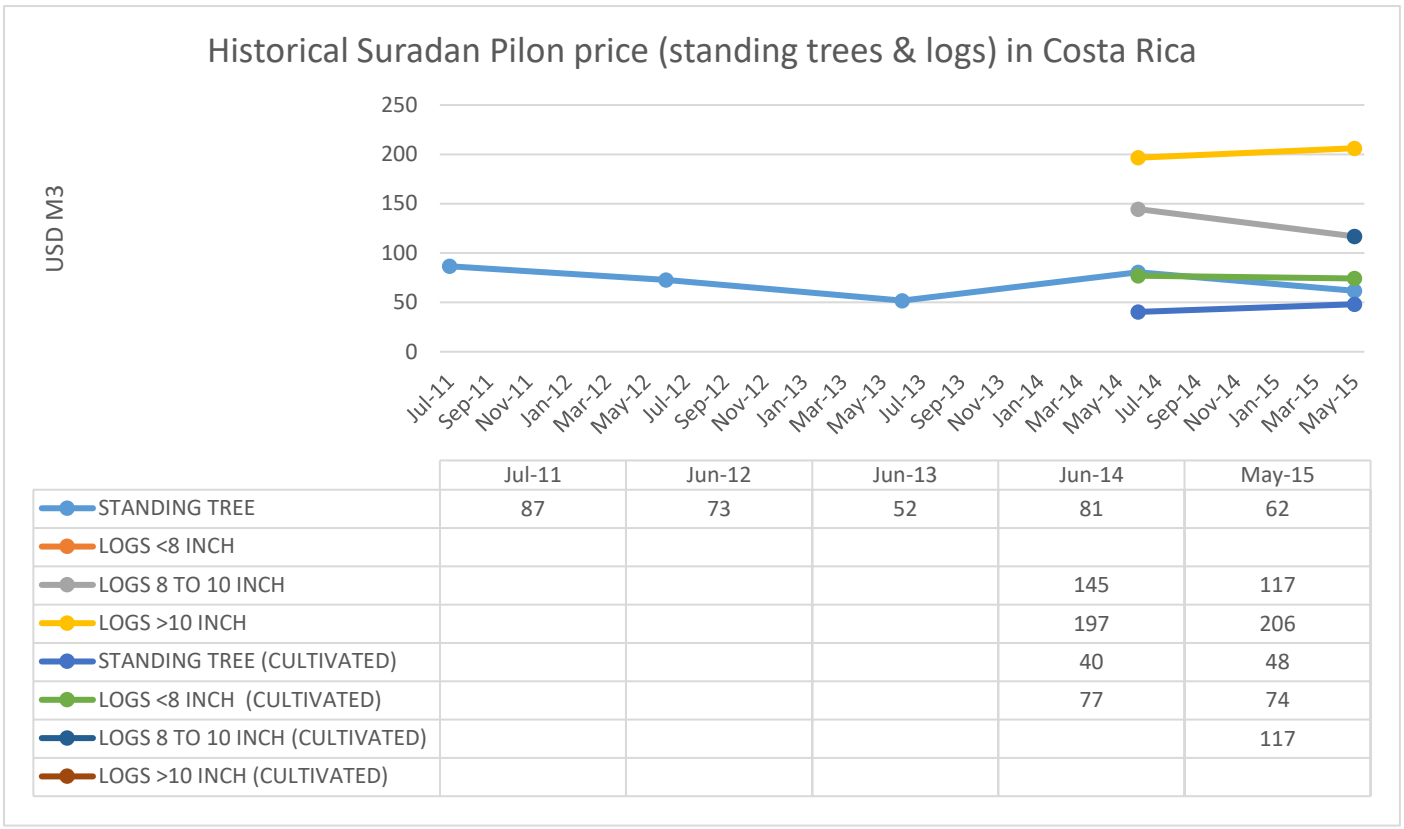
For Panama, the following prices were reported (2015) in Chirique.

	Squared log USD/M3	Sawn timber USD/M3
Suradan Pilon	233	424

Figure 36 - Local Panamian prices Suradan Pilon

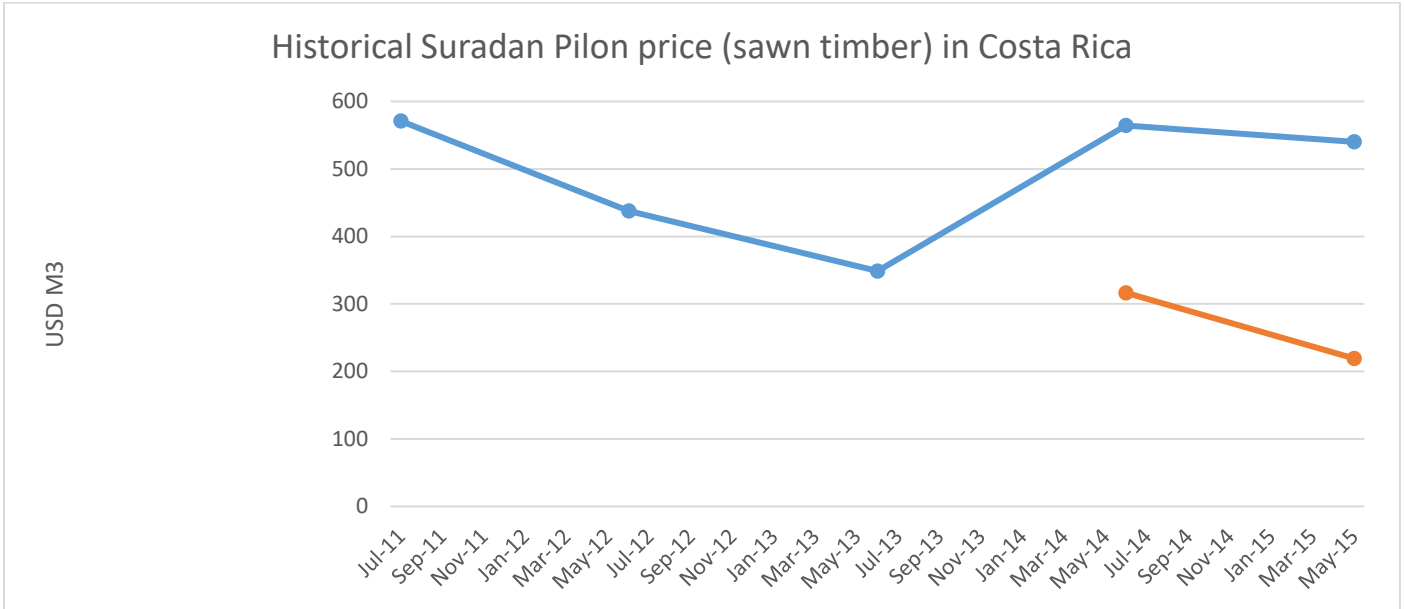
Another source of 2012, reported a roundwood price of 215 USD/M3, FOB, Nicaragua.

Reported prices by ONF from Costa Rica are the following for logs and sawn timber.



	Jul-11	Jun-12	Jun-13	Jun-14	May-15
STANDING TREE	87	73	52	81	62
LOGS <8 INCH					
LOGS 8 TO 10 INCH				145	117
LOGS >10 INCH				197	206
STANDING TREE (CULTIVATED)				40	48
LOGS <8 INCH (CULTIVATED)				77	74
LOGS 8 TO 10 INCH (CULTIVATED)					117
LOGS >10 INCH (CULTIVATED)					

Figure 37 - Historical prices Suradan Pilon, standings trees and logs, Costa Rica



	Jul-11	Jun-12	Jun-13	Jun-14	May-15
SAWN TIMBER	571	438	349	565	540
SAWN TIMBER (CULTIVATED)				316	219

Figure 38 - Historical prices Suradan Pilon, sawn timber, Costa Rica

viii. Spanish Cedar – Cedrela odorata

This commercially important species is known as Spanish Cedar or Cuban Cedar (Cedro Amargo, Cedro Real or Cedro Americano in Spanish), despite not being a real Cedar tree and actually being part of the *Meliaceae* family (like the Mahogany tree). It is a widely spread species from Mexico and the Caribbean all southwards to Argentina, though not equally abundant and also overexploited. The aromatic wood is in high demand in the American tropics because of its rot and termite-resistant properties, though also for its appearance and durability. It has a rather low density and is light-weight, and is well known for its use in cigar boxes. It is commonly used for furniture, music instrument and used for plywood and veneer.

The species is listed on CITES Annex II in several South American countries including Brazil, Peru and Bolivia, which were also the main exporters of Spanish Cedar. Main importers are the United States, Mexico and Argentina[27]. One source reports a total trade volume of 533,927 M3 during the 2002-2011 ten year period, equal to a yearly average of 53,392 M3[28].

Its rapid growth has stimulated widespread use of this species for commercial plantations in many parts of the world, including Africa, Central America and Asia with plantations going back as far as 1898 in Ghana[29]. One 1996 study mentions the existence of 3,500 hectares of Spanish Cedar in the Yucatan peninsula of Mexico[30].

International prices

Prices of different international Spanish Cedar products (Peru) were provided in the ITTO MIS reports. The following (relatively stable) prices were reported:

	Spanish Cedar AD Select Mexican market, FOB Iquitos	Spanish Cedar KD select, Mexican market, FOB Callao Port	Spanish Cedar KD select, North American market, FOB Callao Port
May-09	887 - 909	897 - 921	918 - 922
May-10	887 - 909	897 - 921	918 - 922
May-11	887 - 909	897 - 921	918 - 922
Dec-11	887 - 909	946 - 965	958 - 977
Jan-13	887 - 909	946 - 965	958 - 977
May-13	887 - 909	946 - 965	958 - 977
Nov-13	911 - 931	946 - 965	958 - 977
May-14	911 - 931	946 - 965	958 - 977
Nov-14	911 - 931	946 - 965	958 - 977
May-15	911 - 931	946 - 965	958 - 977
Dec-15	911 - 931	946 - 965	958 - 977

Figure 39 - International Spanish Cedar prices, Peru (price range)

Resulting in the following medians:

[27] In the period 2002-2011, Ferriss, 2014.
[28] Ferriss, 2014.
[29] Grubben, 2008.
[30] Patiño et al., 1996.

	Spanish Cedar AD Select Mexican market, FOB Iquitos	Spanish Cedar KD select, Mexican market, FOB Callao Port	Spanish Cedar KD select, North American market, FOB Callao Port
May-09	898	909	920
May-10	898	909	920
May-11	898	909	920
Dec-11	898	956	968
Jan-13	898	956	968
May-13	898	956	968
Nov-13	921	956	968
May-14	921	956	968
Nov-14	921	956	968
May-15	921	956	968
Dec-15	921	956	968

Figure 40 International Spanish Cedar prices, Peru (medians)

A German timber trader reports roundwood prices of 500 USD (2015). A mayor Nicaraguan company provided the following export prices (FOB Nicaraguan port).

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3		
	AD	KD	TIMBER	AD	KD	TIMBER
SPANISH CEDAR	932	1,026	848	763	869	0

Figure 41 - International Spanish Cedar prices, Nicaragua

Another source provides more historic references (2004): 207 USD/M3 for export of small volumes of logs from Mexico and small volumes of sawn timber at an average price of 322 USD/M3 from Colombia[31].

Central American prices

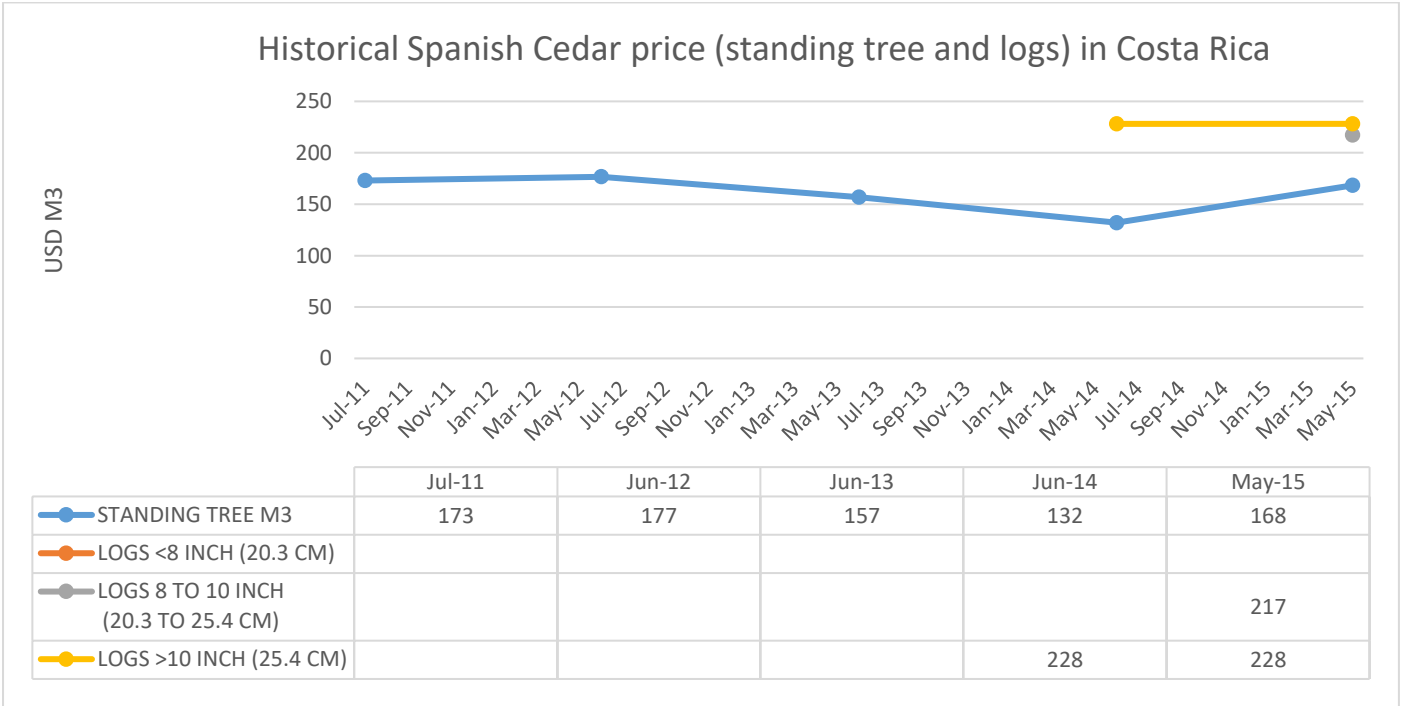
ITTO MIS reports contain information for domestic prices in Peru.

