SUMMARY

In December 2013 Reforestación Grupo Internacional S.A. (Reforestation Group International, or abbreviated RGI) a Costa Rican plantation developer, requested DHForest S.A. to do a review of the stand growth monitoring and financial evaluation of their plantations in Costa Rica. The monitoring and the evaluation has been executed by Silvo Consult Srl, and the reports are dated November/December 2013. DHForest S.A. did similar reviews over the past years.

The productive RGI area in the study included is currently 1.294,2 hectares. This is 65.3 hectares less compared to last years' study (1.359,5 ha). New area was included: Gallito plantations planting 2009 and 2010, some adjustments in area have been implemented as result of updates of mapping material, and two farms, Concho and Conchito, were excluded because these farms form no longer part of the RGI organization. These productive areas consist of 11 plantations in the Northern zone of Costa Rica. The total effective plantation area consists of 1.251,5 hectares of Teak (*Tectona grandis*) and 42.7 hectares of Acacia (*Acacia mangium*). Compared to last year area distribution, some changes were observed; in the planting 1997 some 6.97 ha were cut, Gallito 2009 plantation with 72.8 ha was incorporated, and 131.1 ha of Teak 2005 and 2007 were excluded.

One can observe this in table 1.

Project (Name)	Location (Name)	Planting (Year)	Area (ha)	plots (n)	Plot (area m2)
Monte Verde 1	Corazon de Jesus	1997	51,7	16	5600
Vasconia	Vasconia	1998	21,9	6	2656
Monte Verde 2	Corazon de Jesus	1999	28,4	6	2100
Monte Verde 3	Amparo	2000	55,7	12	5292
Monte Verde 3	Amparo	2001	32,5	7	3087
Monte Verde 4	Arco Iris	2001	84,5	16	7056
Monte Verde 4	Arco Iris	2002	90,5	18	7938
Mairena	Mairena	2002	25,9	5	2205
Cristo Rey	Christo Rey	2002	199,6	35	15435
El Parque	El Parque	2003	317,3	69	30429
El Parque	El Parque (Acacia)	2006	42,7	4	1764
Monte Verde 9	Arco Iris	2004	11,4	3	1323
Carrizal	Carizal	2006	87,0	16	9600
Combate	Combate	2007	133,4	26	11466
Combate	Combate	2008	39,2	8	3528
Gallito	Pavon	2009	58,2	12	5292
Gallito	Pavon	2010	14,6	3	1323
Total			**1294,2**	**262**	**116.094**
			5 ha/plot		**0,90%**

Table 1/ area included by farm location

The detailed plantation maps provided by RGI, were reviewed, and during field sampling proven trustworthy. The minor adjustments and/or updates that were done last year prove adequate, and incorporated in the calculations.

The Teak plantations were established in the years from 1997 thru 2010. Most farms had initial planting density of 1111 trees/ha (3 m by 3 m), but 1400 and 1600 trees per hectare were used also. The Acacia is planted with a density of 800 trees per hectare.

In total, 26 sample plots for Teak and two for Acacia were measured and checked in the field by DHForest, and these measurements do neither show significant deviation nor systematic errors from the measuring data of Silvo Consult.

All plots are easy to locate because they are well defined in the field, and come with sufficient and accurate descriptions. The plot distribution over the area is according to forestry rules, and well designed.

On the average, the teak trees are 10 (9.8) years old, have an average diameter of 17 cm, which accounts for a little over 1.7 cm/yr. Height development reached 16 meters, which is an increment of 1 meter as to last year's measurement.

Illustration 1/Well identified tree measured with Mantax electronic caliper

Thinning reduced the stands to 509 trees per hectare, which corresponds to an absolute removal of 29 trees per hectare, but due to incorporation of measuring data provided by Silvo Consult of new young area in this valuation overall average tree number per hectare calculates 525 (+/- 2 %). The basal area calculates 12 m^2/ha, and with the average of 525 trees per hectare this sums a standing volume of 89 m^3/ha (+/- 2 m^3). The current volume increment since last year is 2 m^3/ha and 5 m^3/ha were thinned; so total production was 7 m^3/ha.

Total calculated trees present in the projects are 656.635, which represents a total standing volume of 110.767 m^3.

The mean annual increment in volume calculates on the average 9 m^3/ha/yr.

Thinning operations have its influence on present value of standing plantations, because its value is withdrawn from the plantation with the harvest of the trees, in order to provide growing space to the remaining trees.

During the field visits, it was observed that infrastructure is weak and not passable the whole year round.

Illustration 2/ Teak trees from plantations recently thinned.

The maintenance of the stands is good; however, thinning interventions are still not in concordance with the stand growth scenarios, but one can observe the efforts by the forestry department to comply with this issue.

