

# ECONOMIC VALUATION OF ARBOLIVIA PLANTATIONS



FOR: SICIREC BOLIVIA LTDA.

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## 1. Introduction

Sicirec Bolivia's Arbolivia project is its largest inclusive reforestation project. Since 2007 more than 1400 hectares of forest were replanted in cooperation with local farmers.

The objective of this valuation is to estimate the value of the plantations. This is done through the estimation of the value of the timber in the future, the cost projected throughout the years and calculating its present value under the assumption of economic and biological parameters and variables.

Sicirec Bolivia provided data on the size of the plantations, expected value per timber type, products, expected costs and growth rates. Parts of the material was already presented in cash flow models, which the author used as a base for further calculations.

Through the whole study, both the values of existing plantation were calculated and a scenario in which growth with 900 hectares of plantations are foreseen for the next three years (2014-2017). In the first scenario, only the actual amount of hectares planted is taken into account (1416 ha) – referred to as *Scenario A*, and in the second one the total amount of hectares will increase with 400 hectares in the planting season 2013-2014 and after that 300 hectares/ year during the next 3 years (2015-2017) –(referred to as *Scenario B*), totalling 2316 ha in 2017.

The following chapter describes the methodology used for this valuation, chapter 2-6 touch on the assumptions underlying the different valuations and the final chapters are reserved for describing the value of the plantations in different classifications and scenarios, including analysis of the outcomes.

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## 2. Methodology

The purpose of this study is to estimate the market value of the plantation under management by Sicirec Bolivia. Market value is generally defined as a current value in a knowledgeable market; the International Valuation Standards Council defines it as follows:

*“the estimated amount for which a property should exchange on the date of valuation between a willing buyer and a willing seller in an arm’s-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently, and without compulsion.”<sup>1</sup>*

Most common international norms that treat about the correct, accountable valuation of assets are the International Financial Reporting Standards (IFRS), sometimes better known by the original name of IAS (International Accountability Standards). In our case, we treat with a biological asset that is defined in IAS 41 – Agriculture<sup>2</sup>.

The IAS treats a forest plantation as a biological asset, of which *felled trees* are its produce, and *logs and lumber* are the products resulting from the processing after harvest.

The IAS defines that if an active market exist, the asset’s value should be defined by its value on the active market. However, an active market is characterized by 3 elements:

- (a) the items traded within the market are homogeneous;*
- (b) willing buyers and sellers can normally be found at any time; and*
- (c) prices are available to the public*

All three characteristics are not fulfilled by the market of plantations in Bolivia, where existing plantations are not homogeneous (quality, age, species, management and site strongly differ), willing buyers and sellers are very scarce and public prices are basically not known.

The IAS informs us:

*“If an active market does not exist, an entity uses one or more of the following, when available, in determining **fair value**:*

- (a) the most recent market transaction price, provided that there has not been a significant change in economic circumstances between the date of that transaction and the end of the reporting period;*
- (b) market prices for similar assets with adjustment to reflect differences; and*
- (c) sector benchmarks such as the value of an orchard expressed per export tray, bushel, or hectare, and the value of cattle expressed per kilogram of meat.”<sup>3</sup>*

The fair value is defined in the IAS 41 as:

*“The fair value of an asset is based on its present location and condition. As a result, for example, the fair value of cattle at a farm is the price for the cattle in the relevant market less the transport and other costs of getting the cattle to that market.”*

<sup>1</sup> International Valuation Standards 1 - Market Value Basis of Valuation, Seventh Edition.

<sup>2</sup> Reference to IAS.

<sup>3</sup> IAS 41 – paragraph 18, IFRS.

In this case of strongly dispersed timber plantations of Sicirec Bolivia, no history of market transaction price exists (a). Also, market prices of similar assets with adjustments can best be found in prices of felled trees or processed timber at commercial centres (b). A recently updated market study performed by Sicirec Bolivia in 2012 can be used in our case for benchmark values.

The focus of the establishment of the plantations by Sicirec Bolivia has always been to produce processed timber, part of it in export quality for international markets, where timber is sawn and transported to a nearby port (Arica, Chili), this way taking advantage of a large part of the added value-chain of the timber. As such, it is assumed in this study to base the *fair value* of the plantation on the prices of processed timber (domestic or international market prices according to product) less costs of felling, transport, processing and sales.