[31] Herriss, 2014.

	Price range	Medians
	Sawn wood, domestic price	Sawn wood, domestic price
May-09	298 - 344	321
May-10	268 - 321	295
May-11	264 - 305	285
Dec-11	264 - 305	285
Jan-13	264 - 305	285
May-13	264 - 305	285
Nov-13	277 - 321	299
May-14	296 - 355	326
Nov-14	296 - 355	326
May-15	305 - 346	326
Dec-15	305 - 364	335

Figure 42 - Peru domestic prices Spanish Cedar

Reported prices by ONF from Costa Rica are the following for standing trees, logs and sawn timber.



	Jul-11	Jun-12	Jun-13	Jun-14	May-15
STANDING TREE M3	173	177	157	132	168
LOGS <8 INCH (20.3 CM)					
LOGS 8 TO 10 INCH (20.3 TO 25.4 CM)					217
LOGS >10 INCH (25.4 CM)				228	228

Figure 43 - Domestic Costa Rican prices Spanish Cedar (standing trees and logs)

Figure 44 - Domestic Costa Rican prices Spanish Cedar (sawn timber)

Reported local prices for Panama (2015) were the following:

	Squared log USD/M3	Sawn timber USD/M3
Spanish Cedar, source 1	254	424
Spanish Cedar, source 2	216	360

Figure 45 - Domestic Panamanian prices Spanish Cedar

Another source mentions a price of 490 USD/m3 at local sawmills in Panama.

Herriss (2014) mentions that Peruvian authorities indicated prices ranging from 592 USD/M3 to 653 USD/M3 for sawn timber during the period 2000-2005, while the timber price in Ecuador was 584/M3 USD in 1995.

Other price information was provided by an international timber trader, who indicated the following prices for standing trees in Panama in 2014:

- 8000 trees, 90-160 cm, were sold for 80 USD/tree
- 400 trees, 160-220 cm, were sold for 140 USD/tree

ix. Massaranduba – Manilkara bidentata

This species is known by the name Massaranduba, Bulletwood and Brazilian Redwood in English and Níspero, Ausubo and Balata in Spanish. It is a large, rather abundant tree native to South America, Central America and the Caribbean with Brazil being its largest producer. The timber has a red heart and is extremely hard and dense (hence the name 'bulletwood'), one first needs to drill the wood to enter a nail and it does not float in water. The timber is used for construction and furniture, and is reported as difficult to air-dry, tending to develop checking and warp. Nevertheless, this is one of the common tropical hardwood species from the America's.

The species is very tolerant to shade, making it an interesting species for mixed plantations[32]. A study of plantations in Puerto Rico and Trinidad mention it has a slow to intermediate growth rate[33].

International prices

The ITTO MIS reports provided the following prices for export prices from Brazil per M3 (only for recent years price information was available):

	Sawnwood for export, Belem/Paranagua Ports,
May-14	707
Nov-14	752
May-15	736
Dec-15	791

Figure 46 - International Massaranduba prices, Brazil

A large Nicaraguan timber enterprise reports the following prices, though for *Manilkara achras* (though also with the common name of Níspero), a related tree from the same family.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3	
ESPECIES	**AD**	**KD**	**TIMBER**	**AD**	**KD**
NISPERO	896	980	811	726	811

Figure 47 - International timber prices Nispero, Nicaragua

Latin American prices

ITTO MIS reports the following domestic prices for Brazil.

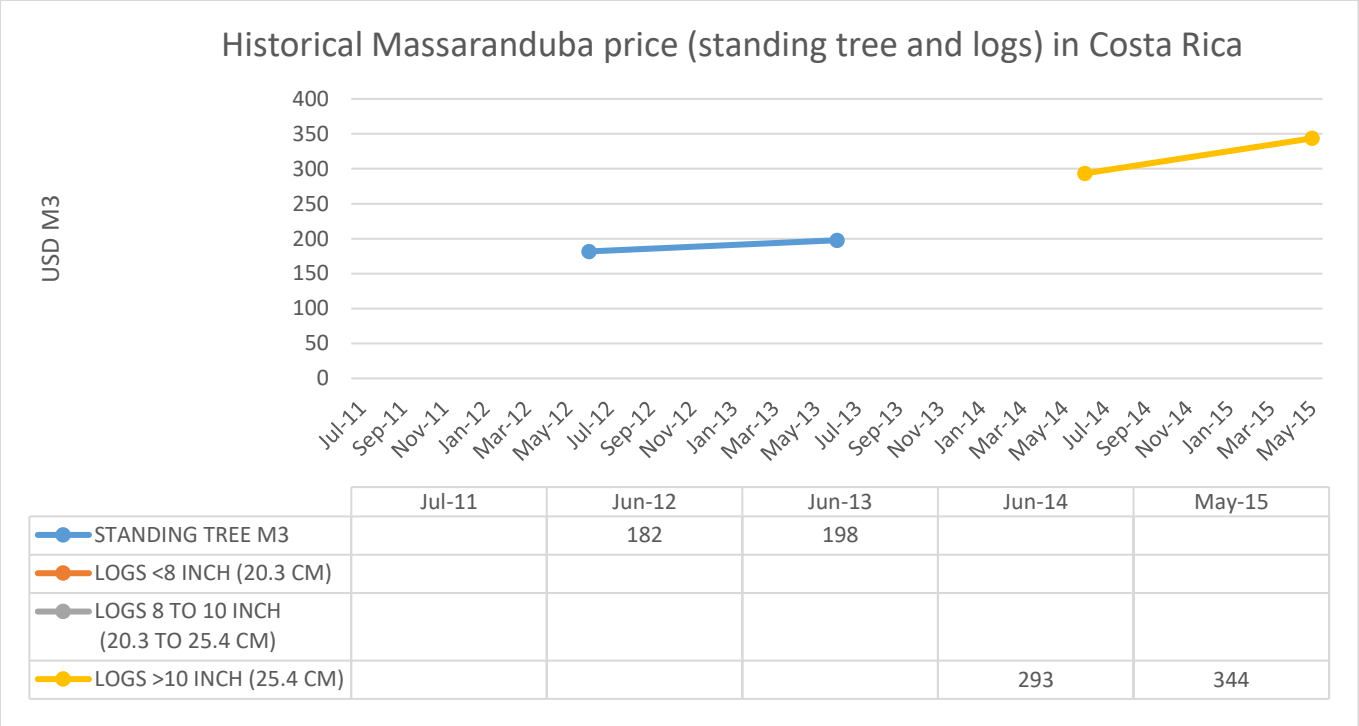
	Brazilian domestic logs	Brazilian domestic sawn wood
May-14	120	409
Nov-14	114	431
May-15	93	354
Dec-15	80	306

Figure 48 - Brazil domestic prices Massaranduba

[32] Weaver, 1990.
[33] http://www.na.fs.fed.us/pubs/silvics_manual/volume_2/manikara/bidentata.htm

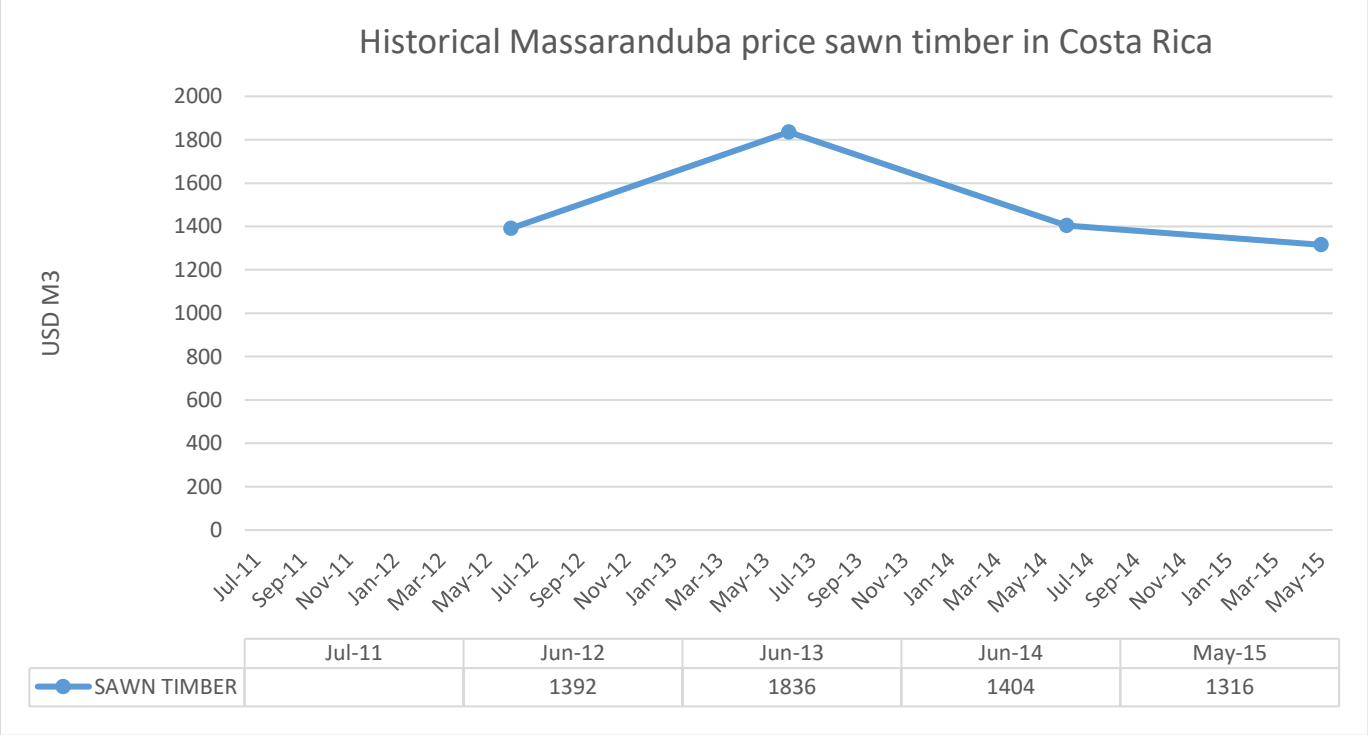
Brazilian domestic prices have fallen considerably in 2015, possibly partly due to the devaluation of the Real and the economic crisis during 2015.

The Costa Rican *Oficina Nacional Forestal* (ONF) reported the following prices of *Níspero* logs and sawn wood in the past years, though the author assumed it concerns *Manilkara Chicle*, part of the Manilkara family[34]. The reported prices for sawn timber are considerably higher than reported international prices.



	Jul-11	Jun-12	Jun-13	Jun-14	May-15
STANDING TREE M3		182	198		
LOGS <8 INCH (20.3 CM)					
LOGS 8 TO 10 INCH (20.3 TO 25.4 CM)					
LOGS >10 INCH (25.4 CM)				293	344

Figure 49 - Costa Rican prices of Níspero (standing trees & logs)



	Jul-11	Jun-12	Jun-13	Jun-14	May-15
SAWN TIMBER		1392	1836	1404	1316

Figure 50 Costa Rican prices of Níspero (sawn timber)

One other source mentions a price of 811 USD/m3 for local sawn timber in Panama (sawmill prices).

[34] Unfortunately the reports of ONF do not specify the Latin name of the reported timber species.

x. Rosy trumpet tree – Tabebuia rosea

This pink-flowering Rusy trumpet tree (or pink poui) is often called Roble de Sabana in Costa Rica, which means 'savannah oak', due to its ability to stay abundant in heavily deforested areas. It is the national tree of El Salvador. In trade, it is also known under the name of Roble and May Flower. The species distribution is from southern Mexico to Ecuador.

Its white-grey timber is commercially appreciated, strong, resistant and easy to work with. Its uses are varied, from construction to furniture, paneling, flooring and for decorative purposes and music instruments.

The species is fast growing and grows tall (to 25 to 30 meters height). It is regularly used in plantations in Central and South America, with good adaptability to degraded soils; one report mentions the existence of 3,988 ha of plantations of *Tabebuia Rosea* in Columbia, which at that time was more than the mentioned sum of teak plantations[35]. The plant has been exported to Asia, including Sri Lanka where the species is used in plantations. It is known as a high-value timber and is regularly exported from Central and South America. It is mentioned as one of the species with strong potentiality for tree plantations.

International prices

No prices were registered in the ITTO MIS reports. A Nicaraguan timber enterprise reported the following international trade prices (2015):

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3		
	AD	KD	TIMBER	AD	KD	TIMBER
ROSY TRUMPET TREE	572	657	509	403	509	0

Figure 51 - International prices Rosy Trumpet tree, Nicaragua

Central American prices

A source from Panama indicated the following prices for 2015:

	Squared log USD/M3	Sawn timber USD/M3
Rosy Trumpet Tree	233	424

Figure 52 - Domestic Panamanian prices Rosy Trumpet Tree

Another source provided a price of 620 USD/m3 at local sawmill in Panama.

The author further counted with 2012 prices of several timber enterprises, listed in the following table.

Species	Roundwood Price (FOB) USD/M3	Country
Roble (Tabebuia rosea)	240	Nicaragua
Roble (Tabebuia rosea)	230	Guatemala

Figure 53 - Central American prices Rosy Trumpet Tree (2012)

[35] Vazquez, 2001.

xi. Red Ceiba – Bombacopsis quinata

This tree inhabits dry forests in Central America and Venezuela and Columbia. Its common name is Red Ceiba or Pochote, but it is also known in Spanish as Cedro Espino, Saqui-saqui or Ceiba Roja. Its bark is spiny, hence the name Cedro Espino.