Overall, performance of the stands is according to monitoring reports. Mean annual increment varies from 7 to 11 m³/ha/yr. Growth models for the Teak areas were presented and adjusted accordingly to the executed thinning regime and growth. Total commercial volume for the five models calculated by SilvoConsult is the same as last year and represents 180, 179, 169, 170 and 126 m³/ha.; respectively 9, 9, 8.5, 8.5 and 6.3 m³/yr/ha, which seems reasonable for the local site conditions.

Farm (name)	Area (ha)	Strata (year)	Silvo Consult Accu. (m3)	Silvo Consult Weighted (m3)	DHF Accu. (m3)	DHF Weighted (m3)
C. de Jesus - MV 1	51,7	1997	165	6,8	154	6,4
Vasconia	21,9	1998	175	3,1	159	2,8
C. de Jesus - MV 2	28,4	1999	171	3,9	159	3,6
Amparo - MV 3	55,7	2000	171	7,6	159	7,1
Amparo - MV 3	32,5	2001	126	3,3	146	3,8
Arco Iris - MV 4	84,5	2001	159	10,8	152	10,3
Arco Iris - MV 4	90,5	2002	169	12,2	136	9,8
Mairena	25,9	2002	154	3,2	155	3,2
Cristo Rey	199,6	2002	164	26,1	154	24,5
Parque	317,3	2003	166	42,2	143	36,3
Arco Iris - MV 9	11,4	2004	155	1,4	121	1,1
Carrizal	87,0	2006	148	10,3	123	8,6
Combate	172,6	2007	126	17,4	121	16,7
Gallito	72,8	2009	135	7,9	113	6,6
Total.	1251,5			**156 m3/ha**		**141 m3/ha**
				7,8 m3/ha/yr		7,0 m3/ha/yr
			year 2012	**155,0**		**143,0**
				1%		**-2%**

Table 2/ Monitoring data from Silvo Consult compering to DHForest.

Overall calculated weighted production is 156 m³/ha according to Silvo Consult, which calculates 1 m³/ha more than last year. Silvo Consult has included the youngest stands now in this overall production level, so some variation was expected[1]. DHF calculates overall weighted production level of 141 m³/ha, which is 2 m³/ha less than last year. This implies, respectively, a 7.8 and 7.0 m3/ha/yr production level for Silvo Consult and DHF.

Total standing volume reported by Silvo Consult was calculated by DHF to have a statistical deviation of + or - 3% (well within the recommended 10% deviation), however within the various strata the deviation is higher which indicates that higher sampling intensity could be necessary.

Analyses of the monitoring data over the years 2005 – 2013 show consistency and no indications were found to doubt the methods nor the measurements. This year's figures show a continuous slight tendency of stagnation in growth, and adequate attention should be paid to determine and react to this tendency.

[1] *For calculation reasons the younger farms (Combate and Gallito) are not divided in their respectively planting years. This will be done in the near future.*

In order to evaluate the growth projections presented by Silvo Consult, the distribution of current height development was projected on the curves of Vallejos[2], (this is graphically illustrated in Figure 1). This distribution was then used to determine the growth level distribution over existing production scenarios for Costa Rica.

Year	I	II	III	IV	V	Total
2011	0,0%	1,3%	44,2%	48,9%	5,7%	100,0%
2012	0,0 Ha	0,0 Ha	591,9 Ha	663,2 Ha	61,7 Ha	1316,8 Ha
	0,0%	0,0%	45,0%	50,4%	4,7%	100,0%
2013	0,0 Ha	0,0 Ha	501,1 Ha	723,0 Ha	27,4 Ha	1251,5 Ha
	0,0%	0,0%	40,0%	57,8%	2,2%	100,0%
Changes	0,0%	0,0%	-5,0%	7,4%	-2,5%	

Table 3/ Growth class distribution 2011 – 2013

The distribution over the different growth classes' shows that compared to the last three years, the extremes are diminishing. Growth class II has disappeared, Growth class III is represented by 40% (91 ha shifted from III to IV) and Growth class V has diminished 2.5 %. This can be explained mostly by thinning activities; providing growing space to the future trees, and the incorporation of the younger stands, and the incorporation of the younger stands.