As all of the produce from the plantations comes from future harvests and market-determined prices or values are not available in its present condition, the present value of expected net cash flows from the asset, discounted at a current market-determined rate is used to determine the fair value (in line with IAS 41:20):

*“In some circumstances, market-determined prices or values may not be available for a biological asset in its present condition. In these circumstances, an entity uses the present value of expected net cash flows from the asset discounted at a current market-determined rate in determining fair value.”*

The asset value is determined excluding calculations of taxes or finance costs, as established in the same IAS<sup>4</sup>:

*“An entity does not include any cash flows for financing the assets, taxation, or re-establishing biological assets after harvest (for example, the cost of replanting trees in a plantation forest after harvest).”*

Calculations were made in the spreadsheet programme MS Excel (2007), based on information, spreadsheets and a market study provided Sicirec Bolivia. For the calculation of Net Present Values (NPVs) and Internal Rates of Returns (IRRs) the corresponding formulas in MS Excel 2007 were used.

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<sup>4</sup> IAS 41 – paragraph 22, IFRS.

### 3. Overview of base parameters

The following information was provided by the administration of Sicirec Bolivia and used as base parameters for the valuation.

All plantations, which are spread over 4 departments in Bolivia, are classified according to their growth class: Fast, Intermediate and Slow. The division is natural, as the growth class determines both the average biological growth rate (mean annual increment), the moments of harvest, type of products and market value.

The following table (1) provides a determination which specie is in which category.

Growth class	Scientific name	Common name
Fast	<i>Schyzolobium amazonicum</i>	Serebo
Fast	<i>Stryphnodendron purpureum</i>	Palo yugo
Intermediate	<i>Aspidosperma macrocarpon</i>	Jichituriqui
Intermediate	<i>Calophyllum basiliense</i>	Palo María
Intermediate	<i>Centrolobium tomentosum</i>	Tejeyeque
Intermediate	<i>Guarea rusby</i>	Trompillo de altura
Intermediate	<i>Tapirira guianensis</i>	Palo román
Intermediate	<i>Tectona grandis</i>	Teca
Intermediate	<i>Virola flexuosa</i>	Gabún
Slow	<i>Buchenavia oxycarpa</i>	Verdolago negro (pepa)
Slow	<i>Dipteryx odorata</i>	Almendrillo
Slow	<i>Terminalia amazonica</i>	Verdolago negro (de ala)
Slow	<i>Terminalia oblonga</i>	Verdolago amarillo de ala

Table 1 – Species classification

As mentioned in the introduction, two scenarios are calculated:

- Scenario A – Only existing plantations
- Scenario B – Existing plantations plus establishment of new plantations in the year

The following table (2) provides an overview of the amount of hectares in both scenarios per establishment year.

Planting season	Scenario A				Scenario B			
	Hectares (actual size)				Hectares (with projected planting)			
	Fast	Intermediate	Slow	TOTAL	Fast	Intermediate	Slow	TOTAL
2007-2008	9,81	81,27	16,36	107,44	9,81	81,27	16,36	107,44
2008-2009	18,81	346,06	49,87	414,74	18,81	346,06	49,87	414,74
2009-2010	11,94	222,45	52,89	287,28	11,94	222,45	52,89	287,28
2010-2011	0,71	107,73	25,24	133,68	0,71	107,73	25,24	133,68
2011-2012	5,57	167,48	2,84	175,89	5,57	167,48	2,84	175,89
2012-2013	20,48	179,39	0,98	200,85	20,48	179,39	0,98	200,85
2013-2014	11,61	81,58	3,2	96,39	11,61	81,58	3,2	96,39
2014-2015	0	0	0	0	50	200	50	300
2015-2016	0	0	0	0	50	200	50	300
2016-2017	0	0	0	0	50	200	50	300
TOTAL	78,93	1185,96	151,38	1416,27	228,93	1785,96	301,38	2316,27

Table 2 – Planted hectares per establishment year and type of specie in both scenarios

The thinning scheme per growth-class is provided in the following tables:

Fast		Intermediate		Slow	
	year		year		year
Thinning 1	4	Thinning 1	5	Thinning 1	7
Thinning 2	7	Thinning 2	8	Thinning 2	12
Thinning 3	10	Thinning 3	12	Thinning 3	18
Thinning 4	0	Thinning 4	16	Thinning 4	25
Thinning 5	0	Thinning 5	20	Thinning 5	30
Final harvest	13	Final harvest	25	Final harvest	35

Table 3 – Thinning schedule per tree species

The plantations of Sicirec Bolivia are spread through four departments: Beni, La Paz, Santa Cruz and Cochabamba.