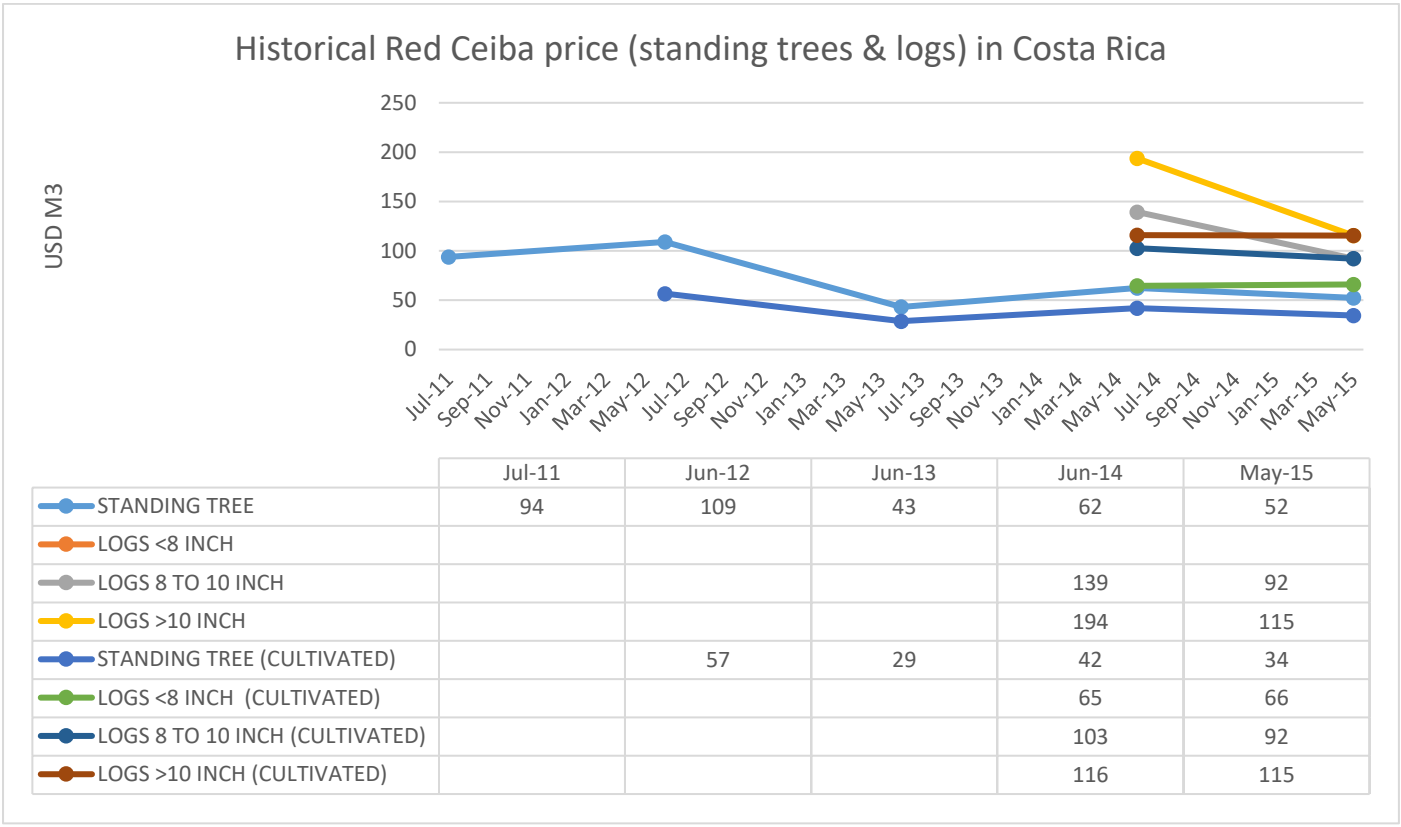
It is a highly valued tree species, used for doors, windows, known for its durability and workability. In a book on this species from 2003, it is mentioned as the highest valued timber species after Mahogany in the region where it grows[36]. The species has been overexploited and has become scarce and is marked as Vulnerable by the IUCN. It has been widely used in reforestation programs in e.g. Costa Rica[37]. Its adaptability to dry climates makes it an interesting species for plantation sites where other rain-demanding species have difficulties to grow. Farmers also use the species to create shade for coffee plantations. Yet, Pochoto needs to reach a certain thickness and age to gain commercial value, a diameter of 35 cm is required. A scientific study from 2000 mentions the existence of 326 hectares of plantations in Costa Rica with this tree species[38].

International prices

The available sources to the author contained no information of international prices of Red Ceiba.

Central American prices

The *Oficina Nacional Forestal* of Costa Rica reported the following timber prices for Red Ceiba, both natural and cultivated (Pochoto).

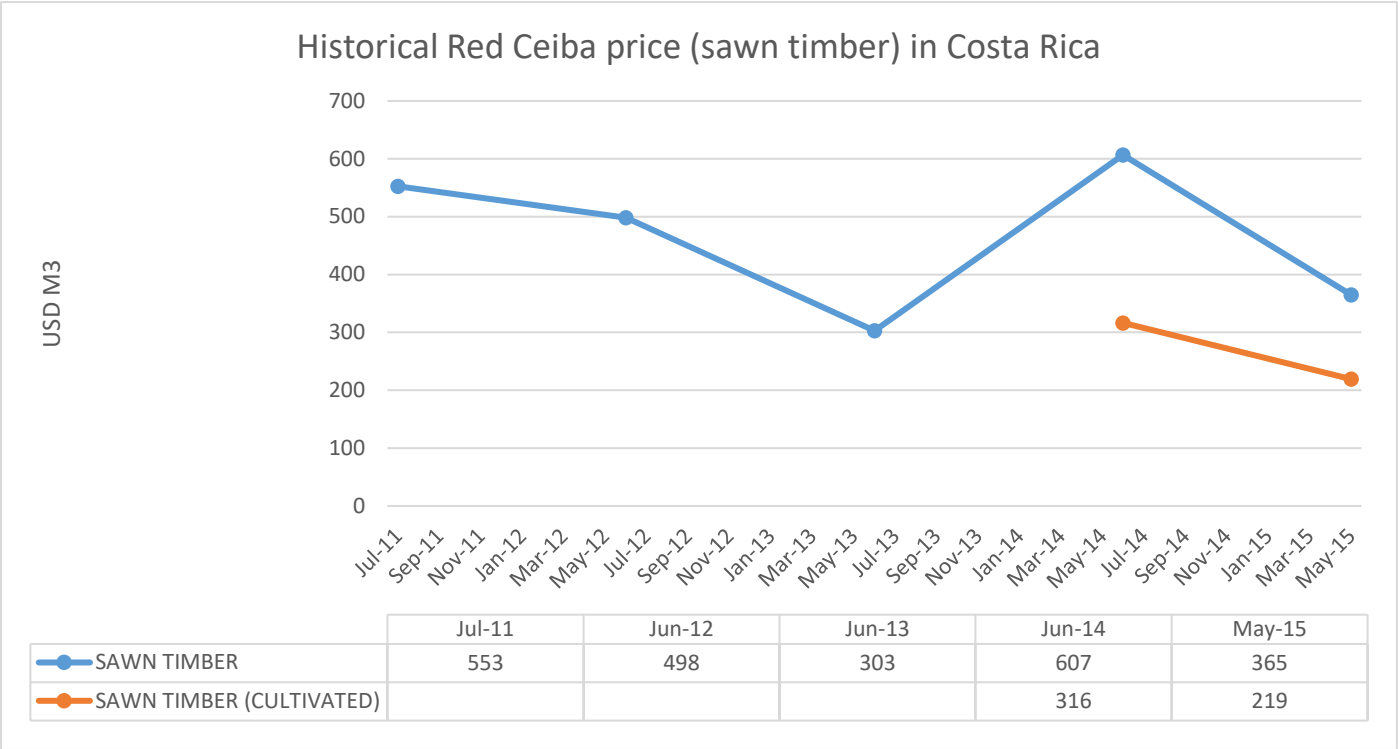


	Jul-11	Jun-12	Jun-13	Jun-14	May-15
STANDING TREE	94	109	43	62	52
LOGS <8 INCH					
LOGS 8 TO 10 INCH				139	92
LOGS >10 INCH				194	115
STANDING TREE (CULTIVATED)		57	29	42	34
LOGS <8 INCH (CULTIVATED)				65	66
LOGS 8 TO 10 INCH (CULTIVATED)				103	92
LOGS >10 INCH (CULTIVATED)				116	115

Figure 54 - Historical Costa Rican prices of Red Ceiba (standing trees & logs)

[36] Cordero-Salvado, J., & Boshier.
[37] Schmincke, 2000.
[38] Herrera, 2000.

Prices of sawn timber:



	Jul-11	Jun-12	Jun-13	Jun-14	May-15
SAWN TIMBER	553	498	303	607	365
SAWN TIMBER (CULTIVATED)				316	219

Figure 55 - Historical Costa Rican prices of Red Ceiba (sawn timber)

Another source provided a price of 620 USD/m3 at a local sawmill in Panama.

xii. Macacauba – Platymiscium pinnatum

The timber of this tree is generally called Macacuaba or Macawood in English and Quira or Cristobal in Spanish. The slow-growing tree is native to Central America to Northern South America.

Timber is known as strong and heavy, with a fine texture and easy to dry and preserve. It is used in heavy construction, flooring, paneling and furniture. It is considered in Costa Rica as one of the finest timbers. Its nitrogen-fixing properties have made this species recommended for use in agroforestry, though the species seem to be only used in small scales plantations in Costa Rica[39].

International prices

A Nicaraguan timber company provided the following international wholesale prices:

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3		
	AD	**KD**	**TIMBER**	**AD**	**KD**	**TIMBER**
MACACAUBA	763	856	636	593	699	0

Central American prices

For Panama, a source provided a price of 820 USD/m3 at a local sawmill in Panama.

[39] CATIE, undated.

xiii. Jacaranda – Jacaranda copaia

The Jacaranda genus consists of 49 species, all native to the America's. The *Jacaranda copaia* is a fast-growing species which timber can be used for interior construction put also for paper production. Also known in Spanish as Nazareno, Chingale, Gallinazo or Chiriguano, this species is widely distributed across in humid tropical forests of the Americas from Costa Rica to Brazil. The timber is soft and light-weight, with a clear, brown color.

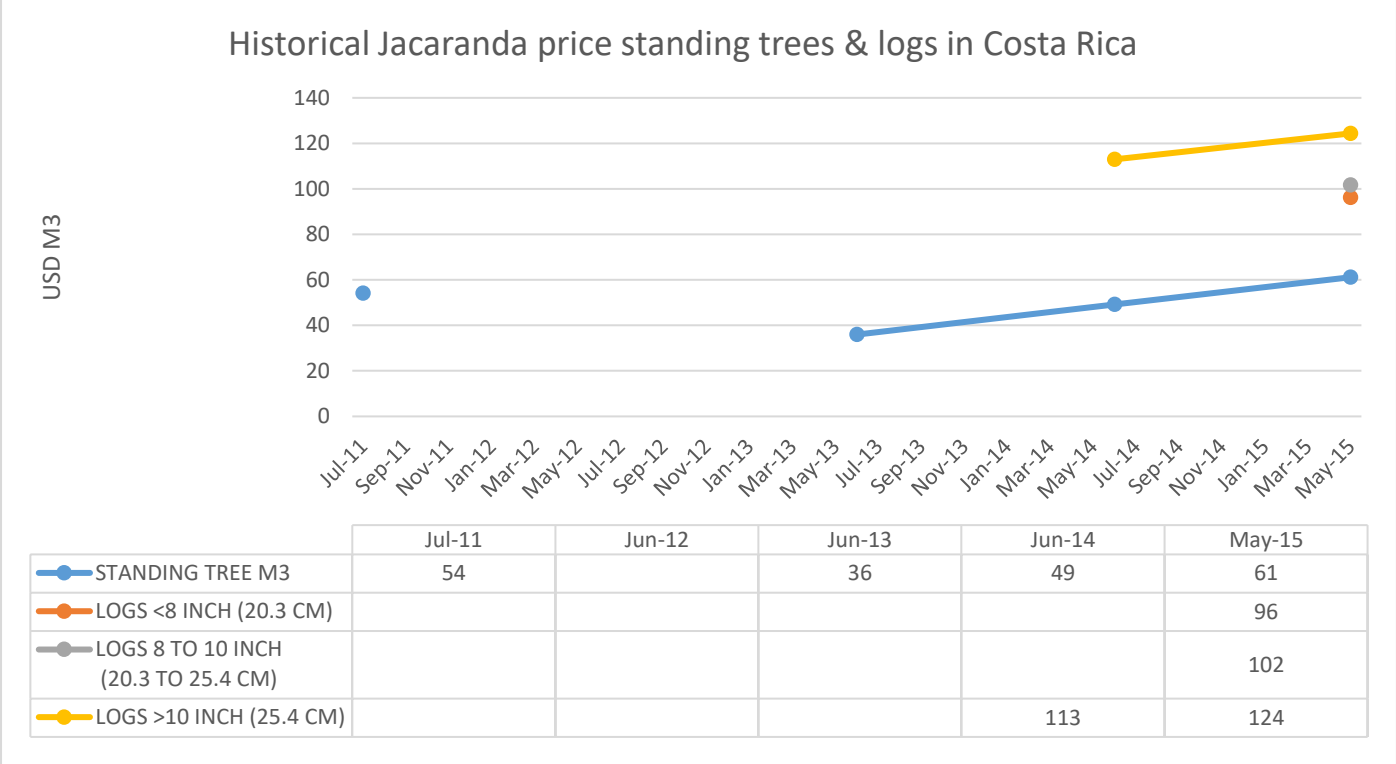
It is a common species used in plantations in many Latin American countries.

International prices

No international prices were found for this timber species. A German timber trader mentions there is no market for this species in Germany.

Central American and South American prices

The following graphs show prices for standing timber, logs and sawn timber. Information is from the ONF of Costa Rica.



	Jul-11	Jun-12	Jun-13	Jun-14	May-15
STANDING TREE M3	54		36	49	61
LOGS <8 INCH (20.3 CM)					96
LOGS 8 TO 10 INCH (20.3 TO 25.4 CM)					102
LOGS >10 INCH (25.4 CM)				113	124

Figure 56 - Costa Rican Jacaranda prices for standing trees and logs

Figure 57 - Costa Rican Jacaranda prices for sawn wood

A Bolivian timber company reported local prices of 1.06 USD/sq.ft for large-sized sawn timber (>7 feet) and 0.72 USD/sq.ft for short-sized timber (<7 feet), which equals 449 USD/M3 and 305 USD/M3 respectively. For kiln-dried timber an additional price is charged of 65 up to 85 USD/M3, reaching prices of 514-534 USD/M3 for large timbers and 370-390 USD/M3 for short timber.

xiv. Santa Maria – Calophyllum longifolium

This tree, Santa Maria or Cedro Maria, is native to the humid forests of Panama and Costa Rica. Its timber is used for floorings, furniture and other uses and its resina has medicinal uses. Limited information about this species was available to the author.

A related tree species of the same family is *Calophyllum brasiliense*, which is often called by the same name Santa Maria (but also known as Guanandí or Calambuco). This is a more widely spread and common species in Central America, South America and the Caribbean, and the hardwood from this species is used for construction and furniture. Its interior heartwood has an attractive purple color. The prices in the upcoming section concern the commonly traded *Calophyllum brasiliense*, as no price information could be found on *Calophyllum longifolium*.