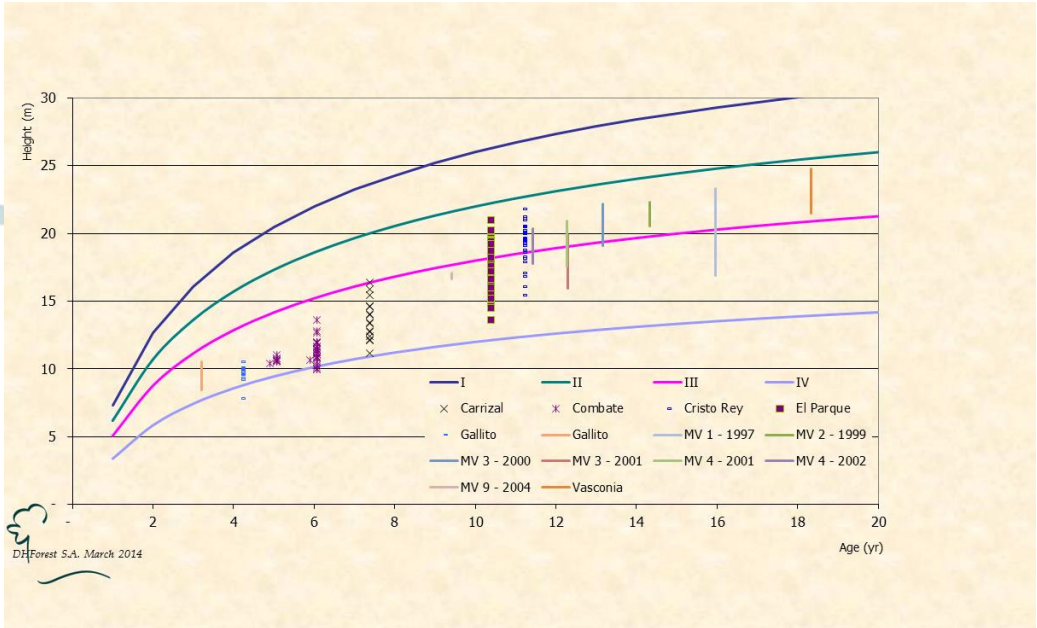

Figure 1/ Height distribution compared to Vallejos

[2] *Vallejos, B., Oscar. S. y Ugalde, A. Luis. Congreso Forestal Latinoamericano. Valdivia, Chile. Nov. 1998. Indice de Sitio Dasometrico y Ambiental para Tectona grandis I.f., Bombocopsis quinatum (Jacq.) Dugand y Gmelina.*

The method of determination of the present value of the objects is, compared to last year, not changed. The prices for standing tree value have been used by Silvo Consult, and DHForest uses for this exercise the current market prices for round wood.

To calculate the future value, a conservative 2.3% increment in wood prices was used.

Overall average increment in Teakwood prices since 1994 calculates 3.4% annual increment (varying from 2.6% up to 5.5%).

After the decline in prices for Teak and other wood products in 2009, prices are continuing going up.

A discount rate of 6.3% is used.

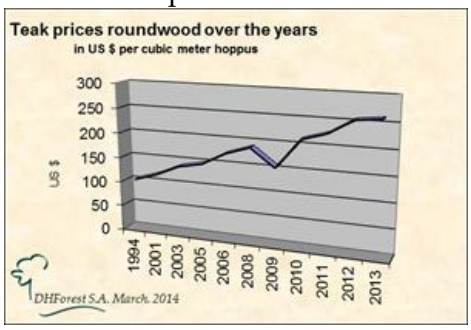

Figure 2/ Price development wood prices Costa Rica.

The Acacia is present with 374 trees per hectare. The diameter has reached 19.5 cm, and height is 15.5 meters. Standing volume calculates 73 m3/ha, hence with its seven years age mean annual increment is 10 m3/ha/yr.

The total expected production of 183 m3/ha was maintained.

Illustration 3/ Recent pruned and thinned Acacia stand

Acacia 2013	2006
Area	42,7 ha
Area(%)	100,0%
Planting year	2006
age	7,1 yr
NPlot	4 plots
PlotArea	1.764 m²
	0,4%
Plot density	10,7 ha/plot
BA/ha	11 m²
Ntrees/ha	374
Var N	2228
N range	± 75
Err%	20,1%
Dg(cm)	19,5 cm
CAI Dg (cm)	8,3 cm
Hgt (m)	15 m
CAI Hgt (m)	1,3 m
Vol (m³/ha)	73 m³
Var Vol	420
Err%	45%
Vol Range	± 33 m³
MAI (m³/ha/yr)	10 m³
CAI (m³/ha/yr)	3 m³
Thinning (trees/ha)	17
Thinning (m³/ha)	3 m³
Volume increment	6 m³
Total present volume (m3)	3.105 m³
Total present trees (n)	15.971

Table 4/ Growth figures Acacia 2013

The Present Value calculated for the different Teak strata vary from $ 29.377,- per hectare (Strata Teak 1997) to $ 16.239,- per hectare (Strata Teak 2010). On the average it calculates $ 23.265,45 per hectare.

For the Acacia the value is calculated at $ 6.155.90 per hectare. Total value of the present 42.7 hectares is $ 262.857,-.

Total overall Present Value[3] calculated for the plantations of R.G.I. S.A. is $ 29.379.569,- or $ 22.700,95 per productive hectare.

Considering all the before mentioned assumptions on the input data and variables, this Present Value reflects fairly well the actual plantation situation.

[3] *The Present Value is partly based on revenue information currently available and provided by RGI S.A., the tree measurements and assumptions for growth and prognostics. No rights can be derived from these values.*