Because of the nature of Sicirec’s incorporative business model, where plantations are managed in close cooperation with local small-holder farmers, many plantations are spread over many different sites. The following table indicates the division of the amount of hectares over the four departments. In Scenario B, no difference is indicated between the departments, as it is not yet known where future plantations will be established.

Amount of hectares (max.)		SCENARIO A					SCENARIO B
		Beni	Cochabamba	La Paz	Santa Cruz	Total	Total
Species type	Fast	43,77	9,61	6,86	18,69	78,93	228,93
	Intermediate	174,90	89,99	105,97	815,10	1185,96	1785,96
	Slow	46,23	29,90	28,57	46,68	151,38	301,38
Total		264,90	129,50	141,40	880,47	1416,27	2316,27

Table 4 - Size of plantations per Department

For this valuation, the plantations in different department were assumed to be homogenous in quality and the economic value that can be generated from it (within each growth class). The information provided by Sicirec is based on conservative estimates regarding economic value, growth rates and quality. Furthermore, variables such as transport and maintenance costs – which differ for every plantation – were provided as an average for all plantations.

## 4. General assumptions underlying the valuation

### Mean Annual Increment

The MAI (Mean Annual Increment) is set at 28 M3 /year/ha for Fast growing species, 15 M3 / year/ha for Intermediate growing species and 8 M3 / year/ha for Slow growing species. These numbers are conservative for forest plantation practices. Yet, no empirical data was provided showing that these numbers are consistent with reality – as such the calculated value of the plantations can differ when in reality MAI is higher or lower. Furthermore it is known that growth of trees is not at a constant rate through the years, but with the largest annual increments after a couple of years, which is then to decline slowly after the top-growth year.

Assumed in the models and calculation of the valuation of the Arbolivia plantations of Sicirec Bolivia is a constant growth rate:

*MAI (Mean Annual Increment) per growth class*

<i>Fast growing species:</i>	<i>28 M3/year/ha.</i>
<i>Intermediate growing species:</i>	<i>15 M3/year/ha.</i>
<i>Slow growing species:</i>	<i>8 M3/year/ha.</i>

### Discount rate

As a discount rate for calculating Net Present Values, usually a discount rate is used that incorporates the risk of the country and type of business. In this valuation, the Risk Premium on Lending for Bolivia is used, provided by the World Bank. This value represents

*“the interest rate charged by banks on loans to private sector customers minus the ‘risk free’ treasury bill interest rate at which short-term government securities are issued or traded in the market.”*

The value has been oscillating between 9.50 % and is 10.60 % between 2009 and 2012 (no more recent values are available)<sup>5</sup>. For this valuation, a value of 10.00 % has been used as a discount rate.

### Exchange Rate

A constant change rate for the Bolivian Currency (Bolivian peso) / USD is set a 6,88 Bs./USD.

### Inflation rate

Assumed is an inflation rate of 5.2 %. This is based on the inflation rate in Bolivia over the years 2008-2013, as measured by the World Bank<sup>6</sup>.

<sup>5</sup> World Bank Website, <http://data.worldbank.org/indicator/FR.INR.RISK>

<sup>6</sup> World Bank Website, <http://data.worldbank.org/indicator/FP.CPI.TOTL.ZG/countries/BO?display=default>

## 5. Assumptions regarding prices of timber and carbon credits

The produce to be provided from the plantations are the following<sup>7</sup>:

- Pulp (I,S)
- Poles (1st quality) (F,I,S)
- Poles (2nd quality) (F,I,S)
- Laths (I,S)
- Lumber (F,I,S)
- Lumber (export quality) (I,S)

Only the lumber (export quality) will reach international markets, for which prices in Arica, Chile were used as references. For all the other timber products, prices were based on the Bolivian, domestic market.

For calculating positive cash flows coming from the sales of produce, prices were based on a market study realized for Sicirec Bolivia Ltda. in 2012<sup>8</sup> with updated prices where necessary.

Based on the prices, costs were reduced for felling and extraction costs, processing costs, saw mill costs, drying costs, processing costs and transportation costs. The used values for all of these costs can be found in the indicated market study. This resulted in a Gross Margin for each product type.

<sup>7</sup> The codes behind the product type indicate which species growth class can produce what product. (F = Fast growing species, I = Intermediate growing species, S = slow growing species). See table 1 for details on the species per growth class).

<sup>8</sup> Wood Products And Market Projections, Sicirec Bolivia Ltda.