International prices

The ITTO MIS reports of recent years reported prices in the Chinese port of Zhangjiagang for logs of '*Calophyllum*', it is assumed that this concerns the *Calophyllum brasiliense*. Prices are in USD/M3.

	Price range	Median
	Logs all grades, Zhangjiagang	Logs all grades, Zhangjiagang
Nov-14	315 - 344	344
May-15	331 - 361	361
Dec-15	347 - 379	379

A Nicaraguan timber enterprise indicated the following export prices for June/July 2015.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3	
ESPECIES	**AD**	**KD**	**TIMBER**	**AD**	**KD**
SANTA MARIA	705	811	641	535	620

Central American prices

Local Panamanian sources provided the following price of sawn timber for 2015:

	Sawn timber USD/M3
Cedro Maria	620

Whereas another source mentioned 641 USD/m3 for sawn timber at a local Panamanian sawmill.

xv. Ipê – Handroanthus spp. *(formerly placed in the Tabebuia genus)*

Ipê timber is an extremely heavy, hard and dense timber. The *Handroanthus* genus consists of 30 species, known by the name of Ipê. It is a widely dispersed species from Central America down to Argentina, Paraguay and Chile. As different trees of this genus fall under the same name, its color range is wide. The tree species was formerly part of the *Tabebuia* genus, but relocated in the *Handroanthus* genus in 2007 after DNA research.

Thanks to its hardness and wide availability, it is one of the main timber species that is exported from South America. In the U.S. the timber is often used for (outdoor) decking, thanks to its rot-resistant qualities. It has a Class A fire rating, the same rating given to concrete and steel. The tree is not commonly used in plantations, though one report mentions that trees on small plots have been tested in Costa Rica with reasonable growth rates[40].

International prices

ITTO MIS tracked prices of this timber species in Brazil and China, illustrated in the following graphs.

	Decking boards Belem/Paranagua Ports, FOB
May-09	1537
May-10	1583
May-11	1657
Dec-11	1879
Jan-13	2400
May-13	2664
Nov-13	2570
May-14	2330
Nov-14	2292
May-15	2368
Dec-15	2575

Figure 58 - International decking board Ipê prices, Brazil

Reported logs prices in Chinese ports:

	Price range		Median	
	Dia. 40 cm, logs, Guangzhou Yuzhu	Logs All grades, Zhangjiagang	Dia. 40 cm, logs, Guangzhou Yuzhu	Logs All grades, Zhangjiagang
May-14	629 - 755		692	
Nov-14	586 - 703	315 - 344	644	330
May-15	615 - 738	331 - 361	677	346
Dec-15	500 - 580	347 - 379	540	363

Figure 59 - International Ipê prices for logs, China

Other 2015 price sources consulted and/or available to the author where the following:

- A large Dutch company mentions 1400-1800 USD/M3 for sawn timber (FOB port of origin), and the following selling prices for IPE Decking (FOB Arica, Chile):
  - 1900 USD/m3 IPE Decking 21x140x7'
  - 1600 USD/m3 IPE Decking 21x90x7'
- A small Bolivian timber company mentions export prices of 1425 USD/M3 for first class Ipê (FOB Chile).

[40] Jiménez. et al, 2002.

- A German trader mentions a price of 1735 USD (1600 EUR) (FOB port of origin).

South American prices

The ITTO MIS reported the following local Brazilian prices:

	Brazilian domestic logs	Brazilian domestic sawn wood
May-09	120	564
May-10	144	692
May-11	165	813
Dec-11	167	856
Jan-13	154	862
May-13	169	927
Nov-13	158	803
May-14	169	856
Nov-14	186	919
May-15	155	770
Dec-15	136	662

Figure 60 - Brazilian domestic prices for Ipê

xvi. Jatoba – Hymenaea courbaril

This tree is common in the Caribbean, Central America and South America. Its timber is valuable and used for construction, furniture, flooring and is hard and dense, though slightly less than Ipê. The timber is also known as Courbaril, Locust, Brazilian copal and Brazilian Cherry.

It is a tree that grows well in plantations, though slow-growing and demanding patience – to reach diameters above 50cm one needs to wait 45 to 65 years, depending on the growth conditions. The tree needs rather intensive management in the first 2 years due to its slow growth.

International prices

ITTO MIS reports the following export prices for Jatoba.

	Export sawnwood prices Belem/Paranagua Ports, FOB	Decking Boards, Belem/Paranagua Ports, FOB
May-09	783	
May-10	827	
May-11	883	
Dec-11	1002	
Jan-13	1330	
May-13	1324	
Nov-13	1278	
May-14	1202	1550
Nov-14	1007	1505
May-15	1976	1545
Dec-15	992	1609

Figure 61 - International export prices Jatoba, Brazil

A Nicaraguan timber enterprise provided the following wholesale export prices for 2015.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3	
ESPECIES	AD	KD	TIMBER	AD	KD
JATOBA	896	980	811	726	811

Figure 62 - International export prices Jatoba, Nicaragua

A large Dutch timber company reported the following prices for Flooring products (per M2), (FOB Arica, Chile):

- 27 USD/m2 Jatoba Flooring ¾”x3-1/4”x1’-7’

Latin American prices

The following local prices were reported by ITTO MIS for Brazil:

	Brazilian domestic logs	Brazilian domestic sawn wood
May-09	85	434
May-10	103	530
May-11	119	620
Dec-11	122	643
Jan-13	111	642
May-13	117	643
Nov-13	105	568
May-14	109	534
Nov-14	109	504
May-15	89	412
Dec-15	76	337

Figure 63 - Domestic prices Jatoba, Brazil

Again, just like for other commonly traded timbers, local recent prices in Brazil have fallen considerably in 2015 (expressed in USD).

A Bolivian timber enterprise reported local prices of 1.33 USD/sq.ft for large-sized sawn timber (>7 feet) and 0.60 USD/sq.ft for short-sized timber (<7 feet), which equals 564 USD/M3 and 254 USD/M3 respectively. For kiln-dried timber an additional 65 up to 85 USD/M3 is added, reaching prices of 629-649 USD/M3 for large timbers and 319-339 USD/M3 for short timber.

Lastly, a Nicaraguan company reported a price in 2012 of 260 USD/m3 (roundwood FOB, Nicaragua).

xvii. Ronrón – Astronomium Graveolens

The local name of this species is Ronrón, Quitacalzon and Ciruelillo, but it is also known as glassywood, and commercialized as Goncalo Alves or Tigerwood in the U.S.. It is a widespread species found in Mexico down south to the Amazon up to Brazil, Bolivia and Paraguay. It is a species that can survive in both humid and dry forests. The Latin name *Astronium fraxinifolium* refers to the same species.

The dense wood is known as very heavy and strong timber and is used for construction but also for interior products such as doors, frames and furniture. The name glassywood already suggest that finished products have a glass-like appearance. The heartwood has a brown to red color.

The species has been used for enrichment planting in both natural forests and mixed plantations[41]. Because of its slow growth, it is not known as a useful tree species for single-species plantations, though experiments with plantations in Costa Rica resulted in high survival rates[42] of plants.

International prices

A Nigerian timber enterprise reported the following prices in 2015.

	LENGTH >6 FOOT (>1.83 M) USD/M3			LENGTH <6 FOOT (<1.83 M) USD/M3		
QUITA CALZON	763	869	720	593	699	0

Central American prices

Locally reported prices from Panama indicate 810 USD/m3 for sawn timber.

[41] CATIE, undated.
http://www.arbolesdecentroamerica.info/index.php/es/species/item/download/48_0ea73c0141305281705aa3ea946b6993
[42] http://www.fincaleola.com/ron_espa.html

i. Argentina Osage Orange – Maclura tinctoria

The species Mora (*Maclura tinctoria*) was not included in the first version of this study of 2016, but was included in the 2017 version.

Maclura tintoria is better known as old fustic or dyer's mulberry. The medium to large tree produces a yellow dye called fustic, known for coloring khaki fabric for the U.S. military. It is also known by the name of or Argentine Osage Orange and also the Latin name *Chlorophora tinctoria* refers to the same species. It is a tree present in Tropical America, from the West Indies to Central and South America.

The heartwood is golden bright to yellow, getting darker because of light influences. It is an extremely durable and dense hardwood species, and is often used for fence posts, musical instruments and small specialty wood items. It is a timber highly resistant to fungi attacks. According to the Wood database, a Guatemalan variant exists by the name of 'Guatemalan Tigerwoord´ or ´Mora´, with more pronounced darker and lighter, reddish brown colors[43], though Mora seems to be also a general name for this timber species.

In terms of prices, the author could only find one reference, which is a local price of sawmills in Panama (2017), charging 2,50 USD/boardfeet for Mora from natural forests. This would equal 1057 USD/M3. Converting this value to roundwood (110 USD/M3 milling costs, 40% efficiency), this results in a price of 378,80 USD/M3. Assuming that plantation timber would have a lower price, the author assumed a price of 340 USD/M3 for valuation purposes.

[43] http://www.wood-database.com/osage-orange/

3. Conclusions on prices

The Generation Forest as analyzed by the author incorporate the five species listed below. Therefore, the author made an estimate for these species, as well as for Teak.

1. Suradan Pilon (Zapatero)
2. Yellow Cedar
3. Spanish Cedar
4. Mahogany
5. Rosewood

In the model that simulates the cash-flow of the Generation Forest, a medium is sought between domestic and international roundwood prices that can indicate a relatively conservative price of timber produced in Panama in the Generation Forest, for either domestic or international markets.

References prices exist for roundwood, yet to be able to derive a roundwood price based on dried sawn timber, the author assumed a 40% efficiency rate for milling, and an estimated cost of 110 USD/M3 for milling (sawn timber). This implies that, for 1 cubic meter of sawn timber one needs 2.5 M3 of round wood timber, plus an additional 110 USD/M3. Assuming a sawn timber price of 700 USD/M3, this results in a price of (700-110)/2.5 = 236 USD/M3 for roundwood.

Native species

1. For **Suradan Pilon (Zapatero)**, reported cultivated prices for roundwood from Costa Rica are 74-114 USD/M3, whereas prices reported for Panama are 233 and 215 USD/M3 for export roundwood prices. Internationally, sawn timber ranges from 556.40 to 832.00 USD/M3 (based on undried, AD and KD timber). Based on the assumptions described in the previous paragraph, prices of sawn timber reported in Nicaragua result in 220 to 229 USD/M3 for undried timber. For modeling, we assumed a price of 200 USD/M3 for full grown Suradan Pilon roundwood.
2. Local **Yellow Cedar** prices for roundwood reported by the Costa Rican ONF were 65 to 112 USD/M3 for roundwood for 2014-2015, whereas another source reported a price of 185 USD/M3 in 2012 (FOB, Nicaragua). One reported international price was 200 USD/M3, while the author derived a price of 212 USD/M3 for based on export prices of sawn timber. The author assumed a price of 185 USD/M3, slightly below those of Suradan Pilon, which prices in generally lie above Yellow Cedar prices.
3. **Spanish Cedar** roundwood prices for Costa Rica provided by the ONF ranged from 217-228 USD/M3 and local Panamanian sources provided prices of 216-254 USD/M3 for squared logs. Median prices in Peru reported by the ITTO ranged from 285 to 335 USD/M3 in the 2009-2015 period (with a rising tendency). Reported sawn timber prices range from 360, 424 and 490 USD/M3 in Panama up to 584/591/653 USD/M3 reported by Herriss (2014) for Peru and 560 to 663 USD/M3 in Costa Rica, which would lead to a price of 100 to 221 USD/M3 for roundwood. The author assumed a price of 220 USD/M3.
4. Price references for roundwood prices of **Mahogany** (Panama) were 466 USD/M3 for squared logs and 254 to 379 USD/M3 for FOB roundwood (2012 prices from Central America), whereas reported sawn timber price range from indicated 847 USD/M3, which is slightly below the reported domestic prices of sawn timber in Peru (medians of 888 to 943 USD/M3 in the past 5 years) and substantially below international sawn timber prices (medians of 952 to 1169 USD/M3 for Grade A, 1613 to 1760 USD/M3 for KD 16%, 1-2", Peru). From a sawn timber price of 847 a price of 295 USD/M3 can be derived, whereas 952 USD/M3 results in 337 USD/M3 for roundwood. Based on these data the author assumed a price of 310 USD/M3.
5. Reported export roundwood prices for **Cocobolo** from 2012 in Central America ranged from 400 to 890 USD/M3. Exportable premium quality sawn timber goes for +4000 USD/M3, and even prices up to 9000+ USD/M3 in May 2014 (ITTO) in Chinese ports are reported. The ITTO of December 2015 reported considerably lower prices, though still in the 4300-6500 USD/M3 range in China. Such sawn timber prices would equal a price of 1676 to 2556 for roundwood. The other assumes a price of 850 USD/M3 for roundwood.

Teak

Teak prices for Central America could probably best be determined by the roundwood value based on information from ITTO and international values. Latin American teak growers claim that exporting logs result in higher yields than exporting processed teak[44]. Median Panamanian log prices reported by the ITTO are 313-518 USD/M3, though this can strongly differ depending on quality, girths and lengths (another source from Panama provided prices in the range of 246 – 509 USD/M3, depending on girth). Reported sawn timber prices in China range from 952-2569 for teak logs (30-60 girth) up to 2050-3224 USD/M3 for special grades. Based on these sawn timber prices, derived roundwood prices would be 337-980 USD/M3 and 776-1246 USD/M3 respectively, though these timbers are most likely from natural forests.
The author assumed a roundwood price of 390 USD/M3 for teak in its model (at age 25).

Prices for thinnings

The assumed prices as listed above are used in the model for final harvests. The harvest scheme of the different generations comprise several thinnings at earlier ages as well, providing thinner, smaller and less valuable timber. The author assumed the following formula to assume a price for wood from thinnings:

*Value (age of timber) = (age of timber) / (full grown age) * price of full grown timber*

This implies that for e.g. a 15 year old teak roundwood a price of (15)/ (25) * 390 = 234 USD/M3 would be used, which is 60% of the price of full-grown teak (assuming teak is full-grown at 25 years). Thinnings below the age of 12 were considered to be of no value. In Appendix I the price tables of each species can be consulted.

[44] Source in FAO, 2015 (Camacho, 2011).

4. Parameters of the Generation Forest

Characteristics of the Generation forest

The Generation forest is characterized by the following properties:

1) Mixed planation of Native species within each hectare[45].
2) Planning of multiple generation of different species over 100 years.
3) Thinnings and re-establishments of species over the course of 100 years.

In the modeled generation forest, the years of establishment of the 8 generations are the following:

Generation	Establishment year
Generation 1	0
Generation 2	11
Generation 3	24
Generation 4	41
Generation 5	53
Generation 6	61
Generation 7	73

The amount of trees planted in each generation are the following:

	GENERATION						
	1	2	3	4	5	6	7
Nanciton /Zapatero / Pilon - Hieronyma alchorneoides	700	60	30	15	50	25	30
Yellow Cedar / Amarillo / Yellow cedar - Terminalia Amazonia	110	30	20	25	30	20	30
Spanish Cedar / Cedro amargo - Cedrela odorata	130	10	25	10	25	25	30
Mahogany/Mara/Caoba - Swietenia Macrophylla	90	15	20	25	25	0	30
Cocobolo/Rosewood - Dalbergia sp.	150	50	25	25	30	30	30

The details of the harvest scheme of each generation can be viewed in Appendix II.

[45] In this case: Panama

Assumptions regarding costs

Costs for management & administration for a single hectare are the following[46] (500 hectare project):

Total Cash Costs	USD/ha	Total Cash Costs	USD/ha	Total Cash Costs	USD/ha	Total Cash Costs	USD/ha
0	3,850	26	630	51	362	76	498
1	1,712	27	625	52	405	77	493
2	1,813	28	577	53	736	78	429
3	1,687	29	609	54	517	79	404
4	1,378	30	644	55	575	80	468
5	1,115	31	383	56	494	81	397
6	752	32	395	57	458	82	438
7	815	33	382	58	430	83	392
8	693	34	385	59	403	84	383
9	684	35	474	60	499	85	456
10	754	36	385	61	623	86	378
11	1,073	37	368	62	493	87	399
12	787	38	360	63	488	88	377
13	746	39	388	64	482	89	370
14	724	40	453	65	543	90	410
15	796	41	583	66	435	91	373
16	686	42	464	67	407	92	346
17	582	43	432	68	411	93	354
18	649	44	427	69	403	94	345
19	632	45	482	70	447	95	392
20	667	46	415	71	416	96	337
21	550	47	371	72	425	97	339
22	549	48	371	73	729	98	342
23	548	49	369	74	500	99	323
24	873	50	436	75	576		
25	724						

Figure 64 - Generation Forest - cost per hectare (USD)

Growth rates

To simulate growth rates, 2 different growth tables were used per species (for each of the five incorporated species), one normal growth rate and one with a reduced growth rate, simulating less favorable growth conditions that are present in a plantation with existing tree coverage, resulting in shade conditions and competition for resources for newly established trees. The normal growth table was applied to the first generation while the second, reduced growth table was applied for the second till the seventh generation. The gr

Prices

Based on the previous chapters, the price table as listed in Appendix I was used for the 5 concerned species, where prices are indicated by age in USD/M3.

Other parameters

The author simulated a 500 hectare generation forest in Panama with the abovementioned characteristics. The assumed a Biological Asset discount rate of 9.1% (applied to all costs and revenues, except land) and a land discount rate of 9.1%. The land is acquired in year 0, and sold for the same value in year 99 (final year). No inflation rate is applied.

[46] The costs for management & administration were calculated in detail with information from private plantation managers.

5. Model results

Simulation (default)

Supplying the model with the above-mentioned data for a 500 ha Generation Forest, the Internal Rate of Return (IRR) reaches a level of 6.20%. The Net Present Value reaches -5,349,509 USD while the equity requirement is 13,647,468 USD. Both values are calculated over a 100-year period.

In terms of costs, the following graph shows a circle diagram that give an idea of the proportion of the costs of this project.

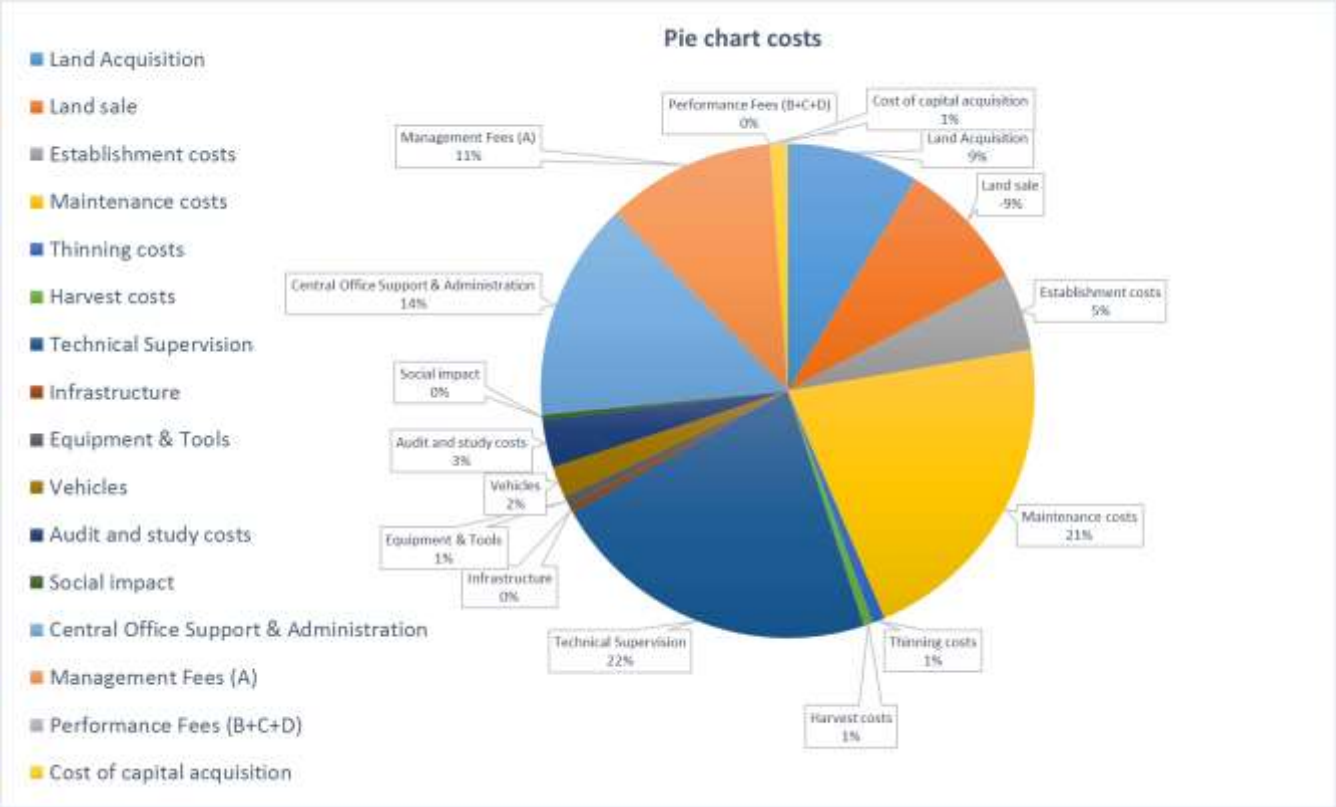


Figure 65 - Pie chart costs Generation forest (100 years)

In the next graph, the Cumulative Cash flows are shown over the whole 100 year period. It can be seen that the break-even point is reached in year 29 (no inflation taken into account).

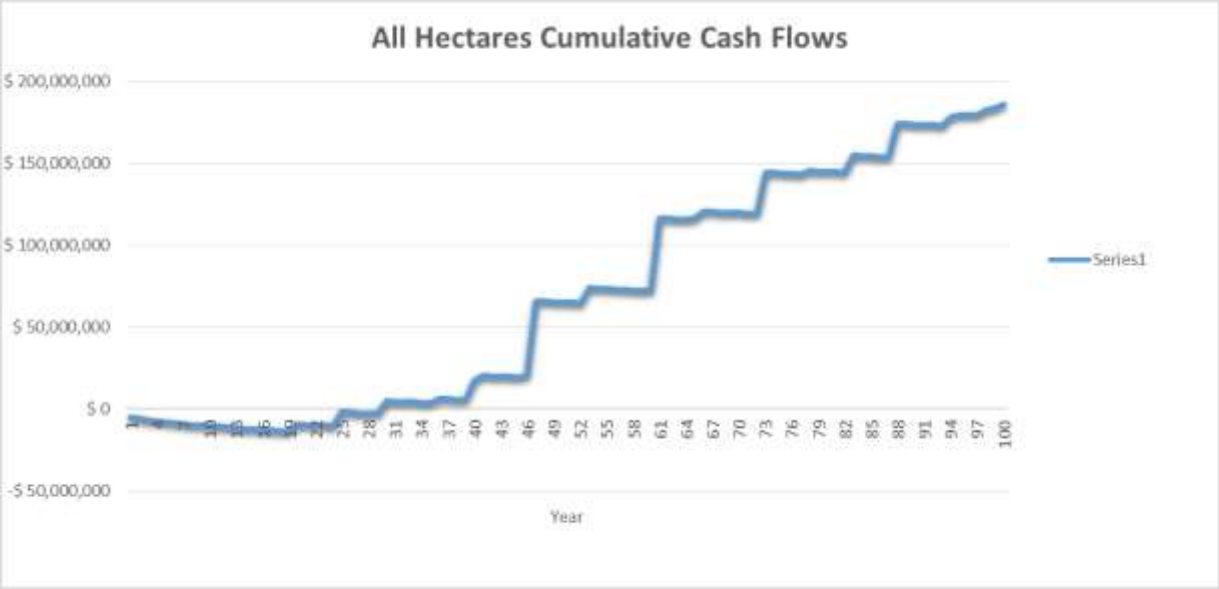


Figure 66 - Accumulated cash flow Generation Forest (500 ha.)

Simulation (teak prices)

The author realized simulation was 'feeding' the model with Teak prices. In this case, all harvested timbers are assumed to have prices equal to teak prices. These teak prices also rise in value according to age. This scenario, results in an Internal Rate of Return (IRR) of 8.04%, while the Net Present Value reaches -2,190,272 USD. The equity requirement is unchanged: 13,647,468 USD. Both values are calculated over a 100 year period.

This results in the following accumulated cash flow. The break-even point is now reached in year 24.

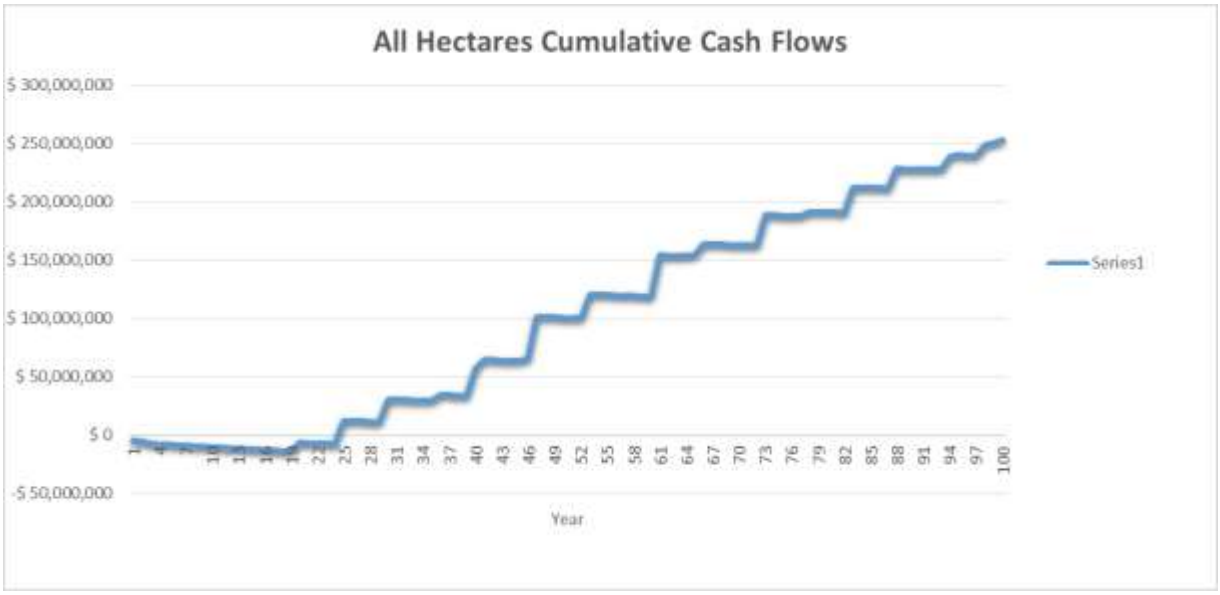


Figure 67 - Accumulated cash flow Generation Forest (teak prices, 500 ha.)

6. Recommendation and conclusions

The carried out price study and simulations calculated with the financial model, specifically designed for the characteristics of the Generation Forest, show that a long-term Generation Forest provides a reasonable rate of return for investors. The country risk for the investor that is calculated by applying a discount rate, is relatively high in the case of Panama, and with the country risk higher than the internal rate of return (IRR), this results in negative NPV values.

In the default scenario, an IRR of 6.20% is obtained, assuming relatively conservative timber prices and a 0 inflation rate (for both costs and revenues). These results are obtained without including potential revenues from carbon trade. In the 'teak price' scenario, the IRR reaches a level of 8.04%.

More research, and factual implementation of this innovative forest scheme, is needed to come up with more empirical data concerning growth rates of especially later generations that suffer from shadow and competition of resources by earlier generations. Furthermore, studies have to be done on the impact of partial thinnings and harvests in Generation Forests on the same and later generation. Is there considerable damage to other trees of the same and later generations? Will this affect general MAI levels, future harvests or timber quality?

In the same line of thought, more research is recommended on the carbon uptake of Generation Forests. These are possibly higher than normal plantations, as the land is covered by different species of different ages, possibly taking better advantage of available resources. Resulting data can provide more clarity on revenues from carbon credits.

The developed model proved to be a handy and fine tool to calculate economic returns of Generation Forests, and could be applied in different countries and settings to determine how Generation Forest potentially perform in different countries and with different parameters. Furthermore, one can easily combine and 'test' different timber species on their overall economic performance. The investigated prices provided in this document can provide a base for such calculations.

Appendix – Price update 2018

Prices for the following species were updated with actual 2018 information:

Species name	Latin name
Teak	*Tectona grandis*
Spanish Cedar	*Cedrela odorata*
Rosy trumpet tree	*Tabebuia rosea*
Cocobolo	*Dalbergia retusa*
Yellow Cedar	*Terminalia Amazonia*
Suradan Pilon (Zapatero)	*Hieronyma alchorneoides*

Information on prices was based on recent bi-monthly ITTO MIS reports, thereby including price updates of May 2016, November 2016, March 2017, May 2017, November 2017 and April 2018.