The **Gross Margins** for the products are the following:

<b>Fast growing species</b>			
Product		Margen (USD)	Margen (BOB)
Pulp		0,00	0,00
Poles*		6,16	42,37
Lumber		66,76	459,34
Plywood (2nd quality)		35,11	241,53
Plywood (1st quality)		63,44	436,44
<b>Annual margen increase</b>	DOM	0,0%	

<b>Intermediate growing species</b>			
Product		Margen (USD)	Margen (BOB)
Pulp		4,18	28,75
Poles (1st quality)		86,92	598,00
Poles (2nd quality)		7,52	51,75
Laths		153,98	1059,37
Lumber		230,43	1585,34
Lumber (export quality)		243,51	1675
<b>Annual margen increase</b>	INT	1,5%	
	DOM	0,5%	

<b>Slow growing species</b>			
Product		Margen (USD)	Margen (BOB)
Pulp		5,18	35,65
Poles (1st quality)		108,65	747,50
Poles (2nd quality)		17,55	120,75
Laths		170,11	1170,39
Lumber		395,23	2719,15
Lumber (export quality)		451,91	3109,15
<b>Annual margen increase</b>	INT	1,5%	
<b>Annual margen increase</b>	DOM	1,0%	

Table 5 – Prices per type of tree species and type of product.

The indicated margins are excluding any taxes (deductable or non-deductable), according to IAS 41. Furthermore, per growth class is indicated what annual price increase is used (conservative estimations) for both domestic and international prices. It was taken into account that from the calculated margin coming from the sale of the product, 50 % is for the farmer of the plantation and 50 % is for Sicirec Bolivia Ltda.

For the actual plantations, revenues generated through the sale of carbon credits (on the voluntary market) were included in the cash flow streams evenly spread during over years 2007-2013, according to the table 6. The price is based on a value of 6 USD net revenue per hectare. No carbon credit revenues were included for future plantations (Scenario B).

Specie Type/ planting year	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012	2012/2013	2013/2014	Total
Fast	7.703	14.488	9.669	716	4.638	20.648	11.705	69.566
Medium	18.178	331.846	201.145	101.297	175.878	188.386	85.671	1.102.401
Slow	5.618	40.803	38.053	25.920	3.310	1.142	3.730	118.575
<b>Total Current Value</b>	<b>31.498</b>	<b>387.137</b>	<b>248.866</b>	<b>127.933</b>	<b>183.826</b>	<b>210.176</b>	<b>101.106</b>	<b>1.290.542</b>

Table 6 – Revenues trough carbon credits

## 6. Assumptions regarding costs of management

Sicirec Bolivia has provided a cost-structure for both Scenarios (A & B). The total cost of the management of the plantation is as follows (table ):

	SCENARIO A	SCENARIO B	COST RELATION A/B
	<i>USD</i>	<i>USD</i>	<i>Percentage</i>
<b>EQUIPMENT</b>	30.073	31.817	95%
<b>FURNITURE</b>		1.337	0%
<b>INVESTMENTS PLANTATIONS</b>	27.733	141.105	20%
<b>OPERATIONAL COSTS</b>	152.199	152.504	100%
<b>PAYMENTS</b>	96.512	154.503	62%
<b>PERSONAL</b>	442.383	453.066	98%
<b>VEHICLE/MOTOCYCLES</b>	10.923	40.160	27%
<b>TOTAL</b>	759.821	974.492	78%

Table 7 – Operating costs for plantations Sicirec Bolivia Ltda.

These costs include all that is needed for the management of the plantations, in both scenarios, yet does not include costs for felling, transport, transformation and selling (see chapter 5).

For the years 2013-2014 till 2049-2050 (Scenario A) and till 2052-2053 (Scenario B), which are the years of final harvest of slow growing species, the yearly cost is adjusted with the following parameters:

- An inflation rate of 5.2 % year on year (yoy).
- Decrease in costs of 5 % year on year due to increase in efficiency.

This results in a net increase of 5 % (10-5 %) year on year, as demonstrated in Annex 1.

The yearly cost of 759.821 USD in Scenario A and 974.492 USD in Scenario B are the estimated costs for the year 2013-2014. The amount of hectares managed in Scenario A is 1416.27 (year 2013-2014). The maximum amount of hectares managed in scenario B is 2316.27 ha (year 2016-2017).

Assumed is that management costs is fully determined by the amount of hectares, and costs increase (and decrease) linearly with the amount of hectares under management<sup>9</sup>. This implies that, with the harvesting of plantations over time, the amount of hectares will also decrease. Costs per hectares were calculated for 2013-2014 based on costs presented in table 6, and adjusted for the following years based on the mentioned assumptions on inflation and efficiency (totalling a 5 % increase yoy). It is assumed, that the year after a plantation is harvested, no costs apply anymore to that harvested plantation.