Updated prices 2018

Teak

The following tables show updates of international log, squared logs and sawn timber prices.

	Brazil Logs	Brazil squares	Costa Rica logs	Nicaragua logs	Panama logs
May-09	-	-	-	-	-
May-10	-	450 - 475	400 - 425	-	300 - 325
May-11	-	500 - 600	350 - 500	-	315 - 400
Dec-11	-	400 - 600	350 - 650	-	350 - 475
Jan-13	-	400 - 600	400 - 650	-	350 - 450
May-13	-	350 - 600	350 - 550	-	350 - 550
Nov-13	-	360 - 680	350 - 700	430 - 535	260 - 550
May-14	- 680	350 - 750	355 - 700	370 - 535	360 - 550
Nov-14	360 - 750	360 - 680	360 - 840	340 - 450	275 - 750
May-15	390 - 1063	370 - 680	455 - 739	350 - 596	286 - 750
Dec-15	404 - 665	370 - 556	320 - 780	402 - 505	368 - 430
May-16	370 - 665	370 - 556	320 - 780	402 - 505	368 - 430
Nov-16	321 - 540	333 - 556	357 - 780	402 - 505	335 - 475
Mar-17	344 - 540	333 - 556	357 - 780	402 - 505	335 - 475
May-17	344 - 540	333 - 556	357 - 780	402 - 505	335 - 475
Nov-17	344 - 560	333 - 556	357 - 780	402 - 505	335 - 475
Apr-18	344 - 540	333 - 556	357 - 780	402 - 505	335 - 475

Figure 68 - International teak log prices (price range)

	Brazil Logs	Brazil squares	Costa Rica logs	Nicaragua logs	Panama logs
May-09	0	0	0	0	0
May-10	0	463	413	0	313
May-11	0	550	425	0	358
Dec-11	0	500	500	0	413
Jan-13	0	500	525	0	400
May-13	0	475	450	0	450
Nov-13	0	520	525	483	405
May-14	680	550	528	453	455
Nov-14	555	520	600	395	513
May-15	727	525	597	473	518
Dec-15	535	463	550	454	399
May-16	518	463	550	454	399
Nov-16	431	445	569	454	405
Mar-17	442	445	569	454	405
May-17	442	445	569	454	405
Nov-17	452	445	569	454	405
Apr-18	442	445	569	454	405

Figure 69 - International teak log prices (medians)

	Teak logs dia. 30-60 cm, Guangzhou Yuzhu	Teak sawn wood, Special grade, Guangzhou Yuzhu	Teak sawn wood, Grade A, Guangzhou Yuzhu	Teak sawn wood, all grade, Shanghai Furen
May-09	1766 - 2569		1365 - 1525	
May-10	1806 - 2134			
May-11	1794 - 2120		1566 - 1566	
Dec-11	1711 - 2022		1493 - 1493	
Jan-13			1564 - 1564	
May-13	1045 - 2089		1543 - 1543	
Nov-13	952 - 1905		1407 - 1407	
May-14	1259 - 1888	2203 - 3147	1510 - 1510	1809 - 5664
Nov-14	1172 - 1757	2050 - 2929	1406 - 1406	1684 - 5272
May-15	1230 - 1846	2153 - 3076	1477 - 1477	1769 - 5537
Dec-15	1370 - 1854	2257 - 3224	0 - 0	0 - 0
May-16	1304 - 1765	2148 - 3069	0 - 0	0 - 0
Nov-16	1250 - 1691	2058 - 2940	0 - 0	0 - 0
Mar-17	1231 - 1665	2027 - 2896	0 - 0	0 - 0
May-17	1231 - 1666	2028 - 2897	0 - 0	0 - 0
Nov-17	1280 - 1295	2108 - 3313	0 - 0	0 - 0
Apr-18	1343 - 1359	2213 - 3477	0 - 0	0 - 0

Figure 70 - International teak prices, Chinese ports (price range)

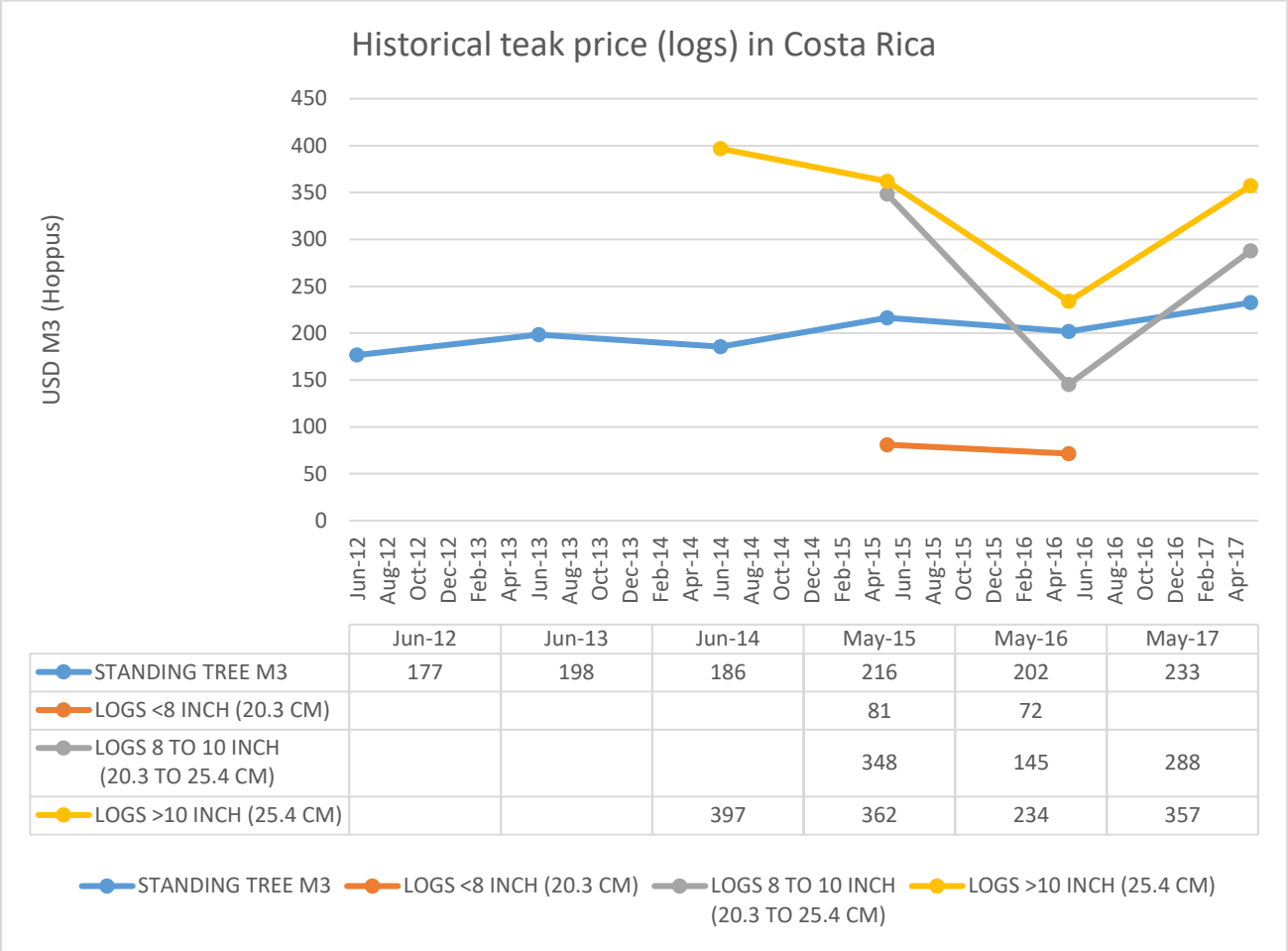
	Teak logs dia. 30-60 cm, Guangzhou Yuzhu	Teak sawn wood, Special grade, Guangzhou Yuzhu	Teak sawn wood, Grade A, Guangzhou Yuzhu	Teak sawn wood, all grade, Shanghai Furen
May-09	2168		1445	
May-10	1970			
May-11	1957		1566	
Dec-11	1866		1493	
Jan-13	0		1564	
May-13	1567		1543	
Nov-13	1429		1407	
May-14	1573	2675	1510	3737
Nov-14	1465	2490	3339	3478
May-15	1538	2615	3507	3653
Dec-15	1612	2740		
May-16	1534	2609		
Nov-16	1470	2499		
Mar-17	1448	2461		
May-17	1448	2462		
Nov-17	1287	2710		
Apr-18	1351	2845		

Figure 71 - International teak prices, Chinese ports (medians)

Price development for teak wood has shown to be very stable, when looking at the ITTO MIS data of Latin American exports[47]. There seems to be a downward tendency in China, when it concerns teak logs, although sawn timber prices have been going up considerably. One direct source from a timber processor in Nicaragua mentioned prices of 508 USD for teak in roundwood.

[47] The prices reported in the ITTO MIS reports for teak logs for the studied countries are actually exactly the same during the whole period March 2017 – April 2018, which it somewhat suspicious – possibly little data was available to the publisher, or possibly their references did not report any changes in price.

The Costa Rican *Oficina Naional Forestal* further published its 2016 and 2017 annual price studies, reflected in the following 2 graphs.



	Jun-12	Jun-13	Jun-14	May-15	May-16	May-17
STANDING TREE M3	177	198	186	216	202	233
LOGS <8 INCH (20.3 CM)				81	72	
LOGS 8 TO 10 INCH (20.3 TO 25.4 CM)				348	145	288
LOGS >10 INCH (25.4 CM)			397	362	234	357

Figure 72 - Costa Rican teak prices (standing trees and logs)

Figure 73 - Costa Rican teak prices (sawn timber)

In 2017 increases can be observed in the Costa Rican teak prices, yet 2017 levels are roughly equal to those of 2015.

As internationally sources do not show a clear up or downward trend overall, the author assumed a similar price for valuations of 390 USD/M3 for roundwood.

Spanish Cedar

The prices for Spanish Cedar were updated based on the bimonthly ITTO MIS reports. The following tables show the recent prices:

	Spanish Cedar KD select, Mexican market, Peru, FOB Callao Port	Spanish Cedar KD select, North American market, Peru, FOB Callao Port
May-09	909	920
May-10	909	920
May-11	909	920
Dec-11	956	968
Jan-13	956	968
May-13	956	968
Nov-13	956	968
May-14	956	968
Nov-14	956	968
May-15	956	968
Dec-15	956	968
May-16	956	968
Nov-16	956	968
Mar-17	956	968
May-17	956	968
Nov-17	956	968
Apr-18	956	968

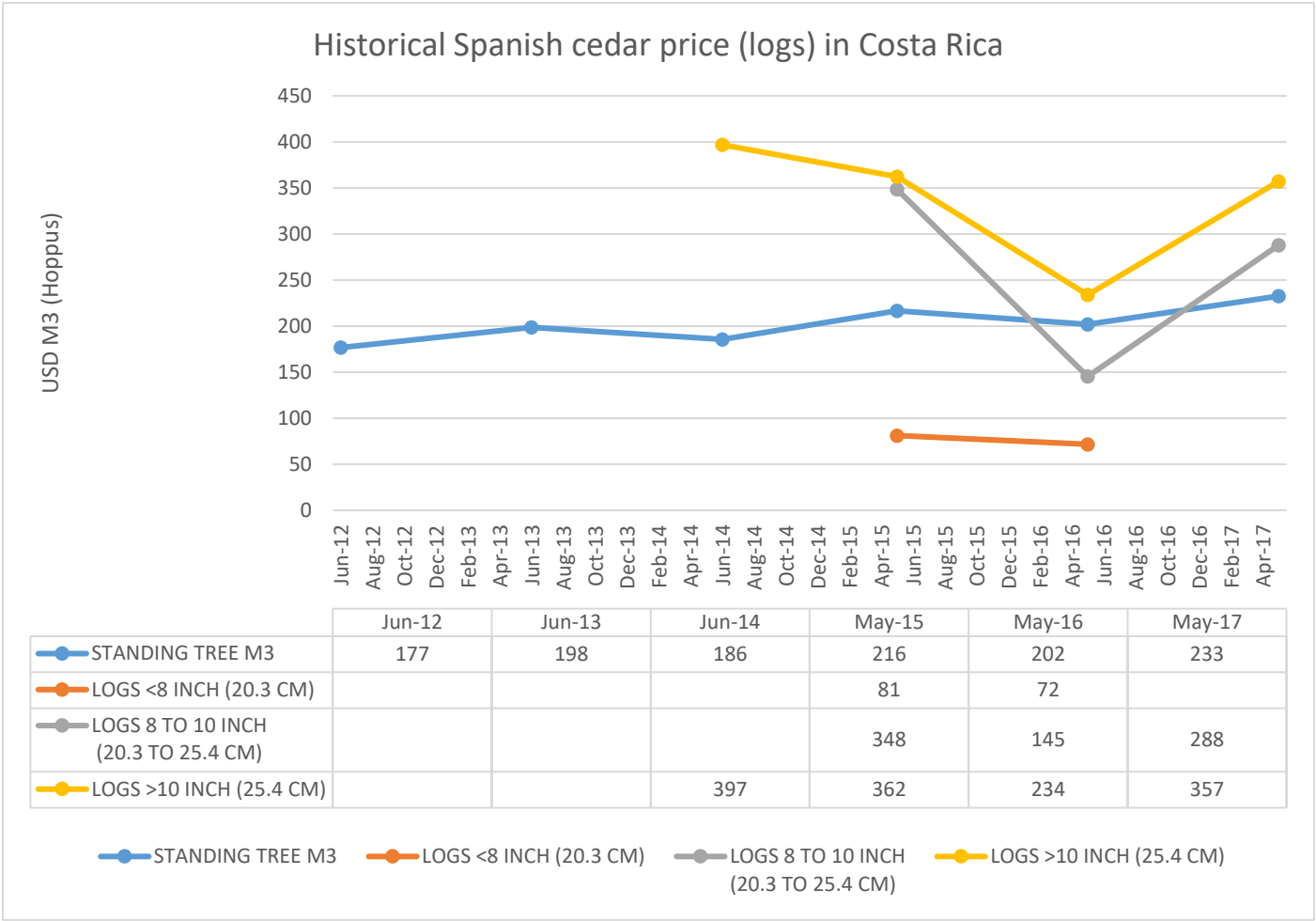
Figure 74 - International Spanish Cedar prices, Peru (price range)

	Price range	Medians
	Sawn wood, domestic price	Sawn wood, domestic price
May-09	298 - 344	321
May-10	268 - 321	295
May-11	264 - 305	285
Dec-11	264 - 305	285
Jan-13	264 - 305	285
May-13	264 - 305	285
Nov-13	277 - 321	299
May-14	296 - 355	326
Nov-14	296 - 355	326
May-15	305 - 346	326
Dec-15	305 - 364	335
May-16	305 - 364	335
Nov-16	316 - 368	342
Mar-17	316 - 368	342
May-17	316 - 368	342
Nov-17	332 - 374	353
Apr-18	332 - 374	353

Figure 75 - Peru domestic prices Spanish Cedar

Only in Peruvian domestic sawn wood the international prices show a slight increase, whereas processed timber stay equal. A second source of local timber processor in Nicaragua mentions a price of 2 USD/bf, which would equal 848 USD/m3 sawn, or roughly 295 USD/M3 for roundwood.