In Annex 1, the costs per hectare and total costs assumed for both scenario A and B are presented.

<sup>9</sup> Strictly speaking management will have a certain fixed costs with variable costs per hectare. Yet, as most of the costs are variable (maintenance, transport, personal) and are determined by the amount of hectares and farmers under management, for simplicity reasons we applied a lineal relationship between costs and hectares under management.

## 7. Valuation per timber specie and product type

The following chapter provides a calculation of Net Present Values (NPV) and Internal Rate of Return (IRR) values for the total plantations. Furthermore, a calculation is provided per department (Scenario A). Both total values and values per hectare are calculated.

In the second part, a calculation is provided for the plantation of each particular year of establishment.

### Valuation of tree plantations per Growth Class and Department in both Scenarios

The calculated Net Present Value (NPV) for all existing plantations (Scenario A) is 5.888.466 USD. The majority of the value is located in Santa Cruz (3.889.260 USD), with smaller values in La Paz and Beni. All IRR values in all regions have a strong positive value, from 17.6 % in Cochabamba to 26.1 % in La Paz.

Worth to mention is that all plantations are considered of equal quality with equal cost and future revenues. The difference of value per region is therefore only attributable to the age and size of the plantation.

		SCENARIO A					SCENARIO B
		Beni	Cochabamba	La Paz	Santa Cruz	Total	Total
<b>NPV</b>							
<b>Growth class</b>	Fast	25.017 USD	-4.176 USD	-27 USD	24.220 USD	45.034 USD	38.050 USD
	Intermediate	839.538 USD	353.818 USD	593.246 USD	3.776.339 USD	5.562.942 USD	8.020.405 USD
	Slow	93.692 USD	36.629 USD	58.605 USD	88.994 USD	280.491 USD	470.845 USD
	<b>Total</b>	<b>958.247 USD</b>	<b>386.271 USD</b>	<b>651.824 USD</b>	<b>3.889.260 USD</b>	<b>5.888.466 USD</b>	<b>8.529.300 USD</b>
<b>NPV per ha</b>							
<b>Growth class</b>	Fast	572 USD	-435 USD	-4 USD	1.296 USD	571 USD	166 USD
	Intermediate	4.800 USD	3.932 USD	5.598 USD	4.633 USD	4.691 USD	4.491 USD
	Slow	2.027 USD	1.225 USD	2.051 USD	1.906 USD	1.853 USD	1.562 USD
	<b>Total</b>	<b>3.617 USD</b>	<b>2.983 USD</b>	<b>4.610 USD</b>	<b>4.417 USD</b>	<b>4.158 USD</b>	<b>3.682 USD</b>
<b>IRR</b>							
<b>Growth class</b>	Fast	14.3%	7.5%	10.0%	21.4%	14.3%	11.3%
	Intermediate	25.8%	20.7%	32.8%	24.6%	25.0%	27.3%
	Slow	13.8%	12.1%	13.9%	13.6%	13.5%	13.4%
	<b>Total</b>	<b>21.6%</b>	<b>17.6%</b>	<b>26.1%</b>	<b>23.8%</b>	<b>22.9%</b>	<b>23.7%</b>
<b>NPV calculated over period</b>							
<b>Growth class</b>	Fast	2013-2027	2013-2027	2013-2027	2013-2027	2013-2027	2013-2030
	Intermediate	2013-2039	2013-2039	2013-2039	2013-2039	2013-2039	2013-2042
	Slow	2013-2049	2013-2050	2013-2049	2013-2050	2013-2050	2013-2052
	<b>Total</b>	<b>2013-2049</b>	<b>2013-2050</b>	<b>2013-2049</b>	<b>2013-2050</b>	<b>2013-2050</b>	<b>2013-2052</b>

Table 8 - Calculated NPV values per Department and Scenario

Interesting to observe is the division of the NPV over the different tree species. Both Fast and Slow growing species have positive NPV values (45.034 USD and 280.491 USD respectively), whereas the Intermediate growing species show a strong positive value (5.562.942). This is also clearly reflected in the IRR per species category: 14.3 % for Fast, 25.0 % for Intermediate and 13.5 % for Slow growing species (Scenario A). This strongest contribution to the high NPV value is almost fully contributable to the Intermediate growing species.

Comparing both Scenario A and B, the total Net Present Value is higher in Scenario B: 8.529.300 (44.8 % more). This is actually relatively less than expected when considering the amount of hectares managed (63.5 % more). This effect can mostly be explained by the smaller

overall share of Intermediate growing species (83.7 % of total in Scenario A, and 77.1 % in Scenario B), which have a mayor effect on the total NPV, and the slightly lower IRRs in Scenario B.

Comparing the IRR of both Scenarios, the total IRR of the plantations increases from 22.9 % (Scenario A) to 23.7 % (Scenario B). This might be less than expected. The improvement of costs of price/hectare in Scenario B does not compensate in a better IRR for Fast growing species. The result is a decrease for this growth class in IRR (from 14.3% to 11.3 %). For Slow growing species a very small decrease is calculated (13.5 % to 13.4 %), while Intermediate growing species show a significant increase on the IRR (25.0 % to 27.3 %), comparing Scenario A and B.

**Valuation per establishment and species category**

Valuation per establishment year			Scenario A		Scenario B		Total NPV Scenario A	Total NPV Scenario B
	Establishment year	# ha	NPV/ha	IRR	NPV/ha	IRR		
Fast	2007-2008	9,81	1.990 USD	29,6%	2.661 USD	41,1%	19.521 USD	26.106 USD
	2008-2009	18,81	1.541 USD	24,1%	2.258 USD	35,5%	28.989 USD	42.470 USD
	2009-2010	11,94	983 USD	17,6%	1.741 USD	26,1%	11.734 USD	20.787 USD
	2010-2011	0,71	587 USD	14,2%	1.383 USD	21,6%	417 USD	982 USD
	2011-2012	5,57	-19 USD	9,9%	811 USD	15,9%	-105 USD	4.520 USD
	2012-2013	20,48	-339 USD	8,0%	523 USD	13,6%	-6.935 USD	10.708 USD
	2013-2014	11,61	-740 USD	5,9%	150 USD	11,0%	-8.587 USD	1.746 USD
	(Scenario B only)	2014-2015	50,00		-501 USD	7,1%		-25.046 USD
	(Scenario B only)	2015-2016	50,00		-461 USD	7,1%		-23.036 USD
	(Scenario B only)	2016-2017	50,00		-424 USD	7,1%		-21.186 USD
	<b>Total</b>			14,3%		11,3%	45.034 USD	38.050 USD
Intermediate	2007-2008	81,27	6.790 USD	110+%	7.804 USD	110+%	551.786 USD	634.270 USD
	2008-2009	346,06	6.197 USD	40,3%	7.227 USD	70,1%	2.144.470 USD	2.500.830 USD
	2009-2010	222,45	5.159 USD	27,0%	6.203 USD	38,4%	1.147.720 USD	1.379.797 USD
	2010-2011	107,73	4.275 USD	21,8%	5.331 USD	29,0%	460.590 USD	574.308 USD
	2011-2012	167,48	3.525 USD	18,8%	4.592 USD	24,5%	590.326 USD	768.992 USD
	2012-2013	179,39	2.773 USD	16,3%	3.850 USD	20,9%	497.523 USD	690.726 USD
	2013-2014	81,58	2.090 USD	14,5%	3.177 USD	18,3%	170.526 USD	259.147 USD
	(Scenario B only)	2014-2015	200,00		2.223 USD	15,1%		444.528 USD
	(Scenario B only)	2015-2016	200,00		2.014 USD	15,1%		402.809 USD
	(Scenario B only)	2016-2017	200,00		1.825 USD	15,0%		364.999 USD
	<b>Total</b>			25,0%		27,3%	5.562.942 USD	8.020.405 USD
Slow	2007-2008	16,36	2.743 USD	15,4%	3.859 USD	20,0%	44.880 USD	63.136 USD
	2008-2009	49,87	2.402 USD	15,0%	3.467 USD	19,0%	119.783 USD	172.913 USD
	2009-2010	52,89	1.618 USD	12,9%	2.745 USD	16,2%	85.594 USD	145.205 USD
	2010-2011	25,24	1.231 USD	12,2%	2.363 USD	15,3%	31.071 USD	59.640 USD
	2011-2012	2,84	782 USD	11,4%	1.918 USD	14,2%	2.220 USD	5.447 USD
	2012-2013	0,98	286 USD	10,5%	1.427 USD	13,0%	281 USD	1.398 USD
	2013-2014	3,20	-164 USD	9,7%	980 USD	12,0%	-525 USD	3.136 USD
	(Scenario B only)	2014-2015	50,00		153 USD	10,3%		7.655 USD
	(Scenario B only)	2015-2016	50,00		132 USD	10,3%		6.615 USD
	(Scenario B only)	2016-2017	50,00		114 USD	10,2%		5.700 USD
	<b>Total</b>			13,5%		13,4%	283.303 USD	470.845 USD

Table 9 - Valuation per establishment year

A more detailed look at the NPV values for each particular establishment year per tree species gives more insight in the value-structure of the plantations. Table 9 shows the calculations in finer detail.