The Costa Rican *Oficina Nacional Forestal* provides an historical overview of local Spanish Cedar prices:



	Jun-12	Jun-13	Jun-14	May-15	May-16	May-17
STANDING TREE M3	177	198	186	216	202	233
LOGS <8 INCH (20.3 CM)				81	72	
LOGS 8 TO 10 INCH (20.3 TO 25.4 CM)				348	145	288
LOGS >10 INCH (25.4 CM)			397	362	234	357

Figure 76 - Historical Spanish cedar price (logs) - Costa Rica

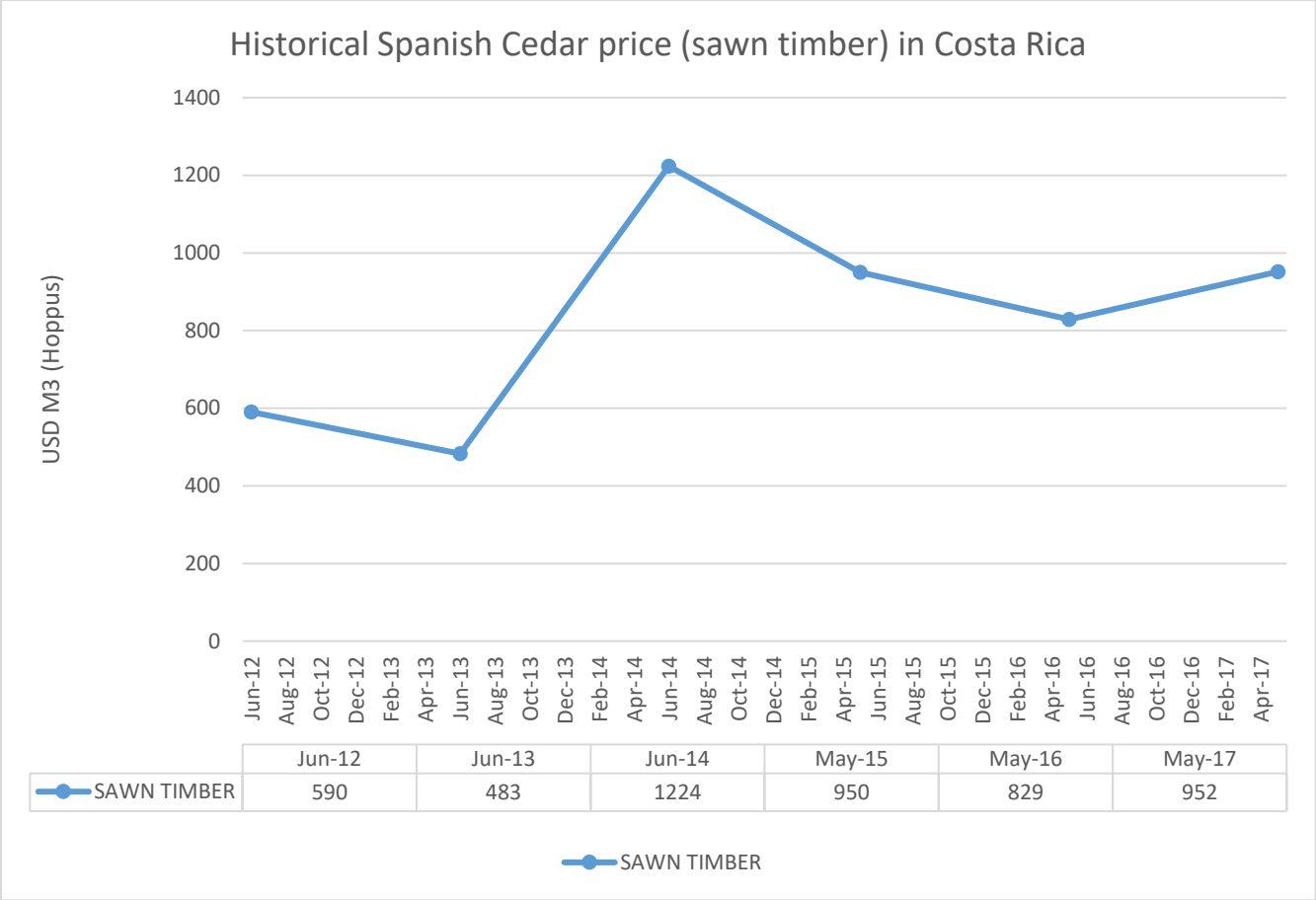


Figure 77 - Historical Spanish cedar price (sawn timber) - Costa Rica.
** June 2013 data was removed by author as it was clearly incorrect.*

While the roundwood shows a price increase, this is not reflected in the sawn timber price in Costa Rica.

Based on the different data sources, the author decided to maintain the slightly increased value of this timber, and applied 230 USD/M3 (from 220 USD/M3 of the previous year for Panama) in his valuations.

Rosy trumpet tree

The author was not able to find price update for this species. In reference to *Chapter x – Rosy trumpet tree*, where reported prices of roundwood are in between 220 and 260 M3, whereas sawn timber is in between 424 and 509 (large-sized – 125 to 160 USD/M3 roundwood equivalent), the author assumed a price of 200 USD/M3 for roundwood.

Rosewood

Based on updates of the ITTO MIS reports, the international prices were updated in the following table.

	Price range		Median	
	Cocobolo logs, All grades, Guangzhou Yuzhu / M3	Cocobolo logs, Shanghai Furen Forest Products / tonne	Cocobolo logs, All grades, Guangzhou Yuzhu / M3	Cocobolo logs, Shanghai Furen Forest Products / tonne
May-14	8339 - 9125	6765 - 28320	8732	17542
Nov-14	7762 - 8494	6297 - 26361	8128	16329
May-15	8152 - 8921	6614 - 27685	8536	17149
Dec-15	4353 - 6448	4514 - 19345	5400	11929
May-16	4143 - 6138	4296 - 18413	5140	11355
Nov-16	3969 - 5881	4116 - 17642	4925	10879
Mar-17	3909 - 5791	4054 - 17373	4850	10714
May-17	3911 - 5794	4056 - 17382	4852	10719
Nov-17	4216 - 6023	5270 - 18068	5119	11669
Jan-18	4311 - 6158	5389 - 18475	5235	11932
Mar-18	4423 - 6319	0 - 0	5371	0
Apr-18	6322 - 11064	0 - 0	8693	0

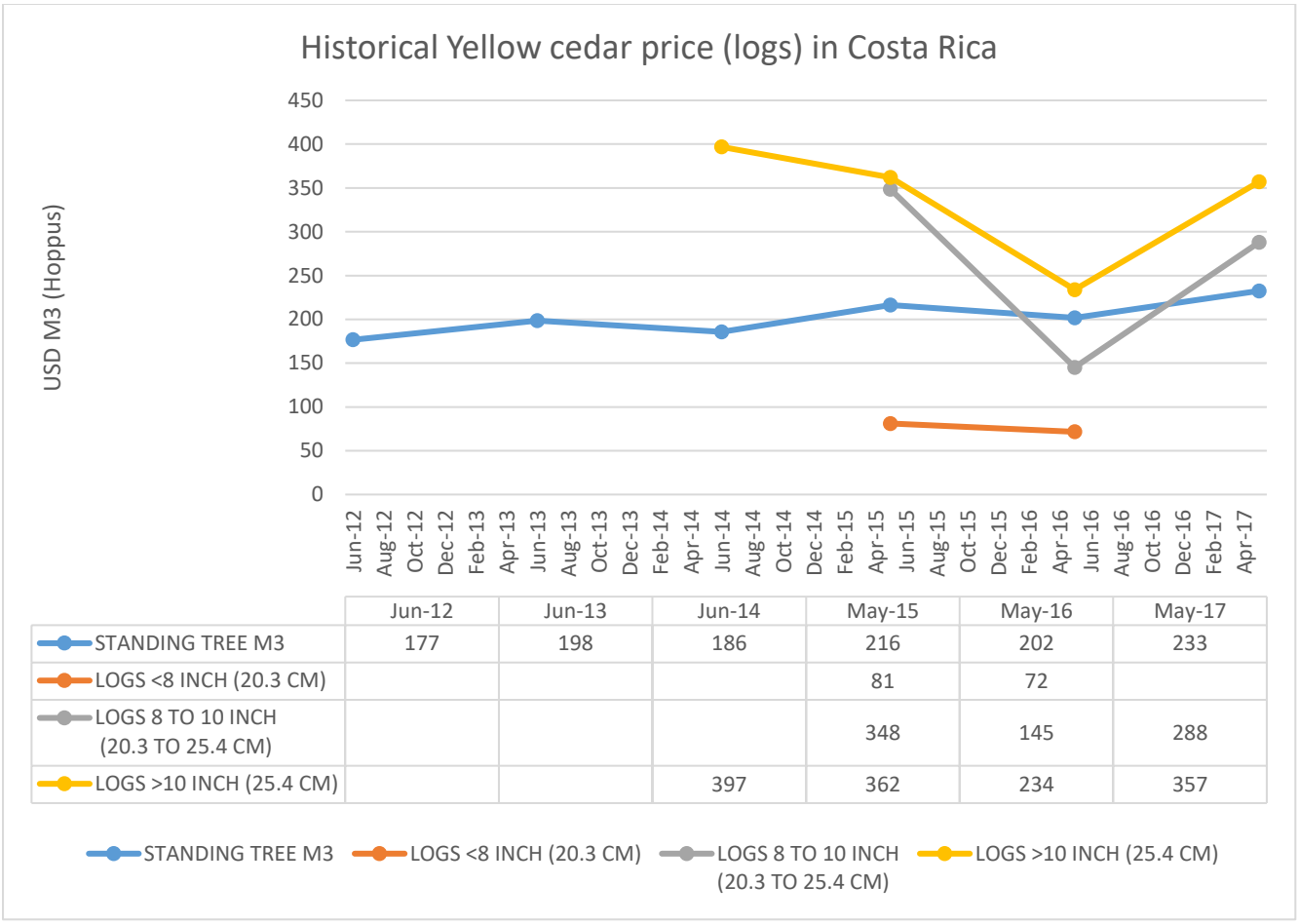
Figure 78 - Cocobolo log prices in Chinese ports

It can be observed that Rosewood, also known as Cocobolo, has seen a price increase at Chinese ports. As the April 2018 median lies 69% (!) above that of November, the author also referenced the ITTO MIS reports of January and March 2018 (both included in the figure 78). Although there is an upward trend from January till March 2018, the April spike is still very considerable compared to March, and possibly fragile. Comparing actual prices with those of the previous May 2017 study, medians have increased at both ports. A Nicaraguan source mentioned prices of 5.5-7 USD/bf for square billets, which equals 2.332 to 2.968 USD/M3.

Concluding, the author also assumed a price increase to 850 USD/M3 for Rosewood from the earlier 765 USD/M3 for roundwood of last year.

Yellow Cedar

The Costa Rican *Oficina Nacional Forestal* provided the only available reference for prices on this timber species, reflected in the following 2 tables.



	Jun-12	Jun-13	Jun-14	May-15	May-16	May-17
STANDING TREE M3	177	198	186	216	202	233
LOGS <8 INCH (20.3 CM)				81	72	
LOGS 8 TO 10 INCH (20.3 TO 25.4 CM)				348	145	288
LOGS >10 INCH (25.4 CM)			397	362	234	357

Figure 79 - Historical Yellow cedar price (logs) - Costa Rica

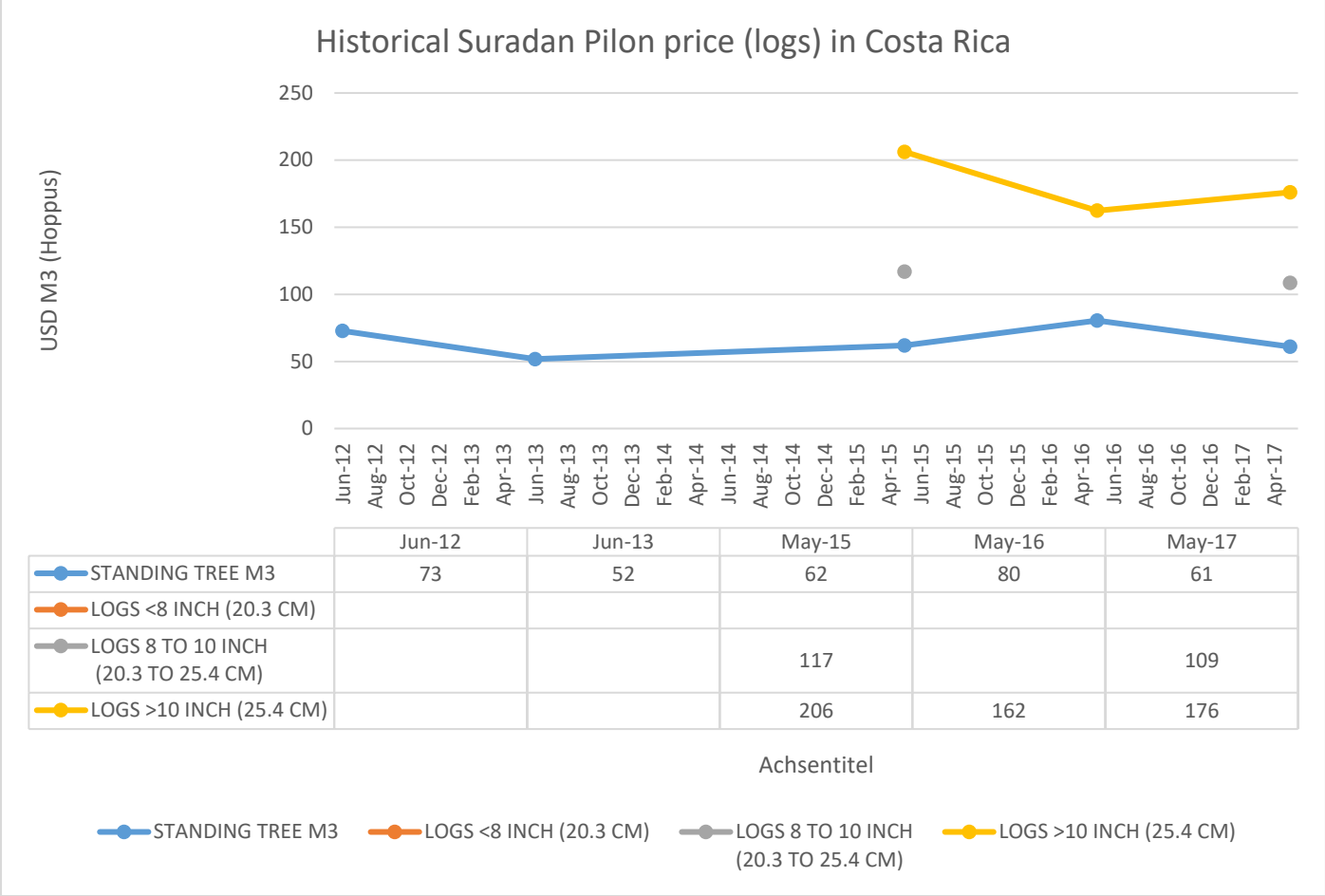
	Jun-12	Jun-13	Jun-14	May-15	May-16	May-17
SAWN TIMBER	590	483	1224	950	829	952

Figure 80 - Historical Yellow cedar price (sawn timber) - Costa Rica

Price levels show a drop in 2016, but a releveling to 2015 levels in the year 2017. The author assumed a price of 185 USD/M3, equal to the 2016 study (in which data until the year 2015 from the *Oficina Nacional Forestal* was taken into account).