The plantations from year 2007-2008 till 2010-2011 all have a positive NPV with IRRs above 10%, no matter what growth class. This is, of course, due to the fact that the plantation has been managed for several years already (investment done in past are not taken into account), and (final) harvest(s) and revenues from carbon credits are soon resulting in a high NPV<sup>10</sup>.

For the existing plantations, all have positive IRRs expect for the Fast growing plantations from the most 3 recent years and the slow growing plantations from year 2013-2014. Nevertheless,

<sup>10</sup> In NPV calculations, profits far away in time have a smaller impact on the NPV than profits that will take place soon. Same with losses.

all total IRR values are above 10%. Analysing Scenario B, it comes clear that most profitable are Intermediate growing species, and after that slow growing species. Note that for the future plantations no carbon credit revenues were included, which result in a significant reduction in IRR compared to the existing plantations.

### 8. Overall valuation and incorporation of risk factors

The total value as indicated in chapter 7 of the existing plantations is calculated at 5.888.466 USD.

The following valuations described in this chapter incorporate an extra risk factor in the valuation of the tree plantations. In the previous calculations, no risk for total losses of plantations were taken into account. Total losses of plantations can occur due to extreme weather conditions, fires, tenancy problems of farmers or other social, regulatory or possible other situations that disrupt future harvest and income possibilities.

Two risk-scenarios were calculated, a best-case scenario of 5 % losses (of all plantations), and a worst-case scenario of 10%-15%-20% losses for respectively fast, intermediate and slow growing species for both Scenario A and B. Assumed is in both risk-scenarios that the losses occur just before the final harvest time, thereby counting for full costs of management per hectare during the whole lifetime of the plantation, while reducing the revenues of the final harvest of the particular plantation with the indicated percentage. Non-final harvests are not reduced in both scenarios.

NPV	SCENARIO A	SCENARIO B
NO RISK	5.888.466 USD	8.529.300 USD
BEST-CASE LOSSES	5.649.989 USD	8.206.325 USD
WORST-CASE LOSSES	5.166.019 USD	7.555.664 USD

  

NPV / HA	SCENARIO A	SCENARIO B
NO RISK	4.158 USD	3.682 USD
BEST-CASE LOSSES	3.989 USD	3.543 USD
WORST-CASE LOSSES	3.648 USD	3.262 USD

  

IRR	SCENARIO A	SCENARIO B
NO RISK	22,9%	23,7%
BEST-CASE LOSSES	22,7%	23,5%
WORST-CASE LOSSES	22,4%	23,2%

Table 10 - Valuation in different Risk Scenarios

The value of the existing plantations is 5.649.989 USD when considering Best-case losses (5%), and 5.166.019 USD in Worst-case losses (10 to 20%).

What can be observed in Table 10, is the decrease in both NPV values (total or per Ha), to respectively 22.7 % in the Best-case scenario and 22.4 % in the Worst-case scenario, compared with the No-risk scenario (Scenario A). In Scenario B, these values are respectively 23.5 % and 23.2 %. In terms of IRR, the values differ only slightly.

## 9. Summary and conclusion

In this study the Arbolivia plantations were valued for both the existing plantations and a second scenario in which a growth of plantations under management is foreseen of 900 hectares in the next three years.

The scope of this study has been to calculate the value of the plantations in different scenarios, also disaggregated per tree species category (Fast, Intermediate and Slow growing species) and region. Additionally, detailed calculations were made to show values per establishment year per growth class and also in 2 risk-scenarios in which losses of plantations occur.

Information on the plantations, growth rates, management costs and products was provided by Sicirec Bolivia Ltda. to the consultant, including a market study with prices and costs of processing and transformation. Assumptions of variables and parameters, such as the increase of economic values and discount rates were described in detail in chapter 3 to 6.

The study finds the total value of the existing plantation to be worth 5.888.466 USD or 40.983.723 Bs. in the case of no losses. The value of the existing plantations is 5.649.989 USD when considering a Best-case scenario of 5 % losses, and a value of 5.166.019 USD in a Worst-case scenario were 10 to 20% of the plantations are lost.