Suradan Pilon (Zapatero)

The Costa Rican *Oficina Nacional Forestal* provided the only available data for determining these prices, reflected in the following two graphs.



	Jun-12	Jun-13	May-15	May-16	May-17
STANDING TREE M3	73	52	62	80	61
LOGS <8 INCH (20.3 CM)					
LOGS 8 TO 10 INCH (20.3 TO 25.4 CM)			117		109
LOGS >10 INCH (25.4 CM)			206	162	176

Figure 81 - Historical Suradan Pilon price (logs) - Costa Rica

Figure 82 - Historical Suradan Pilon price (sawn timber) - Costa Rica

Sawn timber prices are very stable, whereas standing tree and logs show more variation, though with no clearly observable trend. The author assumed a price of 200 USD/M3, equal to the one in the 2016 study.

Appendix I

Price tables of different species according to age. Prices are USD/M3 (roundwood).

AGE	Yellow Cedar - Terminalia Amazonia	Cocobolo/Rosewood - Dalbergia sp.	Suradan Pilon - Hieronyma alchorneoides	Spanish Cedar - Cedrela odorata	Teak - Tectona Grandis
11	78,3	239,7	84,6	105,4	204,3
12	85,4	261,5	92,3	115,0	222,9
13	92,5	283,3	100,0	124,6	241,4
14	99,6	305,1	107,7	134,2	260,0
15	106,7	326,9	115,4	143,8	278,6
16	113,8	348,7	123,1	153,3	297,1
17	121,0	370,5	130,8	162,9	315,7
18	128,1	392,3	138,5	172,5	334,3
19	135,2	414,1	146,2	182,1	352,9
20	142,3	435,9	153,8	191,7	371,4
21	149,4	457,7	161,5	201,3	390,0
22	156,5	479,5	169,2	210,8	408,6
23	163,7	501,3	176,9	220,4	427,1
24	170,8	523,1	184,6	230,0	445,7
25	177,9	544,9	192,3	239,6	464,3
26	185,0	566,7	200,0	249,2	482,9
27	192,1	588,5	207,7	258,8	501,4
28	199,2	610,3	215,4	268,3	520,0
29	206,3	632,1	223,1	277,9	538,6
30	213,5	653,8	230,8	287,5	557,1
31	220,6	675,6	238,5	297,1	575,7
32	227,7	697,4	246,2	306,7	594,3
33	234,8	719,2	253,8	316,3	612,9
34	241,9	741,0	261,5	325,8	631,4
35	249,0	762,8	269,2	335,4	650,0
36	256,2	784,6	276,9	345,0	668,6
37	263,3	806,4	284,6	354,6	687,1
38	270,4	828,2	292,3	364,2	705,7
39	277,5	850,0	300,0	373,8	724,3
40	284,6	871,8	307,7	383,3	742,9
41	291,7	893,6	315,4	392,9	761,4
42	298,8	915,4	323,1	402,5	780,0
43	306,0	937,2	330,8	412,1	798,6
44	313,1	959,0	338,5	421,7	817,1
45	320,2	980,8	346,2	431,3	835,7
46	327,3	1002,6	353,8	440,8	854,3
47	334,4	1024,4	361,5	450,4	872,9
48	341,5	1046,2	369,2	460,0	891,4
49	348,7	1067,9	376,9	469,6	910,0
50	355,8	1089,7	384,6	479,2	928,6

Appendix II

The following tables indicate the harvest scheme of each Generation, as applied in the model to simulate the Generation Forest.

Generation 1 (establishment year: 0)

			THINNING 1					THINNING 2					THINNING 3					THINNING 4					THINNING 5					FINAL HARVEST				
ID	SPECIES	AMOUNT OF TREES/HA	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT
1	6 - Nanciton /Zapatero / Pilon - Hieronyma alchor	700	4	41%	284	2.85	416	7	13%	90	3.59	326	11	18%	125	16.30	201	19	7%	50	22.21	151	24	18%	129	109.12	22	29	3%	22	31.24	0
2	2 - Yellow Cedar / Amarillo / Yellow cedar - Termi	110	4	50%	55	0.52	55	7	16%	18	0.73	37	11	5%	5	0.71	32			0	0.00	32			0	0.00	32	29	29%	32	53.65	0
3	7 - Spanish Cedar / Cedro amargo - Cedrela odor	130	4	46%	60	0.01	70	7	15%	20	0.10	50			0	0.00	50			0	0.00	50			0	0.00	50	19	38%	50	20.16	0
4	1 - Mahogany/Mara/Caoba - Swietenia Macrop	90	4	17%	15	0.05	75	7	11%	10	0.22	65	11	11%	10	0.66	55	19	17%	15	3.92	40			0	0.00	40	33	44%	40	76.30	0
5	3 - Cocobola/Rosewood - Dalbergia sp.	150	4	33%	50	0.24	100	7	17%	25	0.57	75	11	13%	20	1.81	55	19	10%	15	4.24	40			0	0.00	40	46	27%	40	100.92	0
6					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
7					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
8					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
9					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
10					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
11					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
12					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
	Total	1190			464	3.66935	716			163	5.21419	553			160	19.4791	393			80	30.3655	313			129	109.123	184			184	282.267	0

Generation 2 (establishment year: 11)

			THINNING 1					THINNING 2					THINNING 3					THINNING 4					THINNING 5					FINAL HARVEST				
ID	SPECIES	AMOUNT OF TREES/HA	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT
1	14 - Nanciton /Zapatero / Pilon -SLOW - Heronyr	60	17	33%	20	4.40	40	24	33%	20	11.27	20			0	0.00	20			0	0.00	20			0	0.00	20	24	33%	20	11.27	0
2	15 - Yellow Cedar / Amarillo / Yellow cedar-SLOW	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	29	100%	30	55.06	0
3	13 - Spanish Cedar / Cedro amargo - SLOW - Ced	10			0	0.00	10			0	0.00	10			0	0.00	10			0	0.00	10			0	0.00	10	24	100%	10	5.58	0
4	16 - Mahogany/Mara/Caoba-SLOW - Swietenia	15			0	0.00	15			0	0.00	15			0	0.00	15			0	0.00	15			0	0.00	15	41	100%	15	22.21	0
5	12 - Cocobola/Rosewood-SLOW - Dalbergia sp.	50			0	0.00	50			0	0.00	50			0	0.00	50			0	0.00	50			0	0.00	50	49	100%	50	92.18	0
6					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
7					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
8					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
9					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
10					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
11					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
12					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
	Total	163			20	4.3992	145			20	11.2663	125			0	0	125			0	0	125			0	0	125			125	166.297	0

Generation 3 (establishment year: 24)

			THINNING 1					THINNING 2					THINNING 3					THINNING 4					THINNING 5					FINAL HARVEST				
ID	SPECIES	AMOUNT OF TREES/HA	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT
1	14 - Nanciton /Zapatero / Pilon -SLOW - Heronyr	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	28	100%	30	39.24	0
2	15 - Yellow Cedar / Amarillo / Yellow cedar-SLOW	20			0	0.00	20			0	0.00	20			0	0.00	20			0	0.00	20			0	0.00	20	28	100%	20	22.45	0
3	13 - Spanish Cedar / Cedro amargo - SLOW - Ced	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25	21	100%	25	10.70	0
4	16 - Mahogany/Mara/Caoba-SLOW - Swietenia	20			0	0.00	20			0	0.00	20			0	0.00	20			0	0.00	20			0	0.00	20	41	100%	20	29.61	0
5	12 - Cocobola/Rosewood-SLOW - Dalbergia sp.	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25	48	100%	25	45.37	0
6					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
7					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
8					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
9					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
10					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
11					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
12					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
	Total	120			0	0	120			0	0	120			0	0	120			0	0	120			0	0	120			120	147.366	0

Generation 4 (establishment year: 41)

			THINNING 1					THINNING 2					THINNING 3					THINNING 4					THINNING 5					FINAL HARVEST				
ID	SPECIES	AMOUNT OF TREES/HA	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT
1	14 - Nanciton /Zapatero / Pilon -SLOW - Hieronyr	15			0	0.00	15			0	0.00	15			0	0.00	15			0	0.00	15			0	0.00	15	23	100%	15	7.74	0
2	15 - Yellow Cedar / Amarillo / Yellow cedar-SLOW	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25	31	100%	25	31.96	0
3	13 - Spanish Cedar / Cedro amargo - SLOW - Ced	10			0	0.00	10			0	0.00	10			0	0.00	10			0	0.00	10			0	0.00	10	19	100%	10	5.34	0
4	16 - Mahogany/Mara/Caoba-SLOW - Swietenia	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25	41	100%	25	37.01	0
5	12 - Cocobolo/Rosewood-SLOW - Dalbergia sp.	35			0	0.00	35			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25	46	100%	25	43.60	0
6					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
7					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
8					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
9					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
10					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
11					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
12					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
	Total	100			0	0	100			0	0	100			0	0	100			0	0	100			0	0	100			100	123.636	0

Generation 5 (establishment year: 53)

			THINNING 1					THINNING 2					THINNING 3					THINNING 4					THINNING 5					FINAL HARVEST				
ID	SPECIES	AMOUNT OF TREES/HA	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT
1	14 - Nanciton /Zapatero / Pilon -SLOW - Hieronyr	30	19	40%	20	5.79	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	24	60%	30	16.90	0
2	15 - Yellow Cedar / Amarillo / Yellow cedar-SLOW	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	29	100%	30	35.06	0
3	13 - Spanish Cedar / Cedro amargo - SLOW - Ced	25	19	60%	15	5.01	10			0	0.00	10			0	0.00	10			0	0.00	10			0	0.00	10	24	40%	10	5.58	0
4	16 - Mahogany/Mara/Caoba-SLOW - Swietenia	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25			0	0.00	25	40	100%	25	35.05	0
5	12 - Cocobolo/Rosewood-SLOW - Dalbergia sp.	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	49	100%	30	55.31	0
6					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
7					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
8					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
9					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
10					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
11					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
12					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
	Total	160			35	10.7942	125			0	0	125			0	0	125			0	0	125			0	0	125			125	147.907	0

Generation 6 (establishment year: 61)

			THINNING 1					THINNING 2					THINNING 3					THINNING 4					THINNING 5					FINAL HARVEST				
ID	SPECIES	AMOUNT OF TREES/HA	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT
1	14 - Nanciton /Zapatero / Pilon -SLOW - Hieronyr	25	21	60%	15	5.85	10			0	0.00	10			0	0.00	10			0	0.00	10			0	0.00	10	26	40%	10	7.68	0
2	15 - Yellow Cedar / Amarillo / Yellow cedar-SLOW	20			0	0.00	20			0	0.00	20			0	0.00	20			0	0.00	20			0	0.00	20	36	100%	20	32.00	0
3	13 - Spanish Cedar / Cedro amargo - SLOW - Ced	25	21	60%	15	8.43	10			0	0.00	10			0	0.00	10			0	0.00	10			0	0.00	10	26	40%	10	0.00	0
4	16 - Mahogany/Mara/Caoba-SLOW - Swietenia	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
5	12 - Cocobolo/Rosewood-SLOW - Dalbergia sp.	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	49	100%	30	55.31	0
6					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
7					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
8					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
9					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
10					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
11					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
12					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
	Total	100			30	12.3147	70			0	0	70			0	0	70			0	0	70			0	0	70			70	94.9877	0

Generation 7 (establishment year: 73)

			THINNING 1					THINNING 2					THINNING 3					THINNING 4					THINNING 5					FINAL HARVEST				
ID	SPECIES	AMOUNT OF TREES/HA	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT	AGE	% OF TREES	# TREES CUT	COM. M3 / HA	TREES LEFT
1	*14 - Nanciton /Zapatero / Pilon -SLOW - Hieronyr*	30	21	50%	15	5.89	15			0	0.00	15			0	0.00	15			0	0.00	15			0	0.00	15	25	50%	15	9.82	0
2	*15 - Yellow Cedar / Amarillo / Yellow cedar-SLOW*	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	31	100%	30	38.35	0
3	*13 - Spanish Cedar / Cedro amargo - SLOW - Ced*	30	21	50%	15	8.42	15			0	0.00	15			0	0.00	15			0	0.00	15			0	0.00	15	25	50%	15	0.00	0
4	*16 - Mahogany/Mara/Caoba-SLOW - Swietenia*	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	49	100%	30	58.59	0
5	*12 - Cocobolo/Rosewood-SLOW - Dalbergia sp.*	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30			0	0.00	30	49	100%	30	55.31	0
6					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
7					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
8					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
9					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
10					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
11					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
12					0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0			0	0.00	0
	Total	150			30	12.3147	120			0	0	120			0	0	120			0	0	120			0	0	120			120	162.062	0

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