Noteworthy is the difference of value of plantation per year and specie-type. Older plantation are obviously more worth than future plantations, due to past investments and relatively early final harvests. Yet, comparing both fast, intermediate and slow growing species, it is clear that the intermediate growing species outperforms the other two in terms of value-generation. The internal rate of return of the Intermediate-growing species group is 25.0 % for the existing plantations, while 14.3 % and 13.5 % for respectively Fast growing and Slow growing species.

The reduced value of the fast growing specie plantation may come as a surprise, but can be easily understood when looking at the margins of the timber value. Whereas first quality plywood (coming from fast growing species) is valued at a 67 USD/M3 margin, the margin on export quality lumber for intermediate growing species is 212 USD/M3. Though both yearly managed costs are considered equal and the intermediate growing specie lives 12 years longer, the higher margin provides a much better rate of return.

This is also true when comparing intermediate growing species with slow growing species. The extra time for a slow growing specie to be harvested (10 years more than intermediate), does not result in a higher IRR, even though the margin for export quality timber is 403 USD/M3 compared to 212 USD/M3 of the intermediate growing species. This has much to do with the longer project costs per hectare for the time slow growing species take.

Overall, the study shows that rates of return can be increased by expanding hectares under management, and also makes potential economic loss less vulnerable in high-risk scenarios. The intermediate-growing species should be preferred from an economic point of view - they strongly outperform both Fast and Slow growing species.

**Annex 1 – Increase of project costs in time**

Project costs per hectare and total over the years, in both scenarios.

Year	Scenario A			Scenario B		
	Ha managed	Cost/hectare	Total costs (USD)	Ha managed	Cost/hectare	Total costs (USD)
2013 - 2014	1.416,27	536	759.821	1416,27	421	595.847
2014 - 2015	1.416,27	538	761.341	1716,27	422	723.506
2015 - 2016	1.416,27	539	762.864	2016,27	422	851.673
2016 - 2017	1.416,27	540	764.390	2316,27	423	980.350
2017 - 2018	1.416,27	541	765.918	2316,27	424	982.311
2018 - 2019	1.416,27	542	767.450	2316,27	425	984.276
2019 - 2020	1.416,27	543	768.985	2316,27	426	986.244
2020 - 2021	1.416,27	544	770.523	2316,27	427	988.217
2021 - 2022	1.416,27	545	772.064	2316,27	427	990.193
2022 - 2023	1.406,46	546	768.250	2306,46	428	987.971
2023 - 2024	1.387,65	547	759.491	2287,65	429	981.874
2024 - 2025	1.375,71	548	754.462	2275,71	430	978.703
2025 - 2026	1.375,00	550	755.581	2275,00	431	980.354
2026 - 2027	1.369,43	551	754.025	2269,43	432	979.910
2027 - 2028	1.348,95	552	744.234	2248,95	433	973.009
2028 - 2029	1.337,34	553	739.304	2237,34	434	969.922
2029 - 2030	1.337,34	554	740.783	2187,34	434	950.143
2030 - 2031	1.337,34	555	742.264	2137,34	435	930.280
2031 - 2032	1.337,34	556	743.749	2087,34	436	910.335
2032 - 2033	1.337,34	557	745.236	2087,34	437	912.156
2033 - 2034	1.337,34	558	746.727	2087,34	438	913.980
2034 - 2035	1.256,07	559	702.751	2006,07	439	880.151
2035 - 2036	910,01	561	510.154	1660,01	440	729.776
2036 - 2037	687,56	562	386.219	1437,56	441	633.246
2037 - 2038	579,83	563	326.356	1329,83	441	586.963
2038 - 2039	412,35	564	232.554	1162,35	442	514.066
2039 - 2040	232,96	565	131.646	982,96	443	435.598
2040 - 2041	151,38	566	85.716	901,38	444	400.245
2041 - 2042	151,38	567	85.888	701,38	445	312.060
2042 - 2043	151,38	568	86.059	501,38	446	223.522
2043 - 2044	151,38	570	86.231	301,38	447	134.628
2044 - 2045	135,02	571	77.066	285,02	448	127.574
2045 - 2046	85,15	572	48.699	235,15	448	105.463
2046 - 2047	32,26	573	18.487	182,26	449	81.906
2047 - 2048	7,02	574	4.031	157,02	450	70.704
2048 - 2049	4,18	575	2.405	154,18	451	69.564
2049 - 2050	3,2	577	1.845	153,2	452	69.261
2050 - 2051				150	453	67.949
2051 - 2052				100	454	45.390
2052 - 2053				50	455	22.741